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EFFECT OFBEDDING SYSTEMS ON SOMATIC CELL COUNT AND MILK COMPOSITION IN CROSSBRED COWS

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ABSTRACT

The present study was undertaken to analyse the somatic cell count (SCC) and milk composition viz., total solids (TS), fat and solid-not-fat (SNF) in crossbred dairy cows maintained on different bedding systems.Twenty-four crossbred cows with six animals in each group at Cattle farm of the Instructional Livestock Farm Complex, Pookode was selected for the study from February 2018 to January 2019, spread over three seasons such as summer months (Feb-May), monsoon months (June-Sep) and post monsoon months (Oct-Jan). In control group (T_1) was maintained in concrete floor without any bedding materials. In (T_2) rubber mats were provided on concrete floor. In (T_3) coir pith and (T_4) dried solid manure (DSM) on concrete floor was provided as bedding.The milk of cows maintained on concrete floor and coir pith had the mean SCC values of 164.25 ± 0.25 and 164.39 ± 0.28(x10^3 cells/ml) respectively, with significant difference ($P< 0.01$) between them. The TS and SNF had the lowest value in cows maintained on concrete floor while the cows on coir pith had the highest values. The rubber mat and DSM had the mean milk fat values of 3.74 ± 0.17and 3.82 ± 0.17, respectively. The values of TS, fat and SNF were higher during summer followed by post monsoon season.

Keywords: Crossbred cows- bedding systems - somatic cell count-milk composition

INTRODUCTION

Indian dairy industry holds tremendous potential for value-addition and overall development. India has progressed to become 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. India has a sustained growth rate of 5.5 per cent *viz-a-vis* the world average of 2.4 per cent in the availability of milk and milk products. Dairy activities form a prerequisite part of the rural Indian economy, functioning as an important authority of employment and income. The most commonly used bedding materials in cow housing systems are sawdust, wood shavings, sand, straw, peanut shells and woodchips (Leso *et al.,* 2020 and Oliveira *et al*., 2019).Coir pith, a ligno-cellulosic biomass formed during extraction of coir fibre from coconut husk is a comfortable and best suitable material for animal friendly bedding. It is ideal as bedding for cows due to its moisture absorbing quality and soft bed cushioning effects (Leach *et al.,* 2015). Interest in using recycled manure solids (RMS) as a bedding material for dairy cows has grown in commercial milk producers for most farms.RMS were used successfully as a source of bedding for dairy cows and somatic cell count was comparable to the average in the region and not excessively high (Husfeldt *et al.*, 2012). Bouraoui *et al*. (2002) reported that the milk composition improved in lactating Holstein Friesian cows in organic bedding systems in summer. Hence, the effect of different bedding systems on somatic cell count (SCC) and milk composition in crossbred dairy cows was studied.

MATERIALS AND METHODS

The experiment was conducted at Cattle farm of the Instructional Livestock Farm Complex (ILFC), Pookode, Wayanad district in Kerala state. The study was conductedfrom February 2018 to January 2019 spread over three seasons as described by Biya (2011) such as summer (Feb-May), monsoon (June-Sep) and post monsoon (Oct-Jan) months. Twenty-four crossbred dairy cows in early stage of lactation in the age group of 4-6 years were selected for this study. The animals were divided into four groups with six animals in each group as uniformly as possible with regard to body weight, parity and milk yield.

The animals were let loose in the shed except during feeding and milking time during the experiment period. Floor space of 13 m^2 was provided per cow. Dung was removed in the morning and evening. Animals were washed outside the shed during the trial period. Animals were fed as per ICAR (2013) standards and were tied during feeding. Daily concentrate was fed at 5.00 a.m. and 2.00 p.m. and roughage at 10.00 a.m. and 3.00 p.m. Water was provided *ad libitum*. All the treatment groups including control were housed in the same shed in face-to-face arrangement.

In control group (T_1) six experi-mental animals were maintained on the concrete floor in the existing management system without any intervention in bedding materials without any bedding material. In (T_2) rubber mats on concrete floor of 1.2m x 1.8m x 0.025 m dimension were used for six experimental animals. The Rubber mat used in experiment was 16 mm thick, 6'×4' in size and had 40 kg weight. In (T_3) coir pith and (T_4) dried solid manure (DSM) on concrete floor was provided at the rate of 7.5 cm as bedding. The moisture content of the coir pith and DSM was maintained below 25 (Li *et al.,* 2008). All other activities including feeding regime were followed as per standard practice.

