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EFFECT OF BEDDING SYSTEMS ON MICROBIAL COUNTS IN MILK 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 concrete floor, rubber mats, coir pith and dried solid manure on microbial counts in milk and bedding materials in crossbred dairy cows. Twenty-four crossbred cows with six animals in each group at cattle farm was selected for the study for one lactation period spread over three different seasons. The control group (T_1) was maintained in concrete floor without any bedding materials. In (T_2) rubber mats of 1.2 m × 1.8 m × 0.025m area were provided on concrete floor. In (T_3) coir pith and (T_4) Dried solid manure (DSM) on concrete floor was the bedding. The aerobic plate count (APC), coliform count (CC) and total yeast and mould count (TYMC) were assessed in bedding materials to determine the microbial counts.Concrete floor had the highest overall mean APC of 22.44 ± 0.27while coir pith had the lowest overall mean APC of 10.19 ± 0.25×10^5cfu/g with significant difference (P<0.01). The overall mean APC in rubber mats (17.21 ± 0.85) was significantly higher (P<0.01) than DSM bedding12.17 ± 0.61×10^5 cfu/g. 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).

Keywords: Crossbred cows, Bedding systems, Microbial counts, Bedding materials

INTRODUCTION

As per 20th livestock census in 2019, 192.49 million numbers of cattle ranking second in the world population areavailable in India while 93 per cent of the cattle population are crossbreds in Kerala. 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 behavioural patterns, by providing sufficient space, proper facilities and company of other animals of its kind. A clean, dry adequately bedded stall maintains cow cleanliness, inhibits microbial growth and transfer to teat skin. Interest in using recycled manure solids (RMS) as a bedding material for dairy cows has grown in many commercial milk producing farms. Since the bedding material has a direct relation with the microbial quality of milk, the present study was undertaken to evaluate the microbial count in bedding materials and milk of crossbred cows.

MATERIALS AND METHODS

The study was carried out at the Cattle farm of the Instructional Livestock Farm Complex, Pookode, Wayanad District in Kerala state during 2018 to 2019. The study was carried out for one lactation period spread 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 experimental animals were maintained in the existing management system, *viz.,* concrete floor without any bedding materials (T_1). This group was considered as the control group. Rubber mats on concrete floor of 1.2m × 1.8m × 0.025m area were used for six experimental animals (T_2). All other activities including feeding regime were followed as per routine practice. The Rubber mat used in experiment was 16 mm thick, 6'× 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).

Aerobic plate count (APC)

The microbiological quality (Gannon *et al.,* 2012) of bedding materials was assessed. APC was determined at monthly intervals by pour plate technique as described by Mortan (2001). To estimate the microbial load in bedding materials random samples were collected in 1 sq cm area. The number of organisms in the

sample were calculated by multiplying the mean colony count in duplicate plates using standard plate count agar with the dilution factor and expressed as $\log_{10}$ cfu/g for bedding materials.

Coliform count (CC)

The CC was determined in bedding materials and milk at monthly intervals. CC per ml of sample was estimated according to the procedure described by Kornacki and Johnson (2001) using violet red bile agar (VRBA) (Hi-media®). The number of organisms in the sample were estimated by multiplying the mean count of duplicate plate samples with dilution factor and expressed as $\log_{10}$cfu/g for bedding materials.

Total yeast and mould count (TYMC)

Method described by Beuchat and Cousin (2001) was followed for determination of TYMC in bedding materials and milk at monthly intervals. Potato dextrose agar (Hi-media®) was used by spread plate technique. The number of organisms was expressed as $\log_{10}$cfu/g for bedding materials. Two-way ANOVA with season and treatment group was carried out for comparing APC, CC and TYMC.

RESULTS AND DISCUSSION

MICROBIAL COUNT IN MILK

Aerobic plate count (APC) in milk

The overall mean APC in the milk of cows reared on different bedding materials are presented in Table 1. The overall mean APC in the milk of cows reared on concrete floor was highest (1.63 ± 0.24) while the milk of cows maintained on coir pith had the lowest overall mean APC of 0.75 ± 0.12×10^3 cfu/mL with significant difference (P<0.01). The observation of Hasan *et al*. (2015) is in agreement with the present study that proved that the microbial count in milk of cows on coir pith was lower 0.73 ×10^3 cfu/mL than other beddings. The overall mean APC in the milk of cows during summer, monsoon and post monsoon seasons vary non significantly and were ranging from 1.13 ± 0.12 to 1.27 ± 0.19 ×10^3 cfu/mL.

