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Dharma Sahu

Department of Livestock
Production and Management,
ICAR-National Dairy Research
Institute, Eastern Regional
Station, Kalyani, West
Bengal, India

Dilip Kumar Mandal

Department of Livestock
Production and Management,
ICAR-National Dairy Research
Institute, Eastern Regional
Station, Kalyani, West
Bengal, India

Monanki Podder

WBUAFS, Kolkata, West Bengal,
India

Sofi Aaqib Rashid

Department of Livestock
Production and Management,
ICAR-National Dairy Research
Institute, Eastern Regional
Station, Kalyani, West
Bengal, India

Nitin Kumar

Department of Livestock
Production and Management,
ICAR-National Dairy Research
Institute, Eastern Regional
Station, Kalyani, West
Bengal, India

Diwakar

Department of Livestock
Production and Management,
ICAR-National Dairy Research
Institute, Eastern Regional
Station, Kalyani, West
Bengal, India

Manish Kumar Kushwaha

Department of Livestock
Production and Management,
ICAR-National Dairy Research
Institute, Eastern Regional
Station, Kalyani, West
Bengal, India

Correspondence**Dharma Sahu**

Department of Livestock
Production and Management,
ICAR-National Dairy Research
Institute, Eastern Regional
Station, Kalyani, West
Bengal, India

Impact of housing modification on blood biochemical parameters and feed intake of crossbred Jersey cows

Dharma Sahu, Dilip Kumar Mandal, Monanki Podder, Sofi Aaqib Rashid, Nitin Kumar, Diwakar and Manish Kumar Kushwaha

Abstract

The study was carried out to find out the effects of soft flooring and roof thermal insulation on blood metabolites and feed intake of crossbred Jersey cows under loose housing system. Twenty crossbred Jersey cows were divided into two groups, ten in each. Two types of housing were compared- (i) Existing shed (T₀)- having concrete floor and asbestos roof and (ii) Modified shed (T₁)- facilitated with sand flooring (4-6 inch depth; 38% of the total area) and a thatch ceiling under the asbestos roof. Modified house reduced the stress condition of animals by reducing 5-7 °C roof temperature. It was observed that blood metabolites (blood glucose, blood urea nitrogen, protein, albumin, globulin and uric acid) showed no significant differences except glucose (mg/dl) which was significantly ($P<0.01$) higher in T₀ (71.50±1.25) as compared to T₁ (65.39±0.94) group. Though there was no significant differences were observed on feed intake (average dry matter (kg), crude protein (kg) and organic matter (kg) intake) by the animals of the two groups but the feed intake was higher in T₁ group. It was concluded that the housing modification through sand bed flooring and thermal insulation had shown significantly lower in blood glucose level and higher feed intake of crossbred Jersey cows by relieving stress conditions and improving micro-climate of shed.

Keywords: Blood metabolites, Feed intake, Jersey crossbred cow, Modified house, Sand floor and Thatch roof

1. Introduction

Shelter management is one of the important aspects of reducing stress to animals and improving welfare. Modification of existing shelter can help in manipulation of microclimate towards improvement in production and livestock welfare without making much expenditure on modification / construction alteration. Animal shelters are designed to first meet the requirement of animals, then comes other characteristics such as the convenience of routine works, cheap, durable and locally available materials and in compliance to applicable health and environmental regulations. Even then, there remain spaces for improvement and further modification depending upon situation specific problems. Problems related to housing are cost, scarcity of resources, ventilation, hygiene, diseases and environmental changes, which now become a major concern to animal productivity. Amelioration of problems could be achieved by interventions to the respective components. Some cost effective studies [1, 2, 3, 4, 5] have been carried out on shelter modification and stress amelioration, depending upon regional requirements. In tropical conditions thermal stress is one of the major restraints to milk production and dairy cow welfare. The modifications in free stall housing were tested over three summers in 3 treatments with back trials with 10 lactating dairy cows per treatment group and found blood urea nitrogen was higher in the controls during the second summer [6]. Cows under roof sprinkling had higher concentrations of calcium, cholesterol, and protein than controls. Khongdee (2016) [7] had examined and evaluated growth performance and physiological changes of cattle raised in a normal roof (NR) versus a modified roof (MR). It was found that the modified roof (MR) offered a more efficient way to lower heat stress than the normal roof (NR). Rectal temperature (RT) and the average rate of gain (ADG) of the cattle kept under MR (39.02°C; 0.632 kg/d) was significantly lower ($P<0.01$) and higher ($P<0.01$), respectively than the NR (40.05 °C; 0.350 kg/day). The plasma glucose (GLU, mmol/L) increased ($p<0.01$) with heat stress in Holstein and AMZ cows but decreased ($p<0.01$) in Jersey cows. Heat stress increased ($p<0.01$) plasma creatinine but lowered ($p<0.01$)

