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Supplementation of Urea-Molasses-Straw Based Diet with Different Levels of Concentrate for Fattening of Emaciated Bulls

[1]M. Atiqur Rahman, [1,2]A.M.M. Nurul Alam and [1]M. Shahjalal
[1]Department of Animal Nutrition, Faculty of Animal Husbandry,
Bangladesh Agricultural University, Mymensingh-2202, Bangladesh
[2]Seafood Quality Group, Faculty of Biosciences and Aquaculture,
Bodo University College, N-8028, Bodo, Norway

Abstract: An experiment was conducted to investigate the effects of supplementation of Urea-Molasses-Straw (UMS) based diet with different levels of concentrate for fattening emaciated bulls. The unsupplemented control diet T_0 was composed of UMS (80%) and green grass (20%). In the treatment diets T_1, T_2 and T_3 concentrate mix was added at 10, 20 and 30% of DM requirement, respectively to replace the same amounts of UMS and green grass. There was significant ($p<0.01$) difference in average DM intake, which were 3.42, 4.65, 4.79 and 5.14 kg for T_0, T_1, T_2 and T_3, respectively. The animals fed supplemented diets T_3, T_2 and T_1 gained significantly ($p<0.01$) higher live weight (56.0, 46.0 and 40.0 kg, respectively) and had better feed conversion ratio (6.58, 7.34 and 8.22, respectively; non-significantly) than the animals fed on T_0 (Live weight gain 11.0 kg and feed conversion ratio 21.95). There was a tendency to increase nutrient digestibility with increased levels of concentrate supplementation. The highest cost for each kg meat production was recorded for diet T_0 (Tk. 143.45) followed by diets T_3 (Tk. 75.67), T_2 (Tk. 72.91) and the lowest was recorded for diet T_1 (Tk. 68.73).

Key words: Urea-molasses-straw, intake, feed conversion, meat production

INTRODUCTION

The importance of livestock is widely recognized as an integral component of farming system and also for contribution to Gross Domestic Products (GDP) in Bangladesh. Bangladesh has a higher cattle population than any other countries of the European Economic Community (EEC) (Allen, 1990) and is distributed with a greater density (2.6 cattle and buffalo heads per hectare) compared to other South-East Asian countries (Assaduzzaman, 1996). Though livestock are huge in number in Bangladesh, they are one of the poorest in the world in respect of per animal output.

The major constraint of livestock production in the country is an acute shortage of feeds and fodder both in quantity and quality. Due to high pressure on land for crop production for human consumption, farmers cannot spare land for fodder production for feeding cattle (Akbar *et al*., 2000). Cattle and buffalo mainly subsist on straw based diet with limited supplementation of green fodder and little or no concentrate. As a consequence, the productivity of our livestock is very low compared to those of the developed countries. The animal productivity in Bangladesh mainly depends on the efficient utilization of rice straw. Nutritive value of straw can be improved by proper chemical treatment and supplementation with nitrogen and energy. It has been reported that if molasses and urea mixture is supplied to the animals with straw then feed intake, digestibility and palatability of rice straw increases (Barnah *et al*., 1992). On traditional feeding growth rate of young cattle was found to be 100-200 g day^{-1} but on improved feeding it was improved to 300-400 g day^{-1} (Akbar *et al*., 1990). High plane of nutrition has a significant effect on growth rate (Wilson, 1985). Growth rate of an animal depends on its nutritional status specially protein concentration of the diet and protein source in the diet (Banerjee, 1998). On the other hand concentrate supplements are needed to obtain higher intake of nutrients required for higher production (Schiere and Ibrahim, 1986). Supplementation of concentrates with crop residues and agro-industrial by-products are rarely practiced for feeding ruminants in Bangladesh. So, it is important to study the utilization of protein feeds or supplements by growing cattle.

