



Original Research

Effects of Rubber Mat Flooring on Hygiene, Locomotion, Hock and Knee Injury in Crossbred Cows

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Abstract

The present study was conducted on 18 lactating crossbred cows by dividing them into two homogeneous groups randomly. The cows of treatment group were kept in shed having rubber mat flooring, whereas the cows of control were kept on concrete floor. The objective was to study the effect of rubber mat flooring on hygiene, locomotion, hock and knee injury scoring. Cleanliness, locomotion and hock and knee injury scoring were done by standard methods at fortnight interval by two researchers by assigning 1-4 scores. Result revealed that overall locomotion score on rubber mat (1.33 ± 0.07) was significantly lower ($p < 0.01$) than cows on concrete floor (1.70 ± 0.10). Mean overall hygiene score for the cow kept in rubber mat was 1.66 ± 0.09 and 2.00 ± 0.08 in cows kept on concrete floor, whereas the overall hock and knee injury score in cows on rubber mat and concrete floor was 1.21 ± 0.04 and 1.90 ± 0.05 , respectively. The hygiene scoring and hock and knee injury scoring between both groups was also significant ($p < 0.01$). Experimental findings suggested that rubber mat may reduce lameness problem. Chances of hock and knee injury can be reduced and welfare can be improved in crossbred cows by using rubber mats.

Key words: Crossbred Cow, Hygiene, Hock and Knee Injury, Locomotion, Rubber Mat, Score

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Introduction

Crossbred cows are widely distributed in India and their population has increased rapidly in last decade due to their advantages i.e. better milk producer, efficient feed convertor and more docile. Being high producer they are more susceptible to climatic stress and diseases. So they need better care in comfortable housing with soft flooring. Soft walking surfaces such as solid rubber flooring have become increasingly popular alternatives to hard floors in the walking area of dairy facilities. A soft floor may reduce the pressure on the





foot (Nuss *et al.*, 2015) and potentially improve cow comfort and it may reduce the incidence of lameness. Concrete flooring is popular amongst dairy farmers in India due to their durability and convenience in cleaning. However, due to hard and solid consistency it cannot provide comfort necessities for standing, walking and lying (Phillips and Morris, 2001). Slipperiness is another major drawback associated with concrete surface as it doesn't provide enough friction for natural locomotion and standing. The hock and knee injuries are directly associated with concrete floor. So, now-a-days provision of cushioned flooring particularly rubber mat in the animal house is gaining popularity. Impaired locomotion in high producer cows is another serious issue as lame cow will not meet their milk production potential (Green *et al.*, 2002). Venegas *et al.* (2006) found decreased claw growth and wear in cows housed in shed having rubber flooring. Thus, poor flooring has an indirect effect on milk yield by causing lameness and claw disease. Out of available options for flooring, rubber mat is cheaper, long lasting and available in local market with practically zero maintenance. Still the usefulness of rubber mat is not well studied with respect to crossbred cow's physiological responses and welfare. Therefore, present experiment was conducted to study effects of rubber mat flooring on hygiene, locomotion, hock and knee injury in lactating crossbred dairy cows.

Materials and Methods

The experiment was taken at Livestock Research Station, Navsari Agricultural University, Navsari, Gujarat during October 2017 to January 2018 for 90 days. Eighteen mixed parity (1 to 5 parity) Holstein Frisian X Kankrej crossbred cows were selected. Cows were randomly divided into two homogeneous groups based on daily milk production, stage of lactation and parities. Two identical pens in semi-loose, head to head and *pakka* shed were selected. The dimension of each pen was 12 meter X 16 meters. Half of pen was under asbestos roof and remaining area was open to sky. The shed was having 1.5 meters high boundary wall with two gates one on eastern and another on western side. Both the selected pens had *pakka* concrete floor. The cows of concrete floor group (CON) and rubber mat floor group (RM) were housed in each pen. The RM pens have provided with locally available rubber mat of 16 mm thick, 6'×4' in sized rubber mat and had 40 kg weight. Total 20 mats were placed on floor of RM pen in such a way that it covers roughly half floor area. Feed offered in RM and CON were similar throughout the study. *Jowar* (*Sorghum bicolor*) hay @ 3.5 Kg/day and paddy (*Oryza sativa*) straw @ 2 Kg/day were fed as dry fodder. Hybrid Napier grass and/or jowar and/or maize @ 15 Kg/day along with 10 Kg/day lucerne were fed as green fodders to cows during experimental period. Dry and green fodders were chaffed together were fed thrice a day to all cows i.e. 10 am, 3 pm and 9 pm throughout the experimental period. Cows were milked twice a day at morning (3:30 am) and evening (3.30 pm) in milking parlour. The experimental shed was cleaned manually every day and also by forced water spray using jet pump once in week. To study the welfare of cows locomotion scoring,



