



Behavioural changes of Murrah buffalo calves under various upbringing systems

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ABSTRACT

In present study, an effort was undertaken to estimate the “Effect of different bedding materials on the behaviour of Murrah buffalo calves”. Twenty buffalo calves (below 4 months of age) were divided into four groups (5 calves in each 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. Recording of daily activities of calves throughout 8 h (8:00 AM to 4:00 PM) for each month (December, January, and February) of two consecutive days representing time spent for particular behavioural activity along with total time spent in the covered area and the open area was recorded. Throughout the trial, a variety of behavioural activities of calves in all treatments was examined. The time spent by calves in the covered area was considerably greater in T₃, followed by T₁ and T₄, and least in the T₂ group. Calves raised on the floor made of wheat straw had significantly more lying time in the covered area than those raised on the floor made of rubber mat, concrete, or sand. Similar sleep duration was considerably longer in T₃ and T₄ than in T₂, although the difference between T₄ and T₁ was not significant. Compared to T₁ and T₂, moving time in the enclosed area was noticeably shorter in T₃ and T₄. Feeding time in T₃ was likewise noticeably longer than in T₁ and T₂, although it was not significantly different from T₄. The results showed that the T₃, T₄, and T₁, respectively had the best microclimate conditions for calves during the winter, whereas T₂ had the poorer microclimatic condition.

Keywords: Animal welfare, Buffalo calves, Lying time, Rubber mat, Sleeping time, Wheat straw

Animal behaviour has the benefit of being non-intrusive and can be used to evaluate the impacts of stress. Behaviour can exhibit shifts and irregular patterns, which can be signs of stressful situations for animals. Since animals will need more energy to deal with these stressful situations, all of the energy available will not be utilized for calf growth. It is now generally acknowledged that combining behavioural and physiological measurements yields a more thorough evaluation of animal welfare (Ewbank 1985, Lane 2006). Calves must get enough rest in order to be healthy, so lying times can reveal important details about an animal's comfort. Dairy calves normally spend about 18 h per day lying down, suggesting that lying time is vital for growing calves (Wilson *et al.* 1999, Chua *et al.* 2002, Fregonesi *et al.* 2007). Insufficient laying time slows growth (Mogensen *et al.* 1997, Camiloti *et al.* 2012). Regarding the health and welfare of animals, flooring is among the

most crucial elements of animal housing. Many organic (hay, silage, sawdust, crop residue) and inorganic (sand, rubber mattress, concrete) materials can be used as bedding because they give animals more comfort in unfavourable climatic conditions and lead to better health, better growth, and increased output. It was noted that the recent tendency has shifted away from organic bedding materials because of hygienic concerns, labour costs, and shipping costs, which may have an impact on the overall cost and use on farms (Kartal and Yanar 2011, Panivivat *et al.* 2004). Sand, rice hulls (rice husks), rubber matting, and concrete materials are now increasingly frequently employed as sources of materials for animal raising (Panivivat *et al.* 2004, Hanninen *et al.* 2005, Hill *et al.* 2011). Tucker *et al.* (2003) and Vanegas *et al.* (2006) found that rubber mats in dairy animal stalls improved performance and health conditions. Therefore, analysis of these review studies reveals that in order to ensure animal comfort, which results in increased production, the environment surrounding animals must always be taken into account. Providing properly designed free stalls with comfortable bedding materials is one aspect of the dairy hygienic system. Unfortunately, this aspect of buffalo calves, particularly in India, has not received much attention to date. The current work is focused on the “Behavioural changes of Murrah buffalo calves under various bedding materials.”

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MATERIALS AND METHODS

Animals, housing, and test site: The study was carried out for three months, or 90 days, from December 2, 2019, to March 2, 2020, at the buffalo farm of the College of Veterinary Sciences at Lala Lajpat Rai University of Veterinary and Animal Sciences, Hisar. From the buffalo herd of the Livestock Production Management (LPM) and Buffalo Research Centre (BRC), twenty Murrah buffalo calves under the age of four months were chosen. Before the study began, calves were treated with an ectoparasites spray and given a deworming.

