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Study of behavioural and physiological changes of crossbred cows under different shelter management practices

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ABSTRACT

The effect of various kinds of shelter modifications in different seasons, viz. hot dry, hot humid and winter on physiological and behavioral responses of Karan Fries crossbred cows were studied in the present investigation. The mean rectal temperature, respiration rate per min, pulse rate per min and skin temperature in hot dry and hot humid seasons were significantly higher in group 1 with concrete flooring (G1), while in winter these were higher in groups with rubber mattress (G2) and straw bedding (G3). The time spent on feeding and rumination was significantly higher in G3 group with significantly low feeding temperament score. Significantly higher resting time and higher weight gain was observed in G3 as compared to G2 and G1. The study indicated that thatch roof and sand bedding in hot seasons and straw bedding in winter proved to be the most comfortable for crossbred cows in northern India.

Key words: Behavioural responses, Physiological traits, Shelter modifications

The performance of the animals is said to be impaired on exposing them to extremes of climatic conditions (Thomas and Sastry 1991). Environmental conditions especially shelter management also affect the 24 h behaviour (feeding, rumination rate, resting etc.) of dairy animals in a varying range, which could be used to study the effectiveness of housing system in a particular agro-climatic region. Environmental factors especially housing system can be modified for the betterment of animal production, reproduction and welfare. So there is a need to develop different types of suitable housing systems for various agro-climatic regions of the country. Keeping in view these facts the present study was carried out to study the effect of various shelter managemental interventions on production and reproduction performance of crossbred cows.

MATERIALS AND METHODS

Lactating healthy Karan Fries crossbred cows (18) were randomly distributed in 3 experimental groups of 6 each on the basis of the similarity in parity, body weight, stage of lactation and average milk yield per day. Animals selected were at the stage of 30 to 45 days postpartum. Experimental groups referred to 3 different types of shelter managemental interventions considered in the present study, viz. G1 animals were provided with concrete flooring in both covered as well as open area, G2 animals were provided with concrete flooring along with rubber mat bedding and thatched roof, and in G3 animals were provided with concrete flooring with sand (in hot dry and hot humid) and straw bedding (in winter season) and thatched roof were provided. The study was conducted for 270 days duration in 3 seasons, viz. hot-dry (April-June with temperature >36°C and relative humidity 25–40%), hot-humid (July-September with average temperature >33°C and relative humidity 70–90%) and winter season (December-February with temperature <12°C and relative humidity 35–55%). Animals in different systems of housing were provided *ad lib*. green fodder as per availability in different seasons and concentrate mixture (72% TDN and 20% CP) as per NRC requirement. Behavioural observation was recorded manually by visual watching of animals by skilled workers. The observations were obtained for 24 h (twice) in a season for all cows. The activities recorded in present experiment were time taken for fodder eating, standing rumination, standing idle, lying rumination, lying idle, frequency of defecation, urination and drinking as well as temperament score. Animals were also observed for abnormal behaviour.

Statistical analysis was performed by using least square analysis of variance (ANOVA) with interactions. Means and standard error were calculated as per Harvey (1987).

RESULTS AND DISCUSSION

Physiological responses: In the present study, the effectiveness of housing (floor and roof) modifications of

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Table 1. Least squares mean (±SE) of physiological traits for different groups of cows in different season

Traits	Hot dry season			Hot humid season			Winter season		
	G1	G2	G3	G1	G2	G3	G1	G2	G3
RT (°F)	101.62 [a] ±0.09	101.31 [b] ±0.10	101.13 [c] ±0.17	101.73 [a] ±0.21	101.48 [b] ±0.11	101.40 [c] ±0.12	99.63 [a] ±0.22	99.98 [b] ±0.28	100.70 [c] ±0.14
RR/min	33.62 [a] ±1.43	31.17 [b] ±1.15	29.52 [c] ±0.99	30.59 [a] ±1.09	27.61 [b] ±1.12	26.15 [c] ±1.08	24.05 ±0.73	24.12 ±0.77	24.13 ±0.70
PR/min	65.52 [a] ±1.61	61.12 [b] ±1.41	59.95 [c] ±1.02	61.08 [a] ±0.22	56.63 [b] ±0.67	55.95 [c] ±0.74	54.08 [a] ±0.10	54.06 [a] ±1.02	55.37 [b] ±0.88
SKT (°C)	37.35 [a] ±0.15	36.63 [b] ±0.23	37.08 [c] ±0.28	35.38 [a] ±0.35	35.22 [b] ±0.31	35.16 [c] ±0.32	27.87 [a] ±0.23	29.93 [b] ±0.25	31.55 [c] ±0.28

