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ASSOCIATION OF FLOORING TYPE WITH BEHAVIOURS AND PRODUCTION PERFORMANCE IN DAIRY COWS

Research Project

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1. INTRODUCTION

The dairy sector has an important place in a protection of country economy and public health. In last two decades the focus on better quality milk production and well-being of animals has become the priority of many modern farms (Şahin and Uğurlu, 2015). Better management conditions may improve the performance of dairy animals (Singh et al., 2020). The market demand for milk and dairy products is determined by consumers' desire for cheap, safe, high-quality food produced through socially responsible managerial practices (Fulwider et al., 2008). Housing provides shade and protection to cows from excessive solar radiation, rain, cold and wind. The housing system affects behaviour (lying, feeding and rumination), production and reproduction of dairy animals in a varying range. In shelter, lying time of dairy cow depends on the bedding material provided (Manninen et al., 2002). Cows prefer softer bedding materials for lying and they spent longer time in lying down on soft surface as compared to hard surface (Tucker and Weary, 2004).

The presence of contaminated and wet stall bedding results in a higher percentage of mastitis caused by pathogenic micro-organisms from the environment (Gergovska et al., 2012), as well as additional costs of extra labor during milking and lower milk quality (Miteva et al., 2012). For the udder health of the cows that spend most of the day resting, it is essential that the bedding is soft, dry and clean. There is a close relationship between the microbial density of the teats and the material used for bedding. Polluted udder and tits are thought to be the main sources of environmental bacteria causing intramammary infections (Diler, 2019). The most widely used bedding materials in dairy cattle farming in the world can be grouped into two main groups (Kumar Singh, 2018): Organic: straw, hay (dried grass), sawdust, wood shavings, crop residues, composted manure, paper. Inorganic: sand, limestone, rubber mats and mattresses, cement. The present investigation was undertaken to study the effect of flooring type with behaviours and production performance in dairy cows.

2.LTERATURE REVIEW

2.1. Types of Bedding Materials:

2.1.1. Compost

In various European countries, the use of composted bedding materials has become more and more popular in recent years because of the possibility of combining them with slatted floors (Van Gastelen et al., 2011). They are produced in three ways: one process separates the solids from the manure after anaerobic digestion, another separates the solids and then treats them through an accelerated composting process using a drum composter, and the third separates the solids without any treatment process (Gautam et al., 2020). Composting reduces the number of E. coli bacteria. Endres and Barberg (2007) consider that the composted material is promising as a material for bedding, but after drying. Cows with a compost bedding show reduced incidence of lameness as compared to cows housed in freestall barns with a sand bedding (Lobeck et al., 2011). The advantages of compost as bedding are: reduces the incidence of the hock joint lesions in cows (Van Gastelen et al., 2011). Disadvantages of compost as bedding are: the emissions of ammonia that are released are higher for this type of bedding (Misselbrook and Powell, 2005).

2.1.2. Straw

Straw is one of the oldest bedding materials. It used to be a waste product of the agricultural division of a mixed farm, however, these days, straw can be rather expensive in certain areas due to competitive use. Straw can be used long or chopped. Chopped straw is a widely used material for cow bedding and when used in clean, dry, well stored straw and managed properly, it can provide a comfortable environment for cows (Kour, 2017). When used as the only bedding material, it should be applied in a thick layer of a minimum 15 cm, but preferably 30–40 cm (Norring., 2011). However, where straw beds are allowed to become heavily soiled, particularly in deep-bedded

yards, the bedding has the potential for becoming an effective medium for pathogens responsible for causing infectious foot problems. Penev et al. (2019) report the lowest percentage of hock lesions in dairy cows in a loose housing production system using straw for bedding. The highest percentage of hock lesions is observed when using rubber mats, with the addition of a certain amount of straw on the rubber mats, the percentage of hock lesions is significantly reduced. The advantages of straw as bedding are: when straw is used for bedding less lesions, scab's formations and injuries to the hock joints of dairy cows are registered (Wechsler et al., 2000). Disadvantages of the straw as bedding are: the need for more intensive management and higher cost, due to the more frequent bedding addition as a result of scattering from the cows (Benson, 2012); after humidification, straw is a very good environment for development of microorganisms, causative agents of mastitis and other diseases (Nordlund and Cook, 2003).