Design of the experiment, sampling, and dietary interventions: The calves were separated into four groups of five calves each after the preliminary adjustment phase of 10 days before the start of the experiment on the basis of similarity in body weight and age as follows. The 1st-line therapy (T_1): Concrete floor (This group of calves was kept in a loose structure with a concrete floor). Treatment 2 (T_2): Sand bedding and a concrete floor (The calves in this group were also housed in a loose house but sand as bedding was spread over the concrete floor). Treatment 3 (T_3): Concrete floor + Wheat straw bedding (The calves in this group were again confined in a loose home, but the floor of the loose house had wheat straw spread out as bedding). Concrete floor + rubber mat bedding (T_4): The calves in this group were housed in a loose structure, but the concrete floor had rubber mats laid out as bedding. In all treatment groups, feeding procedures and overall management techniques remain unchanged. 1/10th of the calves' body weight, milk was given twice daily, at 4 AM and 4 PM, during the milking period. During the experimental period, roughages and other green fodder were fed *ad lib.*. All of the calves received a fixed amount of concentrate mixture each day for the duration of the experiment. In every shed, fresh, clean drinking water was all time made available. Every day, all the calves were checked for illness, and those who were unwell were dispatched to the appropriate line of care as is standard farm procedure. Each pen was cleaned daily to remove dung, urine, and feed debris, as per standard farm procedure. Additionally, wet sand and straw were removed daily and replaced with an equivalent amount of fresh sand and straw as needed. In addition to being removed every day, the bedding is totally changed every week.

In order to calculate the amount of time spent lying, eating, standing, moving, and sleeping in the covered area in min, CCTV cameras were used to record behavioural study data for each activity for 8 h per day, at monthly intervals, in each group. This is because bedding was only included under the covered area. For the analysis, the data were combined in coding sheets that were specially created. The following behavioural actions were noted and categorized in the above list: (i) Standing time: The amount of time any particular animal spent standing still with no other significant activity was noted. (ii) Laying/Resting: The amount of time an animal spent lying or resting was calculated. During this time, the animal was not engaged

in any other significant activity. (iii) Moving: The amount of time spent moving. (iv) Sleeping: The act of an animal lying down on its left or right side, extending one or both of its front legs, resting its head against its flank, and closing its eyes. (v) Sitting: When the animal was lying down with its eyes open, it was said to be "sitting."

Statistical analysis: Using Snedecor and Cochran's methods, one-way analysis of variance (ANOVA) was used to compare the means of the data from the studies (1994). The "SPSS" software was used to examine the data (version-16).

RESULTS AND DISCUSSION

Sitting period: The analysis of overall behaviour activities is depicted in Table 1 and Supplementary Fig.1. Results showed that the total amount of time (cover + open) spent sitting for T_1 , T_2 , T_3 , and T_4 was 83.83 ± 1.83 , 76.50 ± 2.05 , 87.66 ± 1.33 , and 81.50 ± 1.75 , respectively. This indicated that the T_3 group had significantly more sitting time ($P < 0.05$) than T_1 , T_4 and the T_2 group. Sand bedding had significantly lower sitting time ($P < 0.05$) than other. A close examination of the table revealed that in the covered area, sitting time was significantly higher in T_3 and T_4 than in T_1 and T_2 , indicating that T_2 had the worst cold stress conditions and that the calves continued to be uncomfortable on their sand bedding throughout the winter. However, Sadharakiya and Sorathiya (2019) found that sitting time was significantly greater on rubber mat as compared to the concrete floor, which is somewhat more sitting time in covered areas on rubber mats as compared to the concrete floor. When Lowe *et al.* (2001) compared the preferences of several floor types by finishing beef cattle, they came to the same conclusion that straw bedding was the most favoured floor type, followed by sawdust, then mats, and lastly slats.

Time spent standing: For groups T_1 , T_2 , T_3 , and T_4 , the total time spent standing was 57.17 min, followed by 70.17, 46.66, and 59.00 min, respectively. The T_2 group spent considerably more time standing in covered areas and open paddocks than the T_1 group (24.83 ± 0.38 and 32.34 ± 0.73), T_4 (23.50 ± 0.51 and 35.50 ± 0.88), and T_3 (22.33 ± 0.29 and 24.00 ± 0.76), respectively ($P < 0.05$). The potential of a warm floor in the wheat straw in T_3 may account for a large reduction in standing time. The somewhat greater welfare of calves in the rubber mat group compared to the concrete floor group may be indicated by slightly less standing time in the covered area in T_4 as compared to T_1 . In a similar way, Telezhenko *et al.* (2007) found that most animal species favoured rubber mat flooring over concrete floors as a flooring option.