Means with different superscripts [a, b, c] in a row for a particular season differs significantly (P<0.01). RT, rectal temperature; RR, respiration rate; PR, pulse rate; SKT, skin temperature.

crossbred Karan Fries cows on their physiological and behavioural responses, in different seasons were investigated. It was observed that rectal temperature (RT), respiration rate per min (RR/min), pulse rate per min (PR/min) and skin temperature (SKT) were significantly (P<0.01) different for the cows of all the 3 experimental groups in 3 different seasons (Table 1). The results indicated that housing modifications made for G3 cows were the most suitable in respect to the cow comfort in all the 3 seasons as compared to the modifications made for other 2 groups, as all the physiological parameters, viz. RT, RR/min, PR/min and SKT for G3 groups for hot dry and hot humid seasons were lower than other 2 groups while these parameters for G3 group in winter were higher than other groups, it might be due to the fact that sand bedding and thatched roof in hot dry and hot humid season worked as a good heat reflector as well as provided cooling effect while straw bedding and thatched roof in winter season served as a good insulator to protect the cows from chilling effect. These results are in agreement with the findings of Sagsoz *et al.* (2000) and Gupta *et al.* (2004), who reported that mattress bedding was more comfortable as compared to concrete flooring in terms of physiological responses of dairy cows.

Physical responses: The initial body weight of the cows in different groups did not differ significantly in all the 3 seasons but a significant (P<0.01) difference in the body weights of cows of the 3 groups was reflected in hot dry and winter seasons (Table 2). The final body weight of cows in G3 group for hot dry and winter season were significantly (P<0.01) higher as compared to body weights of cows of two other groups, it might be due to the fact that the housing modification for G3 group animals was most suitable and it reduced the environmental stresses and more over reduced the chances of occurrence of diseases and infections, but unfortunately no significant difference in feed intake and blood constitution of cows in all the three groups was found in different seasons. Thus, highest weight gain was observed with sand and straw bedding, in comparison with rubber matting and least with concrete flooring. These findings are

Table 2. Least square means (±SE) of body weight (kg) for different groups during different seasons

Season	G1	G2	G3
Hot dry			
Initial body wt	403.53± 7.65	411.23±5.29	421.57±12.95
Final body wt	409.20±7.51[a]	418.03±7.29[a]	454.51±9.11[b]
Hot humid			
Initial body wt	389.35±5.29	378.42±5.13	418.25±5.67
Final body wt	414.64±7.29	421.63±11.97	432.72±5.14
Winter season			
Initial body wt	378.34±8.21	381.82±6.74	415.94±5.74
Final body wt	379.02±14.35[a]	407.53±19.11[b]	445.18±10.46[b]

Means with different superscripts [a, b, c] in a row differ significantly (P<0.01).

similar to the observation of Suss (1987) and Weirsma and Armstrong (1989) that daily weight gain in cows with rubber coating was highest as compared to concrete flooring.

Behavioural responses: The mean values regarding these parameters are presented in Table 3. The results of the feeding behaviour reflected that mean time spent on feeding, and sitting/lying rumination for cows of G3 groups in all the three seasons were significantly (P<0.01) higher while for standing rumination were significantly (P<0.01) lower as compared to other groups. Thus it can be interpreted that housing modification in G3 group was most comfortable to the experimental cows that is why cows of this group spent more time on fodder intake as well as on sitting/lying rumination. Moreover time spent on sitting/lying rumination in different seasons was significantly (P<0.01) higher than that of standing rumination but the difference was highest for G3 cows, it also reflects that the flooring modification for these animals was most comfortable. Thus the findings of this study coincide with the observation of Sonck *et al.* (1999), Chaplin *et al.* (2000) and Jat *et al.* (2005 a, b) that cows on mattresses spent time on feeding, rumination and lying. The feeding temperament score of cows of G3 group for different seasons was significantly (P<0.01) lower rather than other group's,

Table 3. Least square means (±SE) behavioural pattern of cows (min) for different groups of cows in different seasons