The somatic cell count (SCC) of milk sample was determined weekly as per the standard protocol (Jadhav *et al*., 2016) in order to judge the milk quality. For this purpose, 10 µl milk sample was spread over one cm^2 marked square area on glass slide. It was left at room temperature for drying. Then, it was fixed in methanol for five minutes. After drying, it was stained by Newman- Lampert stain for two minutes and dried at room temperature, then washed in tap water three times and distilled water two times before a final drying at room temperature. Somatic cells were counted through 1000 X magnification using oil immersion and were calculated as follow: as 0.01 ml (10µl) of milk was spread in one cm^2, possible number of such fields counted in one cm^2 was 3181.82. Milk volume represented by each field was = 1/100 X 1/3181.82. Hence, microscopic field was (MF) 318182. Total number of fields counted was 50. Working factor (WF) was = 3181.82/50 = 6363.63. The SCC per ml of milk= 6363.63 x Number of cells counted (in 50 fields). A representative sample of milk was taken for analysis. These samples were then subjected to fat analysis (IS: 1224. 1977) and TS analysis (IS: 1479. 1961) at weekly interval. The milk SNF was determined using the instrument Ekomilk ultra, milk analyser, milkana KAM 98-2A. Two-way ANOVA with one factor as season and other factor as treatment was carried out for comparing the milk composition values at different seasons and between groups.

RESULTS AND DISCUSSION

Somatic cell count (SCC)

The mean SCC in the milk of cows on different bedding materials is presented in Table. 1. The F-value between treatments (0.001) was found to be significant and between seasons (0.814) was found to be non-significant. Also, the F-value for interaction was noted to be non-significant (0.978) which indicated that variation observed between treatment groups were not dependent on season.

Table 1. Mean somatic cell count in treatment groups

Treatments (n=24)		Somatic cell count (Mean± SE) ($x10^3$ cells /ml)			
		Summer	Monsoon	Post monsoon	Overall
T_1	Concrete	163.08 ± 0.20	165.52 ± 0.24	164.15 ± 0.31	164.25 ± 0.25^c
T_2	Rubber mat	160.07 ± 0.71	162.12 ± 0.93	161.26 ± 0.84	161.15 ± 0.83^d
T_3	Coir pith	163.16 ± 0.12	165.55 ± 0.23	164.46 ± 0.51	164.39 ± 0.28^b
T_4	DSM	170.15 ± 0.17	172.09 ± 0.26	171.17 ± 0.30	171.12 ± 0.24^a
Mean± SE		164.11 ± 0.30	166.32 ± 0.41	165.04 ± 0.49	165.47 ± 0.40

Means with different superscripts (a-b in rows) differ significantly (P<0.01)

The cows maintained on rubber mats had the lowest SCC while the cows on DSM had the highest counts. The milk of cows maintained on concrete floor and coir pith had the mean SCC values of 164.25 ± 0.25 and 164.39 ± 0.28($x10^3$ cells/ml), with significant difference (P<0.01) between them. In all the treatment groups, the somatic cell counts were within the normal range of less than two lakhs which indicated healthy udder producing hygienic milk.

The reports of Barberg *et al*. (2007) are in agreement with the present study who estimated the average milk somatic cell count, 168.20 ± 0.21 to 172.20 ± 0.62 ($x10^3$ cells/ml) in compost bedded farms than bedded with dry fine wood shavings in lactating cows. Eckelkamp *et al*. (2016) differed in opinion who assessed bulk tank SCC was not different among herds using compost bedded pack (CBP) tie-stall barns and sand free stall barns (SFB).

From Table 1, it may also be inferred that the mean SCC in the milk of cows maintained on different bedding materials were not influenced by the seasonal variations as the differences in seasonal means within the cow groups were statistically non-significant. Moreover, the mean values for different seasons ranged from 164.11 ± 0.30 in summer to 166.32 ± 0.41 ($x10^3$ cells/ml) in monsoon. The results of Saravanan *et al.* (2015) supported this study who found that high somatic cell count during the summer season, 165.13 ± 0.21 to 180.12 ± 0.17 ($x10^3$ cells/ml). They also opined that the higher values could be due to harsh climatic condition of high humidity and ambient temperature leading to stress condition and an increase in the

Table. 2. Mean total solids content in treatment groups

Treatments (n=24)		Total solids (Mean± SE) (%)			
		Summer	Monsoon	Post monsoon	Overall
T_1	Concrete	11.84 ± 0.16	11.78 ± 0.18	11.80 ± 0.17	11.80 ± 0.17^d
T_2	Rubber mat	12.01 ± 0.15	11.93 ± 0.15	11.94 ± 0.16	11.96 ± 0.15^c
T_3	Coir pith	12.23 ± 0.14	12.18 ± 0.17	12.20 ± 0.18	12.20± 0.16^a
T_4	DSM	12.13 ± 0.16	12.08 ± 0.15	12.10 ± 0.16	12.10± 0.15^b
(Mean± SE)		12.05± 0.15^A	11.99±0.16^B	12.01 ± 0.17^B	12.02 ± 0.16

