



Comparative evaluation of different bedding materials on growth performance of Murrah buffalo calves

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Received: 3 February 2022; Accepted: 27 July 2022

ABSTRACT

Ideal bedding management is essential for optimal health, welfare, and growth performance of dairy calves. The study was conducted in order to compare the effect of different bedding materials on growth performance of Murrah buffalo calves. Murrah buffalo calves (n=20) of less than 4 months of age were selected and divided into four groups (5 animals/group), viz. T₁: Concrete floor, T₂: Concrete floor bedded with sand, T₃: Concrete floor bedded with wheat straw and T₄: Concrete floor bedded with rubber mat. Body weight and body measurement (body length, height of wither and heart girth) were taken at fortnightly and monthly intervals, respectively. There was no significant difference in body weight between treatment groups. However, average weight gain (kg) and ADG was significantly high in calves reared on T₃ as compared to other treatment groups, though no significant difference was observed between T₁, T₂ and T₄. Body length was significantly lower in T₂ as compared to T₃, however, difference in body length among T₁, T₂ and T₄ groups was relatively non-significant. Moreover, body height and heart girth were significantly higher in calves reared on wheat straw floor as compared to concrete and sand bedded floor. Estimation of net profit per calf after reducing the bedding cost revealed that it was highest for wheat straw bedding followed by rubber mat, concrete and least for sand bedding. It can be concluded that wheat straw followed by rubber mat could be used effectively as bedding over concrete floor during winter season for rearing of calves.

Keywords: Average daily gain, Buffalo calves, Heart girth, Rubber mat, Sand, Wheat straw

India possesses 58% (109.85 million) of the world buffalo population. It contributes more than half of the total milk produced in the country (BAHFS 2019). Being the backbone of Indian dairy industry, buffalo calf survival is of utmost importance for the better future of livestock industry. Calves play an important role in the development and profitability of a farm, as future of the dairy herd solely depends upon the successful raising of the young calves. Healthy calves are not only essential for sustenance of the dairy industry but also for preserving and maintaining good quality germplasm. Calf mortality during first three months of their life causing a severe economic loss to the farming community (Jain 2005). Dairy farmers can get sufficient and quick replacement of their animals if their calf rearing has minimum mortality rate and maximum growth rate (Moran 2011). Animals with poor growth rate require longer time to reach maturity than healthy stock which increases age at first calving (AFC) and reduces profitability (Cooke *et al.*

2013). Providing a suitable environment to improve calf comfort can improve production outcomes. Bedding is the key factor affecting calf comfort, welfare and growth (Sorathiya *et al.* 2019). The type of substrate used in calf rearing facilitates warmth, comfort, cleanliness, weight gain, and decreases incidence of scouring (Panivivat *et al.* 2004, Hill *et al.* 2011). A bedding material should be clean, inert, comfortable and have ideal particle size. This should help the animal to reduce heat loss through conduction and to cope up with cold environment as under stressful conditions, nutrients ingested are partitioned towards maintenance to overcome stress rather than growth (Mariska 2018). It has been observed that growth performance of calves on wheat straw compared to other materials is typically improved in cold season (Hill *et al.* 2007). Long wheat straw had the warmest surface temperature as compared to rice hull, wood shaving, granite and sand bedding (Panivivat *et al.* 2004). Improved performance and better health conditions were also observed in the stall with rubber mats for dairy animals (Tucker *et al.* 2003, Vanegas *et al.* 2006).

So, in order to ensure animal comfort which leads to increased production, an experiment was conducted to study the comparative evaluation of different bedding materials on growth performance of Murrah buffalo calves.

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MATERIALS AND METHODS

Experimental site, animals and housing: The study was conducted at the buffalo farm of College of Veterinary Sciences, Lala Lajpat Rai University of Veterinary and Animal Sciences (LUVAS), Hisar for a period of three months (December 2, 2020 to March 2, 2020). Murrah buffalo calves (20) below four months of age were selected from the buffalo herd of Buffalo Research Centre (BRC). Calves were dewormed and sprayed against ectoparasites before the commencement of study.

Experimental design, sampling and treatments: After the preliminary adjustment period of 10 days prior to start of experiment, the calves were divided into four groups of five calves each on the basis of body weight and age as Treatment 1 (T_1): Concrete floor (calves in this group were housed in a loose house with concrete floor), Treatment 2 (T_2): Concrete floor + Sand bedding (calves were housed in a loose house with sand spread over the concrete floor as a bedding), Treatment 3 (T_3): Concrete floor + Wheat straw bedding (calves were housed in a loose house with wheat straw as a bedding spread over the concrete floor), Treatment 4 (T_4): Concrete floor + Rubber mat bedding (calves in this group were housed in a loose house with rubber mat as a bedding spread over the concrete floor).

