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Growth and behavioural pattern of buffalo calves under different shelter modifications during winter

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Allowing dairy cattle adequate opportunity to lie down and rest is considered important for maximizing production as well as well as for being (Haley *et al*. 2000). Deprivation of lying also changes the response of the hypothalamic-pituitary adrenal axis (Munksgaard and Simonsen 1966). Changes in behavioural pattern are considered to reflect a lack of housing comfort (Jensen 1999). The information about changes in resting and excretory behaviour due to cold stress in young buffaloes is scanty. The present study was contemplated to find out the effects of different housing systems on the growth and behaviour in buffalo calves so as to assess their relative merits for winter housing systems of female buffalo calves.

Female Murrah buffalo calves (20) of 14–16 months of age were divided into 4 groups of 5 animals each on the basis of their nearness of body weight and age. Each group was allotted randomly to following housing conditions/treatment.

T_1 Control (Loose house): House having covered area with asbestos cement sheet roofing, concrete floor and open area with brick paved floor surrounded by 1.5 m high wall from three sides.

T_2 Thatch roof cum asbestos house (Modified house 1st): Approximately 20 cm thick layer of sorghum stover (*Sorghum vulgare*) was put on the asbestos roof of loose house as detailed above in T_1 was used as modification.

T_3 Mud plaster roof house (Modified house 2nd): The roof as detailed in T_1 was plastered with wheat bhusa (20%), cow dung (30%), loam soil (50%). They were thoroughly mixed with sufficient amount of water and kept for a day to make it as semi-solid plaster of about 10 cm thickness.

T_4 Closed barn: Closed barn with a completely closed structure having 4 windows (75 cm × 105 cm) for proper ventilation was used.

Experimental animals were given 2 weeks adjustment period before commencement of actual experiment. All calves were dewormed before the start of the experiment. The maximum, minimum temperature, wet and dry bulb temperature were recorded daily. The relative humidity was calculated from dry and wet bulb theromometer reading using the hygrometric tables. The THI was calculated as per McDowell (1972).

The experimental animals had free access to clean drinking water during the experiment. The concentrate mixture consisting of mustard cake (40), wheat grain (30), deoiled rice polish (27), mineral mixture (2) and common salt (1) was formulated which contained 19.3% CP and 77.5% TDN. The animals were fed in the morning as per their requirement (Pathak and Verma 1993). Berseem (*Trifolium alexandrium*) was used as green fodder and wheat *bhusa* as dry fodder during the experiment. All other management practices were same except treatments.

All the experimental buffalo calves were weighed at the beginning and at fortnightly interval during the experiment. The body weight of the animals was recorded in the morning before providing feed and water. Body measurements , viz. body length, height, heart girth, abdominal girth, hip and pin bone width of the calves were recorded at the beginning and at fortnightly intervals in the experiment.

The actual behaviour of individual buffalo calf with respect to feeding, resting, urination and defecation for day, night and 24 h was recorded at monthly interval during the experiment. The observations recorded were: (i) time spent in standing and lying down, (ii) time spent in eating of feed and fodder, (iii) number of urination and defecation during 24 h period. The feed samples were analyzed for proximate principles (AOAC 1995). The experiment was conducted in a completely randomized design (CRD) and data was statistically analyzed by standard methods (Snedecor and Cocharn 1980).

Microclimate in difference experimental house

The mean values of meterological data recorded under different housing conditions are presented in Table 1. The mean maximum temperature was higher ($P<0.05$) in T_1 as compared to T_2, T_3 and T_4 treatments. Mean maximum temperature was higher ($P<0.05$) in loose house (T_1) as compared to other treatments. There was no significant difference in maximum temperature among T_2, T_3 and T_4 groups. While minimum

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Table 1. Average temperature (ºC), relative humidity (RH%), temperature humidity index (THI) value in different houses during winter