plasma creatinine phosphokinase, aspartate amino-transferase and blood urea nitrogen in all three breeds [8]. Keeping in view the above facts, present study was under taken in Jersey crossbred cows maintained at Eastern Regional Station, ICAR- National Dairy Research Institute, Kalyani with the objective to study the effects of housing comfort on animal welfare (feed intake and blood biochemical profiles) of Jersey crossbred cows.

2. Materials and Methods

The present study was carried out at ICAR-National Dairy Research Institute (ICAR-NDRI), Eastern Regional Station (ERS), Kalyani, West Bengal in the year 2016-17. The weather of Kalyani is hot and humid; the maximum ambient temperature in summer goes up to 39°C and minimum temperature in winter comes down to about 8°C. Twenty lactating crossbred Jersey cows were divided into two groups consisting of ten cows in each group keeping best possible uniformity on their average age, parity, stage of lactation and milk yield. The average age (months), lactation number, stage of lactation (days) and average milk yield (kg/ day) of control group (T₀) was 64.93 ± 9.21, 2.6 ± 0.62, 38.44 ± 9.02 and 12.29 ± 1.47, respectively and that of treatment group (T₁) the values were 58.88 ± 8.15, 2.4 ± 0.45, 37.56 ± 12.95 and 11.69 ± 0.85, respectively. Cows in the control group (T₀) were kept in existing loose housing condition i.e. concrete floor and asbestos sheet as roof material. Treatment group (T₁) was provided with flooring comfort and roof thermal insulation. Flooring comfort was given by sand flooring (4-6" depth), which was nearly 38% of total pen area. Roof thermal insulation was done by thatch (paddy straw) ceiling (4" thick) under the asbestos roof as a part of housing modification. All other management activities were same for both the groups. All the feeding management practices and the feed ingredients were same as of the whole lactating herd. Concentrate, *ad libitum* green fodder and straw was provided to complete the nutrient requirement of all the lactating animals. Clean palatable drinking water was provided *ad-libitum* 24 hours.

Shed 1 (Control)		Shed 2 (Experimental)	
Manger		Manger	
Covered Concrete		Insulated roof by thatching	
		Covered sand bed	
Open concrete		Open sand bed	
		Open concrete (37.94 % of the shed)	

Fig 1: Layout diagram of existing (Control) and modified shed (experimental) at the ERS, NDRI farm

2.1 Proximate analysis of different feed materials

2.1.1 Dry Matter (DM)

A known quantity of sample (about 50-100 g) was taken in a pre-weighed moisture cup. The cup was placed in hot air oven at 100±2°C for 48 h. The loss in moisture content after drying was estimated and DM was calculated as follows:

$$DM (\%) = \frac{\{(Wt. of moisture cup + sample after drying) - Wt. of moisture cup\} \times 100}{Wt. of fresh sample}$$

2.1.2 Total Ash (TA)

A known quantity of oven dried sample (3 g) was taken in pre-weighed silica crucible. After charring the sample on heater (till the smoke disappeared), the crucible was kept in muffle furnace for ignition at 550-600 °C for 2-3 h. The crucible was removed and kept in desiccators for cooling and weighed again to find out weight of ash. The ash content was calculated as given below

$$Total\ ash (\%) = \frac{\{(Wt. of crucible + ash after cooling) - Wt. of crucible\} \times 100}{Wt. of sample (g)}$$

