

Effect of Type of Flooring on Physiology and Skin Health of Murrah Buffalo Calves

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ABSTRACT

Eighteen healthy Murrah buffalo calves of either sex aged 6-8 months, maintained at Buffalo Research Station (BRS), Venkataramannagudem (Andhra Pradesh, India), were randomly selected and housed in three separate pens for a period of 90 days, from August 2022 to October 2022. Calves of first, second and third group were reared on concrete flooring (T1), rubber mat flooring (T2) and soil flooring (T3), respectively. The overall mean rectal temperature (°F) differed significantly ($P < 0.01$) and followed a trend $T3 < T1 < T2$. The overall mean pulse rate and respiration rate also differed significantly ($P < 0.01$) and followed a trend $T3 < T2 < T1$. The overall mean skin health score of T1 (1.52 ± 0.04) was significantly higher ($P < 0.05$) than T3 (1.29 ± 0.04) and T2 (1.36 ± 0.05), which were statistically similar. The overall mean heel erosions of T1 (0.64 ± 0.07) were significantly higher ($P < 0.05$) than T3 (0.33 ± 0.07) but didn't differ from T2 (0.48 ± 0.08). In the last fortnight, the average hoof concavity score of T1 (1.00 ± 0.01) was significantly ($P = 0.05$) higher than T3 (0.33 ± 0.21), but didn't differ significantly from T2 (0.50 ± 0.22). The average hoof overgrowth score at the end of study was significantly ($P = 0.05$) higher in T3 (1.00 ± 0.01) than T1 (0.33 ± 0.21), but didn't differ significantly from T2 (0.50 ± 0.22). It was concluded that rubber mat and soil flooring is better than concrete flooring as they maintain the vitals in normal range and cause less damage to the skin and hoof health.

Key words: Flooring, Health, Murrah, Physiology.

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INTRODUCTION

An important key factor in animal production is the design of production systems that meet the physiological needs of animals, thus improving production, quality parameters, animal activity and welfare. Better management conditions may improve performance of the dairy animals (Singh *et al.*, 2020). Good farm management should be adopted to increase the farm profitability. Rearing and management techniques employed during a dairy calf's pre-weaning stage are more crucial to reduce stress and illness risk (Panivivat *et al.*, 2004). Flooring is one of such factors related to animal housing, which influences the growth, production, health and welfare of the animals. The type of bedding used in calf housing affects the calf skin surface temperature (Sutherland *et al.*, 2013) in addition to providing warmth and comfort. A soft floor may minimise the pressure on feet (Nuss *et al.*, 2015), enhances animal comfort and even reduces the occurrence of lameness. In recent decades, fully slatted floors have become very popular, but cattle kept on slatted floors are more likely to suffer various injuries, especially of legs and claws, than animals kept on more comfortable floors. The locomotion of cattle is also strongly influenced by the type of floor and especially by its coefficient of friction.

Unfortunately, concrete flooring may predispose dairy cattle to lameness. Lameness is one of the most important welfare and productivity problems in the dairy industry that it causes pain (Rushen *et al.*, 2007). Keeping in view the importance of proper bedding material for welfare of calves

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and growth & also lack of sufficient information on the topic, the present study was designed to assess the effect of type of flooring on changes in calf physiology and its skin health (hock and hoof health).

MATERIALS AND METHODS

The study was conducted at Buffalo Research Station, Sri Venkateswara Veterinary University, Tirupati, India. The research station is located at 16°53' 08.8" N longitude and 81°27' 35.8" E latitude, in the village of Venkataramannagudem, Tadepalligudem mandal, West Godavari district of Andhra Pradesh, India. The experiment was conducted for a period of 3 months (90 days) from August 2022 to October 2022.

A total of 18 healthy Murrah buffalo calves of either sex, aged 6-8 months, were randomly selected from the farm and housed in three separate pens consisting of six calves each, based on their average body weight. Calves of first, second and third group were reared on concrete flooring (T1), rubber mat flooring (T2) and soil flooring (T3), respectively. They were maintained under similar managerial practices like feeding, watering, cleaning etc, which was normally practiced in the research station. All groups of animals were reared under loose housing system, which consisted of covered floor area with a floor space of 2 m²/calf. The green fodder (Hybrid Napier) was fed *ad libitum* along with paddy straw and concentrate feed according to their requirements. Standard sanitary practices were followed for the entire experimental period and the calves were closely examined for any kind of health issues or sickness for the entire study period.

Physiological Parameters

Physiological parameters rectal temperature, pulse rate and respiration rate were measured as indirect stress indicators.

Skin Health

Skin health of hock region was determined by observing hock area of the calves every fortnight. The hock scoring was done as per the scores (0, 1, 2, 3) developed by Gibbons *et al.* (2012) as shown in the Fig 1.

