Int.J.Curr.Microbiol.App.Sci (2018) *7*(7): 484-489

International Journal of Current Microbiology and Applied Sciences
***ISSN: 2319-7706* Volume 7 Number 07 (2018)**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2018.707.059

Physiological Responses and Economics of Female Cross-Bred Calves under Different Shelter Managemental Practices in Semi- Arid Zone

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Keywords

Loose house, Barn house, Bedding, Curtains, Respiration rate, Body temperature, Economics, Crossbred calves.

Article Info

Accepted:
06 June 2018
Available Online:
10 July 2018

A B S T R A C T

Fifteen crossbred calves were divided into 3 groups of 5 animals each on the basis of their similar body weight and age. Each group was allotted to three housing system *viz.* (T_1loose house; T_2 loose house + bedding + curtains and T_3 conventional barn) during winter. Average maximum temperature was significantly ($P<0.05$) higher in T_1 and minimum temperature was higher ($P<0.05$) in T_3 as compared to other two groups in microclimate. The mean respiration rate was higher ($P<0.05$) in T_3 calves as compared to other groups. Average body temperature was higher ($P<0.05$) in T_1 (101.79^0F) calves as compared to T_2 (101.54^0F) and T_3 (101.05^0F) calves. The total cost/kg body weight gain was lowest in T_2 (Rs.129.53) followed by T_3 (Rs.131.16) and T_1 (Rs. 142.27) groups. Therefore, it is concluded that the modified house (Loose house+bedding+curtains) and conventional barn improves body growth and physical comfort of crossbred calves as well as more economical during winter season in semi-arid zone.

Introduction

India is a sub-tropical country where climate varies in most of its part. The main constraint in the efficient livestock production in India is climate. The climatic conditions in Rajasthan state are extremely hard both in summer and winter where ambient temperature varies from 46-48˚C in summer and 0˚C to 4˚C in winter. This adverse climatic condition effects the growth and age of maturity of the calves (Antil *et al.,* 1991). During winter, the structures especially those parts coming in contact with animal, like floors and walls, should not get too cold and provide protection from cold winds. To combat cold stress, the animal must increase its metabolic rate to supply more body heat. This increases dietary requirements, particularly for energy. Housing, feeding and managemental technologies are available through which climatic stress on animal can be reduced. The various managemental practices such as water sprinkling, air conditioning, showering and wallowing during summer (Srivastva *et al.,* 1978). The degree of comfort depends upon

the type of housing which indirectly affects the health of animal inhabiting it (Rokde and Tomer, 2000). Animal housing helps in moderating the range of micro-environment to which the animals are exposed and optimizes their production by protecting them from extreme climates.

A shelter is required both during summer as well as winter to counter the various vagaries of adverse climate and to provide a comfortable environment to the animals. Cows may prefer a particular housing system, which may have covered space, open area, tree shade or any other additions. Bedding helps to insulate animals from the cold ground. The calves are exposed to cold atmosphere temperature as well as wet floor which may affect their growth and health.

Materials and Methods

Fifteen crossbred (Tharparkar / Sahiwal x HF) calves (10-30 months) were taken from the dairy farm of SKN College of Agriculture, Jobner from 05-12-2014 to 05-03-2015 and divided into 3 groups of 5 animals each on the basis of their body weight and age. Each group was allotted randomly to the following housing conditions/treatments:-

T_1 - Loose house (control)

House having covered area with asbestos cement sheet roofing, brick paved floor and open area surrounded by 1.5 meter high from three sides.

T_2 - Loose house + Bedding + Curtains

Bedding of left over wheat bhusa was changed at weekly intervals and loose house as detailed above in T1 was used as modification. Curtains were provided to calves at night hours for protection from cold stress.

T_3 Conventional Barn (closed)

In conventional barn is completely closed structure as roofed and walls are also complete with windows and ventilators located at suitable places to get more ventilation and lighting. Animals were tied at neck by iron - chains.

Crossbred calves were offered wheat straw (*Triticum aestivum*) *ad lib*.as dry fodder. The concentrate as pelleted feed (Sarus Gold) / readymade feed was formulated which contained 20.53% CP, 2.25% EE and 14.69% CF. The animals were fed in the morning as per NRC recommendations for dairy cattle. Maximum, minimum, dry and wet bulb temperatures were recorded at 8.30 am and 3.00 pm daily. The relative Humidity was calculated from dry and wet bulb reading using hygrometric table. The Humidity Index (THI) was calculated (MC Dowell 1972).