Coliform count (CC) in milk

The overall mean CC in milk of cows belonged to different treatment groups using different bedding materials are presented in Table 2. The overall mean CC in the milk of cows reared on concrete floor was highest, 1.38 ± 0.18while the milk of cows maintained on coir pith had the lowest overall mean CC of 0.60 ± 0.14×10^3 cfu/ml with significant difference (P<0.01). Hasan *et al*. (2015) had reported similar average CC values in milk samples (1.35 ± 0.27× 10^3 cfu/ml) on cows reared on concrete floor.

Total yeast and mould count (TYMC) in milk

The mean TYMC in the milk of cows reared on different bedding materials is presented in Table 3. The overall mean TYMC in the milk of cows reared on concrete floor was highest, 1.24 ± 0.12while the milk of cows maintained on coir pith had the lowest overall mean TYMC of 0.69 ± 0.13×10^3 cfu/mL with significant difference (P<0.01). Abid (2009) had reported TYMC in milk of cows reared in concrete floor (1.35 ± 0.26) and in rubber mat (1.20 ± 0.35× 10^3 cfu/mL) found similar to the present findings.

MICROBIAL COUNT IN BEDDING MATERIALS

Aerobic plate count (APC) in bedding materials

The overall mean APC in different bedding materials is presented in Table 4.Concrete floor had the highest overall mean APC of 22.44 ± 0.27 while coir pith had the lowest overall mean APC of 10.19 ± 0.25×10^5 cfu/g with significant difference (P<0.01). Kumar and Ganesh (2012) observed similar microbial counts in raw coir pith for bacteria (10.25 ± 0.63× 10^5cfu/g).The overall mean APC in rubber mats (17.21 ± 0.85) was significantly higher (P<0.01) than DSM bedding12.17 ± 0.61×10^5 cfu/g. Sharma and Singh (2015) also had reported the maximum bacterial populations in recycled solid manure (14.26 ± 0.52×10^5 cfu/g) than other beddings.

Coliform Count (CC) in bedding materials

The overall mean CC in different bedding materials is presented in Table 5. Concrete floor had the highest overall mean CC of 11.79 ± 0.44 while coir pith had the lowest overall mean CC of 5.26 ± 0.30×10^5 cfu/g with significant difference (P<0.01). Hogan *et al*. (1990) reported lower CC in coir pith bedding (5.97 ± 0.31 ×10^5 cfu/g). The overall mean CC in rubber mats (6.13 ± 0.34) was significantly higher (P<0.01) than DSM bedding 5.94 ± 0.32×10^5 cfu/g. Husfeldt *et al*. (2012) had found that total bacterial populations in rubber mat beddings were higher (7.01 ± 0.12 ×10^5 cfu/g).

Total yeast and mould count (TYMC) in bedding materials

The overall mean TYMC in different bedding materials is presented in Table 6. Concrete floor had the highest overall mean TYMC of 4.49 ± 0.20 while coir pith had the lowest overall mean TYMC of 3.64 ± 0.25×10^5 cfu/g with significant difference (P<0.01). Divyalakshmi *et al.* (2016) reported similar results who found TYMC of 4.36 ± 0.12 on the concrete floor and 4.37 ± 0.21× 10^5cfu/gin rubber mats which coincides with the present findings.

