Effect of silage and soybean straw based Total Mixed Ration (TMR) on the growth performances of growing bull calves

N.R. Sarker*, D. Yeasmin, F. Tabassum and M.A. Habib

Fodder Research and Development Project, Bangladesh Livestock Research Institute (BLRI), Savar, Dhaka

Abstract

This study was undertaken to know the effect of silage and soybean straw based Total Mixed Ration (TMR) on the growth performances of growing bull calves. 30 growing bull calves were divided into 5 treatment groups considering their initial body weight 111.30±6.67 to115.66±10.69 kg and age 24 to 26 months, respectively. Five types of TMR were prepared with different roughage and concentrate ratios (R: C) as T_1=70:30, T_2=60:40, T_3=50:50, T_4=40:60, T_5=30:70. TMR intake, DM intake, CP intake of animals in T_2 group was significantly ($P<0.001$) higher. Significantly higher ($P<0.01$) DM and CP digestibility were observed in T_2. No significant differences observed for live weight gain. The ADG was slightly higher in T_2 group (0.860 kg/day) but no significant differences were found among the treatments. Based on the results, it may be concluded that using a 60:40 (R: C) TMR can be formulated for fattening bulls for proper growth and maintenance.

(**Key words:** total mixed ration, crop residues, average daily gain, nutrient digestibility, nitrogen retention)

Introduction

Development of dairy and cattle fattening farming in Bangladesh can play a significant role in poverty alleviation, income generation and meet the excess demand of milk & meat. But to make the program fruitful we can face many obstacles. Feed scarcity is one of the major problems and the most limiting factor for livestock production in Bangladesh, and problems of both quantity and quality of roughage that fluctuates on cropping, seasons and regions hinder dairy and fattening cattle production in the country. The pastures are degraded and poorly managed and the area under green forage crops is shrinking due to increase in human population and urbanization. As a result, the bulk of feeds available for ruminants in these regions are the crop residues. The crop residues have low nutritional value and are bulky and fibrous. But crop residues are valuable resources since they form a bulk of ruminant feed in Bangladesh. Due to lack of effective management most of these crop residues are being burnt and causes environmental pollution. The scarcity of green fodder and escalating demand of concentrate ingredients for human consumption has led to the utilization of non-competitive and non-conventional crop residues in livestock feeding. Use of locally available feed ingredients can substantially reduce the cost of livestock production (Saha *et al*., 2002). In the recent years, the concept of feeding complete 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

*Corresponding author: sarkernr62@yahoo.com

without giving any choice to the animal for selection of specific ingredient (Khan *et al*., 2010). The merits of complete rations are related to a stable environment for rumen fermentation, minimal fermentation losses and fluctuation in release of ammonia and enhancement in utilization of low grade roughages (Venkanna *et al*., 1997). Besides these complete rations facilitates control ratio of roughage to concentrate, provides uniform feed intake, reduces feed wastage, enhances nitrogen balance and reduces the cost of feeding (Raut *et al*., 2002; Hundal *et al*., 2004; Lailer *et al*., 2010). Hence a study was undertaken to know the effect of silage and soybean straw based total Mixed Ration (TMR) on the growth performances of growing bull calves.

Materials and Methods

Duration, experimental design and dietary treatments

The experiment was conducted for a period of 120 days at the research farm of Bangladesh Livestock Research Institute (BLRI), Savar, Dhaka, Bangladesh. The study was designed following complete randomized design (CRD) where a total of 30 growing bull calves were selected and divided in to 5 treatment groups having 6 bulls in each. It is noted that due to the shortage of required numbers of same genotype of bulls, 3 Pabna Cattle bulls and 3 RCC bulls were distributed to every treatment group considering their initial body weight ranges from 111.30±6.67 to115.66±10.69 kg and age 24 to 26 months respectively. Different types of TMR had been produced with different ratios of roughages composed of milled soybean straw and Napier-3) and concentrate composition as mentioned in Table 1. The total mixed ration contained 16% CP.

