Effect of high and low energy based concentrate diet supplementation on nutrient intake and body weight changes of buffalo bull calves at Subornochar Upozila of Noakhali district in Bangladesh

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Abstract

This study was designed to investigate the effects of supplementation of high and low energy based concentrate diets (13.77 Vs 12.14 MJ/kg DM metabolizable energy) on the nutrient intake and body weight changes of indigenous growing buffalo bull calves in Bangladesh. The crude protein contents of both the supplemented diets were similar (about 12.50% on DM basis). In this study, a total of fifteen indigenous growing buffalo bull calves (av. Live weight 85.10±0.874 kg) were selected from different villages. It was found that the total dry matter intake was the highest (28.22±0.015 g/kg $W^{0.75}$/d) in group supplemented with high energy concentrate diet along with farmer's practices (D_1), thereafter, in group supplemented with low energy concentrate diet along with farmer's practices (D_2) (27.79±0.015 g/kg $W^{0.75}$/d) and the lowest (26.39±0.016 g/kg $W^{0.75}$/d) in control group (D_0) in which the animals were fed only farmers practices diet. Similarly, the crude protein intake was the highest in D_1 group (2.86 ±0.029 g/kg $W^{0.75}$/d), followed by D_2 group (2.83±0.010 g/kg $W^{0.75}$/d) and the lowest in farmer's practices diet, D_0 (2.08^b±0.021 g/kg $W^{0.75}$/d). However, the final body weight of buffalo bull calves was higher in both groups supplemented with concentrate diets (D_1 and D_2) compared with control (D_0) and differed significantly ($p<0.01$) while there were no significant differences ($p>0.05$) found between D_1 and D_2 where high energy concentrate supplementation group buffalo bull claves, D_1 tended to be higher than low energy concentrate supplementation group buffalo bull claves, D_2. The highest final (254.6 kg) body weight was recorded in high energy concentrate supplemented diets and the lowest (144.0 kg) was found in control. Additionally, the average final body weight was increased by 153.40 kg (151.58%), 150.40 kg (152.22%) and 45.60 kg (46.34%) in D_1, D_2 and D_0 group buffalo bull calves, respectively. On the other hand, the average final body weight of D_1 and D_2 was increased by 110.60 kg (76.80%) and 105.20 kg (73.05%), respectively, compared with D_0. In addition, the highest (6.46) feed conversion efficiency (FCE) was recorded in D_1 followed by D_2 (6.64) and the lowest (12.17) was found in D_0. The trends of cost benefit ratio was the same like other considering factors, the highest (1:3.60) found in D_1 followed by D_2 (1:3.51) and the lowest (1:1.97) in D_0. Finally, considering all the parameters, it was clearly indicated that supplementation of concentrate diet along with farmers practice is essential for fast growing, higher body weight gain and more benefits by rearing buffalo bull calves at Subornochar Upozila of Noakhali district in Bangladesh.

Keywords: buffalo, nutrient intake, body weight gain, feed conversion ratio, cost benefit, buffalo farmer

Introduction

The economy of Bangladesh is depending on agriculture, and livestock is an essential component of the rural as well as national economy which is the predominant source of income generation. The contribution of livestock sub-sector to GDP was 1.60, 1.54, 1.47 and 1.43 percent in FY 2016-2017, 2017-2018, 2018-2019 and 2019-2020 respectively. The growth of this sub-sector was about 2.9% of national GDP is covered by the livestock sector, and its annual rate of growth is 5.5% (Banglapedia, 2021) and 13% of the total foreign exchange earnings from this sector (BBS, 2011). Seventy percent (20% people are directly engaged and 50% are partly associated) people of the country depend on livestock to some extent for their income, which