2.1.3 Organic Matter (OM)

OM was determined by subtracting the total ash content from 100.

$$OM (\%) = 100 - total\ ash (\%)$$

2.1.4 Crude Protein (CP)

Total nitrogen was estimated by micro Kjeldahl method. Volume of N/100 H₂SO₄ solution used in titration was recorded and nitrogen is calculated as given below:

$$N (\%) = \frac{0.014 \times 0.01 \times Volume\ made\ (ml) \times Volume\ of\ N/100\ H_2SO_4\ used \times 100}{Wt. of sample (g) \times Aliquot\ taken (ml)}$$

The crude protein (%) of sample was calculated by multiplying the N content with the factor 6.25. This was based on the principle that all the proteins contain 16% nitrogen.

2.2 Blood metabolites:-

Blood sample was collected from all the 20 experimental animals from starting to end of the trial at fortnight interval. Blood samples were drawn before offering feed, from the jugular vein into 10 ml tube for plasma separations. The anticoagulant used for separation of plasma was EDTA. Samples were centrifuged (3000 x g for 30 min at 4°C), and collected plasma was frozen immediately at -20°C until analyzed. The following estimations were carried out in blood plasma

2.2.1 Blood glucose

Blood glucose was estimated using commercially available glucose test kit (GOD-POD Method), Span Diagnostics Ltd, India. (Product no# 93DP100-74). Glucose concentration in the sample was calculated using the following formula:

$$Glucose (mg/dl) = \frac{Absorbance\ of\ Sample \times 100}{Absorbance\ of\ Standard}$$

2.2.2 Total protein

Blood Total protein was estimated using commercially available Total protein test kit (modified biuret, end point assay Method), Span, ARKRAY Healthcare Pvt. Ltd, India. (Product no#83LS100-60). Total Protein concentration in the sample was calculated using the following formula:

$$\text{Total protein concentration (g/dl)} = \frac{\text{Absorbance of test X 6.5}}{\text{Absorbance of standard}}$$

2.2.3 Albumin and Globulin

Blood albumin was estimated using commercially available ALBUMIN test kit (Bromocresol green, end point assay) Method, Span, ARKRAY Healthcare Pvt. Ltd. India (products no#84LS100-60). Albumin concentration in the sample was calculated using the following formula:

$$\text{Albumin (g/dl)} = \frac{\text{Absorbance of test X 4}}{\text{Absorbance of standard}}$$

$$\text{Globulins} = \text{Total protein} - \text{Albumin}$$

2.2.4 Blood urea

Blood Urea was estimated using commercially available Urea

test kit (urease berthelot, end point assay Method), Span Cogent Diagnostics Ltd., India (products no #81DP300-72). Plasma Urea concentration was calculated using the following formula:

$$\text{Urea concentration (mg/dl)} = \frac{\text{Absorbance of test X 50 X}}{\text{Absorbance of standard}}$$

2.2.5 Uric acid

Blood Uric acid was estimated using commercially available Uric acid test kit (uricase/POD, end point assay Method), Span Cogent Diagnostics Ltd., India (products no #82LS200-20).

Plasma Uric acid concentration was calculated using the following formula:

$$\text{Uric acid concentration (mg/dl)} = \frac{\text{Absorbance of test X 6}}{\text{Absorbance of standard}}$$

2.3 Statistical analysis

The data were analyzed by using SPSS software (16.0 versions) [9]. The statistical methods used to analyze the data were one way ANOVA and General Linear Model.

