www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
TPI 2024; 13(5): 114-118

www.thepharmajournal.com
Received: 23-03-2024
Accepted: 26-04-2024

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Comparative studies on Rubber mat with other floorings on physio-biochemical parameters of Crossbred cows

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Abstract
In the present experiment a total of 18 cows were randomly divided into three groups of six each and exposed to the respective flooring treatments for a period of 90 days. The objectives of experiment was to study the effect of rubber mat and other floors on physio-biochemical parameters of crossbred cows on different floors. The overall mean body temperatures were 100.44±0.05°F, 100.47±0.05°F, and 100.59±0.04°F for concrete, rubber mat, and earthen floor groups respectively, without any statistically significant differences. Similarly, the pulse and respiration rates remained comparable across treatments. Biochemical profiling demonstrated that total serum protein and albumin concentrations were highest in the rubber mat group (7.30±0.034 g/dL and 2.67±0.02 g/dL respectively), differing significantly from the earthen floor group which exhibited the lowest values (7.13±0.03 g/dL and 2.54±0.02 g/dL respectively). However, globulin levels did not vary considerably between groups. The findings demonstrate the superiority of rubber mat flooring in promoting better welfare, comfort, and hygienic conditions for crossbred dairy cows. Rubber mats contributed to reduced stress levels as evidenced by favourable biochemical profiles. Therefore, the adoption of rubber mat flooring can be strongly recommended to dairy farmers as a cost-effective intervention to enhance productivity and ensure optimal well-being of their livestock.

Keywords: Rubber mat, crossbred cows, floors, livestock

1. Introduction
Flooring is one of the most imperative components of animal housing as far as animal health, growth and welfare are concerned. In dairy animals the most common flooring material used is cement concrete. Though concrete flooring has advantages like strength, thermal conductivity and strength, there are some obvious disadvantages like slippery nature and hardness which reduces the animal comfort. Traditionally, organic materials such as sawdust and wood shavings were used as rearing substrates for dairy calves, but the recent trend is to avoid such materials, due to hygiene concerns, labour and transportation costs which affect the total on-farm price and use (Kartal and Yanar, 2011) [9]. Dairying is acknowledged as the major occupation in bringing about socio-economic transformation for rural poor in our country. Indian dairying is the best example for production by masses rather than mass production. Almost 70% of the country's mean milk production is from small and marginal farmers who are maintaining 2-8 animals per household. The improvement in the quantity, quality and competitiveness of milk depends on technological interventions in management practices at the grass root level. To create an environment for dairy cows in which they feel comfortable is of great importance, both from the welfare and economic perspectives. Apart from the dimensions, the comfort of free-stalls depends on the type and quality of the bedding material (Upadhyay *et al.*, 2021) [20] The bedding material should provide thermal comfort and softness, yet be durable and have sufficient friction to allow rising and lying down without slipping. Finally, bedding material should help in keeping cows clean and healthy while minimizing daily labour requirements (Chapinal *et al.*, 2009) [4]. Organic bedding materials could result in a higher risk of mastitis. However, the resulting manure is easier to handle, when using organic bedding and can positively affect soil fertility as a result of higher amounts of organic matter. Regardless of the housing system used, the compostability of bedding materials is a desirable characteristic, as it improves soil fertility and could potentially reduce the

environmental impact of dairy systems (Leso *et al.*, 2020) [12]. Housing the cows in large pens with mattress flooring increased lying time by 4 hours per day to the cows as compared to housing them in tie stalls with concrete flooring (Haley *et al.*, 2001) [8] The cows, housed on rubber mats showed more comfort and thereby improved milk production. A lame cow will not only drop in milk yield during the illness, but also months before and after (Green *et al.*, 2002) [7]. Moreover, the floor microbial load can also be minimized by placing the cows on more hygienic floor *viz*; rubber mats in comparison to other floors.

2. Materials and Methods

The present research work was carried out in the Department of Livestock Production Management, College of Veterinary Science and Animal Husbandry, Nanaji Deshmukh Veterinary Science University, Mhow (M.P., India). Standard sanitary practices were followed for the entire experimental period and the animals were closely examined for any kind of health issues or sickness for the entire study period. Eighteen healthy crossbred cows has been selected having similar body weight, almost in same parity and age for this study. They were randomly distributed into three groups (Six cows in each group).