Table 1: Mean aerobic plate count in milk during different seasons

Treatments** (n=24)		Aerobic plate count (Mean± SE) (cfu/mL)			
		Seasons^{NS}			Overall ($\times10^3$)
		Summer ($\times10^3$)	Monsoon ($\times10^3$)	Post monsoon ($\times10^3$)	
T_1	Concrete	1.38 ± 0.33	1.94 ± 0.51	1.46 ± 0.40	1.63 ± 0.24^a
T_2	Rubber mat	1.04 ± 0.40	1.46 ± 0.34	1.29 ± 0.19	1.26 ± 0.18^b
T_3	Coir pith	0.58 ± 0.08	0.96 ± 0.35	0.71 ± 0.12	0.75 ± 0.12^d
T_4	DSM	1.10 ± 0.18	1.17 ± 0.30	1.13 ± 0.24	1.10 ± 0.13^c
Season (Mean± SE)		1.13 ± 0.12	1.27 ± 0.19	1.16 ± 0.17	1.18 ± 0.09

Means with different superscripts (a-d in rows) differ significantly**;**

** Highly significant (P<0.01); NS: Non-Significant

Table 2: Mean coliform count in milk during different seasons

Treatments** (n=24)		Coliform count (Mean± SE) (cfu/mL)			
		Seasons^{NS}			Overall ($\times10^3$)
		Summer ($\times10^3$)	Monsoon ($\times10^3$)	Post monsoon ($\times10^3$)	
T_1	Concrete	1.33 ± 0.48	1.42 ± 0.18	1.38 ± 0.26	1.38 ± 0.18^a
T_2	Rubber mat	1.17 ± 0.22	1.38 ± 0.35	1.37 ± 0.22	1.31 ± 0.15^b
T_3	Coir pith	0.54 ± 0.35	0.63 ± 0.17	0.61 ± 0.22	0.60 ± 0.14^d
T_4	DSM	1.04 ± 0.29	0.63 ± 0.17	0.67 ± 0.14	0.78 ± 0.12^c
Season (Mean± SE)		0.96 ± 0.11	1.07 ± 0.18	1.01 ± 0.14	1.01 ± 0.08

Means with different superscripts (a-d inrows) differ significantly;

**Highly significant (P<0.01); NS - Non-Significant

Table 3: Mean total yeast and mould count in milk during different seasons

Treatments** (n=24)		Total yeast and mould count (Mean± SE) (cfu/mL)			
		Seasons^{NS}			Overall ($\times10^3$)
		Summer ($\times10^3$)	Monsoon ($\times10^3$)	Post monsoon ($\times10^3$)	
T_1	Concrete	1.17 ± 0.18	1.33 ± 0.17	1.21 ± 0.30	1.24 ± 0.12^a
T_2	Rubber mat	1.01 ± 0.29	1.42 ± 0.30	1.08 ± 0.31	1.17 ± 0.17^b
T_3	Coir pith	0.63 ± 0.31	0.79 ± 0.20	0.67 ± 0.18	0.69 ± 0.13^d
T_4	DSM	0.63 ± 0.13	0.92 ± 0.14	0.83 ± 0.08	0.78 ± 0.07^c
Season (Mean± SE)		0.86 ± 0.14	1.08 ± 0.12	0.97 ± 0.10	0.96 ± 0.07

Means with different superscripts (a-d inrows) differ significantly**;**

**Highly significant (P<0.01); NS - Non-Significant

Table 4: Mean aerobic plate count in different bedding systems during different seasons

Treatments** (n=24)		Aerobic plate count (Mean± SE) (cfu/g)			
		Seasons^NS			
		Summer ($\times10^5$)	Monsoon ($\times10^5$)	Post monsoon ($\times10^5$)	Overall ($\times10^5$)
T_1	Concrete	21.71 ± 0.42	22.83 ± 0.52	22.79 ± 0.42	22.44 ± 0.27[a]
T_2	Rubber mat	17.08 ± 0.86	17.29 ± 0.71	17.25 ± 0.97	17.21 ± 0.85[b]
T_3	Coir pith	10.02 ± 0.41	10.34 ± 0.59	10.23 ± 0.31	10.19 ± 0.25[d]
T_4	DSM	11.63 ± 0.59	13.04 ± 0.78	11.83 ± 0.48	12.17 ± 0.61[c]
Season (Mean± SE)		15.19 ± 0.98	15.76 ± 1.05	15.56 ± 1.07	15.50 ± 0.59

Means with different superscripts (a-d in rows) differ significantly;

** Highly significant (P<0.01); NS: Non-Significant

Table 5: Mean coliform count in different bedding systems during different seasons

