An On-Farm Study for Feeding Impact of Total Mixed Ration (TMR) in Milking Cow

ABSTRACT

Aims: To compare the compatibility of maize stover based Total Mixed Ration (TMR) over conventional feeding in terms of dry matter intake, milk production and composition and economic outcome from cows.

Study design: CRD

Place and duration of study: This field trial was carried out for a period of 60 days on 10 early lactating Holstein Friesian crossbred cows belonging to the farmers of Sirajgonj district.

Methodology: Cows were divided into two homogenous groups considering lactation status and yield. In control (T_0) group, cows were provided conventional feeds comprising of 20.0 kg Napier grass, 5.0 kg paddy straw, 2 kg pelleted feed and 10.0 kg concentrate mixture (composed of 5 kg wheat bran, 2 kg pulse bran, 2 kg red gram bran and 1.0 kg oil cake), while in another group (T_1), cows were fed TMR comprising of maize stover and concentrate with 50:50 proportions, according to their nutrient requirements. The DM and CP contents in concentrate mixture of T_0 and T_1 were 90.33% and 15.6% and 38.01% and 16.7%, respectively. The data were analyzed by "SPSS 20.0" statistical program.

Result: Fresh feed intakes were significantly (P<0.001) higher in T_0 (37.4±0.008) than those of animals in T_1; CP intakes were significantly (P=0.008) higher in T_1 (1.60±0.02). Differences were not significant (P=0.07) in case of DMI and DMI on %live weight between two treatment groups. Milk yield and fat content significantly (P=0.05) differed between groups. Highest milk yield (9.99±0.07 kg) and milk fat (3.62±0.06%) were observed in cows of T_1. However, milk protein, lactose and SNF did not vary significantly between groups. Considering milk price @BDT 60.0/ltr, profit gained maximum in T_1 group.

Conclusion: TMR improved substantial amount of milk yield and quality with concurrent reduction of milk production cost.

Keywords: *Densified TMR, crop residues, milk yield, milk composition.*

1. INTRODUCTION

Nutritional inadequacy for livestock is one of the most burning problems in Bangladesh. Balanced and economic feeding of livestock is extremely important for optimum productivity. Poor livestock production is mainly due to the scarcity of feeds and unbalanced feeding practices. Due to higher population growth rate and its consequential pressure, available land for forage production is declining day by day. Availability of feeds and fodders, both in quantitative and qualitative, is one of the major constraints in sustainable development of the livestock sector. This unpleasant scenario of quality feed resource availability has virtually eclipsed the genetic worth of animals. The ultimate aim of any feeding system is to provide balanced nutrition to maximize milk yield, obtain best reproduction performance and get substantial financial returns from dairy animals. In order to maximize milk production from existing livestock population, it is necessary to meet the nutritional requirements of the animal by appropriate feeding system suitable for our climatic conditions.

In such circumstances, the extensive use of crop residues in livestock feeding seems to be indispensable to meet the nutritional needs of livestock; however, the major constraint in the utilization of these crop residues is high cellulosic contents and poor nutritive value that even cannot support the maintenance nutrient requirement of the animals. Hence, efforts are being directed towards assisting the animals to utilize these low-grade feedstuffs more efficiently as effective utilization of available feed resources is the key to enhance livestock productivity economically.

To minimize feed costs and labor, and to maximize production is the need of the time and can be achieved by blending concentrate, mainly comprised locally available by-products and roughage portions of the ration to form complete feed/diet, synonymously termed as total mixed ration (TMR). Complete feed with the use of fibrous crop residue is a noble way to increase the intake and to improve feed utilization and animal production performance. The complete feed system is being increasingly appreciated as it allows expanded the use of agro-industrial by-products, crop residues and non-conventional feeds in livestock ration for maximizing production and minimizing feeding cost.

