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Could modification of roof using EPE sheet and white paint affect the growth performance in buffalo heifers in summer

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Abstract
An attempt was made to study the effect of microclimate alterations on growth 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. The heifers were weighed individually before feeding and watering in the morning at fortnightly intervals, whereas; body measurements (body length, body height and heart girth) were recorded on monthly intervals. Average weight gain over the experimental period as well as ADG per animal were significantly higher ($P<0.05$) in T_4 (37.80±2.03 and 0.420±0.02, respectively) and lowest in T_1 (28.80±1.32 and 0.320±0.01, respectively) whereas; body measurements were always non-significant among treatments although values were always higher for T_4. So it can be concluded that microclimate alterations by roof modifications using EPE sheets as well as white paint helped heifers to grow at a faster speed as compared to existing asbestos roofs.

Keywords: buffalo, microclimate, roof modifications, growth, average daily gain

Introduction
The success of the livestock industry depends on good health of the livestock that helps to increase productivity. The milk production in India has grown by 5.69% to reach 198.4 MT in 2019-20 with per capita availability of milk reaching a new level of 406 ml. Livestock sector not only provides essential protein and nutrition to the human diet but also plays an important role in utilization of non-edible agricultural by-products. But productive and reproductive performances of buffaloes are compromised due to known problems of biological and management origins, such as low genetic potential, inadequate supply of feed and fodder, poor breeding management and health practices and last but not the least mainly the tropical climate of our country causing heat stress. Environment influences the growth directly and indirectly. The main objective of management of heifers is to obtain optimum growth as per their genetic potential so that they can attain early maturity and subsequently reduced age at first calving. All the body measurements show an increasing trend with advancement of age and increase in body weight but the change depends on the comfortness and wellbeing of animals which is directly affected by the microclimate inside the shed. In the other way, the animals in the thermal comfort zone keep their physiological parameters in normal range so their body energy can be used in increasing body measurements whereas; heat stressed animals divert their body energy to maintain homeothermy. To keep this in mind the proposed study was planned to reduce the thermal load in animal shed for improving the growth performance in buffalo heifers in summer, after a thoughtful roof modification using EPE sheet along with white paint.

Material and Methods
The materials and various methods adopted for the investigation described in this article are as:

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.

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.

Feeding and Watering

Ad libitum, seasonal green fodder was offered to all the heifers daily during the entire experiment period. All the experimental buffalo heifers were fed on balanced ration as per the requirements and ICAR (2013) [2] standards. The quantity of different feeds given to heifers of each group was adjusted at fortnightly intervals as per the change in body weight of heifers. Clean and fresh drinking water was made available in each shed all the time.

Observation

Growth

The heifers were weighed individually before feeding and watering in the morning at fortnightly intervals. Electronic balance was used for weighing heifers and change in body weight was calculated accordingly. The body weights utilized for computation of ration as well as to know weight gain at fortnightly intervals.

The growth rate for every fortnight was calculated as follows:

$$\text{Average Daily Gain (kg)} = \frac{\text{Total Weight Gain (kg) over fortnight}}{15}$$

Whereas; average weight gain over the experimental period was also calculated for each treatment as follows:

Average weight gain (kg) = Body weight at the end of experiment (kg) – Body weight at beginning of experiment (kg)

Body measurements

Body measurements *viz*., heart girth (chest girth), height at withers and body length were taken with the help of measuring tape on centimeters scale (cm) at monthly intervals for each buffalo heifer. Body measurements were taken when the buffalo heifers were standing in a normal body posture.

a) **Heart girth (HG):** The measurement of heart girth was taken when the buffalo heifers were standing in a normal position (smallest circumference immediately behind the shoulder).

b) **Height at withers (HAW):** Height at withers was measured at the highest point of body (from ground level to the point of withers).

c) **Body length (BL):** Body length of heifers was measured by taking distance from the point of shoulder to the base of the tail.

d) 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) [8]. The data was analyzed using "SPSS" software (version-17).

Results

Body Weight Changes (kg) and Average Weight Gain (kg)

The fortnightly body weight changes of buffalo heifers during different fortnights in all the four groups are presented in table-1. The Initial body weight was 172.60±13.69, 170.00±21.28, 164. 20±17.43 and 169.00±19.73 kg in T_1, T_2, T_3 and T_4, respectively and was non-significant. The fortnightly body weight of heifers increased steadily and reached the final body weight of 206.80±21.31, 198.20±17.42, 201. 60±21.98 and 201.40±14.91 kg in T_1, T_2, T_3 and T_4, respectively.