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clearly indicate that the poverty reduction potential of this sub-sectors is high (Begum *et al.*, 2011; DLS, 2020; Banglapedia, 2021). Bangladesh is one of the most concentrated livestock populated country in the world, 145 large ruminant's presence per sq km compared with 94 for India, 30 for Ethiopia and 20 for Brazil (Anonymous, 2007; NARS, 2010). In Bangladesh, livestock contributing through the production of 106.80 lakh metric ton and 76.74 lakh metric ton milk and meat, respectively in fiscle year 2019-2020 (DLS, 2020). Buffalo meat is popular in most buffalo producing countries. The world meat production is 311.8 MMT (FAOSTAT, 2014), and buffaloes contribute about 3 MMT. India has about 98 million buffaloes, which is 57% of total population in the world and about 43% of the world buffalo meat production and produces 1.48 MMT amounting 24.54% of the total meat produced in the country (FAO, 2008). Buffalo meat constitutes with high protein (above 11%) and low cholesterol (Kandeepan *et al.,* 2009). The buffalo meat is the healthiest meat among red meats known for human consumption because it is low in calories. The meat from young buffalo and cattle has clearly shown that buffalo meat is indeed as good as cattle meat (Heinz, 2001) and buffalo meat is tenderer and less in cholesterol (55%) than beef (Neath *et al.,* 2007). Feeding high levels of protein may be effective in promoting rapid live weight gains, especially growing buffalo (Basra *et al.*, 2003b). It has been indicated that the optimum fattening performance of 15 months old Nili-Ravi buffalo male calves may be obtained by providing 10.42 MJ/kg of dietary metabolizable energy and about 10.22% of crude protein (Mahmoudzadeh *et al*., 2007) and 12% CP for 11 to 12 months old male buffalo calves (Tipu *et al.*, 2009). Laxmi *et al.,* (2014) found that supplemented group attain higher weight gain (0.53 to 1.0 kg/day) compared to control (0.43 to 0.70 kg/day). Helal *et al.,* (2011) reported that calves fed 100% concentrate gained more than the other two groups (957, 941 and 1017 g/day). In Bangladesh, the role of buffaloes is not much emphasized and the species did not receive due attention by the policy makers and the researchers. Very little work has been done so far on the effect of supplementation of protein and energy based diet on body weight gain of growing buffalo bull calves. Therefore, considering the above discussion, the present study was undertaken to know the effects of supplementation of protein and energy rich diets on growth performance of buffalo bull calves in Subornochar Upozila at Noakhali district in Bangladesh which is known as delta land located on the tidal floodplain of the Meghna River delta.

Materials and Methods

Selection of study area

The study was conducted at Subornochar Upozila of Noakhali district in Bangladesh during the period of 240 days from September 2013 to April 2014. Subarnachar Upazila is an island, low-lying coastal areas of Bangladesh and highly vulnerable to natural disasters, located in between 22°28' and 22°44' north latitudes and in between 90°59' and 91°20' east longitudes. The livelihoods mainly depend on agriculture more specifically livestock and fishing.

Housing and management practices

The buffaloes were reared by the owners under conventional housing and improved management practices. A good sanitary condition and almost uniform management practice were maintained throughout the experimental period. All the buffaloes were vaccinated with FMD, anthrax, black quarter and HS for prevention of contagious diseases and dewormed for internal parasites using anthelmintic drugs and allowed two weeks to adapt the experimental conditions prior to the commencement of the study.

Table 1: Experimental layout and dietary treatments for growing buffalo

Parameters	Treatments		
	D_0	D_1	D_2
Number of growing buffalo	5	5	5
Average initial live weight (kg) (Av.±SEM)	83.30 ± 3.43	86.30 ± 3.32	85.70 ± 3.00
Supplementation of concentrate diet (kg/day)	No supplementation	1.52 ± 0.04	1.49 ± 0.36

D_0, Farmer's diets (FD) only without the supplementation of concentrate; D_1, FD + supplemented with high energy concentrate diet; D_2, FD + supplemented with low energy concentrate diet

Experimental layout and dietary treatments

The experimental layout and dietary treatments are shown in Table 1. The experiment was conducted for a period of 240 days started with two weeks of adjustment period from September 2013 to April 2014. After adjustment period, the experimental buffalo bull calves were randomly allocated into three (3) treatment groups having five buffaloes in each group.

Table 2: Ingredient and nutrient composition of supplemented concentrate diet

Ingredients	D_0 (Control)	D_1	D_2
Crushed Maize (g/kg)	0	400	0
Rice polish (g/kg)	0	200	325
Broken rice (g/kg)	0	250	250
Wheat bran (g/kg)	0	120	400
Urea (g/kg)	0	5	0
DCP (g/kg)	0	15	15
Common salt (g/kg)	0	10	10
Total	0	1000	1000

D_0, Farmer's diets (FD) only without the supplementation of concentrate; D_1, FD + supplemented with high energy concentrate diet; D_2, FD + supplemented with low energy concentrate diet. DCP, Dicalcium phosphate.

The buffalo bull calves of control group (D_0) received farmer's diets (FD) (gazing 5-6 hours, feeding straw and so on) only, without the supplementation of concentrate diet. Another two groups (D_1 and D_2) of the buffaloes were received supplemented concentrate diet with different energy levels. The crude protein content in supplemented diets for both the groups was same. Feeding group D_1 received FD with the supplementation of concentrate diet according to body weight having high energy (13.77 MJ per kg DM) and feeding group D_2 received FD with supplementation of concentrate according to body weight with low energy (12.14 MJ per kg DM). The crude protein content in supplemented diets was @ 125g per kg/ DM. The concentrate diets were formulated using crushed maize, wheat bran, rice polish, broken rice, DCP, urea and salt at different proportions to maintain the required levels of energy and protein and are shown in Table 2. However, the chemical compositions of feed ingredients used in the supplemented concentrate diet are shown in Table 3.