Means with different superscripts a-b in rows, differ significantly (P< 0.01) and A-C in columns differ significantly (P< 0.05)

susceptibility to infection. The results of Rowbotham and Ruegg, (2015) are in accordance to this study who found the bulk milk somatic cell score (BMSCS) was least in winter and spring, intermediate in fall, and greatest in summer in inorganic bedding (IB), followed by organic non manure bedding (OB) and manure products (MB).

Milk composition

Total solids (TS)

The mean TS in the milk of cows on different bedding materials are presented in Table 2.In case of TS, the F-value between treatments (0.048) and between seasons (0.025) were found to be significant. Also, the F-value for interaction was found to be significant (0.708) which indicated that variation observed between treatment groups was dependent on season. The mean variation observed between treatment groups had similar pattern in all seasons for treatment groups.

The milk of cows maintained on concrete floor had the lowest TS while the cows on coir pith had the highest TS content. The cows on rubber mat and DSM had the mean TS of 11.96 ± 0.15 and 12.10 ± 0.15, respectively indicating their superiority over the concrete floor. Sahu *et al*. (2018), reported the TS content in the milk of crossbred dairy cows reared on DSM was in the range of 12.16± 0.12 to 12.81±0.24 which coincides with the present study.Whereas Mech *et al*. (2008) found TS (15.14± 0.12 to 19.02± 0.14) in crossbred dairy cows which differed from the present study.

From Table 2, it may also be noted that the mean total solids in milk of cows maintained on different bedding materials were influenced by the seasonal variations as the differences of seasonal means within the cow groups are statistically significant (*P*< 0.05). The mean total solids in milk of cows maintained on different bedding materials ranged from 11.99 ±0.16 in monsoon to 12.05 ± 0.15 in summer and influenced by the seasonal variations. Sahu *et al*. (2018) proved that the TS was higher in summer, 12.10 ± 0.12 followed by monsoon, 12.01±0.02. The findings of Nateghi *et al*. (2014) are in line with the study who reported that summer milk had significantly (*P* < 0.01) higher TS 13.31 ± 0.15 than monsoon milk (12.02± 0.17).

Fat

The mean fat content in the milk of cows on different bedding materials are presented in Table 3. In case of fat content, the F-value between treatments (0.010) and between seasons (0.013) was found to be significant. Whereas, the F-value for interaction was also found to be significant (0.602) which indicated that variation observed between treatment groups was dependent on season. The mean variation observed between treatment groups had similar pattern in all seasons for treatment groups.

The milk of cows maintained on concrete floor had the lowest fat content in the milk while the cows on coir pith had the highest milk fat per cent. The rubber mat and DSM had the mean milk fat values of 3.74 ± 0.17and 3.82 ± 0.17, respectively indicating their superiority over the concrete floor. Upadhyay *et al*. (2015) supported this study who reported that the milk fat value was higher in cows reared on rubber mats 3.98 ± 0.03 than on concrete floor 3.87±0.05. Barberg *et al*. (2007) estimated the milk fat content of range 3.80 ± 0.17 to 3.88 per cent in cows maintained on compost barn in dairies which is concurrent to the present study. Whereas, Sharma *et al*. (2002), differed from this study who reported that the fat per cent was 4.49 ± 0.06 to 4.44 ± 0.05 in crossbred cows reared on concrete floor. Radhika *et al*. (2012) attributed to the fact that crossbred cows of Kerala had more of Holstein Friesian inheritance and hence produced milk of low-fat percentage.