Table 1: Details of experimental groups

Groups	No. of cows	Accommodated on	Period (days)
G1	06	Concrete floor (Control Group)	90
G2	06	Rubber mat floor(Cow mat)	90
G3	06	Kachha floor	90

The experimental cows were housed on different flooring material under study. All the experimental cows were offered 20 kg Berseem and ad libitum wheat straw as roughage source to meet their dry matter requirements. Concentrate feed has been given @ 1.5 kg/day/animal for body maintenance in general and milking cows has been given additional concentrate as per their milk production of cows (1 kg concentrate per 2.5 kg of milk) (NRC, 2001). The cows has been provided balanced ration and clean drinking water ad libitum uniformly during entire period of the experiment. The veterinary aid measures like deworming, vaccination has been followed for all the experimental cows as per the farm schedule. Physiological parameters (Rectal temperature, pulse and respiration) were taken at weekly interval and Biochemical parameters were carried out on semi-automatic biochemical analyser.

3. Results and Discussion

The environment in which we raise crossbred cows is important to their well beings and performance. Any adverse change in macro and micro climate of cow house directly or indirectly influence cow physiology. The measurable changes include respiration, rectal temperature and heart rate. Animals will try to cope up with these stressful conditions by altering their physiological response like changing body temperature, pulse, and respiratory rate. Temperature and humidity are to a considerable extent responsible for the variation of the physiological reaction of animals and the reactions vary widely in different breed and species.

The body temperatures of cows managed on different bedding materials were recorded at weekly intervals. Overall means of body temperature of experimental animals reared on different floor material were recorded to be 100.44±0.05, 100.47±0.05 and 100.59±0.04 respectively in control, rubber mat and kachha floor group.

Table 2: Average animals' body temperature (^{0}F) at weekly interval in different experimental groups

Week	G1	G2	G3
0	100.38±0.07	100.52±0.09	100.46±0.11
1st	100.07^a±0.14	100.71^b±0.07	100.68^b±0.16
2nd	100.90±0.14	100.81±0.07	100.70±0.17
3rd	100.61±0.20	100.53±0.25	100.50±0.23
4th	100.81±0.23	100.36±0.19	100.73±0.23
5th	100.30±0.19	100.30±0.28	100.50±0.27
6th	100.68±0.24	100.43±0.24	100.45±0.25
7th	100.45±0.31	100.70±0.20	100.50±0.26
8th	100.43±0.25	100.37±0.26	100.56±0.25
9th	100.51±0.29	100.46±0.22	100.58±0.26
10th	100.21±0.23	100.50±0.30	100.70±0.21
11th	100.46±0.30	100.45±0.24	100.68±0.28
12th	100.55±0.22	100.33±0.21	100.50±0.34
Mean ± SE	100.44±0.05	100.47±0.05	100.59±0.04

With different superscript implicate that (p≥0.05)

The week-wise averages of body temperature starting from initiation of trial (0th week) to 12th week, the means were more or less similar with no significant difference in body temperature of experimental animals reared on different floors except in 1st week of experiment where the body temperature of animals kept in G2 and G3 group was found little higher than that of animals kept in G1 group i.e., control.

Experimental crossbred cows accommodated on rubber mating showed little higher body temperature during initial weeks of trial and then the body temperature gradually settled at lower range over the time, indicating efficient thermoregulation to steady physiological response as a part of body homeostasis and in turn, better ease for animals. Our results are comparable to that of findings obtained by Kumar (2008) [11], Rohilla *et al.* (1990) [15] and Yadav *et al.* (1990) [22] in dairy animals subjected to three different floor types. Their results indicated that mean rectal temperature did not showed any significant difference in body temperature when housed on different floors.

The overall mean of pulse rate of experimental animals kept on different floor material were found to be 62.70±0.62, 61.69±0.69 and 63.37±0.60 respectively in control, rubber mat and kachha floor groups.

Table 3: Average pulse rate (Mean ± SE) at weekly interval in different experimental groups

Week	G1	G2	G3
0	61.81±0.85	61.64±0.94	61.67±0.85
1st	63.00±0.85	64.16±1.04	63.83±0.60
2nd	63.16±0.83	64.83±0.83	64.33±0.66
3rd	59.50^a±1.38	64.16^b±2.24	63.33^b±1.14
4th	63.00±2.63	64.50±1.17	60.00±20.16
5th	63.33±1.99	63.33±1.28	61.33±2.36
6th	63.00±1.98	63.50±2.04	61.60±2.10
7th	62.00±1.75	61.83±2.46	61.50±1.52
8th	65.16^a±1.40	59.50^b±2.26	64.60^a±1.33
9th	61.30±1.99	61.50±2.23	64.00±1.51
10th	62.16±2.35	63.83±2.15	61.50±1.87
11th	64.00±2.11	60.16±1.83	64.33±1.64
12th	61.60±2.20	63.30±1.68	64.30±2.23
Mean ± SE	62.70±0.62	61.69±0.69	63.37±0.60

Mean with different superscript implicate that (p≥0.05)