Feeding

All the buffalo bull calves were supplied feed on the basis of their live weight and were adjusted fortnightly with their live weight changes.

Roughage and supplementation of concentrate diet were fed separately twice daily dividing into two equal portions and supplied at 6.30 hr and 18.30 hr. The concentrate portion of the diet was supplied first followed by roughage. Fresh drinking water was made available to the buffaloes at all the times.

Quantification of daily feed intake

The feed intake was determined by subtracting the amount of left over from the amount of feed given on the previous day. Refusal was collected every morning before feed supply. The feed refused by the buffaloes during the period of 24 hours was weighed and recorded.

Measurement of live weight of animals

The live weight of growing buffalo bull calves were measured with the help of measuring tape and calculated using the Shaeffer's formula:

$$\text{Live weight} = \frac{L \times G^2}{660} \ Kg$$

L, distance between point of shoulder to pin bone in inches; G, Hearth girth in inches.

Cost-benefit ratio

The cost-benefit ratio is a relative measure, which is used to compare benefits per unit of cost. The cost-benefit ratio estimated as a ratio of gross returns (milk & meat) and gross costs (feed, labour, vaccine, medicine).

The formula of calculating cost benefit ratio is show below:-

$$\text{Cost benefit ratio} = \frac{\text{Gross benefit}}{\text{Gross cost}}$$

Statistical analysis

The data were analyzed to compute ANOVA and the mean values with standard error of difference (SED) were recorded (Steel and Torrie, 1980). Least significant difference (LSD) was done to compare the treatment means for different parameters. Analysis was done with the help of computer package program SAS v.9.

Results and Discussion

Dry matter intake

The nutrient intake of growing buffalo bull calves is shown in Table 4. The total DMI was higher in D_1 and D_2 compared with control and differed significantly ($p < 0.01$). The total DMI was found

highest (4.82) in D_1 and the lowest (3.16) was found in control. The result of the present study is in agreement with the result of Hassan *et al.,* (2013) and Tomar *et al.,* (2014), they found that the DMI was significantly increased by increasing energy level in the ration in buffalo calves.

The DMI (kg/100 kg BWT/day) of different treatment groups differed significantly (p<0.01) between the treatment and control where the highest (2.82) DMI was found in D_2 followed by control (2.78) and the lowest (2.64) was found in D_1. The DMI was expressed as metabolic body weight (g/kg $W^{0.75}$/d) showed similar trend in result of DMI (kg/100 kg BWT/day).

Table 3: Chemical composition of supplemented concentrate diet

Ingredients	DM (g/100g sample)	Chemical composition (g/100g DM)								ME (MJ/kg DM)
		OM	CP	CF	EE	NFE	Ash	ADF	NDF	
Diet D_1	90.12	94.32	12.50	10.31	9.81	65.39	5.68	5.14	20.15	13.77
Diet D_2	90.41	96.65	12.48	12.38	9.82	66.39	3.05	3.05	15.25	12.14

DM, Dry matter; OM, Organic matter; CP, Crude protein; CF, Crude fiber; EE, Ether extract; NFE, Nitrogen free extract; ME, Metabolizable energy; MJ, Mega joule; ADF, Acid detergent fiber; NDF, Neutral detergent fiber. Suppl. diet D_1, Supplemented concentrate diet-1, Suppl. Diet D_2, Supplemented concentrate diet-2.

Table 4: Effect of concentrate supplement on nutrient intake, body weight changes and feed conversion efficiency of buffalo bull calves

