



Feeding effects of total mixed ration on rumen metabolic profile in Cattle

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Abstract

A feeding trial was undertaken to select the best combination of roughage and concentrate based on total mixed ration (TMR), to better rumen environment and determine the feeding effects of TMR on rumen metabolic profile in cattle. The experiment was conducted at Bangladesh Livestock Research Institute (BLRI) for a period of 35 days. A total of 5 types of TMR was prepared on fed basis with different roughage and concentrate ratios as T₁=70:30, T₂=60:40, T₃=50:50, T₄=40:60, and T₅=30:70. Five cannulated bulls with an average live weight ranging from 200 to 300 kg and approximately 18 months of age were selected for the experiment. The present study indicated that there was no significant difference in pH among different treatment groups. Concentration of total volatile fatty acids (TVFAs) was highest in T₂ group which was found to be increased up to 12 h after feeding, then gradually decreased up to 24 h. Concentration of total nitrogen (TN), ammonia nitrogen (NH₃-N), non protein nitrogen (NPN) and protein nitrogen (PN) were highest in T₅ group. Concentration of total nitrogen (TN), ammonia nitrogen (NH₃-N) and protein nitrogen (PN) were gradually decreased up to 12 h after feeding but then gradually increased trend observed up to 24 h. Concentration of non protein nitrogen (NPN) was found to be decreased gradually from 0 h up to 24 h after feeding. The result also indicated that rumen NH₃-N was positively correlated with TN intake of the animal. It can be concluded from the present study that the TMR provided better rumen environment at different hours of digestion could be used for better rumen fermentation. The best combination of roughage to concentrate ratio (30:70) was in T₅ group for better N utilization to achieve maximum performance through proper feeding which might reflect the gross return of cattle production.

Key words: feeding effects, total mixed ration, rumen metabolic profile, cattle feed

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Introduction

In the context of Bangladesh, feeds and fodder scarcity is the major problem for better livestock production (Tareque and Chowdhury, 2010). Most of the livestock farmers meet their fodder requirements by grazing animals on common lands, fallow or harvested agricultural land. Large farmers also meet fodder requirements through cultivated forage crops. But due to rapid decline of grazing land and farmer's dependency on concentrate feeds, this will not be possible for sustaining such alternative. Regarding this situation, total mixed rations (TMR) can be an alternative solution to support the dairy cows for achieving maximum production by stall feeding without grazing indoor-housed system like dairy producing countries of the world.

TMR enhances feed intake, improves the ecology of the rumen that leads to stimulated microbial activity to digest more feed, increase dry matter intake and milk production (Wachirapakorn *et al.* 1997) compared to separate feeding which ultimately increases productivity of the cattle. The cost of feed production is rising in the livestock husbandry industry largely due to dietary dependency on raw material. New feeding habits and strategies employing different roughages are clearly necessary to overcome the problem. The TMR has been the subject of great interest from farmers because of its expected benefits in the nutrition, management and production of ruminant animals. The present study was undertaken to compare different ration of TMR based on combination of roughage and concentrate and select the best one for better rumen environment.

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Materials and Methods

Site of the experiment

The experiment was conducted at Bangladesh Livestock Research Institute (BLRI), Savar, Dhaka.

Animal selection

Five cannulated bulls with an average live weight of 200 to 300kg and approximately 18 months of age were selected for the experiment.

Dietary Treatments

During the trial period five cannulated bulls were randomly assigned in replicated 5x5 Latin Square Design (LSD) and were fed with total mixed ration (TMR) diets. Diet combinations of roughage: concentrate was 70:30 (T₁); 60:40 (T₂); 50:50 (T₃); 40:60 (T₄) and 30:70 (T₅). Different types of TMR had been produced with different ratio of roughages (grind soybean straw) and concentrates (Table 1). The total mixed ration (TMR) contained around 16% CP.

Collection Trial

During the trial period, daily feed intake and leftover feed were recorded individually. Approximately, 50 ml of rumen fluid were collected using the installed syringe on the 7th day of each experimental period at 0, 3, 6, 12 and 24 h after feeding. The p^H was measured immediately after collection.

Chemical analysis

Chemical analysis of the collected rumen liquor samples for the estimation of the following parameters were done in the Animal Nutrition Laboratory at BLRI. Rumen pH, Total Volatile Fatty Acids (TVFA), Total nitrogen (TN), Ammonia Nitrogen (NH₃-N), Total Solids (TS), Non Protein Nitrogen (NPN), Protein Nitrogen (PN) were studied in the experiment to evaluate the feeding effects of rumen environment in ruminants.