2.1.3. Sand

In countries with a suitable climate, a big part of farmers values the sand as the most suitable for stall bedding. The amount of sand that has to be added on a daily basis ranges from 14–20 kg per stall (Bernard et al., 2003). The particle size of the sand should be 0.1-1 mm and to be with equal size (Schoonmaker, 1999). Drissler et al. (2005) found that for every 1-cm decrease in sand bedding, cows spent 11 min less time lying down. In their trial, cows had access to free stalls with sand bedding that was 0, 3.5, 5.2, or 6.2 cm at the deepest point. Bacteria counts of used sand bedding are often significantly lower than inorganic bedding materials (Van der Tol, 2005). Cows provided with a softer bed are known to stand up and lie down twice as often as cows on concrete (Chapinal et al., 2009). The advantages of sand as bedding are: it is an unfavorable environment for the development of microorganisms that are a prerequisite for mastitis occurrence in dairy cows (Tucker and Weary, 2004); lowers the incidence of hock joint lesions in cows (van Gastelen et al., 2011); good bedding against heat stress, but not in cold, contributes cooling of the body (Buli et al., 2010); allows the use of the

same sand several times after proper recycling.The major disadvantage of using sand as free stall bedding seems to be manure management. Sand can settle to the bottom of manure collection pits, storages, and spreaders, making removal difficult. In winter months it is not preferred by animals because it offers a cooler surface for lying (Thoreson et al., 2006).

2.1.4. Rubber Matt

Rubber mat is a piece of fabric material that generally is placed on a floor or other flat surface and it is made from the synthetic rubber (often referred to as "thermoplastic") or textile materials. They are manufactured from a variety of commercially available materials (Dimov and Marinov, 2021). In general, mats that get old tend to acquire very small fractures, which can become sources for bacterial infections (environmental mastitis). Care should be taken that the mats do not buckle. In studies of Telezhenko et al. (2009) is reported that when they have a choice, cows prefer to move and stand on a floor covered with rubber flooring instead of directly on concrete. Adding rubber mats on the concrete base of stall improves comfort and contributes to proper locomotion of cows (Schütz and Cox, 2014). Cows spend 11 to 13 h/d standing in freestall housing systems. Use of alternatives to concrete, such as rubber, has increased during the last 2 decades and is thought to improve cow comfort. The use of rubber mats contributes to the health of the dairy cows' hooves and reduces the percentage of lameness in the herd (Rushen et al., 2007). Miteva et al. (2012) find that the use of rubber mats provides better comfort than using straw as bedding on a concrete floor. Zurbrigg et al. (2005) report a relationship between hygiene of udder and rear legs, and the bedding type on the stall base. The advantages of rubber mats and mattresses are: when they are used animals have less problems with hooves the initial cost of purchase are high, but maintenance and labor costs are considerably less subsequently (Bernard, 2004). The disadvantages of rubber mats and mattresses are: after several years of use they are compressed, harden and lose their softness more often

occurrence of injuries to the animal's legs is observed with the time and after wetting, their surface becomes very slippery, which is a danger for cows (Boone, 2009).

2.2. EFFECT OF BEDDING ON COW'S PERFORMANCE:

2.2.1. Temperature Effect of Bedding Materials

The ambient temperature and the floor surface temperature could be two important thermal parameters determining the stress level of animals due to adverse climatic conditions. In cold climates, cows usually eat more to increase their heat production as well as huddle with others or lie down. In warmer climates, the cow must produce as little heat as possible and must release as much heat as possible into the environment. The bedding ability to eradiate or absorb heat can affect the decision of whether cows lie or stand in stall. Wheat straw was found hotter than rubber mat and compost bedding in winter by Dimov et al. 2017. Similarly, animals were found to prefer straw to rubber mats in winter which may be due to the thermal properties of bedding material (Manninen et al., 2002). Few other works of literature also suggest that different bedding materials improved the microenvironment and provide comfort to animals (Bey et al., 2002).

The present study was carried out to investigate the effect of modified housing on behavioral and physiological responses of 16 lactating cows during hot humid season. Data on various parameters such as activity patterns of feeding, rumination, lying and standing time were recorded, showed in (Table 2.1.).

Table 2.1. Distribution of time spent in shed (%) on various activities of the crossbred cows housed under sand and concrete floor in hot-humid and autumn season

Shed Type	Season	Sitting Idle(%)	Sitting Rumination(%)	Eating Time(%)	Standing Rumination(%)
Sand	Hot humid	22	31	30	8
	Autumn	23	32	30	5
Concrete	Hot humid	19	30	29	7
	Autumn	22	27	29	6

Adapted by (Sinha, 2015)

From Table 2.1. it is clear that modified housing (sand) showed more comfort activities like lying, lying ruminating, sitting ruminating and lower standing time. However, higher standing time represents discomfort. Sand bedded animals had significantly sitting rumination (%) which represents more comfort to the animals of sand bedded animals as compared to that of concrete floor. Mattachini et al. (2019) suggested for use of sand as bedding material in defferent season better than concret bed and also better in hoof health.

2.2.2. Milk yield and its quality

The inclusion of bedding in for dairy cows can improve the comfort of cattle, and decrease lameness and hock injuries. At the same time, it can increase milk production and the longevity of cows. However, cattle can distinguish the quality of bedding (dirty and wet) by avoiding lying down (Suárez et al., 2023). Milk yield and its compositional quality directly depend on udder health and its immunity (Szencziova et al., 2013). In a study, Black et al. (2013) found significantly higher milk in compost bedded cows than non-compost bedded cows. Furthermore, Kremer et al. (2012) reported that Milk yield, fat yield, fat %, and Protein yield was non-significantly increased by using rubber mat than concrete floor.

