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Effect of Floor Enrichment with Rubber Mattress of Calving Pen on Prepartum Behaviour of Tharparkar Cow during Winter Season

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ABSTRACT

Background: The study was conducted to evaluate the effect of floor enrichment with rubber mattress of calving pen on prepartum calving behaviour of Tharparkar cow during the winter season.

Methods: A total 28 Tharparkar cows were taken in study during winter season (November to March) and divided into two groups each contain 14 animals. One group placed in floor enriched with rubber mattress and other group kept on bare concrete floor calving pen. Preparturient behaviours like lying time, standing time, lying bout duration, number of lying bouts, rumination time ,rumination bouts, self grooming and frequency of self grooming were evaluated on -12 hr, -7th day, -14th day and -21st day prepartum for period of 12 hr in a day. Repeated Meausures ANOVA was used for the analysis of the data.

Result: It was found that lying time, lying bout duration was significantly more in rubber mattress group as compare to concrete floor. However, 12 hr before parturition standing time was significantly high compare to any other observational day within the group. Similarly, rubber mattress had positive effect on rumination time, lying duration and self grooming frequency as compare to bare concrete floor. It was concluded that rubber mattress had beneficial effect in calving pen of Tharparkar cow during winter season due to its softness and insulating property. It provided comfort and warmth to the parturient cows. which was evident by increase in rumination time, more lying duration and reduced self grooming frequency.

Key words: Floor enrichment, Prepartum behaviour, Rubber mattress, Tharparkar cow, Winter season.

INTRODUCTION

The provision of a comfortable environment around parturition minimises the risk of dystocia and enhances the subsequent health of the cow and calf (Mee, 2004). Calving is an essential and natural phenomenon to initiate lactation and maintain the lineage. However, parturition is stress full and intensive management of cattle in late pregnancy is essential to ensure neonatal and maternal survival, health and welfare. Comfortable housing with proper flooring is vital for adequate rest, sleep and to exhibit normal behaviour. Straw is the choice of bedding as it is easily available and has good insulation property. However, due to shortage of dry fodder, farmers are widely using bare concrete flooring. Concrete flooring is hygienic and maintenance free but causes abnormal standing, lying and transitional movements, as well as reduced traction, which can lead to injuries Cozzi *et al.* (2013). When given the choice, cattle prefer other flooring substrates, such as straw, wood chips or rubber mats as compared to concrete alone (Schutz and Cox, 2014). In recent years, rubber mats and wooden slats have also begun to use as alternative flooring materials. Impact of the various flooring materials on the dairy performance, welfare and health of the cows were investigated by several researchers (Vanegas *et al.,* 2006; Norring *et al.,* 2010). In the last 10 years, there has been a growing body of literature investigating the enrichment, design and management of an appropriate calving site when provided in an indoor calving facility (Rørvang *et al*., 2017a, 2018a; Proudfoot *et al.,* 2019). The alternate or modification to conventional concrete floor particularly in winter is having great role. However, very limited reports are available on effect of floor enrichment with soft rubber mattress during winter season on preparturient behaviour in Tharpakar cows (*Bos indicus*). Therefore, the present study was designed to investigate the effect of floor enrichment with rubber mattress of calving pen on prepartum behaviour of Tharparkar cow during winter season.

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MATERIALS AND METHODS

Location of the study

The present study was carried out at Cattle and Buffalo Farm, Livestock Production and Management Section, Indian Veterinary Research Institute, Izatnagar, Bareilly, UP, India. The institute is located at an altitude of 568 ft above the mean sea level, at latitude of 28.22°N and longitude of 79.22°E. The climatic condition of the place touches both the extreme *viz*. cold (approximately 5°C in winter) and hot (approximately 45°C in summer).The relative humidity ranges between 15 and 85 per cent and average rainfall about 90 to 120 cm.