Statistical analysis

An analysis of variance was done to determine the significant differences in treatment means. Collected data were analyzed statistically by Post Hoc Multiple Comparisons of SPSS 11.5 for Windows (SPSS Inc. 2002). The layout of the experiment was in Latin Square Design (LSD).

Table 1. Composition of total mixed ration (TMR) for different treatment groups

Feed type and nutrients	Ingredients(kg)	Roughage to concentrate ratios in TMR				
		T ₁	T ₂	T ₃	T ₄	T ₅
Roughage	Napier-3 silage	56	48	40	32	24
	Milled soybean straw	14	12	10	8	6
Concentrate	Khesari bran	3	10	13	23	28
	Wheat bran	6.5	10.5	19	20	26
	DCP	2.5	2.5	2.5	2.5	2.5
	Salt	0.5	0.5	0.5	0.5	0.5
Total fresh amount (Kg)		100	100	100	100	100
Nutrients	DM (% Fresh basis)	53.36	54.34	59.86	61.84	64.22
	CP (% DM basis)	16.76	16.25	16.16	16.06	15.10
	ME(MJ/Kg DM)	9.45	9.81	9.55	9.70	9.72

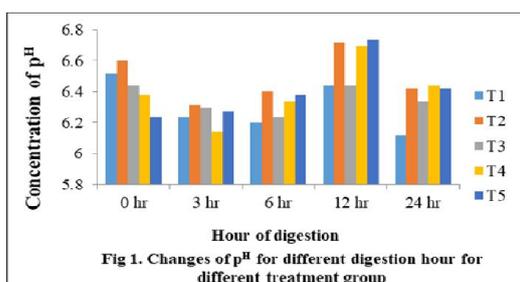
T₁=70:30 (Roughage: Concentrate), T₂=60:40 (Roughage: Concentrate), T₃=50:50 (Roughage: Concentrate), T₄=40:60 (Roughage: Concentrate), T₅=30:70 (Roughage: Concentrate).

Results and Discussion

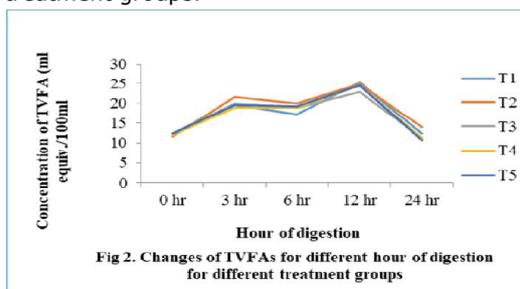
Rumen fermentation parameters

Rumen pH

The Rumen pH of different treatment groups were shown in Fig 1. All the treatment pH were found decreasing gradually from 0 hour to 6 hour after feeding, then increased at 12 hour and again decreased at 24 hour (Fig.1). This also indicated that there was no sequential change in pH in different treatment groups.



The results of the present study corrugated with the observation of Williams and Christian, (1959). They reported no corresponding changes in rumen pH value in different treatment groups.



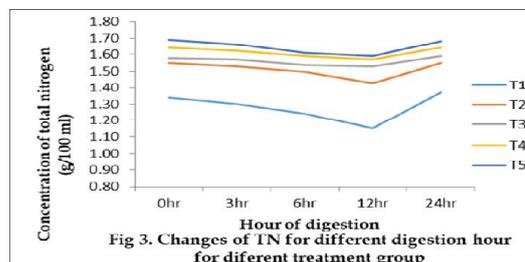
Total volatile fatty acids

The changes of TVFA concentrations in different treatment groups were found to be increased up to 12 h after feeding but gradually decreased its concentration up to 24 h (Fig. 2). The TVFA at 0 hour and at 24 hour post feeding for any of the treatment groups were almost similar. Among the treatment groups, the concentration of TVFAs in T₂ group was tended to be higher irrespective of sampling hours (Fig.2). Reid *et al.*, (1957), conducted experiments at Massey University sequentially reported that with pasture fed to cows indoor or grazed have shown that comparatively large

changes occur in rumen TVFA value with time after feeding. The concentration of TVFA was increased to a peak at three to six hours after the start of feeding. Further it showed that TVFAs production was highest at 12 hour post feeding and the TVFA production from 0 hour to 3 and 6 hours was increasing.

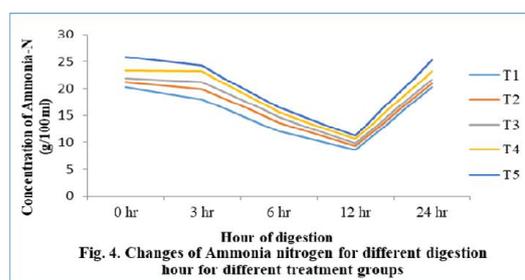
Total nitrogen (TN)

The changes of TN concentrations in different treatment groups were found decreasing gradually up to 12 h after feeding, but then increased gradually up to 24 h (Fig. 3). Among the treatment group the concentration of TN in T₅ group was highest irrespective of sampling hours (Fig. 3). Bourg, (2012) also reported that protein of low nitrogen solubility had more value for ruminants than highly soluble nitrogen source. The nature of dietary protein affects the ruminal TN.