The week-wise averages of pulse rate were ranged from 59.50±2.26 in rubber mat group during 8th week to 64.83±0.83 in same group but in 2nd week. This finding indicates that maximum variation was obtained in animals which were reared on rubber mat floor. The means were approximately similar in entire research period except in 3rd week, where the pulse rate of animals kept in G2 (rubber mat floor) and G3 (Kachha floor) group was found little higher than those recorded in G1 (control) group. The findings of Kumar *et al.* (2018) [10] assessed higher pulse rate (72.15 ± 0.15) in recycled manure solids in loose housing system than in modified housing system (75.03 ± 0.24 per min) in dairy cows during summer than winter season with significant difference (P<0.01) in buffaloes. Kumar (2008) [11] recorded that, average pulse rate (counts per min) varied from 78.57 ± 0.91 to 79.99±0.85 on different ages of calves and floor types. Which is higher than the means obtained in present study which is obvious since the calves has higher pulse rate than adults, however, similar to our results, he too, did not observed any significant influence of different floor types on the pulse rate of calves. The present means of pulse rate was not in accordance with results of Geetha (2021) [6], who reported that, the mean pulse rate was significantly higher (P<0.01) in cows maintained on rubber mats (74.63±0.48) than the cows reared on dried solid manure (DSM) on concrete floor (71.38 ± 0.18 per min). Tej (2015) [18] reported higher estimates of pulse rate as 74.60 ± 1.21 counts per min during summer season in comparison to our means of pulse rate (61.69±0.69) in crossbred cows raised on rubber mats.

Respiratory rate is the physiological parameter that best predicts heat stress in dairy cattle. Overall averages of respiration rate of experimental animals on different floor material were obtained to be 22.49±0.14, 22.41±0.16 and 22.57±0.16 respectively in control, rubber mat and kachha floor groups

Table 4: Averages respiration rate (Mean±SE) in different experimental groups

Week	G1	G2	G3
0	23.13±0.62	23.67±0.74	23.27±0.65
1st	24.83a±0.6	28.66b±0.76	27.16b±0.47
2nd	25.16a±060	28.50b±0.76	26.60a±0.55
3rd	22.16±1.13	22.83±1.49	22.50±0.76
4th	22.80±1.53	22.16±1.30	22.60±1.14
5th	22.30±1.49	22.50±0.76	22.00±1.52
6th	22.00±1.29	22.60±1.14	22.30±1.49
7th	22.50±0.76	22.00±1.52	23.00±1.29
8th	22.66±1.44	22.33±1.49	22.50±0.76
9th	22.00±1.52	23.00±1.29	22.60±1.45
10th	22.30±1.49	22.50±0.76	22.00±1.52
11th	23.00±1.29	22.60±1.14	22.30±1.49
12th	22.50±0.76	22.00±1.52	23.00±1.29
Mean ± SE	22.49±0.14	22.41±0.16	22.57±0.16

The weekly means of respiration rate starting during entire experimental period did not have any prominent difference except in 1st week of experiment where the means of respiration rate of animals of G2(Rubber mat group) and G3 group (Kachcha floor group) were found somewhat at higher side than that the animals of control group (G1) which indicates that the animals took little more time to adjust themselves on rubber mat floor in very initial phase of experiment but later on all animals were accustomed with each type of flooring material during entire period of study. The results reported by Archana (2018) [2] in her study did not support the present results. She found that the respiration rate was significantly (p<0.05) higher in concrete floor followed by straw bedded and rubber mat floor in Sahiwal calves where as in present study, floor material did not influence respiration rate of cows in almost entire period of study. Our results are in agreement with that of Basavaraj (2022) [3] and Tharuntej (2020) [19] in lambs. The findings of Uppiretla *et al.* (2023) [21] were inconsistent with our finding. They had found that the overall mean pulse rate and respiration rate differed significantly (p< 0.01) and followed a trend soil flooring (T_3) < rubber mat flooring (T_2) < concrete flooring (T_1).

Biochemical Parameters

Biochemical indices of blood are considered as an indicator of the health and physiological condition of cows. They reflect animals' metabolic processes and also indicator of stress.

Total protein

It is evident that overall means of total protein of experimental animals reared on different floor material were calculated to be 7.24±0.04, 7.3±0.034 and 7.13±0.03 respectively in control, rubber mat and kachha floor groups.