Climatic variables	T_1 (loose house)	T_2 (LH+thatch)	T_3 (LH+mud plaster)	T_4 (barn house)
Maximum temperature	23.42^{a}±0.823 (19.22–30.09)	21.35^{b} ± 0.797 (17.43–27.25)	21.53^{b} ± 0.799 (18.07–27.75)	21.38^{b} ± 0.815 (17.72–27.84)
Minimum temperature	9.44^{c} ± 0.707 (5.57–15.50)	10.29^{b} ± 0.679 (7.07–16.17)	10.15^{b} ± 0.672 (7.00–16.09)	11.53^{a} ± 0.727 (8.36–15.22)
Relative humidity	65.03^{ab} ± 1.959 (53.00–79.00)	61.77^{oc} ± 2.376 (51.50–78.00)	62.93^{bc} ± 2.298 (51.00–79.00)	67.63^{a} ± 1.930 (59.50–82.00)
Temperature humidity index	61.96^{b} ± 0.918 (56.18–69.10)	61.04^{c} ± 0.919 (55.77–68.20)	61.80^{b} ± 0.868 (56.00–68.69)	63.04^{a} ± 0.924 (56.44–70.74)

Means having different superscripts differ significantly (P<0.05). Figures in parentheses are range of weekly mean of climatic variables.

temperature was significantly higher (P<0.05) in T_4 than T_2, T_3 and T_1 houses. However, no difference (P>0.05) in T_2 and T_3 was observed. The results are in agreement with the findings of Chakrabarti (1991), Sharma (1991) and Singh (2000). The mean relative humidity was significantly higher (P<0.05) in barn house as compared to thatch and mud plaster house. There was no difference in relative humidity percentage of loose house and barn house. Similarly no significant difference in percentage relative humidity of thatch and mud plaster house was observed.

The THI values were higher (P<0.05) in T_4 (barn) than mud plaster house and loose house. The thatch house had lower (P<0.05) THI than other 3 types of houses. This may be because house was completely closed by walls except windows. So that calves were protected from cold. This house was more comfortable during winter as compared to other houses. There was no significant difference between loose house and mud plaster roof house. These values were more or less within tolerable range (Mcdowell *et al.* 1964). Both maximum and minimum temperature values in all the 4 groups fell gradually from the beginning of experiment (December first week) right up to the end of mid of February and thereafter started increasing up to the end of the experiment. Similar trend was reported by Chakrabarti (1991) and Sharma (1991).

Growth and feed conversion efficiency

Growth: The average daily body weight gain was not influenced by the housing system (Table 2). The lowest gain in weight was observed in buffalo calves reared in loose house followed by barn and modified roof house calves. This showed that protection of buffalo calves from cold improved the growth rate. Growth rate is governed by various factors including genetic makeup of the animal, environment interaction, nutritional status and general management. Thus there is a need for temporary modification of loose house during severe cold. The results are agreed for growth trend of calves (Singh 2000) the average daily gain (g) was more in T_2-LH+bedding (319.71) and T_2-LH + Jacketing (325.62) as compared to T_1-LH (273.80) and T_3-LH + curtain (225.62) groups during winter (Chakrabarti 1991).

Feed conversion efficiency: The feed conversion efficiency was not significantly affected by different housing conditions (Table 2). Similar results were obtained by Singh (2000).

Body measurement: Average daily gain in various body measurements, viz. body height, length, hearth girth, abdominal girth, hip width and pin width are presented in Table 2. There was not significant effect of treatment on daily gain in body measurements. However, buffalo calves under T_4 showed slightly increasing trend in body measurement

Table 2. Effect of shelter modifications on body weight gain (kg), body measurements (cm) and feed conversion efficiency in buffalo calves during winter