Hoof health of each calf was also monitored visually every fortnight for any erosions, concavity & overgrowth. For hoof erosions and overgrowth the score '0' was given if they were absent and score '1' if they were present. For hoof concavity the score '0' was given if the hoof was flat, and the score '1' for concave hoof (Gibbons *et al.*, 2012).

Statistical Analysis

The data obtained were analyzed using one-way analysis of variance and Duncan's multiple range test with IBM Statistical Package for the Social Sciences (SPSS) Version 22.

RESULTS AND DISCUSSION

Effect on Physiological Parameters

The mean fortnightly rectal temperature (°F) of the animals in treatment groups T1, T2 and T3 showed significant difference ($P < 0.01$) from the 4th fortnight with lower value in T3 (100.93 ± 0.30) than T1 (102.03 ± 0.25), but didn't differ significantly from T2 (101.47 ± 0.19). However, in the 5th and 6th fortnight the mean rectal temperature of calves in T3 group was significantly ($P < 0.01$) lower than T2 and T1 (Table 1). The overall mean rectal temperature (°F) of T3 (100.58 ± 0.08) was significantly ($P < 0.01$) lower than T2 (100.95 ± 0.12) and T1 (101.25 ± 0.16). This might be due to changes in environmental temperature which caused heat imbalance in the body of calves maintained on the concrete floor resulting in higher temperature. The calves maintained on soil floor and rubber mats regulated the temperature within the body, which may be due to the better heat dissipation through the floor, hence had lower body temperature than calves maintained on concrete floor. These results were in line with the findings of Sutherland *et al.* (2013), Archana (2019) and Chopra *et al.* (2020). In contrast, Chen *et al.* (2017) reported no difference in the rectal temperature among the treatments.

The mean fortnightly pulse rate (beats/min) of the calves in treatment group T3 was lower than T1 with values of T2 intermediate at all intervals with significant differences initially as well as on 1st, 5th and 6th fortnight and in overall pooled values (Table 1). This could be due to the more activity like standing and less lying which indicates the less comfort to the calves on the concrete floor (T1). The soil and rubber floors have more comfort than the concrete floor which has shown better results in terms of less pulse rate in the calves. These results were in accordance with the findings of Archana (2019) and Chopra *et al.* (2020). The present results were however

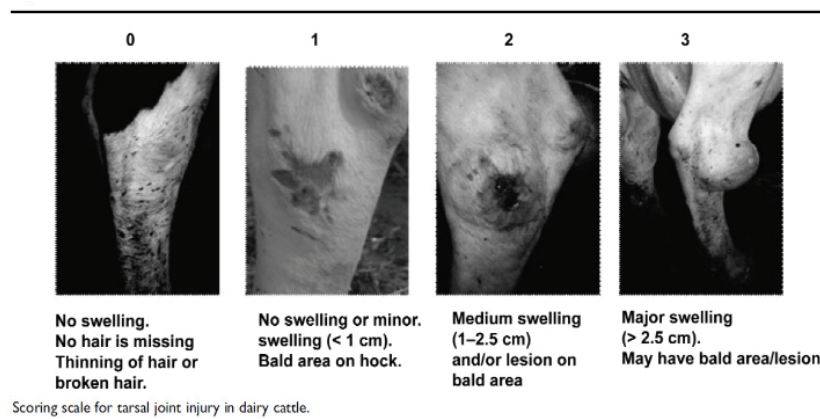


Fig. 1: Scoring scale for tarsal joint injury (Adopted from Gibbons *et al.*, 2012)

not in tune with the findings of Chen *et al.* (2017), who could not find any difference in the pulse rate between the groups.

The mean fortnightly respiration rate (breaths/min) of the animals in treatment groups T1, T2 and T3, showed significantly lower values in T3 than T1 group from the 4th to 6th fortnight (Table 1). The overall mean respiration rate of T3 was significantly ($P < 0.01$) lower than T2 followed by T1. This might be due to restlessness in the calves on the concrete flooring and in response to the more temperature in them. The calves in soil floor and rubber mats had no restlessness and less temperature which do not require more respiration rates. These results were in line with the findings of Archana (2019) and Chopra *et al.* (2020), who reported lower temperatures of animals on mud floor or rubber mat floor than concrete floor.

