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Lactational performance of crossbred dairy cows fed on complete feed block and total mixed ration

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Abstract
The study was conducted to evaluate the effect of feeding complete feed block (CFB) and total mixed ration (TMR) on lactational performance of crossbred cows. Eighteen crossbred cows of similar lactation and milk yield were randomly divided into three groups of six animals each. Animals in group T_0 were given concentrate and roughage separately. In T_1 and T_2 groups, animals were fed CFB and TMR, respectively. The body weight (kg), dry matter intake (g/ kg W $^{0.75}$) and total digestible nutrient intake (kg/day) were comparable among the treatments. Intake of crude protein (kg/day), crude protein (g/ kg W $^{0.75}$) and neutral detergent fibre (kg/day) were higher (P<0.05) in T_1 and T_2 group than T_0 group. Higher (P<0.01) 4% fat corrected milk yield (kg/day) and milk fat percentages (P<0.05) were observed in T_1 and T_2 group than T_0 group. The other milk constituents were not affected by the system of feeding.

Keywords: Complete feed block, fat corrected milk, milk composition, total mixed ration

Introduction
Livestock sector has a major share in Indian economy as the livelihood of large section of the population is based on livestock. Feed availability is one of the most important limitations in growth of the livestock industry, especially in developing countries. The Majority of the farmers are resource poor and cannot afford good quality feeds due to high cost which reduces the productivity of animals [1]. Complete feed as an alternative to high cost feed provides scope for inclusion of alternative feeds such incorporation of tree leaves as routine diets. It provides a blend of all the feed ingredients comprising roughages and concentrates without giving any choice to the animal for selection of specific ingredients [2]. Total mixed ration (TMR) and complete feed block (CFB) are innovative forms of complete ration which increase the utilization of available feed resources.

TMR is a blend of forages and concentrate and other supplementary nutrients in the desired proportion which fulfils the nutrient requirements of animals. CFB is a densified form of a complete feed comprising of forage, concentrate and supplementary nutrients in required proportions able to meet the nutritional requirement of animals. Complete feeds in various physical forms reported to have beneficial effects in dairy animals [3]. It provides a stable rumen environment which leads to optimum fermentation and stabilization of acetate to propionate ratio that favours normal fat synthesis [4, 5]. It also controls the ratio of roughages to concentrate and enhances milk production in dairy animals [6]. Complete feed improves the fibre digestibility leads to increase in milk fat [7]. The other component of milk can also be influenced due to better rumen fermentation and synchronized nutrient supply. Feeding of complete feed also enhances the consumption rate and thus it reduces the wastage and allows the animal to eat according to their yield. A complete ration is considered as one of the best feeding models to reduce the problem of nutrient deficiencies in livestock fed on poor quality feed by providing a uniform supply of essential nutrients for optimum production without affecting animal health [8]. Hence, the study was designed to see the effect of CFB and TMR on lactational performance in crossbred dairy cows.

Materials and Methods
Ethical statement
The present study was conducted as per the guidelines set by Institutional Animal Ethics Committee (IAEC) of Assam Agricultural University, Khanapara, Guwahati.

Location and duration of the experiment

The research was conducted in the Instructional Livestock Cattle Farm, ILF(C), College of Veterinary Science, Assam Agricultural University, Khanapara, Guwahati, Assam located at longitude 91.82° E and latitude 26.12 °N and approximately at a height of 252 m above sea level. The experiment was carried out for 90 days from 31st October 2018 to 29th January 2019.

Dietary treatment and layout of the experiment

A total of eighteen crossbred (Holstein Friesian x Jersey) milch cows of almost similar milk yield and parity were selected and divided into three groups having six crossbred milch cows in each group. One group was considered as control (T_0) and fed in a conventional way of separate concentrate and roughage feeding, the same concentrate and roughage were fed as CFB in T_1 group and as TMR in T_2 group.