Lying/idling/resting: A review of the general behavioural tables showed that, for T_1 , T_2 , T_3 , and T_4 , respectively, the overall lying time was 65.89 ± 1.16 , 60.56 ± 1.38 , 70.67 ± 1.7 , and 64.33 ± 0.92 . For T_3 , it was significantly ($P < 0.05$) higher than for the other groups. The calves kept on concrete floors had less lying frequency, according to Madke *et al.* (2010) and Earley *et al.* (2015), who also reported that there was

no significant difference between concrete and rubber mat. Total lying time was higher T_3 treatment, but in the covered area, lying time was slightly higher on rubber mats than on the concrete bedding. Calves have been seen to feel comfortable on clean, dry, and soft floors. In addition, bedding's ability to provide insulation during the winter is crucial, possibly being greatest when made of wheat straw, leading to more lying and sitting time being seen. Maximum lying time occurs in T_3 followed by T_1 , and T_2 , T_4 , all in covered areas, as pleasant stalls encourage animals to lie down as much as possible (Brouillette and Spanski 1998). Additionally, according to Rushen *et al.* (2007), cows raised on concrete spend more time standing and less time napping than cows raised on rubber mats, although there was no difference in the amount of time spent eating. Although Yarnar *et al.* (2010) claimed that rubber mats and wheat straw generated dirtiness, crossbred calves preferred to lie down on the concrete floor, this component of the study was overlooked due to daily cleaning and weekly changes in bedding. Poor growth on sand bedding as compared to other treatments, according (Hanninen *et al.* 2005), may be explained by insufficient lying times.

Moving: The moving times were 28.50 ± 0.98 , 34.83 ± 0.38 , 22.17 ± 0.84 , and 27.50 ± 0.92 min for T_1 , T_2 , T_3 , and T_4 , respectively. The table reveals that T_1 and T_2 had considerably the longer movement times in covered region than T_3 and T_4 , which had significantly shorter moving times ($P < 0.05$). However, there was no difference between T_3 and T_4 . The results show that calves are uncomfortable on sand bedding, which causes them to move around instead of constantly standing and resting to relieve stress, and that calves spend the least amount of time moving in T_3 and T_4 , where they are in good welfare condition. The findings also suggest that calves on rubber mats may be

slightly more comfortable than those on concrete floors. According to Absmanner *et al.* (2009), rubber mats for slatted flooring have a favourable impact on the behaviour of bulls, but they fall short of the welfare potential of straw bedding. Similar to this, Jain *et al.* (2013) discovered that rubber mats made for more pleasant bedding for animals than concrete floors.

Sleeping: Sleeping time for T_1 , T_2 , T_3 , and T_4 was 53.11 ± 0.64 , 47.00 ± 0.69 , 58.00 ± 0.98 , and 52.00 ± 0.67 min., respectively. The Table 1 shows that the calves in the T_3 group slept more ($P < 0.05$) in comparison to all other groups. Between T_1 and T_4 , the difference was not appreciably different.

The T_2 treatment group showed significantly ($P < 0.05$) the least amount of sleep time compared to all other groups, indicating that the floor surface condition was unfavourable for calves. Dry bedding is probably crucial for calves because it helps the animal stay warm by preventing heat loss through conduction.

This is in agreement with the findings of Jat and Yadav (2010) who concluded that the protection of calf from cold improves the growth rate. Similarly finding of Wathes *et al.* (1983) and Webster (1984) revealed that young calves have a lower critical temperature of 18°C while lying down on concrete floor as opposed to 6°C when lying down on the deep dry straw.

Total time spent in covered and open areas: The total time spent in covered and open area among different treatments is depicted in Supplementary Fig. 2. The T_1 , T_2 , T_3 , and T_4 spent a total of 128.56, 121.84, 137.83, and 126.33 min, respectively, in the covered area, whereas they spent 159.39, 167.11, 147.39, and 158.00 min, respectively, in the open area. Because only daytime behaviour was recorded in this study and the open paddock

