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Amit
Veterinary Surgeon, GVH, Sanwar, Charkhi Dadri, Haryana, India

Subhasish Sahu
Scientist, Department of LPM, Lala Lajpat Rai University of Veterinary and Animal Sciences, Hisar, Haryana, India

Ravinder Saini
Veterinary Surgeon, Haryana Veterinary Training Institute, Hisar, Haryana

Archana Sarangi
Ph.D. Scholar, Department of Animal Physiology and Reproduction Division, CIRB, Hisar, Haryana, India

Devender Singh Bidhan
Associate Professor, Department of LPM, Lala Lajpat Rai University of Veterinary and Animal Sciences, Hisar, Haryana, India

SK Chhikara
Professor and Head, Department of LPM, Lala Lajpat Rai University of Veterinary and Animal Sciences, Hisar, Haryana, India

Vishal Sharma
Assistant Professor, Department of LPM, Lala Lajpat Rai University of Veterinary and Animal Sciences, Hisar, Haryana, India

DC Yadav
Scientist, Department of LPM, Lala Lajpat Rai University of Veterinary and Animal Sciences, Hisar, Haryana, India

Spandan Shashwat Dash
M.V. Sc. Scholar, Department of AGB, Lala Lajpat Rai University of Veterinary and Animal Sciences, Hisar, Haryana, India

Corresponding Author
Subhasish Sahu
Scientist, Department of LPM, Lala Lajpat Rai University of Veterinary and Animal Sciences, Hisar, Haryana, India

Effect on the use of expanded polyethylene sheet and white paint on roof structure as thermal comfort on physiological indices in buffalo heifers

Amit, Subhasish Sahu, Ravinder Saini, Archana Sarangi, Devender Singh Bidhan, SK Chhikara, Vishal Sharma, DC Yadav and Spandan Shashwat Dash

Abstract
An attempt was made to study the effect of microclimate alterations on physiological parameters of buffalo heifers during summer at buffalo farm of LPM, LUVAS, Hisar (Haryana). Twenty buffalo heifers (8-18 months of age) were divided into four groups (5 heifers in each group) *viz*. T_1 (control): Corrugated asbestos roof; T_2: Corrugated asbestos roof painted white on upper side; T_3: Corrugated asbestos roof having EPE (Expanded polyethylene) sheet on lower side and T_4: Corrugated asbestos roof painted white on upper side and EPE sheet on lower side. Physiological parameters *viz*. respiration rate, pulse rate, rectal temperature were recorded fortnightly. The Morning values of physiological parameters *viz*. respiration rate, pulse rate and rectal temperature didn't differ significantly whereas the evening values were significantly ($P<0.05$) higher in T_1. So it can be concluded that microclimate alterations by roof modifications using EPE sheets as well as white paint helped heifers in alleviating the thermal stress in heifers thereby improving physiological parameters during summer.

Keywords: buffalo heifer, roof modifications, EPE sheet, white paint, physiological indices

Introduction
Tropical climate of a country like India is characterized by high ambient temperature which acts as the major constraint on animal productivity. The heat stress affects the physiological systems governing thermoregulation and the maintenance energy of buffalo heifers during extreme summer. The ability of the animal to maintain normal body temperatures by cutaneous and respiratory heat dissipation plays a predominant role in adaptation of animals in hot climates (Gebremedhin and Wu, 2001) [4]. Raghavan and Mullick (1962) [8] reported that change in air temperature appeared to be the major cause for affecting variations in the respiration rate, pulse rate and body temperature of buffaloes. They further observed that the relationship between ambient temperature and respiration rate can be taken as an index to assess the heat tolerance in the species. Animal's ability to withstand the rigor of climatic stress under warm conditions has been assessed physiologically by changes in body temperature, respiration rate and pulse rate. Increased respiration is one of the first visible reactions when ruminants are exposed to ambient temperature above the thermo-neutral zone (Riek and Lee, 1948) [9] where animals begin to store heat, rectal temperature rises and cutaneous heat loss plays the major role in body temperature control mechanism besides increased respiration rates (Pollard *et al.* 2004) [7]. So the effect of microclimate alterations on the physiological values of buffalo heifers was assessed by modifying shade structures using highly reflective materials like white paint or low thermal conductive materials like EPE sheets.