Traits	Hot dry season			Hot humid season			Winter season		
	G1	G2	G3	G1	G2	G3	G1	G2	G3
EF	128.45 [a] ±11.27	143.61 [b] ±12.77	147.35 [c] ±10.14	128.17 [a] ±8.38	133.22 [b] ±10.38	133.33 [c] ±9.62	149.31 [a] ±6.72	155.15 [b] ±8.14	157.87[c] ±7.90
STR	123.09 [a] ±11.06	115.10 [b] ±9.62	117.51 [c] ±6.67	128.62 [a] ±8.75	122.05 [b] ±7.77	120.77 [c] ±7.29	119.32 [a] ±8.004	118.85 [b] ±0.12	112.15[c] ±6.35
SILR	140.16 [a] ±13.29	146.02 [b] ±12.85	163.44 [c] ±7.29	150.64 [a] ±10.35	162.35 [b] ±12.48	167.01 [c] ±10.86	134.62 [a] ±7.04	150.87 [b] ±10.94	153.30 [c]±9.25
FTS	1.73 [a] ±0.04	1.29 [b] ±0.01	1.52 [c] ±0.05	1.55 [a] ±0.02	1.47 [b] ±0.04	1.31 [c] ±0.01	1.50 [a] ±0.01	1.42 [b] ±0.01	1.28 [c] ±0.01
STI	140.52 [a] ±6.77	130.87 [b] ±7.10	107.53 [c] ±7.15	130.19 [a] ±3.36	121.20 [b] ±2.22	106.49 [c] ±4.05	130.31 [a] ±2.17	116.83 [b] ±2.95	97.75 [c] ± 6.57
SII	141.28 [a] ±15.58	136.35 [b] ±11.47	142.41 [c] ±11.36	148.92 [a] ±11.29	149.25 [b] ±8.54	149.87 [c] ±9.40	150.33 [a] ±11.51	146.61 [b] ±8.72	157.20[c] ±10.18
SLEE	9.63 [a] ±1.54	9.03 [b] ±1.48	9.44 [c] ±1.60	9.89 [a] ±1.69	8.89 [b] ±1.51	9.38 [c] ±1.59	9.41 [a] ±1.62	9.16 [b] ±1.57	9.73 [c] ±1.71[c]
DEF	5.64 [a] ±0.03	5.76 [b] ±0.02	6.03 [c] ±0.05	5.21 [a] ±0.10	4.80 [b] ±0.08	4.77 [c] ±0.03	4.06 [a] ±0.03	4.63 [b] ±0.03	4.45 [c] ±0.01
URI	5.95 [a] ±0.07	5.65 [b] ±0.02	6.04 [c] ±0.10	4.45 [a] ±0.06	4.73 [b] ±0.02	4.72 [b] ±0.16	3.45 [a] ±0.03	3.53 [b] ±0.06	4.08 [c] ±0.14
DRI	5.38 [a] ±0.04	5.40 [b] ±0.07	5.04 [c] ±0.03	3.24 [a] ±0.08	3.14 [b] ±0.06	2.91 [c] ±0.06	3.64 [a] ±0.05	2.57 [b] ±0.03	2.71 [c] ±0.02

Means with different superscripts [a, b, c] in a row for a particular season differ significantly (P<0.01).

EF, eating fodder; STR, standing ruminating; STI, standing idle; SILR, sitting lying ruminating; SII, sitting idle; SLEE, sleeping; DEF, defecation; URI, urination; DRI, drinking water; FTS, feeding temperament score.

it means housing modification in G3 group provided cows a stress-free and tranquil environment for fodder intake.

Time spent as standing idle in different seasons (Table 3) was significantly (P<0.01) lower and the time spent as sitting idle was significantly (P<0.01) higher in G3 group cows as compared to other groups but the results for time spent on sleeping was significantly (P<0.01) lower than G1 and higher than G2 group cows in different seasons. So it can be stated that housing modification of G3 group neither made the cows hyperactive nor the lazy but provided the most comfortable environment. The findings of this study may be supported with the observation of Marten and Wolf (1999), Damasceno *et al.* (1999), Haley *et al.* (2000), Frazzi *et al.* (2000) and Buchwalder *et al*. (2000) that soft flooring like rubber mattresses and sand and straw bedding increases the resting time by increasing cow comfort.

No definite trend in time spent on defecation was observed in cows of all the three groups but the time spent on urination for different seasons was significantly (P<0.01) higher for G3 group, which reflected that sand bedding in hot dry and hot humid season as well as straw bedding in winter season provided the most comfortable environment to the cows. The time spent on drinking water was significantly (P<0.01) low in hot dry and hot humid season and significantly (P<0.01) high for winter for G3 cows, which was an indicator of better housing modification in this experimental group. It might be due to the fact that housing modifications in different seasons lead the least environmental stress to the animals resulting into normal intake of water.

Finally it may be concluded that cows with thatch roof and sand/straw bedding received maximum body weight gain, most suitable physiological environment for their growth, development and weight gain as compared to rubber mating and concrete flooring. They had spent more time on fodder intake with better feeding temperament score and rumination time and were having ideal resting time with appropriate activity. Their comfortness was also reflected in time spent on water intake, defecation and urination. Thus present study indicates that sand bedding in hot season and straw bedding in winter season provides more comfort to cows than rubber bedding and concrete flooring.

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