THI = 0.72 (dry bulb temp. ◦C + wet bulb temp. ◦C) + 40.6

The experiment was conducted in a completely randomized design (CRD) and data was statistically analyzed by standard statistical methods (Snedecor and Cochran, 1994).

Results and Discussion

Microclimate in different experimental houses

Table 1 shows that the climatic variables in different houses. The mean maximum temperature was 22.55±0.184, 21.09±0.132 and 20.61± 0.137 ^{0}C in T_1, T_2 and T_3, respectively. The average maximum temperature was higher ($P<0.05$) in loose house (T_1) as compared to T_2 (Modified house) and T_3 (Closed barn). The mean minimum temperature was 13.69 ± 0.245,

14.07±0.204 and 15.50±0.150 in T_1, T_2 and T_3, respectively. While minimum temperature was significantly higher (P>0.05) in T_2 and T_3 was observed due to protection from cold by curtains as well as bedding in modified loose house and maximum area closed by wall in conventional barn But the minimum temperature was lower (P<0.05) in loose house than other groups. The mean relative humidity in T_1, T_2 and T_3 shed was 68.74±0.546, 67.48±0.424 and 72.45±1.676 percent, respectively. The mean relative humidity was significantly higher (P<0.05) in conventional barn (T_3) as compared to other treatments. The mean THI values 63.59±1.256, 64.30±1.138 and 64.64±1.153 in T_1, T_2 and T_3, respectively. The Temperature Humidity Index (THI) values were more in T_3 as compared to T_2 than in T_1 treatment.

Respiration rate

The data on respiration rate recorded at fortnightly interval in different treatments. The average respiration rate (counts/ minute) in morning was 14.40±0.955, 14.27±0.516 and 15.33±0.851 in T_1, T_2 and T_3, respectively, while the corresponding figures for evening were 14.93±0.806, 14.63±0.474 and 15.27±0.761 counts per minute. Average daily respiration rate was 14.67± 0.847, 14.52± 0.418 and 15.30±0.783 counts per minute in respective treatments. Table 2 shows that the average respiration rate was higher (P<0.05) in T_3 group calves as compared to T_1 and T_2 group due to mostly wet floor and higher humidity. The respiration rate in T_2 group was significantly (P<0.05) lower as compared to T_1 and T_3 due to more comfort and warmth made available through wheat straw bedding performed a protective barrier preventing further heat lost from body of calves to cool ambient atmosphere. The present findings are in agreement with the result of Chakrabarti (1991) and Singh (2000).

Body temperature

The data on rectal temperature recorded at fortnightly interval in different treatments. The mean morning rectal temperature of crossbred calves was 101.51±0.561, 101.32±0.429 and 100.81±0.494 ^{0}F in T_1, T_2 and T_3, respectively. The corresponding values for evening were 102.06±0.462, 101.74±0.502 and 101.29±0.477^{0}F. The average daily rectal temperature (^{0}F) was 101.79± 0.270, 101.54±0.399 and 101.05±0.346 ^{0}F in T_1, T_2 and T_3, respectively.

Table.1 Average temperature (^{O}C), relative humidity (RH %) and temperate humidity index (THI) values in different houses

Parameters	T_1	T_2	T_3
Maximum temperature	**22.55^a± 0.184** (19.00 – 28.93)	**21.09^b± 0.132** (18.07 – 26.67)	**20.61^c± 0.137** (16.87 – 26.03)
Minimum temperature	**13.69^c± 0.245** (8.59– 17.69)	**14.07^b± 0.204** (10.04 – 18.92)	**15.50^a± 0.150** (10.12 – 20.51)
Relative humidity (%)	**68.74^b± 0.546** (65.97 – 72.29)	**67.48^c± 0.424** (65.39 – 70.50)	**72.45^a± 1.676** (63.88 – 83.29)
Temperature humidity index (THI)	**63.59^b± 1.256**	**64.30^a± 1.138**	**64.64^c± 1.153**
	(59.80 – 72.52)	(58.02 – 71.28)	(57.27 – 73.39)

Means having different superscript differ significantly (P<0.05)

Table.2 Average respiration rate/minute and body temperature (^{0}F) of crossbred calves