Material and Methods
Animals and Treatments
Twenty Murrah buffalo heifers of 8-18 months of age were selected from the buffalo herd of Livestock Production Management (LPM) and Buffalo Research Centre (BRC) of Department of Livestock Production and Management, College of Veterinary Sciences, Lala Lajpat Rai University of Veterinary and Animal Sciences (LUVAS), Hisar. Heifers were dewormed and sprayed against ectoparasites before the commencement of study. After the preliminary adjustment period of 10 days prior to the start of the experiment, the heifers were divided into

four groups of five heifers each on the basis of similarity in body weight and age and then, one of the four treatments was given to each group randomly *viz.* T_1 (Control): corrugated asbestos roof, T_2: corrugated asbestos roof painted white on upper side, T_3: corrugated asbestos roof having 70 mm thick heat resistant EPE sheet on lower side.T_4: corrugated asbestos roof painted white on upper side and 70 mm thick heat resistant EPE sheet on lower side.

Observation
Respiration rate, pulse rate and rectal temperature of buffalo heifers were recorded at 7:00 AM and 2:00 PM fortnightly. Respiration rate was recorded by counting movements of the right flank (counts/minute) and pulse rate by palpating the coccygeal artery (counts/minute). A digital thermometer was used to record the rectal temperature (°F).

Statistical Method
The means of data obtained from the studies were compared by one way analysis of variance (ANOVA) as per the methods described by Snedecor and Cochran (1994) [16]. The data was analyzed using "SPSS" software (version-17).

Results
The concept of animal adaptation refers to physiological changes taking place in an animal with respect to external and internal stimuli. During severe summer when ambient temperature surpasses animal body temperature at that time most animals rely on evaporation of water from the body as a means to dissipate body heat. Since the buffalo do not possess an efficient sweating mechanism, the primary process of heat dissipation is via evaporation through the respiratory tract (Clark and Mc Arthur, 1994) [2].
The physiological parameters *viz.* respiration rate, pulse rate and rectal temperature of heifers under different treatments recorded at 7:00 AM and 2:00 PM have been presented in table-1, table-2 and table-3, respectively.

Respiration Rate
The overall morning and afternoon respiration rate of each group of heifers were 24.90±0.49, 25.43±0.47, 23.77±0.77, 24.17±0.50 and 34.73±0.56, 32.63±1.04, 31.50±0.63, 29.03±0.69 with average values; 29.82±0.25, 29.03±0.67, 27.63±0.56, 26.60±0.34 counts/minute in T_1, T_2, T_3 and T_4, respectively.
The perusal table revealed that the afternoon respiration rate differs significantly (P<0.05) between the treatments with highest values for T_1 followed by T_2 and least in T_4. There was no significant difference in morning respiration rate and showed irregular trends during different fortnights. Further, the afternoon respiration count was always higher than morning values in all fortnights. The afternoon values were significantly (P<0.05) higher in T_1 as compared to T_3 and T_4 but the difference was non-significant between T_1 and T_2 as well as between T_2 and T_3 which indicates that the heifers in T_1 were under heat stress because of high temperature and THI values. So to get rid-off from body heat through pulmonary evaporative loss they had to increase their respiration rate.

Table 1: Mean ± SE of Respiration Rate (counts per minute) of heifers

Fortnight	Time	Asbestos roof (T_1)	White painted roof (T_2)	EPE sheet roof (T_3)	White painted and EPE sheet roof (T_4)
I	7:00 AM	18.80±0.80	21.80±1.83	21.60±1.33	22.00±2.28
	2:00 PM	28.80±1.62	27.60±1.72	26.40±1.47	25.20±1.20
	Average	23.80±0.86	24.70±1.38	24.00±1.22	23.60±1.21
II	7:00 AM	24.60±0.75	25.20±2.15	24.40±1.17	24.60±1.17
	2:00 PM	30.20±1.11^{a}	28.60±1.17^{ab}	27.40±1.17^{ab}	26.20±1.20^{b}
	Average	27.40±0.70	26.90±1.00	25.90±0.87	25.40±0.37
III	7:00 AM	25.20±1.02	23.80±1.02	22.40±1.60	23.00±1.41
	2:00 PM	36.20±1.93^{a}	33.60±2.64^{ab}	32.80±2.13^{ab}	28.80±1.02^{b}
	Average	30.70±1.33^{a}	28.70±1.07^{ab}	27.60±1.43^{ab}	25.90±0.81^{b}
IV	7:00 AM	27.20±1.02	26.80±1.36	23.40±1.47	23.60±1.21
	2:00 PM	36.60±1.89^{a}	33.20±1.39^{ab}	31.60±1.21^{bc}	28.20±0.58^{c}
	Average	31.90±1.00^{a}	30.00±1.08^{ab}	27.50±1.15^{bc}	25.90±0.53^{c}
V	7:00 AM	26.00±0.95	27.40±1.08	25.40±0.93	25.80±0.80
	2:00 PM	37.40±1.17^{a}	35.20±1.71^{a}	34.00±2.00^{ab}	29.40±1.21^{b}
	Average	31.70±0.46^{a}	31.30±1.29^{a}	29.70±1.09^{ab}	27.60±0.53^{b}
VI	7:00 AM	27.60±1.03	27.60±0.51	25.40±1.69	26.00±0.71
	2:00 PM	39.20±2.42	37.60±1.33	36.80±1.62	36.40±2.32
	Average	33.40±1.49	32.60±0.76	31.10±1.43	31.20±0.85
Overall	7:00 AM	24.90±0.49	25.43±0.47	23.77±0.77	24.17±0.50
	2:00 PM	34.73±0.56^{a}	32.63±1.04^{ab}	31.50±0.63^{b}	29.03±0.69^{c}
	Average	29.82±0.25^{a}	29.03±0.67^{ab}	27.63±0.56^{bc}	26.60±0.34^{c}