Preparation of ration

The rations were formulated in accordance with the directives of nutrient requirements of lactating cows [9] using Para, Napier, Paddy Straw and concentrate mixture. The concentrate mixture was prepared by conventional feed ingredients. The ratio of roughage to concentrate (60:40) was same for all the diet. The compositions of control and treatment rations are given in table 1. TMR (T_2) was prepared by mixing weighed quantity of chopped roughages and concentrate to get uniform mixture. Then the mixed material along with molasses at 10% level was used for the preparation of CFB (T_1) in a complete feed block manufacturing machine.

Table 1: Compositions of experimental rations used during feeding trial (on percent DM basis)

Ingredients, %DM	Percent of ration		
	T_0	T_1	T_2
Concentrates	40	40	40
Napier	20	20	20
Para	20	20	20
Paddy straw	20	20	20

DM, Dry matter

Animal management and feeding

All the experimental animals were kept in a well ventilated intensive housing system. Animals were conditioned for a period of 7 days before start of the actual experiment. During the experimental period**,** the animals were provided with weighed quantity of the respective feed twice daily at 9 A.M. and 3 P.M. as per their requirement. The feed residues were quantified daily and record of feed intake and residue was maintained. Clean drinking water was made available to the animals at all times.

Analytical techniques

At the end of the feeding trial, a digestibility trial of 7 days was followed. Daily representative samples of the feeds, residues and faeces were collected and pooled animal wise. Samples were prepared and preserved in airtight container for further analysis. The chemical compositions of the samples were estimated as per the method of [10]. Fibre fractions were determined according to the method described by [11]. Daily record of milk yield for each cow was maintained. 4% fat corrected milk (FCM) was calculated by the equation of [12]. The heart girth and length (from point of shoulder to pin bone) of the experimental animals were measured using a weigh tape to determine weight by Schaeffer's formula [13].

The milk samples from the individual animals were collected in sterilized plastic vials at an interval of 15 days for the estimation of fat, total solids (TS), solids not fat (SNF) and total protein. Milk fat was estimated as per the Gerber's method [14]. The SNF and TS content of the milk was estimated by lactometer method [15]. The total protein content of milk was estimated by Formol titration method [16].

Statistical analysis

In this study, completely randomized design was followed to compare the performance of different parameters for different ration. The experimental data were analyzed by SAS 9.3 software [17]. In addition, mean comparison was performed using least significant difference at the 5% probability level.

Results

Body weight and nutrient intake

The body weights, nutrient intake for different treatment groups have been presented in table 2. Significant differences were not found among the treatments with regard to body weight (kg). Dry matter (DM) intake (g/ kg $W^{0.75}$) was comparable among the treatments. Higher (P<0.05) crude protein (CP) intake (g / kg $W^{0.75}$) was observed in T_1 (16.61 g) and T_2 (16.29 g) group than T_0 (14.96 g) group. CP intake per day was also higher (P<0.05) in T_1 (1.17 kg) and T_2 (1.19 kg) group compared to T_0 (1.08 kg) group but total digestible nutrient (TDN) intake (kg) per day was similar among the treatments. T_1 (5.26 kg) and T_2 (5.28 kg) group possessed higher (P<0.05) neutral detergent fibre (NDF) intake per day in comparison to T_0 (5.07 kg) group.

Table 2: Body weight, Nutrient intake in different treatment groups

Parameters	T_0	T_1	T_2	SEM	P value
Body weight (kg)	300.20	298.80	299.60	3.057	0.985
DM intake (g/ kg $W^{0.75}$)	152.01	156.73	153.99	2.178	0.706
CP intake (g/ kg $W^{0.75}$)	14.96^a	16.61^b	16.29^b	0.292	0.034
CP intake (kg/day)	1.08^a	1.17^b	1.19^b	0.021	0.044
TDN intake (kg/day)	6.34	6.82	6.63	0.100	0.21
NDF intake (kg/day)	5.07^a	5.26^b	5.28^b	0.038	0.043

Means with different superscripts in a row (a, b) differ significantly at 5% probability level

Milk production and composition

Milk production and composition for different treatment groups have been shown in table 3. The 4% FCM yield was higher (P<0.01) by cows of T_1 (9.63 kg/day) and T_2 (9.63 kg/day) group compared to T_0 group (7.63 kg/day). The T_1 (4.54%) and T_2 (4.49%) group produced milk with higher (P<0.05) fat content than T_0 (3.87%) group. The TS (%), SNF (%) and total protein (%) content of the milk were similar among the treatments.

