

EFFECT OF BEDDING SYSTEMS ON MILK CORTISOL AND PRODUCTION OF CROSSBRED DAIRY COWS

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ABSTRACT

In dairy cattle, bedding and its management contribute predominantly to the comfort of the cow, udder health and milk quality. The aim of the study is to assess the effect of different bedding materials such as rubber mats, coir pith, dried solid manure and concrete floor on milk yield and milk cortisol concentration in Holstein Friesian crossbred dairy cows. A total number of 24 Dairy cattle were grouped into four via control group T1- maintained in concrete floor without any bedding materials, T2- rubber mats of 1.2 m × 1.8 m × 0.025m area were provided on concrete floor, T3 coir pith and T4 Dried solid manure (DSM) on concrete floor. The study was carried out for an entire lactation which spread over three different seasons. In those cows maintained on concrete floor, skim milk cortisol concentration was significantly lower ($P < 0.01$) at the beginning (13.05 ± 0.88) and increased (24.48 ± 1.48 pg/mL)

at the end of summer season. The same trend was found at the beginning and end of both monsoon and post monsoon season. The cortisol concentration in the skim milk of cows reared on rubber mats also significantly increased ($P < 0.01$) at the end (23.75 ± 1.41) than beginning (16.44 ± 1.04 pg/mL) of summer season. Similar pattern was noted in the other two seasons. Whereas, the cortisol concentration of cows reared on coir pith got reduced ($P < 0.01$) from 11.42 ± 0.39 at the beginning to 06.87 ± 0.57 pg/mL at the end of summer season with significant difference ($P < 0.01$) between them and same pattern followed in monsoon and post monsoon. The cows maintained on concrete floor had the lowest overall daily milk yield (8.66 ± 0.22) while the cows on coir pith had the highest yield (9.98 ± 0.30 kg).

Keywords: Crossbred cows-bedding systems-skim milk cortisol-milk yield

INTRODUCTION

India has progressed from being milk deficient country with a production at 20 million MT in 1960 to becoming the world's largest milk producer at 187.7 million MT, in the year 2019 accounting for 18.5 per cent of global milk production and the dairy market in India reached a value of Rs 10,527 billion in 2019. The World Organisation for Animal Health (OIE, 2008) has propounded five freedoms in relation to welfare, among them one is freedom from physical and thermal discomfort by providing access to shelter and a comfortable resting area. Another one is freedom to express normal behavior patterns, by providing sufficient space, proper facilities and company of other animals of its kind. The effectiveness of rubber mats in terms of physiological responses and behaviour in crossbred cows is still being researched. Since the bedding material has a direct relation with the comfort of the cows, the present study was undertaken to evaluate the effect on bedding materials on milk yield and milk cortisol concentration in crossbred cows.

MATERIALS AND METHODS

The study was carried out at the Cattle farm of the Instructional Livestock Farm Complex, College of Veterinary and Animal Sciences, Kerala Veterinary and Animal Sciences University, Pookode,

Wayanad District in Kerala state during the period from 2018 to 2019. The study was carried out in one lactation period which spread over in to three different seasons. over three different seasons as described by Biya (2011) *viz.*, summer months (Feb-May), monsoon months (June-Sep) and post monsoon months (Oct-Jan). Twenty four crossbred dairy cows in early stage of lactation aged between 4 and 6 years were selected for the study. The animals were divided into four groups with six animals in each group as uniformly as possible with regard to their body weight (295 to 350 kg), parity and milk yield (8.10 to 11.30 kg).

The animals were let loose in the shed except during the feeding and milking time. Floor space of 13 sq. m and manger space of 1.2 m length and 0.6 m width were provided per cow. Six animals were considered as control group and were maintained in the existing management system, *viz.*, concrete floor without any bedding materials (T_1). Rubber mats on concrete floor of 1.2m $\times$ 1.8m $\times$ 0.025m area were used for six experimental animals (T_2). The rubber mat used in experiment was 16 mm thick, 6' $\times$ 4' in size and weighed 40 kg. Coir pith was provided at the rate of 7.5 cm thickness as bedding (T_3). Dried solid manure was provided at the rate of 7.5 cm thickness as bedding (T_4). All other activities including feeding regime were followed as per routine practice.