cleanliness scoring and hock and knee injury scoring at fortnight interval was performed by following methods.

Locomotion Scoring

Locomotion scoring was carried out using a modified system from Sprecher *et al.* (1997) as depicted in Table 1. It was scored by two persons when cows were taken to milking parlour at evening. Based on locomotion types described in Table 1 it was categorized into normal locomotion, mild locomotion disruption, moderate lameness and severe lameness and scored 1, 2, 3 and 4, respectively.

Table 1: Scoring of locomotion in cows goes for milking.

Locomotion Score	Description
1	Normal locomotion, normal standing and walking, symmetrical movement, with the same support from all four legs. The rear claw in the same track as the front claw. Flat back posture while standing and walking
2	Mild locomotion disruption, normal standing but arched back while walking. Head lower to the ground and stretched neck. Stiff and slow walk, but with the same support from all four legs
3	Moderate lameness, arched back while standing and walking. Shorter, asymmetric and slower steps. No support with one or more legs, hard to distinguish the lame leg
4	Severe lameness, arched back while standing and walking. No support on injured leg/legs while standing and walking, and/or walking avoided. Easy to distinguish the lame leg

(Sprecher *et al.*, 1997)

Cleanliness Scoring

Cleanliness was scored at fortnight interval by two researchers in the milking parlour at the time of milking. Cows were scored according to Table 2 using procedure from “Fråga kon” described by Norberg (2012). Cows were observed straight behind and both the side of flank and belly and scored. Average value of score of both researchers was used for statistical analysis.

Table 2: Scoring procedure for cleanliness

Cleanliness Score	At a fixed time twice a month
1	Completely clean, minor spatter of manure on hoof.
2	Spatter of manure on hoof, udder and up to hock.
3	Several manure regions with dry manure on the udder, rump and flanks
4	Several manure region on whole body.

(Norberg, 2012)

Hock and Knee Injury Scoring

The hock and knee of the cows were examined at fortnight interval for hair loss, swelling and ulcer according to Table 3. The average score value of the hocks and knees were worked out for each animal.

The injuries were measured with foot roll in case where visual estimates were not enough. The hocks and knees evaluated for hair loss, swelling and ulcer according to Graunke *et al.* (2011). The cows were examined while tied in the milking parlour. Some of the dirty cows were brushed in particular area of hock and knee before scoring.

Table 3: Scoring procedure for hock and knee injuries

Hock and Knee Injury Score	At fortnightly interval, on both hocks and knees. Hock and knee surfaces in both legs will be observed and scored.
1	Hair loss
2	Swelling
3	Ulceration

(Graunke *et al.*, 2011)

Statistical Analysis

The collected data were tabulated. The tabulated data were analyzed by various suitable techniques in IBM® SPSS® Statistics Version 20.0. Statistical significance between two treatments were analyzed by t test, whereas statistical analysis within treatment between various fortnight under study were analyzed by using one way ANOVA technique. The Duncan's method in post hoc test was used to compare various means. The collected data were counted in terms of frequency followed by its conversion into percentage as per standard statistical method (Snedecor and Cochran, 1994). The Pearson's chi square test was used to test significance by working 2- sided exact significance value in frequencies data.