Number of research have been conducted using heifers and milking cows to determine the effect of feeding Urea-Molasses-Straw (UMS) on feed intake, growth performance and milk yield. However, little emphasis was

Corresponding Author: A.M.M. Nurul Alam, Seafood Quality Group, Faculty of Biosciences and Aquaculture, Bodo University College, N-8028, Norway Tel: +47 91626814

given on the effect of supplementation of concentrate on growth and fattening of animals fed on UMS. Keeping this view in mind the present research was undertaken with the following objectives:

- To study the effect of supplementation of different levels of concentrate on feed intake, nutrient digestibility and growth performance of bulls fed UMS diet
- To determine the optimum level of concentrate in the diet for economic fattening of bulls fed UMS

MATERIALS AND METHODS

Experimental site, animals and housing: The experiment was conducted at the Animal Nutrition Field Laboratory, Bangladesh Agricultural University, Mymensingh from 22nd July to 29th September 2002. Twelve emaciated bulls weighing, on an average 109.4±14.9 kg were selected for the feeding trial and kept individually in well ventilated face out stanchion barn. Animals were ear tagged and allowed 7 days to adapt with the experimental conditions. All the animal were dewormed with anthelmentic drugs (Peraclear Bolus and/or Tetranid Bolus, Techno Drugs, Bangladesh) immediately before starting the experiment.

Experimental design and dietary treatments: The animals were blocked into 3 groups according to live weight. The animals in each block were then assigned at random to four dietary treatments having three animals in each treatment. The layout of the experiment is shown in Table 1.

Preparation of Urea-Molasses-Straw (UMS) and concentrate mix: Required amounts of urea (3%), molasses (15%) and straw (82%) were weighed out separately. A polythene sheet was spread on the ground and small amount of chopped straw was spread on the sheet. Urea was dissolved with water (half of the weight of straw) and molasses was added and mixed thoroughly. Urea molasses solution was sprayed over the straw and mixed properly by hand, left for half an hour and then fed to the animals. The concentrate mix was prepared by mixing rice polish, wheat bran, soybean meal and til oil cake at 30:30:20, respectively. Total amount of roughage (UMS + green grass) and concentrate mix required for each animal were weighed out daily and half of the required amount was offered separately at 08:00 h and the remaining half at 16:00 h. Fresh clean water was made available to the animals at all the time.

Measurement of feed intake: The Dry Matter (DM) intake of each animal was determined by subtracting the amount of DM left over from the amount of DM supplied on the earlier day.

Table 1: Layout of the experiment

	#Dietary treatments			
Block	T_0	T_1	T_2	T_3
Initial live weight (kg)				
I	135	124	126	121
II	103	105	108	117
III	91	99	92	92
Mean±SD	109.7±22.7	109.3±13.1	108.7±17.0	110.0±15.7

#T_0: Urea-molasses+green grass, T_1: Urea-molasses+green grass+concentrate (10%), T_2: Urea-molasses+green grass+concentrate (20%), T_3: Urea-molasses +green grass+concentrate (30%)

Measurement of live weight gain: Animals were weighed with an animal weighing balance towards the end of every week to observe the live weight change. At the end of experiment each animal was weighed for three consecutive days and the average of these weights was taken as the final weight of the individual animals. The weight gain was calculated by subtracting the initial weight from the final weight and the daily weight gain was calculated.

Digestibility trial: A conventional digestion trial was conducted for a period of 7 days towards the end of feeding trial to determine the digestibility of proximate components. The amount of feed supplied to each animal during 24 h was recorded. Representative feed samples and left over feeds were collected daily and stored in polythene bags for proximate analysis. The total quantity of faeces voided daily was recorded against each animal for seven days. About 5% of well-mixed faeces of each animal was collected every day and then sun dried and stored in polythene bags. At the end of collection period, the sun-dried faeces were mixed and ground to pass through 20 mm screen sieve for chemical analysis. Some portion of fresh sample collected every day from individual animals was stored at -20°C and then used for determination of DM and CP contents.

Chemical analysis: Representative sample of feed, faeces and left over were subjected to chemical analysis for determination of Crude Protein (CP), Crude Fiber (CF), Ether Extract (EE), ash and Nitrogen Free Extract (NFE) following the methods of AOAC (1995). All the samples were analyzed in duplicate and mean values were recorded.