1. Milk cortisol

Cortisol level was determined in skimmed milk by Enzyme Linked Immunosorbent Assay (ELISA) before and after each season of the experiment (Gellrich *et al.*, 2015). The mean skim milk cortisol (pg/mL) was analysed by paired t-test.

2. Milk yield

Data on daily milk yield (kg) was recorded in all experimental animals both in the morning at 5.30 AM and afternoon at 2.30 PM. Two-way ANOVA with interaction effect was performed to study the effect of different bedding materials and seasons on milk yield of cows.

RESULT AND DISCUSSION

1. Milk cortisol

The mean skim milk cortisol concentration assessed from the cows maintained on different bedding systems is presented in Table 1. Also, the concentration at the beginning and end of each season were analysed to assess the stress levels. In those cows maintained on concrete floors, skim milk cortisol concentration was significantly lower ($P<0.01$) at the beginning (13.05 ± 0.88) and increased (24.48 ± 1.48 pg/mL) at the end of summer season. The same trend was found at the beginning and end of both monsoon and post monsoon season. Fukasawa *et al.* (2008) opined that the milk

cortisol concentration in Holstein cows in a free stall barn on concrete floor was higher (25.48 ± 1.48 pg/mL) in early lactation which upholds the present findings.

The cortisol concentration in the skim milk of cows reared on rubber mats also significantly increased ($P<0.01$) at the end (23.75 ± 1.41) compared to the beginning (16.44 ± 1.04 pg/mL) of summer season. Similar pattern was noted in the other two seasons. Whereas, the cortisol concentration of cows reared on coir pith significantly got reduced ($P<0.01$) from 11.42 ± 0.39 at the beginning to 06.87 ± 0.57 pg/mL at the end of summer season with significant difference ($P<0.01$) between them and same pattern followed in monsoon and post monsoon.

The milk cortisol concentration of cows reared on DSM reduced significantly ($P<0.01$) at the end compared to the beginning in all season. In general, the cortisol level was above the normal range in the animals reared on concrete floor and rubber mats which indicate a increased stress level. Whereas the milk cortisol concentration of cows reared on coir pith and DSM were within normal range (0.5 to 11.7 pg/mL) at the end of seasons which denoted comfort for the animals maintained on the respective bedding.

The results were in conformation with Gellrich *et al.* (2015) who found that

Table 1. Mean milk cortisol in different bedding systems during different seasons

Treatments		Summer (pg/mL)		Monsoon (pg/mL)		Post monsoon (pg/mL)	
		Beginning	End	Beginning	End	Beginning	End
T ₁ (n=6)	Concrete	13.05 ± 0.88 ^c	24.48 ± 1.48 ^a	12.75 ± 0.57 ^c	21.48 ± 0.92 ^b	12.68 ± 0.59 ^d	21.57 ± 0.55 ^b
T ₂ (n=6)	Rubber mat	16.44 ± 1.04 ^d	23.75 ± 1.41 ^a	15.11 ± 0.41 ^d	22.91 ± 0.18 ^b	15.78 ± 0.74 ^d	20.12 ± 0.35 ^c
T ₃ (n=6)	Coir pith	11.42 ± 0.39 ^a	06.87 ± 0.57 ^d	10.15 ± 0.89 ^c	06.05 ± 0.58 ^d	10.81 ± 0.69 ^b	06.17 ± 0.66 ^d
T ₄ (n=6)	DSM	11.58 ± 0.57 ^a	06.56 ± 1.02 ^d	10.09 ± 1.25 ^c	06.02 ± 0.76 ^d	10.71 ± 0.79 ^b	06.08 ± 0.52 ^d

Means with different superscripts (a-d in columns) differ significantly ($P < 0.01$)

the milk cortisol was highest (17.34 ± 1.23 pg/mL) during first week of lactation in multiparous Holstein-Friesian cows reared on rubber mats without a significant difference ($P > 0.05$) in different seasons. Poscic *et al.* (2017) reported that the relocation of cows caused a significant increase ($P < 0.01$) in milk cortisol.