Feed and water intake: Feeding and general management practices remained same in all the treatment groups. The milk was fed during the milking time at the rate of 1/10th body weight twice a day, in morning at 4 AM and in evening at 4 PM. Apart from this, green fodder and roughages were fed *ad lib.* during the experimental period. Fixed amount of concentrate mixture was also given daily to all the calves during whole experimental period. Clean and fresh drinking water was provided *ad lib.* All the calves were monitored daily for sickness and unhealthy calves were sent to the proper line of treatment as routine farm practice. Daily cleaning of each pen was maintained as in a regular farm as per requirement. Apart from daily removal of bedding, wheat and sand bedding were completely changed at weekly intervals.

Growth performance: The calves were weighed individually before feeding and watering in the morning at fortnightly intervals. Electronic balance was used for weighing of calves and change in body weight was calculated accordingly. Practice to remove dung, urine and

feed debris were in each treatment; along with this wet sand and straw were removed daily and replaced by average same amount of fresh sand and straw as per requirement.

The growth rate for every fortnight was calculated as follows:

[Average Daily Gain (kg) = Total weight gain (kg) over fortnight divided by 15]

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: The body length, body height and heart girth were recorded with the help of measuring tape at monthly interval for each buffalo calf. Body measurements were taken when the buffalo calves were standing in a normal body posture. The measurement of heart girth (HG) was taken when the buffalo calves were standing in a normal position (smallest circumference immediately behind the shoulder). Height at withers (HAW) was measured at highest point of body (from ground level to the point of withers). Body length (BL) of calves was measured by taking distance from the point of shoulder to the base of the tail.

Cost effectiveness: To evaluate the cost effectiveness of different bedding materials, firstly, cost of bedding per calf during the experiment was calculated and then after minimizing the bedding cost, net profit was estimated for each treatment.

Statistical analysis: 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). The data was analysed using SPSS (2007 software (version-16)).

RESULTS AND DISCUSSION

Body weight: The fortnightly body weight of all the treatment groups is presented in Table 1. The perusal of table revealed that types of bedding for winter rearing of calves had no significant effect on body weight change of calves in all fortnights, but average weight gain over the experimental period differed significantly and was significantly ($P < 0.05$) higher in calves that were reared on wheat straw bedding as compared to the other treatment

Table 1. Mean $\pm$ SE of body weight changes and average weight gain (kg) at fortnightly intervals

Fortnight/Treatment	Concrete floor (T_1)	Sand floor (T_2)	Wheat straw floor (T_3)	Rubber mat floor (T_4)
Initial	53.20 $\pm$ 3.06	53.00 $\pm$ 3.56	52.60 $\pm$ 3.89	51.80 $\pm$ 2.42
1	58.20 $\pm$ 3.37	56.20 $\pm$ 3.83	57.80 $\pm$ 4.58	56.20 $\pm$ 2.20
2	60.80 $\pm$ 4.04	59.20 $\pm$ 3.50	63.60 $\pm$ 5.27	60.40 $\pm$ 2.29
3	65.00 $\pm$ 4.47	63.40 $\pm$ 3.61	68.20 $\pm$ 5.13	64.60 $\pm$ 2.38
4	70.20 $\pm$ 4.97	67.60 $\pm$ 3.36	75.40 $\pm$ 5.50	69.80 $\pm$ 2.35
5	74.00 $\pm$ 5.36	71.60 $\pm$ 2.76	80.60 $\pm$ 5.50	73.80 $\pm$ 2.35
6	78.60 $\pm$ 4.74	76.80 $\pm$ 2.65	87.00 $\pm$ 5.03	79.80 $\pm$ 2.65
Average wt. gain	25.40 $\pm$ 2.54 ^b	23.80 $\pm$ 1.39 ^b	34.60 $\pm$ 1.57 ^a	28.00 $\pm$ 2.88 ^b

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

groups. Significantly ($P<0.05$) higher average weight gain in T_3 calves might be due to better welfare condition of calves on wheat straw bedding followed by rubber mat as compared to concrete floor and sand bedding. Kartal and Yarnar (2011) also revealed that up to 4 months of age, weight of calves was not significantly influenced by the type of floor. It was also reported that when giving a free choice between different bedding materials, cows avoided sand, preferring straw and soft rubber mats during winter and summer (Manninen *et al.* 2002).

Average daily gain (kg) (ADG): The fortnightly ADG of calves is presented in Table 2. Overall values of ADG were significantly ($P<0.05$) higher in T_3 as compared to T_1 , T_2 , and T_4 . The ADG ranged from 0.20 ± 0.04 kg to 0.48 ± 0.05 kg indicating a huge difference of growth between calves in different treatments used in the experiment. The result are in agreement with Sorathiya *et al.* (2019), who reported that ADG (g/d) was significantly ($P<0.05$) higher in *kachcha* soil floor with paddy straw bedding (424.00 g), concrete floor with paddy straw bedding (400.20 g) and rubber mat bedding (373.00 g) as compared to concrete floor (294.80 g). They concluded that bedding with either paddy straw or rubber mat might have increased the comfort zone of calves thus better ADG was observed in all treatment groups as compared to concrete floor. Similarly, higher ADG was found in Karan-fries calves that were kept on floor bedded with paddy straw as compared to rubber

mat or concrete floor (Madke *et al.* 2010).