Parameters	Treatments (Mean ± SE)			Overall Mean ± SE	LSD Value	Sig. level
	D_0 (Control)	D_1	D_2			
Total DMI	$3.16^c \pm 0.062$	$4.82^a \pm 0.079$	$4.54^b \pm 0.060$	4.175 ± 0.513	0.209	**
DMI (Kg/100 kg BWT/day)	$2.64^c \pm .003$	$2.82^a \pm 0.000$	$2.78^b \pm 0.003$	2.74 ± 0.546	0.014	**
DMI (g/kg $W^{.75}$/d)	$26.39^c \pm 0.016$	$28.22^{ab} \pm 0.015$	$27.79^b \pm 0.015$	27.47 ± 0.552	0.044	**
Total CPI (g/d)	$19.65^c \pm 0.375$	$43.41^a \pm .716$	$38.27^b \pm 0.336$	33.77 ± 7.22	1.56	**
Total CPI (g/kg $W^{.75}$/d)	$2.08^b \pm 0.021$	$2.86^a \pm 0.029$	$2.83^a \pm 0.010$	2.594 ± 0.255	0.062	**
Total MEI (MJ/d)	$0.160^c \pm 0.00$	$0.250^a \pm 0.00$	$0.230^b \pm 0.00$	0.213 ± 0.027	0.014	**
MEI (MJ/kg $W^{.75}$/d)	$0.160^c \pm 0.00$	$0.250^a \pm 0.00$	$0.230^b \pm 0.00$	0.213 ± 0.027	0.014	**
Initial body weight (kg)	98.40 ± 2.14	101.20 ± 2.08	98.80 ± 2.29	99.47 ± 0.874	6.69	NS
Final body weight (kg)	$144.0^b \pm 2.34$	$254.6^a \pm 2.48$	$249.2^a \pm 2.60$	215.9 ± 36.00	7.63	**
Average daily gain (g/d)	$190.0^c \pm 2.12$	$639.2^a \pm 3.39$	$626.7^b \pm 3.87$	485.3 ± 147.69	9.89	**
FCE	$11.25^a \pm 0.231$	$6.91^b \pm 0.094$	$6.53^b \pm 0.076$	8.233 ± 1.51	0.463	**

*D_1, Supplemented diet-1 containing 125% energy of NRC (2001) and 12.5% CP; D_2, Supplemented diet-2 containing 115% energy of NRC (2001) and 12.5% CP; Control, Farmers feeding; SE, Standard error. NS, Non significant; *, Significant at 5% level of probability; **, Significant at 1% level of probability, SE, Standard error, LSD, Least significant difference.*

Crude protein intake

The total CP intake was higher in D_1 and D_2 compared with control and differed significantly ($p<0.01$) between the treatment and control where highest (481.8) CP intake was found in D_1 and the lowest (236.2) was found in control. The CP intake (g/100 kg BW) was significantly higher in 20% higher energy fed group (286.39) compared with both control (259.27) and 10% higher energy fed group (267.15) of 7- 12 moth old male Murrah buffalo calves reported by Tomar *et al.,* (2014), agreed with the present findings. The present findings closely associated with the findings of Shahzad *et al.,* (2011), who found that the buffalo calves of 12–15 month-old perform adequately well when fed on diets containing 12.2% CP and 2.10 Mcal ME /Kg feed.

Metabolizable energy intake

The total MEI was higher in D_1 and D_2 compared with control and differed significantly ($p<0.01$) between the treatment and control where highest total MEI was found in D_1 followed by D_2 and the lowest was found in control. The present findings closely associated with the findings of Shahzad *et al.,* (2011), who found that the buffalo calves of 12–15 month-old perform adequately well when fed on diets containing 12.2% CP and 2.10 Mcal ME /Kg feed. However, the metabolizable energy intake was expressed as metabolic energy intake (MJ/kg $W^{0.75}$/d) showed similar trend in result of total MEI (MJ /day). Moreover, the nutrient intake of buffalo bull calves also influenced by the availability of feed, quality of feed (freshness of the feed, mould condition, spoilage, taste, moisture and temperature), feeding management, body size, rumen health, water quality and accessibility, heat stress, overall animal health and nutrient supply.

Body weight change

The body weight change and average daily gain of growing buffalo bull calves is shown in Table 4 and Figure 1 and 2. The average initial body weight was higher in D_1 and D_2 compared with control and did not differ significantly ($p>0.05$) within the treatment and control where the highest (101.20 kg) average initial body weight was found in D_1 and the lowest (98.40 kg) was found in control.