From Table 3, it may also be inferred that the mean fat in milk of cows maintained on different bedding materials were influenced by the seasonal variations as the differences of seasonal means within the cow groups are statistically significant and the mean values ranged from 3.75 ± 0.18in monsoon to 3.79 ±0.17in summer. Sahu *et al*. (2018), reported higher milk fat percentage 4.04 ± 0.21 during summer than monsoon, 3.82 ± 0.11 may be due to lower milk yield as both the traits are adversely correlated. Nateghi *et al*. (2014) supported this study who reported milk fat 3.39 ±

Table. 3. Mean fat content in treatment groups

Treatments (n=24)		Fat content (Mean± SE) (%)			
		Summer	Monsoon	Post monsoon	Overall
T_1	Concrete	3.64 ± 0.18	3.60 ±0.19	3.61 ± 0.21	3.62 ± 0.19^d
T_2	Rubber mat	3.76 ± 0.14	3.72 ±0.16	3.73 ± 0.20	3.74± 0.17^c
T_3	Coir pith	3.93 ± 0.16	3.90 ±0.19	3.91 ± 0.21	3.91 ± 0.18^a
T_4	DSM	3.84 ± 0.19	3.81 ±0.16	3.82 ± 0.15	3.82 ± 0.17^b
Mean± SE		3.79±0.17^A	3.75± 0.18^B	3.76 ± 0.20^B	3.77 ± 0.19

Means with different superscripts a-b in rows, differ significantly (P<0.01) and A-C in columns differ significantly (P<0.05)

Table. 4. Mean Solids-not-fat content in treatment groups

Treatments (n=24)		Solids-not-fat (Mean± SE) (%)			
		Summer	Monsoon	Post monsoon	Overall
T_1	Concrete	8.20 ± 0.15	8.18 ±0.17	8.19 ± 0.14	8.19 ± 0.16^c
T_2	Rubber mat	8.25 ± 0.16	8.21 ±0.15	8.20 ± 0.13	8.22 ± 0.14^b
T_3	Coir pith	8.30 ± 0.13	8.28 ±0.14	8.29 ± 0.17	8.29 ± 0.15^a
T_4	DSM	8.29 ± 0.14	8.27 ±0.15	8.28 ± 0.18	8.28 ± 0.16^a
Mean± SE		8.26± 0.15^A	8.23 ±0.16^B	8.24± 0.15^B	8.24 ± 0.15

Means with different superscripts a-b in rows, differ significantly (P< 0.01) and A-C in columns differ significantly (P< 0.05)

0.26and 3.25 ± 0.26 per cent in summer and monsoon respectively. Kumar *et al.* (2020) contradicted the results who found the fat content, 5.18 ± 0.14 in summer and 5.12 ± 0.01 per cent in monsoon season.

Solids-not-fat (SNF)

The mean SNF content in the milk of cows in different bedding materials are presented in Table 4.In case of SNF, F-value between treatments (0.032) and between seasons (0.025) was found to be significant. Also, the F-value for interaction was found to be significant (0.704) which indicated that variation observed between treatment groups was dependent on season. The mean variation observed between treatment groups showed similar pattern in all seasons for treatment groups.

The cows maintained on concrete floor had the lowest SNF while the cows on coir pith had the highest SNF per cent. The rubber mat and DSM had the mean SNF values of 8.22 ± 0.14and 8.28 ± 0.16, respectively indicating their superiority over the concrete floor. The results are in agreement with Radhika *et al*. (2012) who found 8.35 ± 0.15 per cent SNF in the milk of crossbred cows. They also reported that the crossbred cows in Wayanad with low level of SNF might be an indication towards insufficient energy intake. Anaemia was another reason for decline in SNF and since incidence of haemoparasites was quite high in Wayanad due to the proximity to forest areas. Hypoalbuminaemia was reported to be another reason for low SNF in cow milk.Whereas Kumar *et al.* (2020) found different SNF value of 9.12 ± 0.16 per cent in Jersey crossbred cows.

From Table 4, it may also be noted that the means SNF in the milk of cows maintained on different bedding materials were influenced by the seasonal variations as the differences of seasonal means within the cow groups were statistically significant ($P< 0.05$). The mean SNF in milk of cows maintained on different bedding materials ranged from 8.23 ±0.16in monsoon to 8.26 ± 0.15in summer. Sharma *et al*. (2002), SNF varied among seasons and highest in summer, 8.30± 0.13and lowest in monsoon, 8.30± 0.11 which coincides with the present study.

SUMMARY

The cows maintained on rubber mats had the lowest SCC while the cows on DSM had the highest counts. The cows maintained on concrete floor, rubber mats, coir pith and DSM had somatic cell counts within the normal range of less than two lakhs which indicated healthy udder producing hygienic milk.SCC was lower in summer followed by post monsoon and monsoon. The milk of cows maintained on concrete floor had the lowest TS, fat and SNF while the cows on coir pith had the highest values respectively. The values of TS, fat and SNF were higher during summer followed by post monsoon season. The coir pith and DSM bedding resulted in normal SCC and better milk composition. The use of coir pith bedding and dried solid manure as bedding materials could be recommended as an important management practice to dairy farmers compared to rubber mats and concrete floor bedding.

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