Results and Discussion

The effect of flooring on lameness was studied by locomotion scoring method. Fortnight treatment wise mean data of the same is presented in Table 4. The frequency distribution of cows based on severity of lameness is presented in Table 5.

Table 4: Effect of flooring on locomotion score in crossbred cows

Fortnight	n	RM (Mean±S.E.)	CON (Mean±S.E.)	p value
1	9	1.72±0.35	1.67±0.28	0.903
2	9	1.33±0.19	2.00±0.37	0.129
3	9	1.17±0.12	1.78±0.30	0.078
4	9	1.11±0.07	1.67±0.25	0.049
5	9	1.33±0.14	1.72±0.25	0.199
6	9	1.22±0.09	1.56±0.19	0.138
7	9	1.39±0.14	1.50±0.17	0.616
Overall	63	1.33±0.07	1.70±0.10	0.002
F value		1.247	0.374	
p value		0.297	0.892	

Table 4 revealed that overall mean locomotion score was 1.33 ± 0.07 and 1.70 ± 0.10 in crossbred cows kept on rubber mat and concrete floor, respectively. Statistically it was significant. The said data of various fortnights within both the group was non-significant. The fortnight observation of locomotion score between the group shows that it was non-significant except during 4th fortnight. The finding of present study is in agreement with the result reported by Fjeldass *et al.* (2011), Norberg (2012) and Bergsten *et al.* (2015). Mostly they have reported that use of rubber mat have either reduced number of lame cows or reduced the lameness scoring. Furthermore the table indicated that mean locomotion score was found in decreasing trend from 1st fortnight (1.72 ± 0.35) to 7th fortnight (1.39 ± 0.14) in cows kept on rubber mats. Thus, the prolonged use of rubber mat may have positive effect on locomotion scoring. Norberg (2012) also reported that the incidence of severe lame cows was decreased by 3.5% in cows kept on rubber mat, whereas, it was increased by 16% in cows kept on concrete floor in three month study. It showed that continuous use of rubber mat for period of at least three month was proved to be beneficial in reducing lameness in the cows. However, the result of present study was contradictory with Solano *et al.* (2015), as they didn't observed any significant difference in prevalence of lameness in cows kept either on rubber mat or concrete flooring. As they surveyed lactating, non-lactating cows and heifers, whereas, present study was focused on lactating cows with more physiological stress which is predisposing factor for lameness.

Table 5: Frequency distribution of severity of lameness affected by floor types in crossbred cows

Severity of Lameness	Flooring				Overall		Chi-square test	
	Rubber Mat		Concrete		n	%	Value	P
	n	%	n	%				
Normal (Score 1-1.5)	53	84.1	40	63.5	93	73.81	10.317	0.016
Mild (Score 1.5-2.5)	9	14.29	15	23.81	24	19.05		
Moderate (Score 2.5-3.5)	0	0	7	11.11	7	5.56		
Severe (Score 3.5 - 4)	1	1.59	1	1.59	2	1.59		
Overall	63		63		126			

The frequency distribution of crossbred cows in both groups based on severity of lameness scores is presented in Table 5 revealed that 84.10, 14.29, 0 and 1.59 per cent of cows kept on rubber mats were normal, mild, moderate or severe lame, respectively, whereas, 63.50, 23.81, 11.11 and 1.59 per cent of cows were having either normal, mild, moderate or severe lame, respectively. The chi-square value suggested that the severity of lameness was significant between both the groups under study. It reflected that the cows kept over rubber mat were mostly (98.39%) either normal or mild lame which was significantly less (92.86%) in concrete group. Similar results were also revealed by Fjeldass *et al.* (2011) and Bergsten *et al.* (2015). Vokey *et al.* (2001) revealed that 32% of cows housed on concrete floor were having severe lameness, whereas only 11% of cows kept on rubber mat were lame. Fjeldass *et al.* (2011) also reported that 46.34 and 24.39 per cent cows were severely lame on either concrete or rubber mat floor,

respectively. However, numbers of cows having severe lameness in present study was less in comparison with above said studies. It may be due to differences in species of animals, production level, weather etc like non-genetic factors which were different from place to place. Furthermore, present study was conducted at organized research station where all the animals are regularly inspected for health aspects by veterinarian as routine farm operation, hence, due to continuous treatment of lame cows, less numbers of severely cows were found in this study in both the groups.