Source of experimental animals and animal selection

A total of 28 advance pregnant (six week prepartum) Tharparkar cows maintained at Cattle and Buffalo Farm, Indian Veterinary Research Institute, Izatnagar which were belonging from 2nd to 4th parity, were considered for the study. The experiment was conducted during winter season *i.e.* November, 2020 to March 2021. All 28 animals were uniformly divided based on the parity into 2 groups *i.e.* 14 animals in each group. One group was transferred to pen with concrete floor which was considered as control group, whereas, another group was transferred to pen with rubber mattress and considered as treatment group. They were transferred to calving pen 6 weeks before expected date of their calving. The specifications of rubber mattress were 5 x 8 feet, thickness 1.5 cm, tensile strength 3.0-3.5 MPA and weight 14 kg.

Housing of experimental animals

Animals were maintained under loose housing system with 1/3rd covered and 2/3rd open parturition pen with pucca flooring. During winter season cows were offered with adlib green fodder chiefly Berseeem, Mustard sp and Barley and some amount wheat straw along with optimum quantity of concentrate mainly crushed maize, wheat bran, soyabean meal, standard quantity of mineral mixture and salt and also fresh clean water.

Recording of behaviours

For observing the various pre parturient behaviours of the cow, video recording was done with a low light-intensity camera and a time-lapse digital video recorder (Hik vision, Turbo HD DVR, Country). Four cameras were fit in the calving pen (two dome types and two bullet type) and one camera was also placed in the open paddock. 40 W Fluorescent lamps of 40 W capacity were installed in the calving pen to facilitate the data recording at night hours. All cows were given minimum ten days acclimatization period before recording of actual behaviours and behaviours were analyzed between 6.00 AM to 6.00 PM in a day. In brief the important behviours like lying time describe total time spent on lying in 12 hr of observational period similarly standing time indicate duration standing in 12 hr and number and duration of lying bouts indicate how many times cow sit in 12 hr and what was the average duration of a single lying bout respectively. Total time spent on rumination 12 hr period indicate the rumination time and in same period how many set of times rumination activities were performed by cow represent the rumination bout. Self grooming time indicate the time spent by the animal on grooming her body by own or scratching against some inanimate object like wall, pillers etc. and the number of self grooming activities performed by the animal in 12 hr recording period.

Statistical analysis

The effect of rubber mattress, day pre-partum and their interaction on the dependent variables of prepartum behaviors such as lyting time, lying bouts, standing time, rumination time, frequency of self grooming was analyzed by full factorial repeat measures Anova. The pair-wise multiple comparisons between the groups was done by using Tukey test. Significance was set at 95%. The analysis was done by JMP 9.0 software.

Following general linear model was used for the analysis-

$$Y_{ijk} = \mu + G_i + ID(G_i) + P_j + (GP)_{ij} + e_{ijk}$$

Where

Y_{ijk} = k^{th} observed value of the response variable for i^{th} group for the j^{th} period.
μ = General mean effect.
$ID(G_i)$ = Random effect.
G_j = Effect of i^{th} group.
P_j = Effect of the j^{th} period.
$(GP)_{ij}$ = Interaction effect of i^{th} group and j^{th} period.
e_{ijk} = Error term.

RESULTS AND DISCUSSION

Cows clearly prefer lying surfaces with more bedding, and spend more time lying down in well bedded stalls than in those with little or no bedding (Tucker and Weary, 2004). Softer lying surface reduces injuries to legs and also have a positive effect on the lying behaviour and movements (Haley *et al.,* 2000; Rushen *et al.,* 2007). Norring *et al.* (2010) reported that installing soft rubber mats on concrete floor can ameliorate the adverse effects of reduced bedding on lying behavior. It appears that when a small amount of straw is available, cows lie down more on soft rubber mats. Further rubber mat have insulating property which is absent in bare concrete flooring. Similar type of observation were reported in winter calving of Tharparkar cow in present study wherein prepartum lying time was relatively higher in floor with rubber mattress as compare to bare concrete floor on each prepartum observational day and significantly high (315.4±10.40 min./12 h *vs* 269.14±14.80 min./12 h) on day 7 prepartum (Table 1) possibly air layers underneath the rubber mat could have improved its thermal properties during winter temperatures that ranged from +5°C to +18°C. On the day of calving, there is an increase in the number of standing bouts, possibly indicating restlessness Huzzey *et al.*

(2005). Significantly low lying time was recorded, 12 h before prepartum as compared other days of prepartum in either group. In contrast, preparturient cows spent significantly more time in standing 12 h before calving as compare to other days (Table 1 and 2).