Table 5: Averages (Mean ± SE) of total protein (g/dl) in different experimental groups

Fortnight	G1	G2	G3
0	7.13±0.08	7.18±0.09	7.11±0.08
1st	7.14±0.06	7.24±0.04	7.07±0.04
2nd	7.15±0.05	7.41±0.04	7.15±0.08
3rd	7.43±0.12	7.39±0.08	7.28±0.11
4th	7.33±0.04	7.22±0.04	6.97±0.12
5th	7.25±0.04	7.28±0.06	7.13±0.08
6th	7.29±0.03	7.38±0.04	7.20±0.06
Mean ± SE	7.24ab±0.04	7.30a±0.034	7.13b±0.03

Mean with different superscript implicate that (p≥0.05)

The overall means of total protein was found to be highest (7.30±0.034) in rubber mat (G2) group and significantly lowest in crossbred cows of Kachha floor group (7.13±0.03), however, means of G1 group was not differed from values of G2 and G3 cows. However, the means of G2 group was found to be higher than that of G3 group. The averages of total protein at fortnight interval were ranged from 6.97±0.12 in kachha floor group during 4th fortnight to 7.43±0.12 in concrete floor group in 3rd fortnight. Similar to present study, Shakya *et al.* (2021) [17] reported that, the total protein(mg/dl) were significantly (P>0.05) higher in Rubber mat installed flooring group and Cow dung bed flooring (6.11 and 6.08) than concrete flooring (5.45) These values are lower than those obtained in present study. Our outcomes are dissimilar to that of findings obtained by Earley *et al.* (2015) [5] and Mousa-Balabel *et al.* (2023) [14] in dairy cows subjected to three different floor types. Their results showed that mean total protein did not show any significant difference in crossbred cows when housed on different floors.

Albumin

Albumin is the best marker and fundamental part of nutrition, most abundant plasma protein and major component of fetal bovine serum, is the best predictor of malnourishment.

Overall means of albumin of experimental animals reared on different floor material were observed to be 2.67±0.03, 2.67±0.02 and 2.54±0.02 respectively in control, rubber mat and kachha floor groups.

Table 6: Averages (Mean ± SE) of albumin (g/dl) in different experimental groups

Fortnight	G1	G2	G3
0	2.81±0.05	2.74±0.06	2.56±0.09
1st	2.61±0.08	2.79±0.05	2.6±0.09
2nd	2.7±0.07	2.65±0.06	2.56±0.08
3rd	2.67±0.1	2.64±0.09	2.46±0.07
4th	2.63±0.06	2.62±0.12	2.53±0.1
5th	2.53±0.05	2.49±0.04	2.49±0.05
6th	2.75±0.07	2.76±0.05	2.57±0.05
Mean ± SE	2.67^{a}±0.03	2.67^{a}±0.02	2.54^{b}±0.02

The figures suggest that the means of albumin was significantly lower in G3 (Kachha floor) group in comparison to cows of G1 (Control) and G2(Rubber mat floor) group. The study conducted by Chikwanda and Muchenje (2017) found that, albumin value was significantly higher ($P<0.01$) for goats on slatted floors than earth floors, which implies the same finding as our study. The findings are not in accordance with Antil *et al.* (2019) [1] and Earley *et al.* (2015) [5] who revealed that the change in floor types didn't affect the value of albumin.

Globulin

Globulins are a group of protein in blood. They are made in liver by immune system. Globulin play an important role in liver function, blood clotting and fighting from infections. Overall means of globulin of experimental animals reared on different floor material were observed as 4.62±0.05, 4.66±0.05 and 4.60±0.06 respectively in control, rubber mat and kachha floor groups.

Table 8: Averages (Mean ± SE) of animal's globulin (g/dl) in different experimental groups

Fortnight	G1	G2	G3
0	4.32±0.07	4.44±0.13	4.56±0.16
1st	4.53±0.08	4.45±0.05	4.47±0.12
2nd	4.45±0.07	4.77±0.05	4.60±0.13
3rd	4.76±0.20	4.75±0.10	4.82±0.14
4th	4.70±0.08	4.59±0.14	4.45±0.13
5th	4.72±0.07	4.79±0.08	4.65±0.09
6th	4.54±0.08	4.62±0.03	4.63±0.10
Mean ± SE	4.62±0.05	4.66±0.05	4.60±0.06

The globulin concentration observed in this research was within normal range, representing that the animal's immune system is working properly in all the groups. Our results are comparable to that of findings obtained by Sahu *et al.* (2018) [16] and McGettigan *et al.* (2022) [13] in dairy animals subjected to three different floor types. Their results indicated that mean globulin did not showed any significant difference when housed on different floors. According to Shakya *et al.* (2021) [17] the total globulin (mg/dl) was significantly higher in rubber mat installed flooring (2.60) than concrete flooring and cow dung bed flooring and (1.24 and 1.74) which is not in line with the present study.

4. Conclusion

The results obtained in our study reveals that rubber mat has positive impact on crossbred cows for lameness, hygiene and hock and knee injury and the crossbred cows proved themselves better on rubber mat flooring. The material of floor did not affect on body temperature, pulse rate and respiration rate.

5. Acknowledgments

The authors acknowledge the Dean, College of Veterinary Science and A.H., Mhow (M.P.) and University authorities of Nanaji Deshmukh Veterinary Science University, Jabalpur (MP) for providing the necessary help and facilities to conduct this research.

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