Effect on Skin Health Score

The mean fortnightly skin health score of the calves in treatment group T1, T2 and T3, didn't differ significantly ($P > 0.05$) in all the fortnights, but the overall mean skin health

score of T1 was significantly higher ($P < 0.05$) than T3 and T2 (Table 2). The calves maintained on the soil floor were found to be less prone to lesions or any kind of skin related abrasions unlike the calves maintained on concrete floor, which were having more skin health scores indicating more abrasions or lesions than other treatment groups. The present results were in corroboration with Elmore *et al.* (2015), Islam *et al.* (2020) and Shakya *et al.* (2021). The present results were however not in agreement with the findings of Norring *et al.* (2008) and Graunke *et al.* (2011), which might be due to several factors like weather, region, managerial conditions etc.

The mean fortnightly heel erosion scores of the calves in treatment group T1, T2 and T3, didn't differ significantly ($P > 0.05$) at any of the fortnightly intervals, but the overall mean heel erosion score of T1 was significantly higher ($P < 0.05$) than T3, but didn't differ from T2 (Table 2). This might be due to the hardy nature of concrete floor rather than soil and rubber mat floorings, which were softer. These results were in line with the findings of Rahman *et al.* (2014), and

Table 1: Effect of type of flooring on fortnightly mean rectal temperature, pulse rate and respiration rate of Murrah buffalo calves

Physiological Parameter	Fortnights	Treatment groups (n=6)		
		T1 (Concrete flooring)	T2 (Rubber mat flooring)	T3 (Soil/Earth flooring)
Rectal temperature (°F)	Initial	100.22 ± 0.10	100.20 ± 0.04	100.13 ± 0.05
	1	100.17 ± 0.10	100.13 ± 0.03	100.10 ± 0.04
	2	100.62 ± 0.20	100.63 ± 0.17	100.58 ± 0.19
	3	100.87 ± 0.17	100.43 ± 0.17	100.55 ± 0.13
	4	102.03 ^a ± 0.25	101.47 ^{ab} ± 0.19	100.93 ^b ± 0.30
	5	102.38 ^a ± 0.25	101.85 ^a ± 0.23	100.82 ^b ± 0.21
	6	102.43 ^a ± 0.20	101.80 ^b ± 0.16	100.93 ^c ± 0.21
	Mean ± SE	101.25 ^a ± 0.16	100.95 ^a ± 0.12	100.58 ^b ± 0.08
Pulse rate (beats/min)	Initial	69.00 ^a ± 1.44	64.00 ^{ab} ± 2.00	61.33 ^b ± 1.61
	1	67.33 ^a ± 2.11	64.00 ^{ab} ± 2.25	58.67 ^b ± 0.84
	2	68.00 ± 1.46	67.33 ± 1.61	64.67 ± 1.23
	3	68.67 ± 1.23	67.00 ± 1.77	66.67 ± 1.23
	4	78.67 ± 7.28	70.67 ± 4.22	67.33 ± 3.49
	5	87.67 ^a ± 2.09	85.00 ^a ± 1.61	73.67 ^b ± 2.44
	6	78.33 ^a ± 2.85	73.00 ^{ab} ± 3.61	66.00 ^b ± 2.19
	Mean ± SE	73.95 ^a ± 1.61	70.14 ^b ± 1.40	65.48 ^c ± 0.99
Respiration rate (breaths/min)	Initial	22.50 ± 0.72	22.00 ± 0.73	22.00 ± 0.73
	1	23.83 ± 0.83	23.67 ± 0.61	23.33 ± 0.84
	2	23.83 ± 0.83	23.00 ± 0.45	22.67 ± 0.67
	3	23.67 ± 0.95	23.67 ± 1.20	23.00 ± 0.86
	4	26.00 ^a ± 1.03	23.50 ^b ± 0.72	21.17 ^b ± 0.65
	5	27.67 ^a ± 0.80	26.33 ^a ± 0.61	23.00 ^b ± 0.82
	6	27.83 ^a ± 1.05	24.17 ^b ± 0.75	23.83 ^b ± 0.65
	Mean ± SE	25.05 ^a ± 0.44	23.76 ^b ± 0.33	22.71 ^c ± 0.29

Means bearing the different superscripts within a row differ significantly ($P < 0.01$).

Graunke *et al.* (2011). The results of this current study were not in agreement with the findings of Earley *et al.* (2015), Keane *et al.* (2015) and Earley *et al.* (2017).

The mean fortnightly hoof concavity score of the calves in treatment group T1 was significantly higher ($P = 0.05$) than T3, but didn't differ significantly from T2 at the end of study (Table 2). The average hoof concavity score was increased in T1 & decreased in T3, indicating that hoof concavity was slowly decreasing & increasing in the calves maintained on the concrete and soil floors, respectively. The average hoof concavity score was irregular in T2. This may be due to the cushioning effect of floor provided by soil and rubber mat floor; the concavity was maintained in those floors than in concrete floor. These results were in line with the findings

of Telezhenko *et al.* (2009), but not in agreement with the findings of Keane *et al.* (2015) and Earley *et al.* (2017).