Effect of Flooring on Hygiene

The effect of flooring types on hygiene was studied by hygiene scoring method. Fortnight treatment wise mean data of the same is presented in Table 6. The frequency distribution of cows based on severity of dirtiness is presented in Table 7.

Table 6: Effect of flooring on hygiene score in crossbred cows

Fortnight	n	Rubber mat (Mean±S.E.)	Concrete (Mean±S.E.)	p value
1	9	2.44 ^b ±0.28	2.06±0.18	0.259
2	9	1.89 ^{ab} ±0.22	2.28±0.21	0.212
3	9	1.61 ^a ±0.20	2.11±0.16	0.07
4	9	1.39 ^a ±0.18	2.00±0.14	0.018
5	9	1.39 ^a ±0.18	2.22±0.15	0.003
6	9	1.56 ^a ±0.18	2.11±0.11	0.017
7	9	1.33 ^a ±0.17	2.00±0.08	0.003
Overall	63	1.66 ^a ±0.09	2.11±0.06	0
F value		3.739	0.491	
p value		0.003	0.812	

Means with different superscript within columns are statistically different

Table 6 shows that overall mean hygiene score was 1.66±0.09 in cow kept on rubber mat and 2.11±0.06 in cow kept on concrete floor, which was statistically significant. The given data in table 6 also indicate that there was significant difference in mean hygiene score of different fortnight on rubber mat flooring, whereas there was no significant difference found in mean hygiene score within fortnight on concrete flooring. The hygiene score revealed that there was significant difference during 4th, 5th and 7th fortnight between both the groups. The highest hygiene score observed during 1st fortnight (2.44±0.28) and lowest during 7th fortnight on rubber mat while on concrete floor highest and lowest score observed during 2nd (2.28±0.21) and 7th (2.00±0.08) fortnight, respectively. The result of present study was in agreement with Lowe *et al.* (2001). They reported that cows on rubber mat flooring were cleaner than cows on other type of flooring. While Kara *et al.* (2011) and Norberg (2012) found the beneficial effect of rubber mat flooring on cleanliness but it was not significant. However, the present finding was contradictory with Schutz and Cox (2014). They found that cows on rubber mat flooring were 3 times dirtier than cows on other flooring. However, they compared the effect of wooden chips on concrete and concrete with rubber mats on cows

maintained by daily 6 hour grazing and remaining hours in houses. Further, the rubber mats used in present study was routinely cleaned manually every day and was also cleaned by jet spray pump weekly. Similar cleaning practice was also performed in concrete floor also. It was observed that proper cleaning of rubber mat was more time consuming than concrete surface. The former study didn't show such intense cleaning practices.

Table 7: Frequency distribution of severity of dirtiness affected by floor types in crossbred cows

Severity of Dirtiness	Flooring				Overall		Chi-square Test	
	Rubber Mat		Concrete					
	n	%	n	%	n	%	Value	p
Clean (Score 1-1.5)	38	60.32	8	12.7	46	36.51	33.73	0
Little dirty (Score 1.5-2.5)	21	33.33	52	82.54	73	57.94		
Moderate dirty(Score 2.5-3.5)	3	4.76	3	4.76	6	4.76		
Dirty (Score 3.5 - 4)	1	1.59	0	0	1	0.79		
Overall	63		63		126			

The group wise frequency distribution of experimental cows based on severity of dirtiness is presented in Table 7. It revealed that 60.32, 33.33, 4.76 and 1.59 per cent of cows kept on rubber mats were clean, little dirty, moderate dirty or dirty, respectively, whereas, 12.70, 82.54, 4.76 and 0 per cent cows were falls under corresponding category in other group. Statistically it was significant in both the groups. It reflected that the cows cleaner kept over rubber mat (60.32%) were cleaner than cows kept on concrete (36.51%). Overall moderate or dirty cows were less in both the groups which is in agreement with findings of Kara *et al.* (2011) and Norberg (2012).