The magnitude of profit from livestock can be further expanded by curtailing disproportionate expenditure on feed through exploration of nutrient-rich alternate feed resources, which do not compete with human food chain, coupled with proper feed-waste management. Incorporation of locally available crop residues, such as cereal stovers and straw, in the form of complete ration is a plausible option for ruminant feeding Schiere [1]; Venkateswarlu et al. [2] , because blend of feed ingredients offers little choice to the animal for selection of specific ingredients in feed Wadhwa and Bakshi, [3]. Among various available feed resources, maize (*Zea mays*) cob can be considered to be one of the important potential crop residues available for ruminants feeding in country. Maize is indigenous to Bangladesh (corn) belongs to the Family: *Gramineae,* Genus*: Zea,* Species: *Mays*. It is grown in temperate and tropical countries of the world for its grain utility in both human beings and livestock. The major residues obtained from this crop are maize husk (covering on seed), cob, shank and stover. Corn cob, shanks are by-products of maize grain and may be used as alternative feed resources for ruminants especially during dry season. These are the relatively available and abundant agricultural wastes used as livestock feeds in large scale farms. They are usually in medium density when they are finely ground and facilitate better uniformity with other ingredients, especially concentrate feeds after grinding. Hence, corn cob, shanks can be efficiently utilized in total mixed rations. In the recent years, the concept of feeding total mixed rations comprising of fibrous crop residues to dairy animals became popular among the farmers. The objective of complete rations is to provide a blend of all the feed ingredients including roughages without giving any choice to the animal for selection of specific ingredient Khan et al. [4]. The merits of total mixed ration are related to the enhancement of utilization of low grade roughages, provides uniform feed intake, and reduces feed wastage, a stable environment for rumen fermentation, minimal fermentation losses and fluctuation in release of ammonia. Rao et al. [5]. The present study was undertaken to study the effect of feeding chopped maize stover based TMR on milk production in Holstein-Friesian crossbred lactating cows as compare to the conventional feeding system in the household premises of the farmers.

2. MATERIALS AND METHODS

2.1 LOCATION AND DURATION OF EXPERIMENT

This field experiment was conducted for 60 days from 8th April to 8th June, 2018 on 10 Holstein Friesian crossbred lactating cows belonging to the farmers at Alokdiar village in Baghabarighat of Shahzadpur upazilla in Sirajgonj district.

2.2 COMPOSITION OF FEED, DIETARY TREATMENTS AND LAYOUT OF THE EXPERIMENT

The selected cows were in 1st to 3rd lactation at early stage (1-2 months) of production and were divided into two homogenous groups. In control group (T_0), animals were provided conventional feeds comprising of 20.0 kg Napier grass, 5.0 kg paddy straw, 2 kg pelleted feed (Provita®) and 10.0 kg concentrate mixture (composed of 5 kg wheat bran, 2 kg pulse bran, 2 kg red gram bran and 1.0 kg oil cake), while animals in other group (T_1) were fed with a complete ration comprising of chopped maize stover and

concentrate with 50:50 proportions according to their nutrient requirements. The dry matter (DM), crude protein (CP), organic matter (OM), ash, neutral detergent fiber (NDF), acid detergent fiber (ADF) contents were 90.33, 14.75, 89.8, 10.2, 39.1 and 21.3 percent, respectively in the concentrate mixture (T_0), and 38.01, 15.89, 89.58, 10.42, 45.2 and 35.7 percent, respectively in TMR (T_1).

In each 100 kg TMR mixture, the amount of maize stover was 50 kg and rest 50 kg was concentrate feed composed with 25 kg soybean meal, 10 kg molasses, 8 kg wheat bran, 4 kg pulse bran, 2.5 kg di-calcium phosphate and 0.5 kg table salt. The formulation of T_0 ration (fresh basis) was composed with 53.33 kg Napier/Jumbo, 13.33 kg paddy straw, 13.33 kg wheat bran, 5.33 kg pulse bran, 2.67 kg oil cake, 5.33 kg ready feed (provita®), 5.33 kg red gram bran and 0.5 kg table salt. ME of 56.71 MJ/d and 52 MJ/day were supplied for T_0 and T_1 groups, respectively.

Table 1: Dietary and ingredient's composition

Feed Ingredient	DM%	CP%	Amount in 100 kg (T_0)	Amount in 100 kg (T_1)
*Napier/ Jumboo	16.38/15.92	09.30/10.11	53.33	-
Paddy straw	89.00	03.40	13.33	-
Maize stover	88.96	05.72	-	50.00
Wheat bran	87.43	15.06	13.33	8.00
Pulse bran	86.55	12.22	05.33	4.00
Soybean meal	85.78	44.13	-	25.00
Oil cake	85.19	35.27	02.67	
Molasses	80.19	05.20	-	10.00
Pellet feed	87.80	10.25	05.33	-
Red gram bran	89.36	07.21	05.33	-
Salt	99.5	-	00.50	0.5
DCP	98.01	-	-	2.5
DM (%) in diet	-	-	47.91	58.21
CP (%) in diet	-	-	14.75	15.89
ME (MJ/kg DM)	-	-	10.01	10.56
ME requirement (MJ/day/animal)	-	-	50.13	50.09
ME consumed (MJ/day/animal)	-	-	56.71	52.00

2.3 FEEDING AND MANAGEMENT OF ANIMALS

The animals in both control and treatment groups were housed in well ventilated, conventional stalls maintained under hygienic conditions with individual feeding and watering arrangements.