Table 3: Milk production and composition in different treatment groups

Parameters	T_0	T_1	T_2	SEM	P value
4% FCM (kg/day)	7.63^a	9.63^b	9.63^b	0.252	<.0001
Total solid (%)	13.09	13.77	13.76	0.159	0.135
Fat (%)	3.87^a	4.54^b	4.49^b	0.115	0.018
Solid not fat (%)	9.23	9.23	9.27	0.076	0.976
Total protein (%)	3.29	3.47	3.49	0.048	0.168

FCM, fat corrected milk**.** Means with different superscripts in a row (a, b) differ significantly at 5% probability level

Discussion

Meeting the animal's nutritional demand in an efficient way is very important in an intensive ruminant production system. Nutrient intake plays a major role in the production performance of dairy animals. The objective of the current study was to compare the conventional feeding system to CFB and TMR based feeding system in terms of nutrient intake, 4% FCM yield, and composition of milk. In the present study, the body weight of the cows under different treatments was similar which is in line with the reports of [3, 18]. DM intake per kg metabolic body weight was not affected by the feeding regimes. Similar result was reported in conventional and complete feed system by [19, 18]. Improved CP intake per day, as well as CP intake per kg metabolic body weight in CFB and TMR fed (T_1 and T_2) groups compared to the group fed on control (T_0) diet, is in accordance with the other studies of comparing conventional system of feeding with different forms of complete feed [2, 20]. In analogy to report of [2], higher CP intake in cows fed CFB and TMR might be due to increased nutrient density of the rations. However, TDN intake was comparable among the treatment groups corroborating the findings of [7]. In the present study, the intake of NDF was higher in cows offered CFB and TMR ration than the cows offered control ration. This could be due to the decrease in particle size of the ration which has resulted in increased intake of NDF in T_1 and T_2 group. Increase in NDF intake due to particle size reduction was reported by [21]. Higher intake of NDF was observed by [22] in buffaloes fed compressed complete feed block than in buffaloes fed conventional ration. The higher 4% FCM yield supported by CFB and TMR diet in the present study are in agreement with the earlier reports of [23, 24] who observed higher milk yield in cows fed on complete feed than in cows fed on conventional feed. The higher milk yield in TMR fed dairy cows was due to higher crude protein intake [20]. Similarly, increased 4% FCM yield in CFB and TMR group in the current study might be associated with increased crude protein intake. The higher fat percentage of milk from CFB and TMR fed cows compared to those fed on control diet is inconsistent with previous reports of [7, 6]. In terms of milk fat content, increase in intake of NDF has been associated with increase in milk fat content [25]. Thus higher fat percentages of the milk from CFB and TMR fed groups might be related to higher intake of NDF compared to control diet. Dietary treatment did not influence the TS, SNF, and protein content of milk. Similar level of TS between cows on TMR and conventional feeding system was reported by [19, 24]. Comparable level of SNF and total protein was reported by [26, 19] in cows fed complete feed and conventional diet.

Conclusion

From the result of the present experiment, it may be conferred that complete feed in the form of CFB or TMR increased the CP and NDF intake but intake of DM and TDN were not affected. Improvement in nutrient intake was accompanied by increase in 4% FCM yield and milk fat percentage without having any effect on other constituents of milk. Based on the observation, it can be concluded that CFB and TMR feeding may be suitable for feeding lactating cows compared to conventional feeding of concentrates and roughages separately.

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