During the last 24 h before parturition, cows managed in the indoor housed conditions spent less time lying down compared with previous days, showing a greater number of shorter duration lying bouts - transitions between standing and lying - per day (Jensen, 2012; Ouellet *et al.,* 2016). When the stalls were all bedded with the same small amount of straw, the cows preferred stalls with soft rubber mats over those with concrete Fregonesi *et al*. (2007). These findings support the results of present study where lying bout duration was relatively higher in rubber mattress group compare to concrete floor. The lying bout duration was significantly low on 12 hr prepartum as compare to any other day of prepartum within the group. Similar finding where reported by Titler *et al.* (2015) and Black and Krawezel, 2016, that lying bouts (transitions standing/ lying) increases 12 h and 24 h before calving and also frequency of transitions from lying to standing Neave *et al.* (2017). In present study, the frequency of lying bout was significantly higher in number on 12 h prepartum as compared to other days (Fig 1 and 2) during winter season.

Changes in the rumination behaviour were evaluated as a signal of impending calving for cows housed in confinement (Ouellet *et al.,* 2016; Mishra *et al*., 2018). Soriani *et al.* (2012) observed that rumination time declined progressively in the week before parturition; further, on the day of calving, it decreased 3 h compared with the dry period. Calamari *et al.* (2014) found that the decrease in rumination time on the day of calving was 70% on average of the dry period. In the present study, rumination time significantly decreased on 12 h prepartum in the both groups compared to other days of prepartum. However, rumination time was significantly higher on day 7 and 14 prepartum and rumination bouts were higher on day 14 and 21 prepartum in the rubber mattress group than that of concrete group (Table 3 and 4).

Table 1: Prepartum lying time (Mean ± SE) of Tharparkar cows under different flooring regimes during winter season.

Groups	Lying time (min.)/12 hr at different days of prepartum			
	-12 h	-7th	-14th	-21st
Control	226.21±13.59 ^{bA}	269.14±14.80^{aB}	276.14±12.18^{aA}	289.36±15.25^{aA}
Treatment	254.35±11.75^{bA}	315.43±10.40^{aA}	311.71±11.02^{aA}	309.36±14.64^{aA}

Different small case superscripts within a row indicate a significant difference, while upper case superscripts indicate a significant difference within a column. Calving was considered as day 0.

Table 2: Prepartum standing time (Mean ± SE) of Tharparkar cows under different flooring regimes during winter season.

Groups	Standing time (min.)/12 hr at different days of prepartum			
	-12 h	-7th	-14th	-21st
Control	493.78±13.59^{aA}	450.85±14.80^{bA}	443.85±12.18^{bA}	430.64±15.25^{bA}
Treatment	465.64±11.75 ^{aA}	404.57±10.40 ^{bA}	408.28±11.02^{bA}	410.64±14.63^{bA}

Different small case superscripts within a row indicate a significant difference, while upper case superscripts indicate a significant difference within a column. Calving was considered as day 0.

Table 3: Prepartum Rumination time (Mean ± SE) of Tharparkar cows under different flooring regimes during winter season.

Groups	Rumination time (min/12h) at different days of prepartum			
	-12 h	-7th	-14th	-21st
Control	170.36±3.97^{bA}	191.07±8.21^{aA}	185.71±6.51^{aA}	195.92±7.16^{aA}
Treatment	185.36±3.38^{bB}	202.57±7.85^{aB}	207.93±6.55^{aB}	205.0±7.71^{aA}

Different small case superscripts within a row indicate a significant difference, while upper case superscripts indicate a significant difference within a column. Calving was considered as day 0.