The final body weight of buffalo bull calves was higher in D_1 and D_2 compared with control and differed significantly ($p<0.01$) but no significant differences ($p>0.05$) were found within the treatment group of D_1 and D_2, where D_1 tended to be higher than D_2. The highest (254.6 kg) body weight was found in D_1 and the lowest (144.0 kg) was found in control. The average final body weight was increased by 153.40 kg (151.58%), 150.40 kg (152.22%) and 45.60 kg (46.34%) in D_1, D_2 and control, respectively, compared with initial body weight. On the other hand, the average final body weight of D_1 and D_2 was increased by 110.60 kg (76.80%) and 105.20 kg (73.05%), respectively, compared with control. In this study the highest body weight was found in buffalo bull calves at 125% energy diet of NRC (2001) beef cattle steer requirements which disagreed with the result of Mahmoudazeh *et al.,* (2007). They reported that significantly higher daily gain (503 to 951 g/day) was obtained when animals received medium energy diet that was similar to 100% beef cattle steer requirements. The body weight gain of buffalo bull calves in this study is in accordance with the findings of Kumar *et al.,* (2011), Tomar *et al.,* (2014) and Laxmi *et al.,* (2014). They did not find any significant effect on body weight gain in male buffalo calves when fed rations having different energy levels.
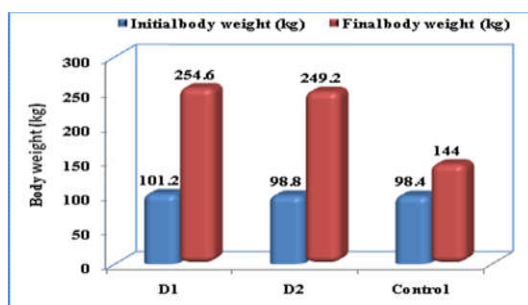

Figure 1: Initial and final body weight (kg) of buffalo bull calves supplemented with concentrate diets in Subornochar Upozila
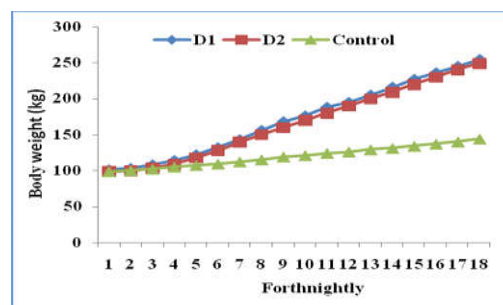

Figure 2: Trend of fortnightly body weight change (kg) of buffalo bull calves in Subornochar Upozila

Table 5: Cost benefit analysis of farming buffalo bull calves according to treatments

Parameter	Treatments (Mean ± SE)			Level of sig.
	D_0 (Control)	D_1	D_2	
Total cost (Tk/buffalo/day)	$31.40^a \pm 3.01$	$32.51^b \pm 2.93$	$32.49^b \pm 2.69$	*
Total income (Tk/buffalo/day)	$61.86^a \pm 4.24$	$117.25^b \pm 5.62$	$114.12^b \pm 4.43$	**
Total profit (Tk/buffalo/day)	$30.46^a \pm 0.19$	$84.74^b \pm 1.96$	$81.72^b \pm 1.04$	**
Cost- benefit ratio	1:1.97	1:3.60	1:3.51	

**, Significance at 1% level of probability; *, Significance at 5% level of probability; NS, Non-Significant; D_1, Supplemented diet -1 containing 125% energy of NRC (2001) and 12.5% CP, D_2, Supplemented diet -2 containing 115% energy of NRC (2001) and 12.5% CP; D_0, Control, Farmers feeding; SE, Standard error.

Average daily gain

The ADG of buffalo bull calves was higher in D_1 and D_2 compared with control and differed significantly ($p<0.01$) within the treatment and control where D_1 tended to be higher than D_2. The highest (639.2 g) ADG was found in D_1 and the lowest (190.0 g) was found in control.

Feed conversion efficiency

Feed conversion efficiency of buffalo bull calves is presented in table 4. The mean average FCE of different treatment groups differed significantly (p<0.01) between the treatment and control but no significant differences ($p>0.05$) were found within the treatment group of D_1 and D_2 where the highest (6.46) FCE was found in D_1 followed by D_2 (6.64) and the lowest (12.17) was found in control. The FCR ranged 5.2 to 5.8 when the animals received standard energy diet reported by Yunus *et al.,* (2004) and Homayoun and Fazaeli, (2009), did not agree with the present findings. The feed conversion ratio for different energy and protein diets ranged from 6.9 to 7.6, reported by Mahmoudzadeh *et al.,* (2007) in male buffalo calves, the result is in accordance with the present findings.

Cost benefit analysis

The cost benefit analysis of buffalo bull calves of Subornochar Upozila is presented in table 5. The cost benefit analysis of buffalo bull calves of different treatment groups differed significantly ($p<0.01$) between the treatment and control but no significant differences ($p>0.05$) were found within the treatment group of D_1 and D_2 where highest (1:3.60) cost benefit ratio was found in D_1 followed by D_2 (1:3.51) and the lowest (1:1.97) was found in control.

Conclusion

Buffalo rearing is a profitable practice in the selected areas and improved the socio-economic status and livelihood of buffalo farmers; although the management practices need to be improved with scientific approaches.

Acknowledgement

Conflict of interest

The authors declare that there is no conflict of interest that could be perceived as prejudicing the impartiality of the research reported.

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