Parameters	T_1	T_2	T_3	T_4
Initial body weight (kg)	212.20 ± 8.279	212.80 ± 4.420	212.80 ± 9.269	212.40 ± 9.395
Final body weight (kg)	271.60 ± 7.579	282.70 ± 7.054	279.04 ± 7.215	276.21 ± 11.382
Average daily BW gain (kg)	0.593 ± 0.037	0.699 ± 0.029	0.662 ± 0.032	0.638 ± 0.033
Fed conversion ratio (DMI: gain)	12.010 ± 1.043	9.650 ± 0.578	10.470 ± 0.661	10.860 ± 0.598
Height	0.074 ± 0.007	0.093 ± 0.007	0.089 ± 0.008	0.084 ± 0.007
Length	0.097 ± 0.008	0.084 ± 0.006	0.095 ± 0.006	0.102 ± 0.007
Heart girth	0.129 ± 0.007	0.137 ± 0.008	0.135 ± 0.007	0.142 ± 0.007
Abdominal girth	0.175 ± 0.010	0.168 ± 0.009	0.165 ± 0.009	0.150 ± 0.030
Hip bone width	0.049 ± 0.004	0.055 ± 0.005	0.055 ± 0.006	0.061 ± 0.006
Pin bone width	0.032 ± 0.005	0.036 ± 0.006	0.032 ± 0.006	0.042 ± 0.008

Means having different superscripts differ significantly (P<0.05).

except abdominal girth as compared to T_1 group calves. The findings are similar to those reported by Chakrabarti (1991).

Bahaviour pattern of calves

Eating behaviour: The data on time spent in eating by calves under different housing conditions is presented in Table 3. The mean eating time per day and also during the day was affected (P<0.05) by housing systems, however, eating time in the night was not affected by treatment. The average time spent in eating during 24 h was significantly less (P<0.05) in loose house as compared to T_2 and T_4 during winter. However, no significant difference in daily eating time amongst T_2, T_3 and T_4 was observed. Similarly eating time taken by T_1, T_3 group calves was not affected (P>0.05) by treatments. The results are in close agreements with the findings by Sharma and Singh (2002).

Lying (resting) down and standing time: The data on resting behaviour are presented in Table 3. Daily (24 h) mean resting and standing time as well as day time (12 h) were not affected by treatments. However, the resting and standing time in the night was significantly affected (P<0.05) by treatments. Buffalo calves reared in thatch roof (418.80 min) and barn housed (484.50 min), spent more (P<0.05) time for resting as compared to mud plaster roof (396.45 min) of loose house calves during night due to better micro-climate, more comfortable and protect from cold. However, there was no significant difference amongst T_1, T_2 and T_4 as well as between T_1 and T_3 group. Higher resting time in T_2 and T_4 by calves might be due to better micro climatic conditions. The results are in close proximity with the findings of Sharma and Singh (2001).

Eliminatory behaviour

Urination frequency: The average urination frequency during 24 h, day (12 h) and night (12 h) were presented in Table 3. The urination was more during day as compared to night in all groups. The urination frequency during day time was significantly lower (P<0.05) in T_2 as compared to T_1, T_3 and T_4. The higher (P<0.05) frequency of urination in T_1 as compared to T_2, T_3 and T_4 during night time was recorded. The average frequency of urination/day was significantly (P<0.05) higher in T_1 as compared to T_2 and T_3. However, there was no significant difference between T_1 and T_4 as well as T_2 and T_3 was noticed, while urination frequency during night was higher (P<0.05) in T_1 as compared to other three groups. There was no significant difference in urination frequency amongst T_2, T_3 and T_4 during night. This shows that buffalo calves in loose house (T_1) were under stress due to cold and as such urinated more. Similar reports for urination were also reported by Singh (1982).

Defecation frequency: The average defecation frequency (Table 3) was not affected (P>0.05) in day but affected (P<0.05) in nights by treatments. The average defecation frequency during night was higher (P<0.05) in T_4 as compared to T_2 treatment. The mean defecation frequency per day (24 h) was also higher (P<0.05) in T_4 as compared to T_2 and T_3. The defecation number was more during night as compared to daytime. The average defecation frequency/day was influenced (P<0.05) by housing systems. However, it was not significantly different between T_1 and T_4 as well as T_2 and T_3 group calves. Higher urination and defecation frequency in loose house than thatch roof housing may be due to more cold stress to the

Table 3. Effect of shelter modification on behaviour patterns of buffalo calves during winter season