Table 4: Prepartum rumination bouts (Mean ± SE) of Tharparkar cows under different flooring regimes during winter season.

Groups	Rumination bouts (no./12h) at different days of prepartum			
	-12 h	-7th	-14th	-21st
Control	5.29±0.39^{aA}	5.29±0.27^{aA}	3.64±0.30^{bA}	3.64±0.26^{bA}
Treatment	4.4286±0.36^{aA}	5.14±0.25^{aA}	5.0±0.28^{aB}	4.50±0.25^{aB}

Different small case superscripts within a row indicate a significant difference, while upper case superscripts indicate a significant difference within a column. Calving was considered as day 0.

Cows preferentially ruminate when lying down. Because rubber mattress favoured the lying behavior, both the lying time and lying bout duration were more in the cows of rubber mattress group. Increased self grooming was associated with elevated cortisol concentrations Matamala *et al*. (2021). It follows that periparturient cattle may demonstrate increased auto-grooming (Munksgaard and Simonsen, 1996; Kruk *et al.,* 1998; Hussain *et al.,* 2015) due to elevated cortisol level at approaching parturition. Increased time as well as frequency of self grooming in >90% pregnant Tharparkar cows (Fig 3 and 4) of either group at 12 h before calving is consistent with the above reports.

Jensen *et al.* (2012) and Lange *et al.* (2017) observed that during the final 12 h prior to calving, multiparous cows frequently turned their head toward their abdomens, behaviour that increased during the final 2 h prior to calving and typically occurred during contractions. Pain and discomfort associated with abdominal contractions during the second stage of parturition (Mainau and Manteca 2011) likely explain that cows might be turning their head due to

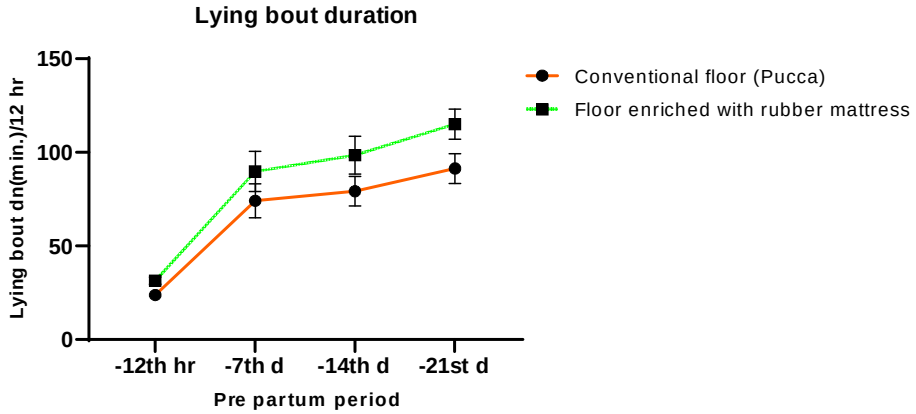

Fig 1: Lying bout duration (min/12hr) of Tharparkar cows under different flooring regimes during winter season.

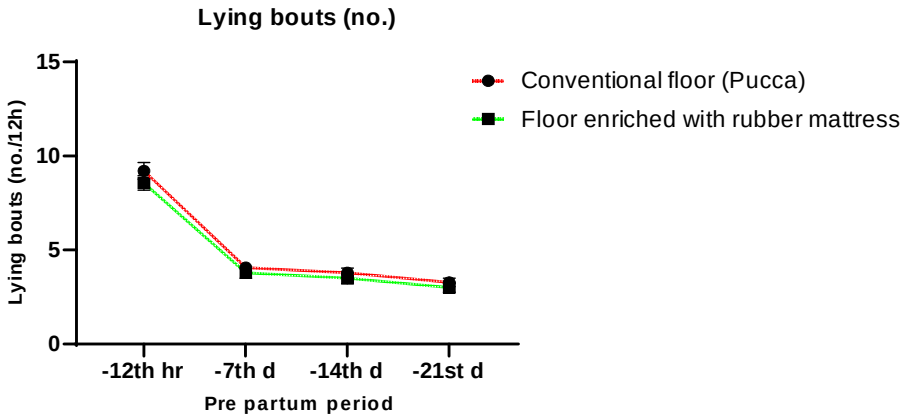

Fig 2: Lying bout (No/12hr) of Tharparkar cows under different flooring regimes during winter season.