The perusal table revealed that body weight changes of heifers under different treatment in all fortnights did not differ significantly with each other and average weight gain over the experimental period differed significantly ($P<0.05$) between the treatments and found to be maximum in T_4 group (37.80±2.03 kg) followed by T_3 (34.00±0.71 kg) then T_2 (31.60±1.54 kg) and T_1 (28.80±1.32 kg). However there was no significant difference between T_1 and T_2. Significantly higher average weight gain in T_3 and T_4 heifers might be due to more DMI and better microclimate in shed which improved the growth of heifers irrespective of higher maximum ambient temperature during experimental period.

The results corroborates with Singh (2000) [7] who concluded that buffalo heifers kept in aluminium foil pasted roof and thatched roof gained more body weight as compared to asbestos and white painted roof however the difference was non-significant between treatments.

Average daily gain (kg) (ADG)

The fortnightly ADG of heifers is presented in table-2. The ADG during the 1st fortnight was 0.280±0.03, 0.293±0.04, 0.320±0.02 and 0.373±0.03 kg which increased to 0.373±0.03, 0.413±0.02, 0.440±0.02 and 0.480±0.02 Kg at last fortnight with overall values; 0.320±0.01, 0.351±0.02, 0.378±0.01 and 0.420±0.02 for T_1, T_2, T_3 and T_4, respectively. Further, ADG during the 6th fortnight was comparatively higher in all the groups which might be due to higher DMI during last fortnight. The ADG ranged from 0.280±0.03 kg to 0.480±0.02 kg indicating a huge difference of growth between heifers in different sheds used in the experiment. The ADG was significantly higher ($P<0.05$) for T_3 and T_4 grouped heifers as compared to T_1 and T_2 grouped heifers.

The faster gain in T_2, T_3 and T_4 as compared to control was due to modifications in the roof of sheds causing microclimate alterations. White paint on the outer surface (T_2) reflects the solar radiation and prevents the roof from becoming hot. This decreased the indirect solar radiation and its adverse effect on animals. Similarly, in T_3 where EPE sheet acted as an insulating agent preventing the rise of temperature inside the shed whereas, T_4 was the combination of T_2 and T_3. This shows that T_3 and T_4 provide more comfortable conditions to the heifers than white painted asbestos roof (T_2) or conventional asbestos roof (T_1). The beneficial effects of white painted asbestos roof with EPE

sheet were more due to high reflectivity of solar radiations by white paint and superior insulating property of EPE sheet. Patil *et al.* (2008) [4] reported higher weight gain by providing simple thatch shed to the kids in comparison to tin roofs.

The results are in close agreement with Kamal (2013) [3] who observed that ADG for calves was significantly ($P<0.05$) higher in agro-net followed by thatch roof, asbestos roof and least under tree in summer season. Similarly, Barman *et al.* (2017) [2] concluded that the ADG was significantly higher ($P<0.05$) in buffalo calves kept in thatch with a polythene shading roof as compared to other groups. Whereas, Shrikhant and Kumar (2001) [6] found no significant difference between ADG in a loose house with a single wall and loose house with four feet side wall.

Table 1: Mean ± SE of fortnightly Body Weight Changes and Average Weight Gain (kg):

Fortnight	Asbestos roof (T_1)	White painted roof (T_2)	EPE sheet roof (T_3)	White painted and EPE sheet roof (T_4)
Initial	172.60±13.69	170.00±21.28	164.20±17.43	169.00±19.73
I	176.80±13.81	174.40±21.32	169.00±17.68	174.60±19.59
II	181.20±14.14	179.60±21.37	174.20±17.42	180.60±19.93
III	185.80±14.33	184.40±21.67	179.20±17.53	186.40±20.35
IV	190.60±14.48	189.60±21.91	185.20±17.64	192.60±20.69
V	195.80±14.90	195.40±22.01	191.60±17.44	199.60±21.05
VI	201.40±14.91	201.60±21.98	198.20±17.42	206.80±21.31
Average weight gain	$28.80±1.32^{c}$	$31.60±1.54^{bc}$	$34.00±0.71^{ab}$	$37.80±2.03^{a}$

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

Table 2: Mean ± SE of fortnightly Average Daily Gain (kg)