Statistical analysis: The data were analyzed using MSTAT statistical program to compute analysis of variance (ANOVA) for a Randomized Block Design (RBD) and the mean values with Standard Error of Difference (SED) were recorded. Least Significant Difference (LSD) test was also done to compare the treatment means for different parameters.

RESULTS

Feed intake: As shown in Table 2, daily total DM intake of the animals was 3.41, 4.65, 4.79 and 5.14 kg for T_0, T_1, T_2 and T_3, respectively. The lowest DM intake was observed in animals fed diet T_0 and the highest was for T_3. The total daily DM intake increased ($p<0.05$) linearly as the level of concentrate supplementation increased from unsupplemented control diet (T_0) to 30% supplemented diet (T_3).

In general, intake of UMS was significantly ($p<0.01$) higher in concentrate supplemented diets (T_1, T_2 and T_3) compared to control T_0 (Table 2). The highest UMS intake was recorded for diet T_1 containing 10% concentrate supplement and UMS intake decreased non-significantly as the level of concentrate supplementation was raised to 20 and 30%. Similarly, intake of green grass decreased non-significantly with the increased level of concentrate supplementation. In contrast, concentrate DM intake increased significantly ($p<0.05$) as the level of supplementation was raised from zero (T_0) to 30% (T_3). Animals receiving different levels of concentrate with UMS and green grass (T_1, T_2, T_3), consumed significantly ($p<0.05$) higher amounts of DM than those receiving UMS and green grass only (T_0). The DM intake per 100 kg live weight was significantly ($p<0.05$) higher in supplemented groups than that in control group, but no significant difference was recorded among the supplemented groups (Table 2).

Live weight gain: Total live weight gains were 11.0, 40.0, 46.0 and 56.0 kg when animals fed with different levels (0, 10, 20 and 30% of DM requirement) of concentrate respectively (Table 2). T_1, T_2 and T_3 showed significantly ($p<0.05$) higher live weight gain than those fed on diet T_0. But there were no significant differences in live weight gain between treatments T_1, T_2 and T_3.

The daily average live weight gain in animals fed diets T_0, T_1, T_2 and T_3 were 157, 571, 657 and 800 g, respectively (Table 2). Live weight gain on diets T_3, T_2 and T_1 was significantly ($p<0.05$) higher than that on diet T_0.

Feed conversion efficiency: There were significant ($p<0.01$) differences among the diets (T_0, T_1, T_2 and T_3) for feed conversion efficiency (Table 2). The animals fed on diets T_1 (8.22), T_2 (7.34) and T_3 (6.58), which had different levels of concentrate, showed significantly ($p<0.01$) superior values for feed conversion efficiency than that of the animals fed on diet T_0 (21.95).

Apparent digestibility and nutritive value: There was no significant ($p>0.05$) difference among the dietary treatments for digestibility of DM and OM (Table 3).

The digestibility of CP was significantly ($p<0.05$) higher for diets T_2 (55.28%) and T_3 (58.05%) compared to that of diets, T_0 (41.39%) (Table 3). The digestibility of CF was similar for all dietary treatments with a trend to decrease with the increase of concentrate supplementation. The digestibility of Ether Extract) EE was 58.64, 60.56, 66.02 and 69.25% for diets T_0, T_1, T_2 and T_3, respectively, which had significant ($p<0.05$) difference. Nitrogen Free Extract (NFE) digestibility of different diets did not differ significantly ($p>0.05$). It appears from the Table 3 that there were significant ($p<0.01$) differences among the dietary treatments for DCP. Results indicated that DCP content increased with the increasing levels of concentrate in UMS based diet. There was a significant ($p<0.05$) reduction of DCF content due to concentrate