Kara et al. (2015) revealed that in this study 709 lactating cows within normal managerial limits (lactation length: min 260 d; max 400 d) were examined in 37 dairy herds in Turkey. For each cow, the following data was collected: lactation length (day), milk yield (kg).

Table 2.2. Means (±SE) of milk yield and lactation length on three different resting surfaces

Bedding Type	Cow	Milk yield (kg)	Lactation length (d)
Concrete	235	6,279.7±59.12 a	323.0±2.42 a
Sand	130	6,314.9±106.24 a	325.0±3.22 a
Rubber	112	7,402.7±133.43 b	341.9±2.90 b
Average		6,553.0±55.87	331.4±1.65

SE, standard error.

Means in a column with no common superscript differ significantly ($p<0.01$).
Adapted by (Kara et al., 2015).

The effects of resting surface types on milk yield and lactation length are shown in Table 2.2. There was a significant difference between mean milk yield and lactation length of herds used rubber resting surface and the others ($p<0.01$). Ruud et al. (2010) found that multilayer mats (15.04 kg/day) and mattresses (14.84 kg/day) were associated with greater milk yield compared with concrete (14.17 kg/day) and rubber mat (14.48 kg/day) which showed the effect of softness of flooring in milk yield. On other hand, Bengtsson et al. (2009) found that when cows kept on rubber mats there was significant increase in milk production.

2.2.3. Behavior Effect

Lying is an important behavior for cattle occupying approximately 50% of their daily time budget (Krohn and Munksgaard, 1993). Cows prefer to lie down on soft bedding materials. A reduction in the time cows spend resting can lead to physiological changes associated with stress which can ultimately affect the overall health and production of the cow. As a result, the more a cow lies down, the udder function and milk production increases. Leso et al. (2020) remarked that composed bedding than free stall or straws may improve overall cow comfort, better leg health, better expression of natural behavior.

Daily Time Budget for Lactating Dairy Animals (Grant, 2004)

1) Eating 3 to 5 hr (9 to 14 meals/day)
2) Lying/resting 12 to 14 hour
3) Ruminating 7 to 10 hour
4) Drinking 30 minute
5) Management activities 2.5 to 3.5 hour
6) Social interactions 2 to 3 hour

The present study was conducted at Livestock Research Station, Navsari Agricultural University, Navsari, Gujarat state, India during 10th October 2017 to 20th January 2018 for 90 days. Eighteen lactating H. F. X Kankrej crossbred cows of mixed parity were randomly divided into two homogeneous groups based on milk production and date of calving. One group was kept on rubber mat while other was on concrete floor. The Rubber mat used in experiment was 16 mm thick, 6'×4' in size and had 40 kg weight. Total 20 mats were placed in one pen.

Table 2.3. Effect of flooring types on lying and rumination time (minutes) in crossbred cows

Behaviours	Rubber Mat	Concrete	t Value	p value
	Mean±S.E.	Mean±S.E.		
Standing	346.52±6.36	335.33±3.71	1.52	0.131
Sitting	581.90±4.72	557.60±6.65	2.98	0.003
Rumination	522.10±4.45	435.30±3.21	15.815	0

Adapted by (Sadharakiya and Sorathiya, 2019)

The effect of flooring types on mean time spent in standing, sitting and rumination is presented in Table 1. Results revealed that the overall mean standing time (minutes) on rubber mat (346.52±6.36) and concrete (335.33±3.71) was non-significant. Overall sitting time was significantly ($p<0.01$) higher in cows kept on rubber mat flooring (581.90±4.72) than the cow kept on concrete flooring (557.60±6.65). When cows were provided rubber mat flooring the mean sitting time was higher in rubber mat group as compare to concrete group (Haley et al., 2001; Schutz and Cox, 2014 and Bhamare, 2017). All the said studies revealed 1.5 to 4 hours more sitting time in cows housed on rubber mat or similar soft flooring materials which is quite higher than sitting time observed (about 24 minutes more) on rubber mat in present experiment. Overall rumination time (minutes) was significantly ($p<0.01$) higher in cows kept on rubber mat flooring (522.10±4.45) as compare to concrete flooring (435.30±3.21). It might be attributed to feeling of comfort in crossbred cows lied on rubber mat (Bhamare, 2017).

3. CONCLUSION AND RECOMMENDATIONS

Selection of proper bedding material should be considered equally important as housing. Providing soft bedding materials such as straw, sand, mattress than conventional concrete floor reduces the chance of lameness and improves the reproductive performance. Bedding material has a high impact on walking and lying comfort of dairy animal. Rubber mat has been introduced recently seeing its positive impact on health and performance of dairy animals however, one should be cautious while considering its usage under different environmental conditions.

So on the basis of following reviews it could be advised that rubber mat could be use effectively for animals rearing.

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