Fortnight	Asbestos roof (T_1)	White painted roof (T_2)	EPE sheet roof (T_3)	White painted and EPE sheet roof (T_4)
I	0.280±0.03	0.293±0.04	0.320±0.02	0.373±0.03
II	0.293±0.03	0.347±0.04	0.347±0.04	0.400±0.03
III	0.307±0.02	0.320±0.02	0.333±0.02	0.387±0.04
IV	$0.320±0.01^{b}$	$0.347±0.02^{ab}$	$0.400±0.02^{a}$	$0.413±0.03^{a}$
V	$0.347±0.03^{b}$	$0.387±0.02^{ab}$	$0.427±0.03^{ab}$	$0.467±0.03^{a}$
VI	$0.373±0.03^{b}$	$0.413±0.02^{ab}$	$0.440±0.02^{ab}$	$0.480±0.02^{a}$
Overall	$0.320±0.01^{c}$	$0.351±0.02^{bc}$	$0.378±0.01^{ab}$	$0.420±0.02^{a}$

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

Body Measurements

Increase (cm) in the body measurements such as body length, body height and heart girth of heifers has been presented in table-3. The overall increase (cm) in body length measurement was 2.47±0.31, 2.67±0.32, 2.89±0.26 and 3.14±0.23 while, in body height was 2.07±0.04, 2.18±0.12, 2.28±0.16 and 2.43±011 cm, whereas; in heart girth measurement was 3.45±0.20, 3.48±0.39, 3.75±0.29 and 4.08±0.13 in T_1, T_2, T_3 and T_4, respectively.

The poor growth rate in heifers under T_1 as compared to T_2, T_3 and T_4 was because of the fact that they were not protected against indirect solar radiation and remained under constant heat stress during experiment. It may be possible that the heifers in asbestos roof would have diverted their maximum body energy gained from feed intake to maintain homeothermy instead of utilizing it for growth. Whereas, in differently modified sheds more growth was achieved due to protection of heifers against thermal stress, either by keeping them in sheds having roof which reflected the incoming solar radiation (T_2) or the sheds having EPE sheets in roof which acted as an insulating agents (T_3 and T_4), so that adverse effect of indirect solar radiation was reduced.

The results corroborate with the study of Pradhan *et al.* (1999) [5] and Barman *et al.* (2017) [2] who found non-significant differences in body measurements changes. However, Singh (2000) [7] found significantly ($P<0.05$) less increase in body height and heart girth in buffalo heifers in conventional asbestos roof as compared to modified sheds whereas, the difference was non-significant in body length changes.

Table 3: Mean ± SE of monthly average Increase (cm) in Body Measurements of heifers

Fortnight	Asbestos roof (T_1)	White painted roof (T_2)	EPE sheet roof (T_3)	White painted and EPE sheet roof (T_4)
Body Length				
I	1.84±0.22	1.94±0.36	2.06±0.35	2.56±0.29
II	2.34±0.39	2.62±0.31	2.96±0.28	3.08±0.36
III	3.22±0.47	3.44±0.32	3.64±0.34	3.78±0.17
Overall	2.47±0.31	2.67±0.32	2.89±0.26	3.14±0.23
Body Height				
I	1.90±0.10	1.76±0.24	1.84±0.20	2.18±0.11
II	2.06±0.04	2.14±0.10	2.30±0.18	2.34±0.12
III	2.26±0.02	2.64±0.17	2.70±0.15	2.76±0.14
Overall	2.07±0.04	2.18±0.12	2.28±0.16	2.43±0.11
Heart Girth				
I	2.60±0.53	2.70±0.54	2.80±0.25	3.10±0.24
II	3.80±0.46	4.10±0.60	4.10±0.58	4.30±0.30
III	3.90±0.29	4.10±0.46	4.20±0.46	4.60±0.51
Overall	3.45±0.20	3.48±0.39	3.75±0.29	4.08±0.13

Conclusion

Microclimate modifications using expanded polyethylene sheets and white paint improved total weight gain as well as average daily gain, which were evident in body measurements changes. Heifers under asbestos roofs diverted their energy to maintain homeothermy while in modified sheds heifers showed maximum growth as they were less heat stressed in these sheds. So, it can be concluded that heifers can be raised more efficiently by using new shed material like EPE sheet on inner side of existing sheds to provide thermal insulation in summer to underneath heifers.

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