Table 2: Intake and growth performance of bulls fed different diets

Parameters	#Dietary treatments T_0	T_1	T_2	T_3	SED	Level of significance
Initial live weight (kg)	109.70	109.30	108.70	110.00	5.39	NS
Final live weight (kg)	120.70^b	149.30^a	154.70^a	166.00^a	9.30	**
Total live weight gain (kg)	11.00^b	40.00^a	46.00^a	56.00^a	6.86	**
Average live weight gain (g day^{-1})	157.00^b	571.00^a	657.00^a	800.00^a	98.04	**
DM intake from UMS (kg day^{-1})	2.57^c	3.37^a	3.13^{ab}	3.04^b	0.13	**
DM intake from grass (kg day^{-1})	0.84	0.83	0.76	0.69	0.05	NS
DM intake from concentrate (kg day^{-1})	-	0.44^c	0.90^b	1.41^a	0.09	**
Total DM intake (kg day^{-1})	3.41^d	4.65^c	4.79^b	5.14^a	0.22	**
DM intake (kg/100 kg LW)	2.98^b	3.59^a	3.63^a	3.73^a	0.08	**
DM intake (g/kg$^{0.75}$/day)	97.20^c	121.00^b	122.90^{ab}	127.70^a	2.31	**
Feed conversion efficiency (DMI/LWG)	21.95^a	8.22^b	7.34^b	6.58^b	1.07	**
Crude protein intake (g day^{-1})	294.20^b	600.90^a	619.40^a	665.10^a	31.65	**
Protein conversion efficiency (CPI/LWG)	1.89^a	1.06^b	0.94^b	0.85^b	0.12	**
Estimated ME intake (MJ day^{-1})	27.46^b	37.73^a	40.04^a	43.59^a	3.59	*
Energetic efficiency (MJMEI/kg LWG)	178.00^a	66.50^b	61.10^b	55.60^b	9.90	**

Mean values having different superscripts letter(s) in a row differ significantly ($p<0.05$). #T_0: Urea-molasses+green grass, T_1: Urea-molasses+green grass+concentrate (10%), T_2: Urea-molasses+green grass+concentrate (20%), T_3: Urea-molasses+green grass+concentrate (30%). NS: Not significant

Table 3: Apparent digestibility and nutritive value of different diets

Parameters	#Dietary treatments T_0	T_1	T_2	T_3	SED	Level of significance
Apparent digestibility (g/100 g)						
Dry Matter (DM)	53.42	54.81	55.39	55.65	3.26	NS
Organic Matter (OM)	57.93	59.19	59.89	60.37	2.90	NS
Crude Protein (CP)	41.39^{b}	48.16^{ab}	55.28^{a}	58.05^{a}	4.46	*
Crude Fiber (CF)	74.27	70.53	66.76	65.48	2.93	NS
Ether Extract (EE)	58.64^{c}	60.56^{bc}	66.02^{ab}	69.25^{a}	2.40	*
Nitrogen Free Extract (NFE)	48.42	53.45	55.99	57.02	3.20	NS
Nutritive value (g/100 g DM)						
DCP	3.57^{c}	6.12^{b}	7.15^{ab}	7.50^{a}	0.48	**
DCF	25.19^{a}	18.45^{b}	17.47^{b}	17.14^{b}	0.77	**
DEE	1.33^{c}	2.56^{b}	2.79^{a}	2.93^{a}	0.09	**
DNFE	20.52^{b}	23.68^{ab}	24.81^{a}	25.26^{a}	1.41	*
TDN	52.27	54.12	55.72	56.50	2.62	NS
D-value	50.62	50.92	52.22	52.84	2.53	NS
Estimated ME (MJ kg^{-1} DM) ●	8.09	8.14	8.36	8.45	0.41	NS

●ME values were estimated from digestible organic matter (D-value) as ME (MJ kg^{-1} DM)= 0.16×D-value (MAFF, 1984). Mean values having different superscripts letter(s) in a row differ significantly ($p<0.05$). #T_0: Urea-molasses+green grass, T_1: Urea-molasses+green grass concentrate (10%), T_2: Urea-molasses+green grass+concentrate (20%), T_3: Urea-molasses+green grass+concentrate (30%)