Table 1. Mean values of overall behavioural activities (minutes) of calves

Fortnight	Area	T_1	T_2	T_3	T_4
Sitting	Covered	35.11 ± 0.78^b	29.83 ± 0.88^c	39.67 ± 0.58^a	36.67 ± 0.83^b
	Open	48.72 ± 1.05^a	46.66 ± 1.17^{ab}	48.00 ± 0.75^{ab}	44.83 ± 0.92^b
	Total	83.83 ± 1.83^{ab}	76.50 ± 2.05^c	87.66 ± 1.33^a	81.50 ± 1.75^{bc}
Time spent standing	Covered	24.83 ± 0.38^b	28.00 ± 0.19^a	22.33 ± 0.29^c	23.50 ± 0.51^c
	Open	32.34 ± 0.73^c	42.17 ± 0.10^a	24.00 ± 0.76^d	35.50 ± 0.88^b
	Total	57.17 ± 0.67^b	70.17 ± 0.29^a	46.66 ± 0.83^c	59.00 ± 1.39^b
Lying/idling	Covered	27.17 ± 0.48^b	23.06 ± 0.53^c	32.50 ± 0.79^a	27.72 ± 0.43^b
	Open	38.50 ± 0.88	37.50 ± 0.86	38.17 ± 0.96	36.61 ± 0.49
	Total	65.89 ± 1.16^b	60.56 ± 1.38^c	70.67 ± 1.74^a	64.33 ± 0.92^{bc}
Moving	Covered	14.67 ± 0.51^b	18.61 ± 0.24^a	10.66 ± 0.60^c	11.94 ± 0.34^c
	Open	13.83 ± 0.48^b	16.22 ± 0.15^a	11.50 ± 0.35^c	15.56 ± 0.58^a
	Total	28.50 ± 0.98	34.83 ± 0.38	22.17 ± 0.84	27.50 ± 0.92
Sleeping	Covered	27.11 ± 0.29^b	22.39 ± 0.43^c	31.22 ± 1.73^a	26.50 ± 0.25^b
	Open	26.00 ± 0.35^{ab}	24.61 ± 0.28^b	26.78 ± 0.99^a	25.50 ± 0.42^{ab}
	Total	53.11 ± 0.64^b	47.00 ± 0.69^c	58.00 ± 0.98^a	52.00 ± 0.67^b
Total time spent	Covered	128.56 ± 0.49^b	121.84 ± 1.30^c	137.83 ± 1.42^a	126.33 ± 0.82^b
	Open	159.39 ± 1.16^b	167.11 ± 2.12^a	147.39 ± 1.08^c	158.00 ± 1.40^b
Feeding	Covered area	118.22 ± 2.40^{bc}	114.33 ± 0.58^c	123.39 ± 0.40^a	119.67 ± 0.35^{ab}

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

receives more sunlight during the day than the covered area does. More time was spent in the open area during all treatments than in the covered area. However, because bedding was only included in the covered area, the covered area's behaviour was studied more thoroughly. The Table 1 showed that calves in the T_3 group spent noticeably ($P<0.05$) more time in the covered area. It could be because the wheat straw bedding was hotter and drier. Camiloti *et al.* (2012) also found that calves preferred dry bedding more than rubber mats or concrete floors, and they spent less time in covered areas when using sand bedding, which suggests that calves did not prefer sand bedding in the winter. Greater time spent in sheltered areas on wheat bedding suggests that it is the preferred choice of bedding in the winter.

Feeding time: The feeding times were 118.50 ± 0.50 , 114.33 ± 0.58 , 123.39 ± 0.40 , and 119.67 ± 0.56 min. for T_1 , T_2 , T_3 , and T_4 , respectively. Compared to the T_1 , T_2 , and T_4 groups, the T_3 group of calves appeared to spend the most time ($P<0.05$) eating. It could be because T_3 's microclimate offered calves the greatest comfort compared to the other groups, which meant that the animals needed more food to meet their energy requirements for a quicker-growing body. In T_2 , where calves may be attempting to deal with cold stress, the least amount of time was spent feeding. The results of the current study are consistent with those of Madke *et al.* (2010), who found that feeding time was much longer in straw bedding than in rubber materials or on floors. Calves find straw bedding to be more pleasant in the winter. Rushen *et al.* (2007), however, found that there was no change in the amount of time spent eating, but they did find that rubber mats were more pleasant than concrete because there was less time spent standing.

A comparison of the main behavioural activities of calves raised under various conditions shows that calves raised on rubber mats or wheat straw were kept in more comfortable and well-cared-for environments because they spent more time lying down, sleeping, and sitting than the other two groups. Our results are consistent with those of Sorathiya *et al.* (2019), who found that paddy straw provides better well-being conditions for calves and is more cost-effective than alternative bedding materials when used as bedding during the winter, whether on concrete or dirt surface. Similar to this, Vanegas *et al.* (2006) claimed that interlocking rubber flooring is preferable for animals to a concrete floor since it is softer.

Based on the behavioural analysis, calves reared on wheat straw and rubber mat bedding demonstrated significantly higher levels of comfort, as evidenced by increased lying, sleeping, and sitting times compared to those on sand and concrete floors. These findings underscore the importance of providing suitable bedding materials, such as wheat straw and rubber mats, to enhance calf welfare, particularly during winter months, and align with previous research emphasising the preference for softer bedding surfaces for optimal calf well-being.

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