Climatic variables	T_1 (loose house)	T_2 (LH+Thatch)	T_3 (LH+mud plaster)	T_4 (barn house)
Eating time				
Day	$195.00^{b} \pm 8.005$	$203.45^{ab} \pm 6.996$	$202.20^{ab} \pm 4.977$	$218.05^{a} \pm 6.339$
Night	89.45 ± 5.866	105.05 ± 6.445	102.25 ± 5.600	96.95 ± 6.751
24 h	284.45 ± 6.438	$308.50^{a} \pm 7.639$	$304.45^{ab} \pm 7.190$	$315.00^{a} \pm 9.927$
Resting time				
Day	290.75 ± 17.916	318.85 ± 15.683	317.45 ± 20.049	289.60 ± 27.019
Night	$428.30^{ab} \pm 25.063$	$418.80^{a} \pm 20.606$	$396.45^{b} \pm 22.672$	$484.50^{a} \pm 32.696$
24 h	719.05 ± 39.917	800.65 ± 27.799	713.90 ± 35.892	774.10 ± 43.197
Standing time				
Day	429.25 ± 17.916	401.15 ± 15.683	402.55 ± 20.049	430.40 ± 27.019
Night	$291.70^{ab} \pm 25.063$	$238.20^{b} \pm 20.606$	$323.55^{a} \pm 22.672$	$235.50^{b} \pm 32.695$
24 h	720.95 ± 39.920	639.35 ± 27.799	726.10 ± 35.892	665.90 ± 43.196
Urination number				
Day	$5.35^{a} \pm 0.274$	$4.15^{b} \pm 0.208$	$4.95^{a} \pm 0.320$	$5.50^{a} \pm 0.276$
Night	$4.40^{a} \pm 0.183$	$3.40^{b} \pm 0.168$	$3.60^{b} \pm 0.197$	$3.45^{b} \pm 0.198$
24 hours	$9.97^{a} \pm 0.409$	$7.55^{c} \pm 0.276$	$8.55^{bc} \pm 0.438$	$8.95^{ab} \pm 0.373$
Defecation number				
Day	3.20 ± 0.247	2.95 ± 0.185	3.20 ± 0.212	3.65 ± 0.209
Night	$4.05^{a} \pm 0.211$	$3.45^{b} \pm 0.185$	$3.75^{ab} \pm 0.143$	$4.30^{a} \pm 0.242$
24 h	$7.25^{ab} \pm 0.347$	$6.40^{b} \pm 0.265$	$6.95^{b} \pm 0.266$	$7.95^{a} \pm 0.413$

Means having different superscripts differ significantly (P<0.05).

animals in loose house, where animal adjusted the thermal balance by passing more urine and faeces. Similar results were obtained by Sharma and Singh (2001) who reported higher frequency of defecation in conventional barn as compared to loose house. Contrarily Singh (1982) reported higher number of defecation in loose house as compared to conventional barn and shed open.

It can be concluded that barn and thatch houses are better as compared to loose house, where buffalo calves were more comfortable as indicated by higher eating time and resting time with less urination frequency. However, growth rate of calves was slightly higher but not significantly influenced by shelter modification during winter season in Northern region of India.

SUMMARY

Female Murrah buffalo calves (20), 14 to 16 month-old, were divided into 4 groups of 5 each on the basis of age and body weight and allotted to 4 housing [loose house (T_1), LH + thatch roof (T_2), LH + mud plaster roof (T_3) and closed barn (T_4)] systems to study effect of housing on growth and behavioural pattern. The daily weight gain and feed conversion efficiency were not influenced significantly by roof modifications. The housing system had no significant effect on the mean gain in length, height, heart girth, abdominal girth, hip bone and pin bone width of calves. The buffalo calves kept in loose house spent less eating time than those kept in thatch roof and barn house. The resting and standing time in the night was significantly affected by housing systems. The average resting and standing time in 24 h were not significantly affected by treatments. The average urination and defecation frequency per day was affected by type of houses. The defecation frequency was more in barn housed calves than those kept in modified house. It is inferred than barn house is better as compared to loose house for buffalo calves during winter.

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