Body measurements: Increase (cm) in the body measurements such as body length, body height and heart girth of calves is presented in Table 3. The maximum change in body length in T_3 differed significantly from T_2 , however, no significant difference was observed from T_1 and T_4 . The analysis of following result revealed that change in body height was significantly ($P<0.05$) higher in T_3 as compared to T_1 and T_2 , however it was not significant to T_4 . The overall change in heart girth was significantly ($P<0.05$) higher in T_3 as compared to other groups.

Minimum change in heart girth was observed in T_2 group however, no significant difference was observed among T_2 and T_4 . The results corroborated with the study of Yarnar *et al.* (2010) who revealed that body measurements between birth and fourth month of age were not affected significantly by types of floors. They concluded that there was no significant difference among body length and height of calves reared on three different floors - concrete, wheat straw and rubber mat, although there was significant difference in chest girth in between treatments (wheat straw, rubber mat) and control (concrete floor). Moreover the result was not significant between the treatment groups.

Cost effectiveness: Cost of rearing of calves on different bedding material was computed without adding feed and transportation cost. The result revealed that total cost of

Table 2. Mean $\pm$ SE of average daily gain (kg) at fortnightly intervals

Fortnights/Treatments	Concrete floor (T_1)	Sand floor (T_2)	Wheat straw floor (T_3)	Rubber mat floor (T_4)
1	0.33 $\pm$ 0.08	0.21 $\pm$ 0.02	0.35 $\pm$ 0.07	0.29 $\pm$ 0.05
2	0.23 $\pm$ 0.05 ^{ab}	0.20 $\pm$ 0.04 ^b	0.39 $\pm$ 0.06 ^a	0.28 $\pm$ 0.06 ^{ab}
3	0.23 $\pm$ 0.04	0.28 $\pm$ 0.05	0.31 $\pm$ 0.05	0.28 $\pm$ 0.02
4	0.35 $\pm$ 0.05 ^{ab}	0.28 $\pm$ 0.04 ^b	0.48 $\pm$ 0.05 ^a	0.35 $\pm$ 0.05 ^{ab}
5	0.25 $\pm$ 0.03	0.27 $\pm$ 0.05	0.35 $\pm$ 0.01	0.27 $\pm$ 0.04
6	0.31 $\pm$ 0.05 ^b	0.35 $\pm$ 0.04 ^{ab}	0.44 $\pm$ 0.03 ^a	0.40 $\pm$ 0.04 ^{ab}
OVERALL	0.28 $\pm$ 0.03 ^b	0.26 $\pm$ 0.02 ^b	0.38 $\pm$ 0.02 ^a	0.31 $\pm$ 0.03 ^b

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

Table 3. Mean $\pm$ SE of monthly average increase (cm) in body measurements of calves

Fortnight	Concrete floor (T_1)	Sand floor (T_2)	Wheat straw floor (T_3)	Rubber mat floor (T_4)
Body length				
1	0.88 $\pm$ 0.33	0.66 $\pm$ 0.22	0.90 $\pm$ 0.19	0.86 $\pm$ 0.13
2	1.18 $\pm$ 0.22	1.16 $\pm$ 0.22	1.40 $\pm$ 0.29	0.96 $\pm$ 0.29
3	1.30 $\pm$ 0.19	0.98 $\pm$ 0.20	1.72 $\pm$ 0.31	1.56 $\pm$ 0.26
Overall	1.12 $\pm$ 0.10 ^{ab}	0.93 $\pm$ 0.11 ^b	1.34 $\pm$ 0.10 ^a	1.13 $\pm$ 0.13 ^{ab}
Body height				
1	1.08 $\pm$ 0.09 ^b	1.38 $\pm$ 0.13 ^{ab}	1.80 $\pm$ 0.12 ^a	1.36 $\pm$ 0.20 ^{ab}
2	1.36 $\pm$ 0.16 ^a	0.94 $\pm$ 0.10 ^b	1.46 $\pm$ 0.16 ^a	1.32 $\pm$ 0.08 ^{ab}
3	1.34 $\pm$ 0.19	0.98 $\pm$ 0.05	1.50 $\pm$ 0.29	1.28 $\pm$ 0.21
Overall	1.26 $\pm$ 0.09 ^b	1.10 $\pm$ 0.07 ^b	1.59 $\pm$ 0.15 ^a	1.32 $\pm$ 0.08 ^{ab}
Heart girth				
1	1.34 $\pm$ 0.05 ^b	1.16 $\pm$ 0.09 ^b	1.80 $\pm$ 0.25 ^a	1.32 $\pm$ 0.12 ^b
2	1.92 $\pm$ 0.45	1.84 $\pm$ 0.11	2.70 $\pm$ 0.44	1.94 $\pm$ 0.30
3	1.94 $\pm$ 0.37	2.08 $\pm$ 0.09	2.60 $\pm$ 0.24	2.30 $\pm$ 0.22
Overall	1.73 $\pm$ 0.16 ^b	1.69 $\pm$ 0.03 ^b	2.37 $\pm$ 0.13 ^a	1.85 $\pm$ 0.19 ^b