Table 1. Composition of TMR for different treatment groups

Feed type & Nutrient	Ingredients	Chemical composition (% DM basis)		Amounts of feed in TMR (kg/100kg)				
		DM	CP	T_1	T_2	T_3	T_4	T_5
Roughage	Napier-3 silage	20.3	10.2	56	48	40	32	24
	Soybean straw	88.19	4.1	14	12	10	8	6
Concentrate	Khesari bran	89.58	13.6	3	10	13	23	28
	Soybean meal	87.6	40.0	17.5	16.5	15	14	13
	Wheat bran	87.9	16.7	6.5	10.5	19	20	26
	Salt	-	-	0.5	0.5	0.5	0.5	0.5
	DCP	-	-	2.5	2.5	2.5	2.5	2.5
Roughage : Concentrate				70:30	60:40	50:50	60:40	70:30
Total Fresh amount		-	-	100	100	100	100	100
	DM (%)	-	-	53.3	54.3	59.8	61.8	64.2
Nutrients	CP (%)	-	-	16.7	16.2	16.1	16	15.9
	ME(MJ/kg DM)	-	-	9.4	9.8	9.5	9.7	9.7

Feeding management of experimental animals

Soybean straw was collected from Noakhali district. Before preparation of TMR, soybean straw was milled through the roughage grinder and then mixed with concentrate ingredients. The concentrate mixture consisted of Wheat bran, Kheshari bran, Soybean meal, Salt and DCP. Before feeding in each day to the experimental animals, the silage portion of the TMR was mixed properly with the previously mixed soybean straw + concentrate manually. Different types of TMR were offered in each group twice daily, once in the morning at 8.00 am and rest in the afternoon at 4.00 pm. Fresh, clean and safe drinking water was available to the animals at all time.

Metabolic trial

In middle of the feeding trial, a conventional digestibility trial was conducted considering 07 days adjustment period and 07 days collection periods. During the collection period, daily feed intake, feces and urine voided were recorded and collected individually.

Chemical analysis

The samples of feeds and faeces were analyzed by the method of AOAC (2005) for determination of DM, CP, OM and Ash, while, ADF and NDF by Van Soest *et al*., (1991) and ME using Bomb Calorimeter. Urine samples were analyzed for Nitrogen and crude protein (CP). All the samples were analyzed in duplicate and mean values were recorded.

Statistical analysis

There were five treatments with 6 replications (animals) in each group. Thus the design of the experiment was completely randomized design (CRD). The data were analyzed using the "SPSS 17.0" statistical program using one way ANOVA. Duncan's Multiple Range Test (DMRT) was done to compare among the treatment means for various parameters. Significant difference was declared when $p<0.05$

Results and Discussion

Feed intake

The feed intake of animals supplied different form of TMR in different treatment groups are given in Table 2. Fresh feed intake, DM intake, CP intake and %DM intake on live body weight differed significantly ($P<0.001$). The fresh feed intake, DMI, CP intake of growing bull in T_2 group was significantly higher than those of T_4 and T_5. This could be

Table 2. Feed intake of animal for different treatment group

Parameters	Treatment groups (mean±SE)					
	T_1	T_2	T_3	T_4	T_5	Sig. Level
Feed intake (kg/day)	9.0^{a}±0.1	9.1^{a}±0.1	9.0^{a}±0.1	7.8^{b}±0.1	8.5^{b}±0.1	***
DMI (kg/day)	4.7^{c}±0.1	5.8^{a}±0.1	5.5^{a}±0.1	5.1^{b}±0.1	5.1^{b}±0.1	***
CPI (kg/day)	0.7^{b}±0.1	0.9^{a}±0.1	0.9^{a}±0.1	0.8^{b}±0.1	0.8^{b}±0.1	***
DMI% LW	2.2^{b}±0.1	2.6^{a} ±0.1	2.6^{a} ±0.1	2.5^{a} ±0.1	2.4^{b} ±0.1	***

DMI=Dry matter intake; CPI= crude protein intake LW=Live weight of animal; ***-P<0.001means with uncommon superscript within the same column differed significantly

due to different ratios of roughage and concentrate in TMR. Though, animals of all treatment groups were supplied TMR containing same % CP but variation of CP intake could be due to variation of DM intake from TMR.