Means bearing different superscripts in a row differ significantly (P<0.05)

Pulse Rate
The overall morning and afternoon pulse rate were 57.37±1.02, 57.87±0.86, 56.77±1.16, 55.63±0.59 and 71.83±1.51, 66.93±1.41, 65.47±1.75, 63.80±0.99 with average values; 64.60±0.89, 62.40±0.32, 61.12±1.41, 59.72±0.74 counts/minute in treatments T_1, T_2, T_3 and T_4, respectively. The perusal table revealed that the morning pulse rate was not significantly different between treatments; however, afternoon values were significantly (P<0.05) high in T_1 as compared to T_2, T_3 and T_4. This indicates that the heifers in conventional asbestos were under heat stress because of higher ambient temperature. So to get rid-off from body heat through pulmonary evaporative heat loss they also had to increase their pulse rate in addition to increasing respiration rate. On the other hand, the group of heifers with modified sheds kept their pulse rate at a fairly low level.

Table 2: Mean ± SE of Pulse Rate (counts per minute) of heifers

Fortnight	Time	Asbestos roof (T_1)	White painted roof (T_2)	EPE sheet roof (T_3)	White painted and EPE sheet roof (T_4)
I	7:00 AM	49.60±1.47	51.20±2.24	50.80±1.50	50.40±1.72
	2:00 PM	57.60±2.14	56.00±1.90	54.40±2.14	54.40±1.33
	Average	53.60±1.50	53.60±0.60	52.60±1.72	52.40±1.25
II	7:00 AM	51.20±1.16	52.80±2.06	52.00±1.41	51.60±1.47
	2:00 PM	66.60±2.71	64.80±2.65	62.40±1.17	60.60±1.99
	Average	58.90±0.93	58.80±1.11	57.20±1.24	56.10±1.54
III	7:00 AM	52.80±1.20	53.00±1.14	52.60±1.17	52.40±1.33
	2:00 PM	77.20±0.37^{a}	77.20±0.49^{a}	73.80±0.66^{ab}	70.00±2.49^{b}
	Average	65.00±0.52^{a}	65.10±0.62^{a}	63.20±0.75^{ab}	61.20±1.32^{b}
IV	7:00 AM	62.40±1.47	62.00±2.28	61.40±2.09	59.60±1.72
	2:00 PM	76.20±1.93^{a}	69.60±2.01^{ab}	69.00±3.08^{ab}	67.60±2.01^{b}
	Average	69.30±1.12^{a}	65.80±1.12^{ab}	65.20±2.33^{ab}	63.60±1.76^{b}
V	7:00 AM	63.60±1.96	63.20±1.56	61.60±2.14	59.40±1.63
	2:00 PM	76.80±2.75^{a}	68.00±2.00^{b}	67.40±3.44^{b}	66.00±2.17^{b}
	Average	70.20±2.22^{a}	65.60±1.03^{ab}	64.50±2.62^{ab}	62.70±1.68^{b}
VI	7:00 AM	64.60±2.18	65.00±1.30	62.20±2.58	60.40±2.32
	2:00 PM	76.60±3.71^{a}	66.00±2.00^{b}	65.80±3.51^{b}	64.20±2.20^{b}
	Average	70.60±2.63^{a}	65.50±0.69^{ab}	64.00±2.89^{ab}	62.30±2.14^{b}
Overall	7:00 AM	57.37±1.02	57.87±0.86	56.77±1.16	55.63±0.59
	2:00 PM	71.83±1.51^{a}	66.93±1.41^{b}	65.47±1.75^{b}	63.80±0.99^{b}
	Average	64.60±0.89^{a}	62.40±0.32^{ab}	61.12±1.41^{b}	59.72±0.74^{b}

Means bearing different superscripts in a row differ significantly ($P<0.05$)

Similar results were observed by Fulsounder (1982) [3] and Sethi *et al.* (1994) [10], Singh (2000) [14] and Seerapu (2014) [11]. The results were also in agreement with the findings of Singal (2001) [12] who found significant difference in evening pulse rate of buffalo heifers in improved management. Similarly, Sinha *et al.* (2017, b) [15] concluded that pulse rate was significantly ($P<0.05$) higher in the control group (83.59±0.83) as compared to the treatment group (78.65±1.09).