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

Table 4. Cost-effectiveness of different bedding materials in each treatment group

Material/treatment	T ₁	T ₂	T ₃	T ₄
Initial body weight	53.20±3.06	53.00±3.56	52.60±3.89	51.80±2.42
Final body weight	78.60±4.74	76.80±2.65	87.20±5.04	79.80±2.65
Average weight gain	25.40±2.54	23.80±1.39	34.60±1.57	28.00±2.88
Net income (A) from total live weight gain (₹80/kg live weight)	2032	1904	2768	2240
Total amount of bedding used (in kg)	Nil	8780	272	2 × Rubber mat
Bedding cost (₹)/pen	Nil	1141.4	1632	375*
Bedding cost (₹)/calf (B)	Nil	228.28	326.4	75*
Net profit (₹)/calf (A-B)	2032	1675.72	2441.6	2165

Note: Cost of wheat straw (₹) = 600/100 kg; Cost of sand (₹) = 13/100 kg; *, Depreciated cost of rubber mat = 15% depreciation cost (Total cost of each Rubber mat ₹1250).

bedding per calf or calf rearing was highest for wheat straw (₹326.4/calf) and lowest (₹75/calf) for rubber mat. The least cost of bedding on rubber mat was due to permanent bedding material and its use for longer duration of period as compared to sand and wheat bedding, which required timely change of bedding resulting in higher cost of bedding per calf during the period of experiment. The cost of rearing of dairy calves was highest ($P < 0.05$) for long wheat straw (Panivivat *et al.* 2004). But closely overlooking cost effectiveness (Table 4) revealed that Net profit on each calf after reducing the bedding cost remained highest in wheat straw bedding. It was observed that wheat straw bedding was 12.75% and 20.13% more profitable as compared to rubber mat bedding and concrete floor, respectively. Sand bedding over concrete floor during winter season adversely affect calf health and growth besides 17.53% less profit as compared to control (concrete floor).

The overall result of cost-effectiveness of different bedding revealed that net profit by each calf after minimizing the total bedding cost remained highest on wheat straw bedding followed by rubber mat bedding, concrete floor and least profitable on sand bedding. Highest weight gain and maximum net profit per calf for wheat straw bedding indicates not only comfort for calves but also cost-effectiveness thus making it a first choice for farmers for calves rearing during winter. Our finding correlates with Sorathiya *et al.* (2019) who concluded that paddy straw as bedding material during winter either on concrete or soil surface provides better welfare condition to calves and better cost-effectiveness as compared to other bedding materials (Concrete surface, Rubber mat surface). Similarly, soft flooring surface as interlocking rubber was found more beneficial for animals as compared to concrete floor (Vanegas *et al.* 2006). The results of our study revealed that the poor growth rate in calves under T₂ as compared to T₁, T₃ and T₄ may be due to the fact that they were not protected against cold and remained under constant cold stress during experiment.

It may be possible that the calves reared on sand and concrete floor would have diverted their maximum body energy gained from feed intake to maintain homeothermy instead of utilizing it for growth. Whereas, on wheat straw

and rubber mat floor, calves remained in more or less good welfare condition and also protected against cold stress condition as compared to concrete and sand, so that most of the energy obtained from feed was utilized for growth in these groups due to decrease in stress conditions significantly by increasing the animal comfort, thus resulting in better production (Perissinotto *et al.* 2006, Navarini *et al.* 2009).

Wheat straw is ideal cost effective bedding for calves rearing during winter, as calves obtained maximum body weight under its use. Although rubber mat bedding remains cheaper than wheat straw bedding but calves reared on rubber mat bedding have lesser body weight gain as compared to when wheat straw was used. Sand bedding over concrete floor during winter season had negative effects on calf growth, therefore sand bedding over concrete floor should not be recommended for calf rearing during winter season. It may be concluded that wheat straw and rubber mat could be used effectively as bedding over concrete floor during winter season for calves rearing.

ACKNOWLEDGEMENTS

The authors are thankful to the HOD of Department of Livestock Production and Management and Dean, PGS for providing all necessary facilities and funds to carry out the research work smoothly.

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