3. Results and Discussion

3.1 Impact of housing modification on blood biochemical parameters

Table 1: Effect of modified house on different blood metabolites in respect to different seasons
(No of animals: N=20, No of observation: n=158)

Particulars	Control group (T0)	Treatment group (T1)	Total
Blood Glucose (mg/dl)			
Winter Season	71.02±1.49	64.30±0.91	67.73±0.94
Summer season	72.31±2.25	67.14±1.92	69.72±1.51
Over all	71.50±1.25 ^A	65.39±0.94 ^B	68.49±0.82
Blood Urea Nitrogen (mg/dl)			
Winter Season	21.11±0.65	21.08±0.63	21.10±0.45
Summer season	21.97±0.74	20.79±0.81	21.38±0.55
Over all	21.44±0.49	20.97±0.49	21.21±0.35
Total Protein (g/dl)			
Winter Season	5.99±0.06	6.09±0.06	6.04±0.04
Summer season	6.15±0.08	6.19±0.11	6.17±0.07
Over all	6.05±0.05	6.13±0.06	6.09±0.04
Albumin (g/dl)			
Winter Season	3.70±0.05	3.57±0.05	3.64±0.04
Summer season	3.76±0.07	3.73±0.09	3.75±0.05
Over all	3.72±0.04	3.63±0.05	3.68±0.03
Globulin (g/dl)			
Winter Season	2.29±0.07	2.51±0.08	2.40±0.05
Summer season	2.40±0.10	2.46±0.10	2.43±0.07
Over all	2.33±0.06	2.49±0.06	2.41±0.04
Uric Acid (mg/dl)			
Winter Season	1.31±0.02	1.31±0.02	1.31±0.01
Summer season	1.29±0.03	1.34±0.02	1.31±0.02
Over all	1.30±0.01	1.32±0.01	1.31±0.01

Row wise means with different superscripts differ significantly (A, B Significant $P < 0.01$), otherwise non-significant

Table -1 showed the Mean \pm SE of blood glucose(mg/dl), blood urea nitrogen(mg /dl), total protein (g/dl), albumin(g/dl), globulin(g/dl) and uric acid(mg/dl) of Jersey crossbred cows in different seasons. There was no significant difference for above mentioned blood metabolites except blood glucose which was higher in T₀ group (71.50±1.25) as compared to cows of T₁ group (65.39±0.94). All the values of

blood metabolites like glucose, albumin, globulin, total protein and blood urea nitrogen, investigated in the present study were within the normal range The values reported earlier in this crossbred were 43.29-77.58, 2.91-4.14, 2.6-4.25, 6.15-8.39, 13.50-24.73, respectively [10,11,12,13,14]. The value of uric acid reported by Gonda *et al.* (1991) [15] was 0.8-1.2 and by Khosla *et al.* (2005) [16] was 0.3-1.52.

In the present study, in the control group (T_0) plasma glucose level was higher as compared to T_1 group, which might be due to as a response of animals on more stress in the non-modified shed. Like our findings, Srikandakumar and Johnson (2004) [8] reported plasma glucose increased ($p < 0.01$) with heat stress in Holstein and Australian Milking Zebu cows. Calamari *et al.*, (2009) [17] carried out experiment on lactating dairy cows in an experimental free stall barn comparing four different lying surfaces: straw bedded pack (ST), rubber mat (RM), mattress (MA) and sand (SA). In MA greater plasma globulin and lower plasma albumin were observed. The other blood parameters (PCV, glucose, cholesterol, urea, inorganic Na, K, P, Mg, Cl, ALP, AST/GOT and total bilirubin) were not affected significantly by the different lying surfaces used and their values came within the reference range.

3.2 Impact on feed intake with or without housing modifications in different groups in different seasons

During the season of winter, fodders like Sorghum, Rice Bean, Oat, Maize, Berseem and Mustard were offered whereas, during summer season Maize, Cowpea, Oat & Berseem were offered to the animals twice daily. Chemical composition of the feeds and fodder offered to animals are given in Table -2

Table 2: Chemical composition of concentrate, green and paddy straw fed to the experimental animals

Parameters	Concentrate	Green fodder	Paddy Straw
Dry Matter (DM) %	91.03	16.38	89.14
Crude Protein (CP) %	18.98	12.49	4.65
Total Ash (TA)%	11.97	10.38	13.67
Organic Matter (OM)%	88.03	89.62	86.33