Effect of Flooring on Severity of Injury at Hock and Knee

The effect of flooring types on severity of injury at hock and knee was studied by hock and knee injury scoring method. Fortnight treatment wise mean data of the same is presented in Table 8. The frequency distribution of cows based on their severity is presented in Table 9.

Table 8: Effect of flooring on Hock and knee injury score in crossbred cows

Fortnight	n	Rubber mat (Mean±S.E.)	Concrete (Mean±S.E.)	p value
1	9	1.39±0.18	1.72 ^{ab} ±0.17	0.204
2	9	1.22±0.12	1.56 ^a ±0.13	0.079
3	9	1.11±0.06	1.86 ^{abc} ±0.10	0
4	9	1.17±0.07	2.03 ^c ±0.09	0
5	9	1.22±0.07	2.11 ^c ±0.12	0
6	9	1.17±0.04	2.03 ^c ±0.11	0
7	9	1.17±0.04	2.03 ^c ±0.08	0
Overall	63	1.21±0.04	1.90±0.05	0
F value		0.86	2.95	
p value		0.53	0.01	

Means with different superscript within columns are statistically different

The findings of Table 8 showed that the overall hock and knee injury score was 1.21 ± 0.04 in cows kept on rubber mat and 1.90 ± 0.05 in cows kept on concrete flooring. The data was statistically significant. The fortnight observation of hock and knee injury score of various fortnight within the group was non-significant in rubber mat group and it was significant in concrete floor group. The comparison of hock and knee injury score between both the groups was significant except 1st and 2nd fortnight. The highest score of hock and knee injury was observed during 1st fortnight (1.39 ± 0.18) and lowest score was observed during 3rd fortnight (1.11 ± 0.06) in cow kept on rubber mat flooring, while on concrete flooring highest score observed during 5th fortnight (2.11 ± 0.12) and lowest score was observed during 2nd fortnight (1.56 ± 0.13). The result of present study was in agreement with the Kielland *et al.* (2009), Norberg (2012) and Zaffino (2012). They found that prolong use of rubber mat was beneficial in preventing the hock and knee injury in cows. The softness of the rubber mat is main contributory factors which was responsible for preventing such injuries. It may be due to cows on rubber mat flooring had longer bout of standing and sitting which reduce the frequency of friction between floor and hock and knee.

Table 9: Frequency distribution of severity of injury at hock and knee region affected by floor types in crossbred cows

Severity of Injury at Hock and Knee	Flooring				Overall		Chi-square Test	
	Rubber Mat		Concrete					
	n	%	n	%	n	%	Value	p
Only hair loss (Score 1)	60	95.24	15	23.81	75	59.52	66.706	0
Hair loss with swelling (Score 2)	3	4.76	48	76.19	51	40.48		
Ulcer (Score 3)	0	0	0	0	0	0		
Overall	63		63		126			

The group wise frequency distribution of experimental cows based on severity of injury at hock and knee is presented in Table 9. It revealed that 95.24, 4.76 and 0 per cent of cows kept on rubber mats were having only hair loss, hair loss with swelling and ulcer, respectively, whereas, 23.81, 76.19 and 0 per cent cows were under corresponding category in concrete group. Statistically it was significant in both the groups. It reflected that the cases of hair loss with swelling were more in concrete group. However, ulcers were not found in any cows of both groups. In support of present finding Kiell and *et al.* (2009) found more cases of hock and knee injury in cows kept on solid floor (34.9%) than rubber mats (7.76%). Zaffino (2012) also reported that the cows kept on rubber mat were having less hock and knee injuries.

Conclusion

The rubber mat has positive impact on crossbred dairy cows for lameness, hygiene and hock and knee injury. The claw health of crossbred cows remains better in rubber mat flooring. Overall it may be



concluded that rubber mat is better than the traditional concrete floor for hygiene and welfare in crossbred cows.

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