2.4 CHEMICAL ANALYSIS

The feed samples, leftover and faeces were analyzed by the method of AOAC [6] for determination of DM, CP, OM and Ash, while, ADF and NDF by Van Soest et al. [7]. All the samples were analyzed in duplicate and mean values were recorded.

2.5 MILK ANALYSIS

Milk yield was estimated on the basis of two complete milking of the animals daily at 5.00 AM and 5.00 PM, and 3.5% fat corrected milk yield was computed. Representative samples of milk were collected in sterile bottles once in a week to estimate the milk constituents, *viz*., fat, protein, lactose, SNF by Funk Gerbar.

2.6 STATISTICAL ANALYSIS

The data were analyzed using the "SPSS 17.0" [8] statistical program. Least significant difference (LSD) test was also done to compare the significant difference between treatment means for various parameters.

3. RESULTS AND DISCUSSION

3.1 FEED INTAKE

The feed intakes of animals supplied with two dietary groups are shown in Table 2. Although, fresh feed intake in T_0 group was significantly higher (P<0.001) than T_1 group, but DM intakes did not differ (P=0.07) between groups. This conformed to the findings of Kishore et al. [9], who had reported that palatability of complete ration was as good as the conventional ration. Fan et al. [10] also reported similar DMI in cows and buffaloes, respectively on TMR and conventional feeding, while a contradictory result were obtained by Verma *et al.* [11], Pandya et al. [12], Lee et al. [13], Pachauri et al. [14] and Khan et al. [4]. All of them reported increased DMI in TMR fed cows and buffaloes because of its higher palatability and the reduced particle size. Total DM intake depends on the live weight of the animals. The live weights of all experimental animals were closely alike with each other. That could be the reason for similar DM intake during the experimental period which also reflected on the calculated DMI on %live weight of the animals.

Table 2: Feed intake of cows fed on conventional and complete ration (TMR) during on-farm trial

Parameter	T_0 (mean ±SE)	T_1 (mean ±SE)	Significance level
Fresh feed intake (kg/day)	37.4±0.008	16.42 ±0 .02	***
DM intake (kg/day)	11.39±0.48	11.46±0.16	NS
CP intake (kg/day)	1.25±0.05	1.60±0.02	**
DMI on %LWT	2.41±0.05	2.46±0.03	NS

DM-Dry matter; LW-Live weight of animal; **-p<0.01; ***-p<0.001.

The CP intake of animals differed significantly between groups. Significantly higher (*P*=0.008) CP intakes were obtained in animals of T_1 group than those animals in other group. This finding is in accordance with the findings of Chander [15]. Khan et al. [4] found that the feeding of total mixed ration in the form of pellets increased the CP intake as compared to conventional feeding system (feeding roughage and concentrate separately) which also corresponds with this study. Pachauri et al. [14] observed that wheat straw based total mixed ration and urea ammoniated based total mixed ration increased the dry matter, DCP intake as compared to feeding of wheat straw and concentrate fed separately (conventional feeding) which conforms with this study. Sharma et al. [16] conducted to discern the effect of feeding complete ration as mash or block form in comparison to conventional feeding system on feed intake, growth, nutrient utilization in growing crossbred female calves for a period of 90 days and observed DM/kg $W^{0.75}$ and DCP intake (g/kg $W^{0.75}$) was significantly higher in mash group in comparison to conventional feeding system and also with complete feed in block form which contradicts with this study.

3.2 MILK YIELD

Milk production of cows for animals of two groups are shown in Table 3 which varied significantly (*P*=0.05) between groups. Highest average daily milk yield was observed in T_1 group.