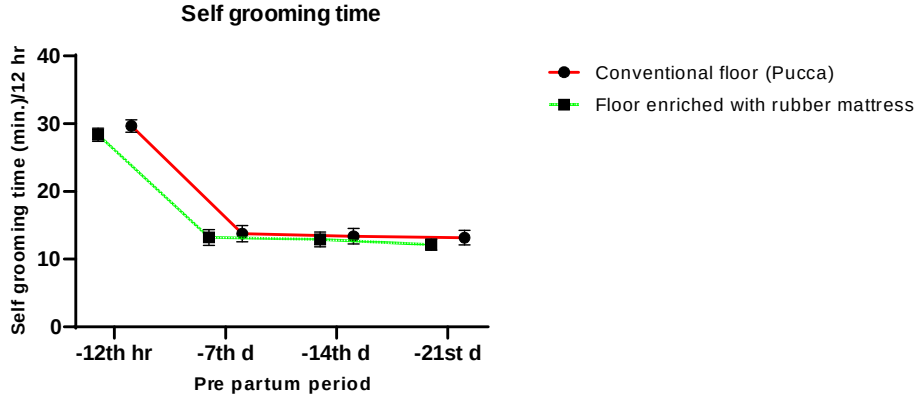

Fig 3: Self grooming time (Min./12hr) of Tharparkar cows under different flooring regimes during winter season.

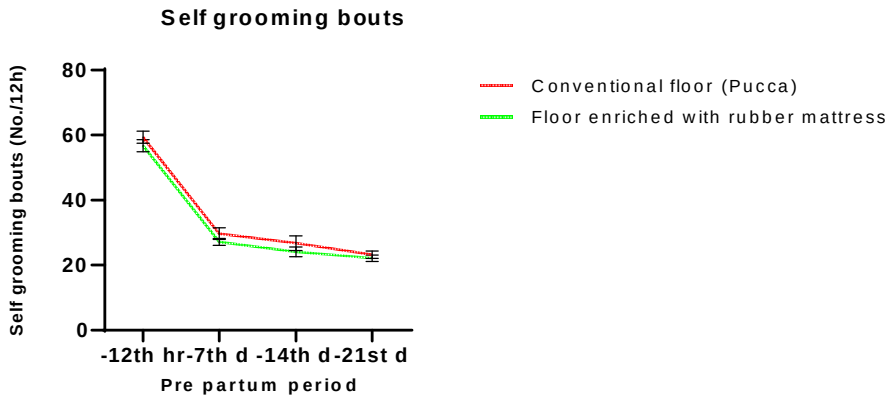

Fig 4: Self grooming bouts (No/12hr) of Tharparkar cows under different flooring regimes during winter season.

pain experienced during contractions as described by Jensen *et al.*(2012), especially during the last hours before calving. In present study also frequent turning of the head were also observed and majority of the time cow lick the abdomen with tongue and or rub their neck and shoulder region against the pole.

CONCLUSION

It was observed from the above experiment that floor with rubber mattress during winter season improved lying time, lying bout duration, rumination time and decreases standing time, self grooming time and frequency of self grooming as compare to bare concrete floor. Therefore, the calving floor with rubber mattress might be recommended for pregnant Tharparkar cows during winter season as the rubber mattress had beneficial effects on the wellbeing of animals.

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Disclosure statement

No potential conflicts of interest reported by authors.

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