Several studies on feeds and ration formulation for high yielding cows have shown positive relationships between increased ratio of concentrate and feed intake, these relations have been well documented by Macleod *et al*. (1983) where forage: concentrates ratios were considered from 80:20 to 35:65. They found that as the proportion of concentrate increased, daily DM intake increased linearly, which is similiar with this study. Macleod *et al*. (1983) stated that the DM intake increased until the hay Changes towards lower forage: concentrate ratios in total mixed rations fed ad libitum to dairy cows also resulted in higher total intake of DM (Moseley *et al*., 1976). In tropical environments, Mahal *et al.*, (1997) found that daily DM intake differed (10.4, 10.2 and 9.9 kg) between groups fed roughage and concentrates in the ratios 50:50, 60:40 and 70:30, respectively. The result contradicted by Knonoff and Heinrichs (2003) who reported that DM intake was increased by reducing forage particle size. The DM intake of animals in T_1 was significantly lower than those of animals in other 4 treatments (T_2, T_3, T_4 and T_5).

Nutrient digestibility

Nutrient digestibility of animals supplied different type's form of TMR based diet in different treatment are given in Table 3. There were no significant differences in DM digestibility between T_1, T_4 & T_5 treatment groups. This higher DM digestibility in T_2 may be due to the different roughage concentrate ratio in treatment groups. This result is similar with the findings reported by Konka *et al*. (2015) who conducted an

Table 3. Effect of Different ratios of TMR on nutrient digestibility (%) of Growing bulls

Nutrients	Treatment groups (mean ± SE)					Sig. level
	T_1	T_2	T_3	T_4	T_5	
DM	$62.6^{b} \pm 1.4$	$68.0^{a} \pm 1.5$	$63.5^{ab} \pm 0.7$	$58.9^{b} \pm 2.1$	$59.3^{b} \pm 1.5$	**
CP	$76.8^{a} \pm 0.6$	$78.0^{a} \pm 0.8$	$73.8^{ab} \pm 1.3$	$70.0^{b} \pm 2.4$	$70.0^{b} \pm 2.6$	**
OM	$67.1^{ab} \pm 1.4$	$70.1^{a} \pm 1.8$	$65.8^{abc} \pm 0.6$	$61.7^{c} \pm 2.1$	$63.5^{bc} \pm 1.5$	*
Ash	$40.1^{ab} \pm 3.7$	$50.1^{a} \pm 1.1$	$45.4^{ab} \pm 1.7$	$38.5^{b} \pm 4.0$	$36.4^{b} \pm 5.2$	NS
ADF	$67.6^{a} \pm 1.8$	$67.3^{a} \pm 3.1$	$67.6^{a} \pm 1.1$	$59.2^{b} \pm 2.8$	$61.3^{ab} \pm 1.5$	*
NDF	$70.8^{ab} \pm 1.1$	$70.9^{a} \pm 2.1$	$66.2^{bc} \pm 1.9$	$61.6^{c} \pm 2.5$	$62.9^{c} \pm 1.5$	**

DM=Dry matter; CP=Crude protein; OM=Organic matter; ADF=Acid detergent fiber; NDF=Neutral detergent fiber; SE=Standard error,**-$p<0.01$,*-$p<0.05$, means with uncommon superscript with in the same column differed significantly ($p<0.01$)

experiment with the crop residue based complete ration (crop residue with concentrate in 60:40) on buffalo in India. Similarly, CP digestibility was significantly ($p<0.01$) higher in treatment T_2 but the difference was not significant ($p>0.05$) between T_4 & T_5 and the lowest CP digestibility was observed in T_4. The highest OM digestibility was found in T_2 and lowest in T_4. There were no significant difference ($p>0.05$) in Ash digestibility. There were significant ($p<0.05$) difference in ADF digestibility. ADF digestibility was higher in T_3 and lowest in T_4. There were significant ($P<0.01$) difference in NDF digestibility. ADF digestibility was higher in T_2 and lowest in T_4. Wang *et al*. (2004) mentioned that the increase in DM digestibility appeared to be associated with higher NDF digestibility.