Table 3: Total dry matter, crude protein and organic matter consumption (kg/ cow) by the different groups and seasons

Particulars	Group/ Seasons	Control group (T_0)	Treatment group (T_1)	Total
Average dry matter (kg) intake/cow	Winter	13.37±0.48	13.33±0.53	13.35±0.35
	Summer	12.00±0.65	12.68±0.78	12.34±0.50
	Over all	12.83±0.41	13.07±0.44	12.95±0.30
Average crude protein (kg) intake/cow	Winter	4.74±0.51	4.99±0.53	4.86±0.36
	Summer	5.78±0.81	6.16±0.82	5.97±0.56
	Over all	5.15±0.45	5.46±0.46	5.31±0.32
Average organic matter (kg) intake/cow	Winter	11.78±0.41	11.76±0.47	11.77±0.31
	Summer	10.66±0.57	11.26±0.68	10.96±0.44
	Over all	11.33±0.35	11.56±0.39	11.45±0.26

(No significant difference between groups /season)

Table -3 showed the Mean \pm SE of average dry matter (kg) intake/cow, average crude protein (kg) intake/cow and average organic matter (kg) intake/cow of Jersey crossbred cows in different seasons. Though there was no significant differences for average dry matter (kg) intake/cow, average crude protein (kg) intake/cow and average organic matter (kg) intake/cow between the groups but still those were higher in T_1 group (13.07±0.44, 5.46±0.46 and 11.56±0.39 respectively) as compared to T_0 group (12.83±0.41, 5.15±0.45 and 11.33±0.35 respectively).

Thermo-neutral zone of dairy cows ranged from 16°C to

25°C, within that they had maintained a physiological body temperature [18]. However, air temperatures above 20-25°C and 25-37°C in temperate and tropical climate, respectively like in India, it increases heat gain beyond that vanished from the body and induces heat stress [19,20]. As a result, body temperature, respiration rate, rectal temperature and heart rate increases which sequentially affects feed intake, production and reproductive capability of animals. Rectal temperature >39.0°C and respiration rate >60/min indicated heat load to cows which were sufficient to affect milk yield and fertility [21]. High temperature caused an increase in body temperatures and respiration rate and ultimately decreased in feed intake and milk production in cows [22]. High environmental stress decreased milk production mainly due to lower feed intake [23]. In the present study no significant difference in feed intake was observed due to thermal stress amelioration and provision of soft flooring, however, it was marginally higher in cows kept in comfortable shed (T_1).

4. Conclusion

Blood metabolites did not (blood urea nitrogen, protein, albumin, globulin and uric acid) show significant differences except glucose which was higher in T_0 group indicating the higher stress condition to this group of animals compared to T_1 group. Chemical composition of concentrate, green and paddy straw fed to the experimental animals was analyzed. No significant differences were observed on feed intake (average dry matter, crude protein and organic matter) by the animals of two groups; however, intake was marginally higher in cows kept in thermo-comfortable soft floored shed. It can be concluded that housing modifications by thermal insulation using thatch under the asbestos roof and provision of soft sand bed flooring created favorable micro-environment to the crossbred Jersey.

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6. References

- Singh K, Kumar P, Saini LA, Bhattacharyya KN. Micro-climate within three types of liter roof sheds in shade on thermoregulatory response to heat hot semi-arid zone. Indian Journal of Animal Science. 1989; 59(8):997-1005.
- Sharma P, Singh K. Effect of shelter system on environmental variables. Indian Journal of Animal Science. 2002; 72:806-809.
- Madke KP, Lathwal SS, Singh Y, Kumar A, Kaushik V. Study of behavioural and physiological changes of crossbred cows under different shelter management practices. Indian Journal of Animal Science. 2010; 80(8):771-774.
- Roy PK, Chatterjee A. Effect of different types of dairy cattle shelters on micro-climatic variables in rural West Bengal. Indian Journal of Animal Science. 2010; 80:781-784.
- Kamal R, Dutt T, Patel MHB, Ram PR, Biswas P, Bharti KP, *et al.* Effect of roofing materials on micro-climate in loose house for animals during rainy season. Veterinary World. 2013; 6(8):482-485.
- Fuquay JW, Zook BA, Daniel WJ, Brown HW, Poe EW. Modifications in freestall housing for dairy cows. Journal of Dairy Science. 1979; 62:577-583.