Ammonia nitrogen (NH₃-N)

The changes of NH₃-N concentrations in different treatment groups were found decreasing gradually towards 12 h after feeding but then again increased up to 24 h (Fig.4). The NH₃-N at 0 hour and at 24 hour after feeding for any of the treatment groups was almost the similar. The concentration of NH₃-N in T₅ was tended to be higher irrespective of sampling hours (Fig.4).



Spires and Clark (1979) observed that protein with high solubility in the rumen produced more ammonia and subsequently less efficiently

utilized. According to Carvalho *et al.*, (1997), the reduction in ruminal NH₃-N concentration can be explained by the increase in energy availability in the rumen, allowing higher use of ammonia for microbial growth, with consequent reduction in ammonia loss due to synchronization in the carbohydrates and protein degradation.

Total solids (TS)

The changes of TS concentrations in different treatment groups were found to be increased gradually from 0 hour up to 24 h after feeding. The concentration of TS in T₃ was tended to be higher irrespective of sampling hours (Fig. 5)

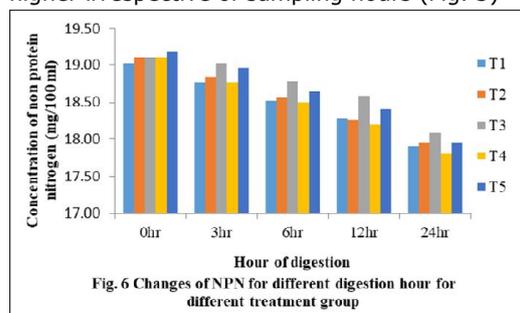


Fig. 6 Changes of NPN for different digestion hour for different treatment group

Non protein nitrogen (NPN)

The changes of NPN concentrations in different treatment groups were found to be decreased gradually up to 24 h after feeding. The concentration of NPN in T₅ was tended to be higher irrespective of sampling hours (Fig. 6).

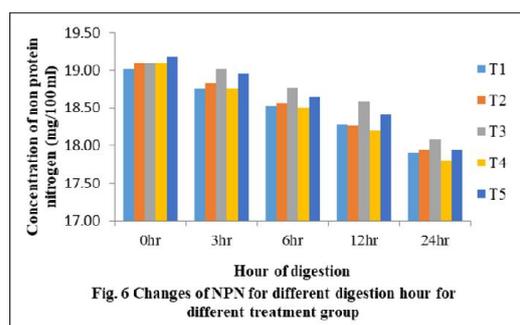


Fig. 6 Changes of NPN for different digestion hour for different treatment group

Protein nitrogen (PN)

The changes of PN concentrations in different treatment groups were found to be decreased up to 12 h after feeding but increased its concentration up to 24 h (fig. 7). The PN at 0 hour and at 24 hour after feeding for any of the treatment groups were almost similar. The concentration of PN in T₅ was tended to be higher irrespective of sampling hours (fig 7)

Total mixed ration for cattle

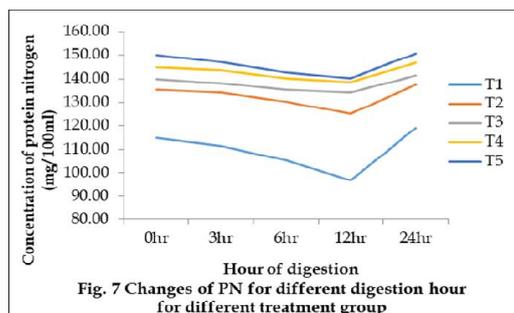


Fig. 7 Changes of PN for different digestion hour for different treatment group

Conflicts of interest

We, the affiliated authors whose names are mentioned in the manuscript, hereby, clearly certify that, we have no affiliations with or involvement in any organization or entity with any financial interest or non-financial interests in the subject matter or materials discussed in this manuscript.

Conclusion

Total mixed rations (TMR) can help to achieve maximum performance and can be the most adopted method for feeding high producing animals in almost all over the world. The best combination of roughage to concentrate ratio was in T₅ group for better N utilization to achieve maximum performance through proper feeding. It can be concluded from the findings of the present study that using a combination of the proper amount of roughage and concentrates in a TMR ensure better rumen environment for fermentation and TMR can very well replace the other high nutritive and expensive roughage sources without adversely affecting growth and milk production in indigenous dairy cow.

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