Treatments** (n=24)		Coliform count (Mean± SE) (cfu/g)			
		Seasons^NS			Overall ($\times10^5$)
		Summer ($\times10^5$)	Monsoon ($\times10^5$)	Post monsoon ($\times10^5$)	
T_1	Concrete	11.17 ± 0.58	12.88 ± 0.89	11.33 ± 0.67	11.79 ± 0.44[a]
T_2	Rubber mat	6.00 ± 0.71	6.29 ± 0.43	6.08 ± 0.69	6.13 ± 0.34[b]
T_3	Coir pith	5.08 ± 0.53	5.29 ± 0.55	5.42 ± 0.55	5.26 ± 0.30[d]
T_4	DSM	5.75 ± 0.70	6.13 ± 0.50	5.96 ± 0.56	5.94 ± 0.32[c]
Season (Mean± SE)		7.29 ± 0.59	7.43 ± 0.73	7.32 ± 0.54	7.38 ± 0.36

Means with different superscripts (a-d in rows) differ significantly**;**

** Highly significant (P<0.01); NS - Non-Significant

Milk yield

The mean daily milk yield of cows in different bedding materials is presented in Table 6. 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) while the cows on coir pith had the highest yield (9.98 ± 0.30). The 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. Kremer *et al*. (2007) reported higher

Table 6: Mean daily milk yield in different bedding systems during different seasons

Treatments (n=6)		Daily milk yield (Mean± SE) (kg)			
		Summer	Monsoon	Post monsoon	Overall
T_1	Concrete	8.16 ± 0.07	9.31 ± 0.03	9.28 ± 0.03	8.66 ± 0.22^{d}
T_2	Rubber mat	8.23 ± 0.01	10.28 ± 0.03	9.30 ± 0.03	9.26 ± 0.20^{c}
T_3	Coir pith	8.35 ± 0.04	11.28 ± 0.04	10.35 ± 0.03	9.98 ± 0.30^{a}
T_4	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)

Table 7: Mean total yeast and mould count in different bedding systems during different seasons

Treatments** (n=24)		Total yeast and mould count (Mean± SE) (cfu/g)			
		Seasons^{NS}			Overall ($\times10^5$)
		Summer ($\times10^5$)	Monsoon ($\times10^5$)	Post monsoon ($\times10^5$)	
T_1	Concrete	4.21 ± 0.26	4.65 ± 0.44	4.51 ± 0.32	4.49 ± 0.20^{a}
T_2	Rubber mat	3.88 ± 0.57	4.88 ± 0.49	4.08 ± 0.70	4.28 ± 0.34^{b}
T_3	Coir pith	3.29 ± 0.53	4.21 ± 0.34	3.42 ± 0.39	3.64 ± 0.25^{d}
T_4	DSM	3.75 ± 0.46	4.13 ± 0.39	4.04 ± 0.43	3.97 ± 0.23^{c}
Season (Mean± SE)		3.95 ± 0.24	4.16 ± 0.21	4.10 ± 0.24	4.07 ± 0.13

Means with different superscripts (a-d inrows) differ significantly;

**Highly significant (P<0.01); NS - Non-Significant

milk yield 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 mean values for different seasons ranged from 8.15 ± 0.09 kg to 10.66 ± 0.09 kg. Singh *et al*. (2015) obtained the average highest seasonal milk production of 10.52 ± 0.12 and 9.54 ± 0.14 kg in crossbred during winter and summer season, which coincides with the present study.

CONCLUSION

Concrete floor had the highest overall mean APC of 22.44 ± 0.27while coir pith had the lowest overall mean APC of 10.19 ± 0.25×10^5cfu/g with significant difference (P<0.01). The overall mean APC in rubber mats (17.21 ± 0.85) was significantly higher (P<0.01) than DSM bedding12.17 ± 0.61×10^5 cfu/g. The overall mean APC for summer, monsoon and post

monsoon seasons vary non-significantly and were ranging from 15.19 ± 0.98 for summer to 15.76 ± 1.05 $\times 10^5$cfu/g for monsoon season. Similar results were found for CC and TYMC. 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). Thus, coir pith and dried solid manure as bedding materials could be recommended to the dairy farmers compared to rubber mats and concrete floor bedding for reducing microbial count and improving and milk production.

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