The mean fortnightly hoof overgrowth score of the treatment group T3 was significantly higher ($P = 0.05$) than T1, but didn't differ significantly from T2, in the last fortnight (Table 2). The average hoof overgrowth score was increased in T3 & decreased in T1, indicating that the hoof overgrowth was slowly increasing & decreasing in the calves maintained on the soil and concrete floors, respectively. The average hoof overgrowth was irregular in T2. These results were in line with the findings of Cozzi *et al.* (2013), but contradicted with Graunke *et al.* (2011), which might be due to different managerial conditions, location of study, duration of study, etc.

Table 2: Effect of type of flooring on fortnightly average skin and hoof health scores of Murrah buffalo calves

Skin & hoof parameters	Fortnights	Treatment groups (n=6)		
		T1 (Concrete flooring)	T2 (Rubber mat flooring)	T3 (Soil/Earth flooring)
Skin health score	Initial	1.25 ± 0.11	1.17 ± 0.11	1.08 ± 0.08
	1	1.25 ± 0.11	1.25 ± 0.11	1.17 ± 0.11
	2	1.50 ± 0.01	1.25 ± 0.11	1.25 ± 0.11
	3	1.58 ± 0.08	1.25 ± 0.11	1.25 ± 0.11
	4	1.58 ± 0.08	1.33 ± 0.17	1.25 ± 0.11
	5	1.67 ± 0.11	1.58 ± 0.15	1.42 ± 0.08
	6	1.83 ± 0.11	1.67 ± 0.11	1.58 ± 0.08
	Mean ± SE	1.52 ^a ± 0.04	1.36 ^b ± 0.05	1.29 ^b ± 0.04
Heel erosions	Initial	0.50 ± 0.22	0.33 ± 0.21	0.17 ± 0.17
	1	0.50 ± 0.22	0.33 ± 0.21	0.17 ± 0.17
	2	0.67 ± 0.21	0.50 ± 0.22	0.17 ± 0.17
	3	0.67 ± 0.21	0.50 ± 0.22	0.33 ± 0.21
	4	0.67 ± 0.21	0.50 ± 0.22	0.50 ± 0.22
	5	0.67 ± 0.21	0.50 ± 0.22	0.50 ± 0.22
	6	0.83 ± 0.17	0.67 ± 0.21	0.50 ± 0.22
	Mean ± SE	0.64 ^a ± 0.07	0.48 ^{ab} ± 0.08	0.33 ^b ± 0.07
Concavity of hoof	Initial	0.33 ± 0.21	0.67 ± 0.21	0.67 ± 0.21
	1	0.50 ± 0.22	0.50 ± 0.22	0.67 ± 0.21
	2	0.67 ± 0.21	0.83 ± 0.17	0.67 ± 0.21
	3	0.67 ± 0.21	0.67 ± 0.21	0.50 ± 0.22
	4	0.83 ± 0.17	0.50 ± 0.22	0.50 ± 0.22
	5	0.83 ± 0.17	0.50 ± 0.22	0.33 ± 0.21
	6	1.00 ^a ± 0.01	0.50 ^{ab} ± 0.22	0.33 ^b ± 0.21
	Mean ± SE	0.69 ± 0.07	0.60 ± 0.08	0.52 ± 0.08
Hoof over-growth	Initial	0.67 ± 0.21	0.67 ± 0.21	0.33 ± 0.21
	1	0.67 ± 0.21	0.50 ± 0.22	0.50 ± 0.22
	2	0.67 ± 0.21	0.83 ± 0.17	0.67 ± 0.21
	3	0.50 ± 0.22	0.67 ± 0.21	0.67 ± 0.21
	4	0.50 ± 0.22	0.50 ± 0.22	0.83 ± 0.17
	5	0.33 ± 0.22	0.50 ± 0.22	0.83 ± 0.17
	6	0.33 ^b ± 0.21	0.50 ^{ab} ± 0.22	1.00 ^a ± 0.01
	Mean ± SE	0.52 ± 0.08	0.60 ± 0.08	0.69 ± 0.07

Means bearing the different superscripts with in a row differ significantly ($P < 0.01$).



CONCLUSIONS

There was significant difference in vital signs like rectal temperature, pulse rate and respiration rate of Murrah buffalo calves kept on different floor types, being lowest in the soil floor. The skin health of the calves reared on rubber mats and soil floor was better compared to calves reared on concrete floor. Flooring type has significant effect on hoof health, which was least in concrete floor, but was better in rubber mat floor followed by soil floor. An over-grown hoof was a major observation on rubber mats, soil floor as compared to concrete floors.

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