Table 4: Production cost of animals fed different diets

Parameters	#Dietary treatments T_0	T_1	T_2	T_3	SED	Level of significance
Cost of feed ingredients (Tk/d/animal)	9.89^{d}	16.74^{c}	20.51^{b}	25.06^{a}	1.29	**
Feed cost (Tk/kg live wt. Gain)	63.73^{a}	29.60^{b}	31.47^{b}	32.89^{b}	4.99	**
Carcass yield (kg/d/animal) ●	0.07b	0.25^{a}	0.28^{a}	0.35^{a}	0.04	**
Cost of meat production (Tk kg^{-1})	143.45^{a}	68.73^{b}	72.91^{b}	75.67^{b}	12.30	**

● Carcass yield was estimated based on the killing out proportion of 0.43 (carcass wt./slaughter wt.) (Shahjalal *et al*., 1999). Mean values having different superscripts letter(s) in a row differ significantly ($p<0.05$). #T_0: Urea-molasses+green grass, T_1: Urea-molasses+green grass+concentrate (10%), T_2: Urea-molasses+green grass+concentrate (20%), T_3: Urea-molasses+green grass+ concentrate (30%)

supplementation (Table 3). Digestible Ether Extract (DEE) content of diets T_2 and T_3 were significantly higher ($p<0.05$) than that of diets T_0 and T_1 (Table 3). There was significant ($p<0.01$) difference for Digestible Nitrogen Free Extract (DNFE) among the treatments. There was no significant ($p>0.05$) difference in TDN among the dietary treatments (Table 3) although there was a trend of increase with the increase of concentrate supplementation.

Production cost on different diets: The daily feed cost for each animal was Tk. 9.89, 16.74, 20.51 and 25.06 on diets T_0, T_1, T_2 and T_3, respectively (Table 4). There was a linear increase ($p<0.05$) in daily feed cost as the level of concentrate feeding was raised. In contrast, average feed cost for each kg live weight gain reduced significantly ($p<0.05$) from un-supplemented control diet to supplemented diets (Table 4). The average feed cost for each kg live weight gain was lowest in group T_1 (Tk. 29.60) followed by T_2 (Tk. 31.47), T_3 (Tk. 32.89) and T_0 (Tk. 63.73).

The average carcass yield estimated from killing out proportion (carcass wt./slaughter wt.) increased significantly ($p<0.05$) with the inclusion of different levels of concentrate in the UMS based diet (Table 4). The average cost of meat production ran in parallel to feed cost for live weight gain. The highest cost for each kg meat production was recorded for diet T_0, followed by T_3, T_2 and lowest was recorded for diet T_1 (Table 4).

DISCUSSION

In the present study, the highest UMS intake was recorded (Table 2) for diet T_1 containing 10% concentrate supplement and thereafter UMS intake decreased non-significantly as the level of concentrate supplementation was raised from 10 to 20% and also from 20 to 30%. The results suggest that 10% concentrate supplementation may be suitable for optimum fermentation of UMS based diets in ruminants. However, UMS intake decreased at the higher levels of concentrate supplementation indicated that the animals satisfied most of their nutrient requirements from the more palatable concentrate mix rather than UMS content of the diets. The results of the present study are in accordance with those of Chowdhury (2001), who stated that increase in Cotton Seed Cake (CSC) with UMS, total DM intake increased by 1 g kg^{-1} $w^{0.75}$/day but straw DM intake decreased by 0.54 g kg^{-1} $w^{0.75}$/day. Similarly, DM intake was higher in diets containing concentrate to roughage ratio of 60:40 than that in diet 30:70 (Santra and Pathak, 2001).