Rectal Temperature

The overall morning and evening rectal temperature (^{0}F) of buffalo heifers were 100.66±0.03, 100.77±0.11, 100.61±0.10, 100.60±0.12 and 102.26±0.16, 101.98±0.06, 101.69±0.04, 101.48±0.06 with average values; 101.46±0.07, 101.38±0.06, 101.15±0.04, 101.04±0.09^{0}F in treatments T_1, T_2, T_3 and T_4, respectively.

Table 3: Mean ± SE of Rectal Temperature (^{0}F) of heifers

Fortnight	Time	Asbestos roof (T_1)	White painted roof (T_2)	EPE sheet roof (T_3)	White painted and EPE sheet roof (T_4)
I	7:00 AM	100.92±0.21	101.50±0.44	100.92±0.21	101.04±0.27
	2:00 PM	101.96±0.16^{a}	101.76±0.16^{ab}	101.42±0.05^{bc}	101.08±0.11^{c}
	Average	101.44±0.15	101.63±0.29	101.17±0.09	101.06±0.17
II	7:00 AM	99.92±0.12	100.28±0.34	100.30±0.16	100.44±0.16
	2:00 PM	102.36±0.23^{a}	102.24±0.28^{ab}	101.66±0.38^{ab}	101.44±0.11^{b}
	Average	101.14±0.12	101.26±0.25	100.98±0.18	100.94±0.11
III	7:00 AM	99.80±0.17	99.24±0.24	99.70±0.28	99.50±0.28
	2:00 PM	102.10±0.08^{a}	101.84±0.12^{b}	101.78±0.06^{b}	101.58±0.06^{b}
	Average	100.95±0.12^{a}	100.54±0.09^{b}	100.74±0.13^{ab}	100.54±0.14^{b}
IV	7:00 AM	100.76±0.13	100.90±0.15	100.60±0.20	100.78±0.12
	2:00 PM	102.26±0.16^{a}	101.92±0.11^{b}	101.76±0.05^{bc}	101.54±0.05^{c}
	Average	101.51±0.04^{a}	101.41±0.06^{a}	101.18±0.11^{b}	101.16±0.07^{b}
V	7:00 AM	101.16±0.09	101.18±0.09	100.88±0.16	100.86±0.05
	2:00 PM	102.46±0.26^{a}	102.06±0.10^{ab}	101.76±0.10^{b}	101.62±0.04^{b}
	Average	101.81±0.10^{a}	101.62±0.03^{a}	101.32±0.12^{b}	101.24±0.04^{b}
VI	7:00 AM	101.38±0.06^{a}	101.52±0.07^{a}	101.24±0.13^{ab}	101.00±0.13^{b}
	2:00 PM	102.44±0.19^{a}	102.06±0.05^{b}	101.76±0.09^{bc}	101.64±0.10^{c}
	Average	101.91±0.08^{a}	101.79±0.05^{a}	101.50±0.10^{b}	101.32±0.09^{b}
Overall	7:00 AM	100.66±0.03	100.77±0.11	100.61±0.10	100.60±0.12
	2:00 PM	102.26±0.16^{a}	101.98±0.06^{b}	101.69±0.04^{c}	101.48±0.06^{c}
	Average	101.46±0.07^{a}	101.38±0.06^{a}	101.15±0.04^{b}	101.04±0.09^{b}

Means bearing different superscripts in a row differ significantly ($P<0.05$)

The study revealed that there was no significant difference in morning rectal temperature however afternoon rectal temperature was significantly ($P<0.05$) higher in T_1 as compared to T_2, T_3 and T_4. This is because of high thermal stress in T_1 as compared to T_2, T_3 and T_4. Inability to eliminate excess heat might probably have led to the rise in rectal temperature in T_1 whereas; modifications in T_2, T_3 and T_4 reduced rectal temperature as they prevented direct and indirect solar radiations in these sheds. The findings were in agreement with the observations already made by Sethi *et al.* (1994) [10], Singh (1996) [13] and Singh (2000) [14]. Similarly, Khongdee *et al.* (2010) [6] observed significantly lower mean rectal temperature (38.56 °C) in shade cloth than that of the cows housed under normal roofing (39.86 °C). Similarly, Kamal *et al.* (2014) [5] found significantly (P<0.05) lower rectal temperature in calves kept in thatch and agro-net as compared to asbestos. Barman (2016) [1] concluded that the overall rectal temperature of buffalo calves under thatch roof showed significant (P<0.05) difference from all other groups with lower values.