Parameters	T_1	T_2	T_3
Respiration rate/minute			
Morning	14.40 ^{b}±0.955	14.27 ^{bc}±0.516	15.33 ^{a}±0.851
Evening	14.93 ^{b}±0.806	14.63 ^{c} ±0.474	15.27 ^{a}±0.761
Average	**14.67 ^{b}±0.847**	**14.52 ^{bc}±0.418**	**15.30 ^{a}±0.783**
Body temperature (^{o}F)			
Morning	101.51^{a} ±0.561	101.32 ^{ab}±0.429	100.81 ^{c}±0.494
Evening	102.06^{a} ±0.462	101.74 ^{ab}±0.502	101.29 ^{c}±0.477
Average	**101.79^{a} ±0.270**	**101.54 ^{b} ±0.399**	**101.05 ^{c}±0.346**

Means having different superscript differ significantly (P<0.05)

Table.3 Cost of calves rearing under different housing modifications

Particulars	T_1	T_2	T_3
1. Cost of curtain/bedding	-	695 (2.11)	-
2.Cost of labour	5500 (17.74)	6000 (18.16)	6500 (19.67)
3. Cost of medicine	240 (0.77)	240 (0.73)	240 (0.73)
4. Quantity of feed consumed (Qt) i. Concentrate- ii. Wheat straw-	 11.25 14.48	 11.25 15.62	 11.25 15.92
5. Cost of feed consumed (Rs.) i. Concentrate- ii. Wheat straw- iii. Total	 14850.0 10425.6 25275.6 (81.49)	 14850.0 11246.4 26096.4 (79.00)	 14850.0 11462.4 26312.4 (79.60)
6. Total variable cost of raising (5 calves)	31015.6 (100)	33031.4 (100)	33052.4 (100)
7. Total variable cost of one calve	6203.12	6606.28	6610.48
8. Total body weight gain/ calf (kg)	43.6	51	50.4
9. Cost/kg gain	142.27	129.53	131.16

(Figures in parentheses are percentage)

Cost of items (concentrate, Dry fodder and other items in Rs./Qt.)

S. No.	**ItemsFarm Prices**	
1.	Concentrate	@ Rs. 1320
2.	Wheat straw	@ Rs. 720
3.	Medicine (Panacure)	@ Rs. 48/3g
4.	Curtain	@ Rs. 335 cost for preparing /stitching of bags
5	bedding (120 kg)	@ Rs 3 /kg waste straw
6.	Labour cost /day	@ Rs 200

Table 2 revealed that the morning, evening and average rectal temperature was higher ($P<0.05$) in T_1 as compared to T_2 and T_3 group calves. The higher rectal temperature in loose housed calves might be due to sunrays coming directly in the loose house leading to warming of shed which in correlation to maximum higher temperature. The present findings are in agreement with the result of Chakrabarti *et al.,* (1996), and Parihar *et al.*, (1992) reported that rectal temperature was significantly higher in morning and evening in loose house as comfort to conventional barn.

Economics / variable cost

Table 3 shows that the cost on different accounts (total cost, cost of raising per calf, cost per kg gain etc.) for crossbred calves rearing under different housing conditions. The total feeding cost based on farm price was Rs. 25275.6, 26096.4 and 26312.4 in T_1, T_2 and T_3, respectively. The total variable cost per kg gain was Rs.142.27, 129.53 and 131.16 in T_1, T_2 and T_3, respectively. The total variable cost per calf was Rs.6203.12, 6606.28 and 6610.48 in T_1, T_2 and T_3, respectively. The higher cost inT_3 group may be due to more expenditure incurred on labour and feed. The labour cost was higher in barn house group as compared to other groups. The cost per unit gain in body weight was less in T_2 followed by T_3 and T_1. Relatively lower cost/kg gain in body weight in T_2 can be attributed to higher growth rate of calves in this group. The present findings are in conformity with those reported by Singh (2000) and Jat *et al.*, (2002).

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How to cite this article:

Kailash, R.P. Jat and Rashmi Bhinda. 2018. Physiological Responses and Economics of Female Cross-Bred Calves under Different Shelter Managemental Practices in Semi- Arid Zone. *Int.J.Curr.Microbiol.App.Sci.* 7(07): 484-489. doi: https://doi.org/10.20546/ijcmas.2018.707.059