- 7 Khongdee T. Effects of roof modifications on growth performance and physiological changes of crossbred beef heifers (*Bos indicus*). Songklanakarin Journal Science Technology. 2016; 38(2):183-188.
- 8 Srikandakumar A, Johnson HE. Effect of heat stress on milk production, rectal temperature, respiratory rate and blood chemistry in Holstein, Jersey and Australian milking Zebu cows. Tropical Animal Health Production. 2004; 36:685-692.
- 9 SPSS Inc. Released SPSS for Windows, Version 16.0. Chicago, SPSS Inc, 2007.
- 10 Sharma J, Kumar A, Tiwari PD, Mondal CB. Effect of dietary supplementation of calcium, copper and manganese on nutrient utilization, growth, blood-biochemical and mineral profile in crossbred heifers. Indian Journal of Animal Science. 2011; 81(5):493-97.
- 11 Verma RK. Effects of supplementation of area-specific mineral mixture on onset of pubertal process in growing crossbred heifers. M.V.Sc. Thesis, ICAR-NDRI Deemed University, Karnal, India, 2015.
- 12 Dey D. Effect of feeding rice distillers grain with solubles on growth rate and milk production of cross bred cattle. M.V.Sc. Thesis, ICAR-NDRI Deemed University, Karnal, India, 2016.
- 13 Muwel N. Effects of supplementation of area-specific mineral mixture on productive and reproductive performances of crossbred cows during pregnancy to lactational transition phases. M.V. Sc. Thesis, ICAR-NDRI Deemed University, Karnal, India, 2016.
- 14 Satapathy D, Mishra KS, Swain KR, Sethy K, Sahoo RG. Effect of supplementation of area specific mineral mixture on performance of crossbred cows with reproductive disorders in kakatpur block. Indian Journal of Animal Nutrition. 2016; 33(3):279-284.
- 15 Gonda HL, Lindberg EJ. Evaluation of dietary nitrogen utilization in dairy cows based on urea concentrations in blood, urine and milk, and on urinary concentration of purine derivatives. Acta Agric. Scand., Sect. A, Animal Science. 1991; 44:236-245.
- 16 Khosla UM, Zharikov S, Finch LJ, Nakagawa T, Mu WRC, Krotova K, *et al.* Hyperuricemia induces endothelial dysfunction. Kidney International. 2005; 67(5):1739-42.
- 17 Calamari L, Ferdinando C, Luigi S. Effect of different free stall surfaces on behavioural, productive and metabolic parameters in dairy cows. Applied Animal Behaviour Science. 2009; 120:9-17.
- 18 Yousef MK. Stress physiology in livestock. CRC Press, Boca Raton. 1985; 1:67-73.
- 19 Vale WG. Effects of environment on buffalo reproduction. Italian Journal of Animal Science. 2007; 6(2):130-142.
- 20 Sunil Kumar BV, Kumar A, Kataria M. Effect of heat stress in tropical livestock and different strategies for its amelioration. Journal of Stress Physiology and Biochemistry. 2011; 7(1):45-54.
- 21 Sakatani H, Hansen MJP. Perspectives on improvement of reproduction in cattle during heat stress in a future Japan. Animal Science Journal. 2012; 83(6):439-445.
- 22 Vagtapilly P, Frazzi E, Lombardelli R, Maiuti GM, Cappa V. Effect of microclimate on the physiological and metabolic response of dairy cows and on milk quality. Fide Dairy Science. 1990; 55:48.
- 23 Singh SP, Mishra A. Importance of climatic variation on animal health and productivity. Indian Dairyman. 2007; 59:47-54.