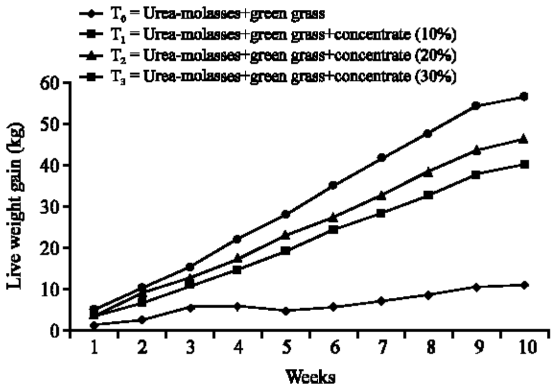

Fig. 1: Cumulative live weight gain of animals given different diets

Figure 1 shows that growth rate of growing cattle improved with the increasing levels of concentrate supplementation to the UMS based diet. The animals received increased amounts of energy and protein due to concentrate supplementation. This may have resulted in the availability of increased substrates at the tissue levels for anabolic activities and ultimately reflected in the growth performance of the animals.

The findings of the current experiment are in agreement with those of Budmaska and Kalinka (1994), who found 713, 726, 748 and 807 g day^{-1} weight gain in bulls. Dolberg and Finlayson (1995) supplemented urea treated straw with cottonseed cake ranging from 0 up to 4 kg/head/day and recorded a curvilinear response ranging from 236 to 861 g day^{-1}. Anuez *et al.* (1991) reported that Holstein steers having live weight of 150-420, 150-250, 251-330 and 331-420 kg were given concentrates 4.0, 4.8, 4.0 and 3.2 kg plus forage and molasses, urea separately or mixed. They reported that average daily gain was 878, 1003, 908 and 1084 g for 4 treatments, respectively. In another study, Simmental bulls fed grass silage or wet grass silage with supplemental concentrate 45 and 65 g kg$^{-0.75}$ gave average daily weight gains of 910-950 g (Brzoska *et al.*, 1999). Rahman (2001) studied on bull calves to see the body weight gain, giving 1 kg concentrate mix with green grass + UMS and reported 492 g gain day^{-1}.

In general, feed conversion efficiency improved with increased level of concentrate supplementation. In a previous study, Loerch and Fluharthy (1998) reported that feed efficiency (LWG/DMI) was highest ($p<0.05$) for steers continually fed 100% concentrate and the lowest ($p<0.05$) for those continually fed 85% concentrate.

Protein conversion efficiency (CPI/LWG) also showed significant ($p<0.01$) difference among the dietary groups T_0, T_1, T_2 and T_3 (Table 2). Superior protein conversion efficiency was recorded for diet T_3 (0.85) followed by T_2 (0.94), T_1 (1.06) and T_0 (1.89). The energy conversion efficiency (MJMEI/kgLWG) was 178.04, 66.54, 61.06 and 55.56 in animals given the diets T_0, T_1, T_2 and T_3, respectively. Significant ($p<0.01$) differences were observed in energy conversion efficiency among the dietary treatments. These results indicated that protein and energy requirements for live weight gain reduced linearly as the level of concentrate supplementation increased in the diets.

There was a trend to increase DM and OM digestibility with increased levels of concentrate supplementation with UMS based diet. Similarly, Chowdhury (1999) stated that digestibility of DM, OM and ADF of straw based diet were not affected by the levels of supplementation of mustard oil cake (MOC). In contrast, Ladeira *et al.* (1999) reported that supplementation of concentrate in the diets resulted in linear increase in DM digestibility of the diet. However, the digestibility of CP of diet T_1 (48.16%) did not differ significantly ($p>0.05$) with either diet T_0, or T_2 or T_3. In fact CP digestibility improved with the increase of concentrate supplementation. Chowdhury (1999) stated that with increasing levels of MOC, CP digestibility increased. Similar to the present study, increased concentrate supplement increased DM digestibility and TDN content when steers fed on diets based on sugarcane bagasse with 40 and 60% concentrate (Carvalho *et al.*, 1998). The overall results suggested that the supplementation of UMS based diet with different levels of concentrate improved feed intake, nutrient digestibility and live weight gain in emaciated bulls. Based on the above findings it may be concluded that supplementation of UMS based diet with 10% concentrate may be effective for economic fattening compared with either 20 or 30% level of concentrate supplementation.

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