Table 3: Milk production of cows fed on conventional and complete ration (TMR) during on-farm trial

Parameter	T_0 (mean ±SE)	T_1 (mean ±SE)	Level of significance
Initial milk yield (ltr)	9.30±0.29	9.35 ±0.11	NS
Final milk yield (ltr)	9.60±0.2	9.99±0.07	*

NS-p>0.05; *-p<0.05.

The result obtained in this study is coincided with Reddy et al. [17]. Feeding complete feeds significantly increased milk production in buffaloes and crossbred cows as compared to conventional rations Reddy and Reddy [18]. Holter et al. [19] reported that feeding with the blended diet resulted in more milk with higher efficiency of ME utilization for milk production. Das et al. [20] reported higher average milk yield in complete feed block fed than in mash fed lactating buffaloes during an on-farm trial and farmers were of opinion that complete feed blocks not only enhanced milk yield but were also easy at feeding and storage. However, Rakes [21] concluded that complete rations containing 13-14% CP supported milk production at par with that obtained with conventional ration in dairy animals. Furthermore, Kumar et al. [22] reported that feeding of TMR to lactating buffaloes had no significant effect on milk yield compared to those fed the diet in conventional form, which is not in agreement with this study. Variations could be due to difference of cattle type, formulated feed or feed ingredients.

3.4 MILK COMPOSITION

Changes of milk compositions for two groups of cows are given in Table 4, which shows that significant difference was observed for fat% in milk between groups. However, there were no significant variations of protein, lactose and SNF contents in milk between groups. Significantly higher (*P*=0.05) fat% was obtained in cows of T_1 group.

Table 4: Milk composition of cows fed on conventional and complete ration (TMR) during on-farm trial

Parameter	T_0 (mean ±SE)	T_1 (mean ±SE)	Significance level
Fat (%)	3.51±0.04	3.62± 0.06	*
Protein (%)	3.62±0.04	3.69±0.27	NS
Lactose (%)	4.96 ±0.29	5.04±0.32	NS
SNF (%)	9.57±0.5	9.79±0.08	NS

*-p<0.05; NS-p>0.05.

Feeding complete diets to dairy animals has variable results on milk composition. Nagalakshmi and Reddy [23] reported higher (p<0.01) milk fat and 6% FCM yield in buffaloes fed expander-extruder processed complete diet compared to those fed conventional diet in one on-farm trial, with no effect on milk solid-not-fat (SNF) content. Bargo et al. [24] in their study found highest milk fat percentages in cows fed TMR compared to cows fed partial TMR and pasture plus concentrate which is in agreement with this study. The result also similar with the study of White et al. [25] who reported that cows fed on TMR had higher total milk fat percentage than those grazed on pasture, while the protein percentage did not differ between the two groups. Gaafar et al. [26] observed highest milk fat in cow fed with TMR. O'Neil et al. [27] concluded that cows offered TMR had higher fat yield as compared to those fed ryegrass. Their results are in accordance with this study. It is evident that lots of genetic and non-genetic factors are responsible for variability of milk composition like breed, heredity, dietary regime, time and frequency of milking, season etc.

3.5 ECONOMIC ANALYSIS

At the end of the whole experiment, economic analysis was also conducted based on benefit cost ratio (BCR) of two treatment groups as shown in Table 5.

Table 5: Economic analysis for two feeding groups

Cost analysis	T_0	T_1
Feed cost (BDT/day/animal)	384	320
*Income from milk (BDT/day)	559	594
Net profit earned in a day/cow (BDT)	175	265
Benefit cost ratio (BCR)	1.45	1.86

*Considering milk price @BDT 60.0/ltr.

The average feed cost for animals in T_0 group was higher as compared to animals in T_1 group fed TMR. The net profit over feed cost was higher in cows fed TMR compared to those fed on conventional ration. This result is similar with earlier reports on feeding of jowar, wheat and bajra straw based complete

rations to cattle and buffalo, that reduced the cost of feeding animals for milk production, compared to conventional ration Khan et al. [10] ; Lailer et al. [28] , Kishore et al. [9] .

4. CONCLUSION

Feeding ruminants with total mixed ration is comparatively better option than conventional feeding of concentrates and roughages separately or grazing plus supplementation. This has advantages in provision of balanced diet to the ruminants and helping better utilization of the locally available feed resources, resulting in higher productivity along with reduction in feed cost and labor. Thus, the concept of feeding system with complete feed is becoming increasingly popular. However, lots of efforts are still needed to be taken for extending the concept extensively to the field.

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