2. Milk yield

The mean daily milk yield of cows maintained in different bedding materials is presented in Table 2. The results revealed that the type of bedding material, season and the interaction between seasons and bedding materials significantly alter the mean milk yield of cows ($P < 0.05$). The cows maintained on concrete floor had the lowest overall daily milk yield (8.66 ± 0.22 kg) while the cows on coir pith had the highest yield (9.98 ± 0.30 kg). The results are in agreement to Barberg *et al.* (2007) as they noted increase in milk production of Holstein Friesian crossbred cows 9.57

± 0.12 kg in compost bedded pack than bedded with dry fine wood shavings or sawdust (9.76 ± 0.03 kg). The animals maintained on rubber mat and DSM had the overall mean milk yield of 9.26 ± 0.20 kg and 9.48 ± 0.22 kg, respectively indicating their superiority over the concrete floor.

The results of Kremer *et al.* (2007) as they reported greater activity and better overall milk yield of high-yielding dairy cows which were on elastic rubber flooring (9.28 ± 0.12) than that on concrete flooring (8.68 ± 0.12 kg) in a loose housing system was complementary to the present study. The per cent increase in milk yield was 19.50, 17.21, 15.33 and 12.14 on coir pith, DSM, rubber mat and concrete floor, respectively. The findings of Singla *et al.* (2007) are in agreement with this findings, as they reported mean milk yield of 11.34, 10.32, 9.31 and 9.26 L/animal/d in coir pith bedding in depth of 30 cm, 20 cm, 10 cm on concrete floor and in the present study,

Table 2. Mean daily milk yield in different bedding systems during different seasons

Treatments (n=24)		Daily milk yield (Mean± SE) (kg)			
		Summer	Monsoon	Post monsoon	Overall
T ₁ n=6	Concrete	8.16 ± 0.07	9.31 ± 0.03	9.28 ± 0.03	8.66 ± 0.22 ^d
T ₂ n=6	Rubber mat	8.23 ± 0.01	10.28 ± 0.03	9.30 ± 0.03	9.26 ± 0.20 ^c
T ₃ n=6	Coir pith	8.35 ± 0.04	11.28 ± 0.04	10.35 ± 0.03	9.98 ± 0.30 ^a
T ₄ n=6	DSM	8.28 ± 0.01	10.75 ± 0.03	9.41 ± 0.05	9.48 ± 0.22 ^b
(Mean± SE)		8.15 ± 0.09 ^C	10.66 ± 0.09 ^A	9.52 ± 0.15 ^B	9.34 ± 0.13

Means with different superscripts (a-d in rows, A-C in columns) differ significantly ($P < 0.05$)

bedding material of 7.5 cm thickness was provided.

From Table 2, it may also be noted that the mean milk yield of cows maintained on different bedding materials were influenced by the seasonal variations as the differences of overall means of milk yield during different seasons within the groups were statistically significant ($P < 0.05$). Moreover, the mean values for different seasons ranged from 8.15 ± 0.09 kg in summer to 10.66 ± 0.09 kg in monsoon. Singh *et al.* (2015) obtained the average highest seasonal milk production of 10.52 ± 0.12 and 9.54 ± 0.14 kg in crossbred cattle during winter and summer season, respectively with high significant difference ($P < 0.05$) in seasonal variation and milk production performance which coincides with the present study.

CONCLUSION

The effect of different bedding

materials on milk yield and milk cortisol concentration in crossbred dairy cows was studied. In cows maintained on concrete floor and rubber mats, skim milk cortisol concentration was lower at the beginning and increased at the end of summer season. The same trend was noticed at the beginning and end of both monsoon and post monsoon season. Whereas, the cortisol concentration of cows reared on coir pith and DSM bedding got reduced at the end of summer season than beginning and same pattern followed in monsoon and post monsoon. The cows maintained on concrete floor had the lowest overall daily milk yield while the cows on coir pith had the highest yield. The stress level has reduced in the cows maintained on coir pith and DSM bedding than reared on concrete floor and rubber mats. Coir pith and dried solid manure as bedding materials could be recommended to reduce stress level and improving milk production in cross bred dairy cattle.

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