Nitrogen utilization

Nitrogen balance of animals supplied different form of TMR based diet in different treatment groups are given in Table 4. There were significant differences in nitrogen intake between different treatment groups. This higher nitrogen intake observed in 50:50 (R: C) may be due to the different roughage concentrate ratio in treatment groups. The fecal nitrogen of animals in all treatment groups were not significantly ($P>0.05$) different. The urinary nitrogen of animals in all treatment groups were not significantly ($P>0.05$) different. There were significant ($P<0.05$) difference among the dietary treatments for nitrogen outgo. Nitrogen balance of animals supplied different form of TMR based diet in different treatment groups were not significantly ($P>0.05$) differences in nitrogen balance.

Similar results were reported by other studies (Devant *et al*., 2000). The fecal N excretion was not affected by dietary CP concentration ($P>0.05$). This result agrees with Marini and van Amburgh (2003), who observed no increase in fecal N excretion. In contrast, Hunter and Siebert (1980) observed increases

Table 4. Effect of different ratios of TMR on nitrogen utilization of growing bulls

Parameter	Treatment groups (mean ± SE)					Sig. level
	T_1	T_2	T_3	T_4	T_5	
Nintake(g/d)	12.7±0 .1	14.5± 0.3	15.0± 0.2	13.0± 0.2	13.2± 0.2	***
Fecal N(g/d)	2.4± 0.1	2.7± 0.2	3.1± 0.2	2.8± 0.1	3.0± 0.1	NS
Urinary N(g/d)	1.5± 0.2	1.8± 0.2	1.7± 0.2	1.3±0.1	1.1± 0.2	NS
Noutgo(g/d)	4.06± 0.1	4.5± 0.1	4.9± 0.1	4.2± 0.1	4.2± 0.1	*
N balance(g/d)	68.1± 1.4	68.5± 1.3	67.3± 0.7	67.7± 0.9	68.1± 0.8	NS

N=Nitrogen,***-$p<0.001$,*-$p<0.05$, means with uncommon superscript within the same column differed significantly

in fecal N excretion with increasing protein supplementation. There were no significantly different N retention (Percentage of N intake, p>0.05) among different treatments. Castillo *et al*. (2001 a, b) indicated that N retention was not affected by level of CP concentration. Sporndly (1986) concluded that changing the ratio of roughage to concentrate from 62:38 to 50:50 significantly increased live weight gain.

Table 5. Changes of animal's body weight for different treatment groups

Weight parameters	Treatment groups (mean±SE)					
	T_1	T_2	T_3	T_4	T_5	Sig. level
Initial WT (kg)	113.5±6.1	112.9±5.2	115.6±10.6	111.3±6.6	112.9±5.1	NS
Final WT (kg)	211.6±8.5	217.5±8.6	214.6±12.5	195.7±10.1	213.6±10.8	NS
ADG (kg/d)	0.7 ±0.1	0.8 ± 0.1	0.7 ± 0.1	0.6 ± 0.1	0.7 ± 0.1	NS

WT= weight, ADG =Average daily gain ; NS-non significant (p>0.05); means with uncommon superscript within the same column differed significantly

Body weight change

Initial body weight and body weight changes after the experiment are given in Table 5. Final body weight of animals in all treatment did not affected by the dietary treatments (p>0.05). The results also indicate that the body weight gain has no significant effect for variable ratios of roughage and concentrates in all treatment. There were no significant changes of body weight gain of animals with increasing concentrate or decreasing roughages. Though DM and CP intake and nutrient digestibility was higher in T_2 compared to other groups, but why body weight gain was not significantly different among the treatment groups was not clear. Further investigation is needed.

The result is in agree with Mahal *et al*. (1997) who reported no differences in live weight changes at forage : concentrates ratios of 50:50, 60:40 and 70:30. Sanh *et al*. (2002) also reported that, increased concentrate ratio in the diet and feeding forage ad libitum increased body weight gain. In contrast,

Conclusion

The results of the present study revealed that the ration fed in T_2 60:40 (R:C) are better compared to those ratio that fed to other groups in terms of intake, digestibility of different nutrients and that helps in proper growth and maintenance of growing bull.

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