Conclusion

Use of EPE sheets on the inner side of the existing sheds altered microclimate of heifers indicating highly superior thermal insulation power of EPE sheet thus might have reduced heat stress resulting in better physiological values while conventional asbestos roof was unable to cut down the heat load falling on it through radiations, thus it could not provide proper microclimate to heifers witnessed by high physiological values. White painted roof might have lesser protection against direct sunlight resulting in high physiological values as compared to those in EPE sheet sheds which indicates that white painted roof was also insufficient to provide better micro-environment to heifers during summer however; the conditions were more favourable as compared to conventional asbestos roof. So, it can be concluded that heifers can be raised efficiently by using new shed material like EPE sheet on the inner side of existing sheds to maintain normal physiology in buffalo heifers during summer.

Reference

1. Barman RSD. Studies on the effect of different shade materials on the performance of buffalo calves. PhD thesis submitted to Bihar Agricultural University, Bhagalpur, Bihar 2016.
2. Clark JA, Mc Arthor AJ. Thermal Exchange In: Watches, C.M and Charles, D.R. (Eds) Livestock Housing. CAB International, Wallingford. U.K 1994.
3. Fulsounder AB. Effect of body cooling by splashing water on physiological responses, milk production and compositions in female Mehsana buffaloes. M.V. Sc. thesis, Gujarat Agri. Uni., Sardarkrushinagar, Gujarat, India 1982.
4. Gebremedhin KG, Wu B. Sensible and latent heat losses from wet-skin surface and fur layer. ASAE Annual international Meeting, Sacramento, CA. ASAE ASABE, St. Joseph, MI, USA 2001, 01-4040.
5. Kamal R, Dutt T, Patel BH, Dey A, Chandran PC, Barari SK, Chakrabarti A, Bhusan B. Effect of shade materials on microclimate of crossbred calves during summer, Veterinary World 2014;7(10):776-783.
6. Khongdee S, Sripoon S, Chousawai S, Hinch G, Chaiyabutr N, Markvichitr K *et al.* The effect of modified roofing on the milk yield and reproductive performance of heat-stressed dairy cows under hot-humid conditions. Anim. Sci. J 2010;81(5):606-11.
7. Pollard BC, Dwyer ME, Fitzgerald AC, Genty PC, Henderson DA, Collier RJ. Effect of ambient temperature and solar radiation on skin evaporative water loss in dairy cattle. J Dairy Sci 2004;87(1):198 (Abst.)
8. Raghavan GV, Mullick DN. Effect of air temperature and humidity on the pulse rate, respiration rate and rectal temperature in buffaloe bulls. Indian Vet. J 1962;38:391-396.
9. Riek RF, Lee DHK. Reaction to hot atmosphere of Jersey cows in milk. J Dairy Res 1948;15:219-226.
10. Sethi RK, Bhardwaj A, Chopra SC. Effect of heat stress on buffaloes under different shelter strategies. Indian J Anim. Sci 1994;64(11):1282-1285.
11. Seerapu SR. Effect of microclimate alterations on temperature-humidity index (thi) production and reproduction traits of murrah buffaloes. M.V. Sc. thesis submitted to Sri Venkateswara Veterinary University, Tirupati, India 2014.
12. Singal JS. Effect of feeding bypass protein and improved managemental practices on growth performance of murrah buffalo heifers, Ph.D. thesis, submitted to C.C.S. Haryana Agricultural University, Hisar 2001.
13. Singh Y. Studies of certain summer management practices on performance of growing buffalo calves. M.V.Sc. thesis, submitted to CCS Haryana Agricultural University, Hisar, India 1996.
14. Singh Y. Effect of certain managemental practices on the performance of buffalo heifers. PhD thesis, submitted to C.C.S. Haryana Agricultural University, Hisar, India 2000.
15. Sinha R, Kamboj ML, Ranjan A, Lathwal SS. Effect of modified housing on behavioural and physiological responses of crossbred cows in hot humid climate. Indian J Anim Sci 2017;87(10):34-37.
16. Snedecor FW, Cochran WG. Statistical Methods (8th *ed*.). Oxford and IBH Publishing Company, Calcutta 1994.