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Original Article

Effect of ration on growth and cost of production during fattening of upgraded Shahiwal bulls

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Upgraded Shahiwal bull, mixed concentrate, urea molasses straw, digestibility, fattening.

A B S T R A C T

The study was conducted to find out the effect of beef cattle diet on the performance of upgraded Shahiwal bulls at Bangabandhu Academy for Poverty Alleviation and Rural Development (BAPARD) cattle farm in Gopalganj. For this purpose, twelve local x Shahiwal upgraded bulls (L×SH) of average 19 months of age and 169 kg live weight were divided into three equal groups. Three different rations such as: a mixed concentrate ration (T_1), mixed concentrate ration and urea molasses straw (UMS) at a ratio of 1:1 on dry matter basis (T_2) and green grass (pakchong) based ration without concentrate and UMS (T_3) were selected for this experiment. Upgraded bulls were randomly distributed into 3 groups for 3 above different rations. The results found that the average daily live weight gains of three groups was 320g, 315g and 314g respectively, which were not differ significantly ($P<0.05$). Daily DM intake was significantly higher in T_3 (8.1 g/head/day) compared to T_1 and T_2 ($P<0.05$), but the digestibility found lower than other treatments. Feed conversion ratio (FCR) was significant higher in T_1 (2.63) but interestingly, cost of per kg live weight gain was the lowest in T_3 (85 BDT) compared to other two treatments ($P<0.05$). Therefore, considering the above factors, it might be stated that a beef ration only with green grass would be the appropriate diet for the floodplains area for local x Shahiwal upgraded bulls.

Introduction

Livestock is one of the most important components of agriculture that contributes about 6.5% of gross domestic products (GDP) and 14.21% of total foreign exchange earnings in Bangladesh (DLS, 2017, Mustafa *et al*., 2020). Livestock plays a vital role in the traditional agriculture and largely subsistence economy of Bangladesh (Barman *et al*., 2017; Baset *et al*., 2003; Sarker *et al*., 2018; Rahman *et al*., 2002; Quddus and Rahman, 1998). The rural poor farmers largely depend on livestock (especially on small ruminants) for their survival (Ahmed, 1992). Cattle of Bangladesh are an inseparable and integrated part of the agricultural farming systems and it ranks 12th in the world and 3rd in the Asian countries (Alam, 1995). Feeds and strategy of feeding are the important factors for livestock development. The feeding practice of livestock of Bangladesh is very much traditional and conventional (Tareque, 1991; Rahman *et al*., 1997, 1998 and 1999). Bangladesh has a higher cattle population than any other countries of European Economic Community (Allen, 1990) and distributed with a greater density (2.6 cattle and buffalo heads per hectare) compared to other Southeast Asian countries (Assaduzzaman, 1996). Beef fattening is the intensified feeding of cattle to obtain the greatest quantity of high quality meat. It can also compensate the deficiency of protein and energy of the cattle which promote weight gain. The cattle population of Bangladesh commonly suffers in malnutrition as well as beef fattening need energetic diet. Nutrient supplementation to the growing cattle enhances muscle development, meat quality and marbling. It's also a tool for livelihood improvement and income generation of rural poor. Beef fattening is an emerging sector for employment and income generation for the rural poor, especially landless, destitute and divorced women. Cattle fattening is an effective tool for poverty alleviation for the rural poor. Cattle fattening for beef production has become an important business of the small

farmers in Bangladesh. One of the advantages of the cattle fattening by the rural farmers is that they use locally available cattle feed resources during the Eid festival. In recent years the women farmers of Bangladesh have been involved and sustained beef fattening program in rural areas of the country (Ahmed *et al*., 2010; Begum *et al*., 2007; Islam *et al*., 2012). Green fodder along with concentrate supplementation enhances the growth performances of cattle. Ruminant animals primarily depend on microorganisms available in the rumen to digest roughages (cell wall polysaccharides) and other feedstuffs to produce volatile fatty acids (VFA) and other organic acids. Various types of microorganisms from different species (bacteria, protozoa, fungi) are involved in the ruminal digestion process to digest the fibrous materials and other feed ingredients. There is a scarcity of green grass and rice straw might be the major feed resource for the livestock production in Bangladesh (Molla *et al*., 2009). Straw can be used through urea treatment along with molasses that increase the digestibility of straw and very much effective for the growth and also for fattening (Baset *et al*., 2002; Mazed *et al*., 2004; Kawsar *et al*., 2006; Sarkar *et al*., 2008). Carbohydrates represent the most dominant fractions of cattle diets such as starch, cellulose, hemicellulose, pectin, arabans and xylans (Allen and Piantoni, 2014; Das *et al*., 2015). The digestion and utilization of carbohydrate by cattle varies according to type of carbohydrate and physiological condition of the animal (Noziere *et al*., 2010). Forages composed up to 40 to 100% of the cattle diet and are vital for maintaining health and productivity of animal (Prins and Kreulen, 1991). Cattle need minimum of 16% CP in their ration for their optimum growth, production, and reproduction (NRC, 1990), but in the conventional feeding system cattle gets a very low amount of CP (Khalek *et al*., 2004). The true protein feeds are very much expensive and so rural farmers can't supply high protein source feeds to their cattle. On the other hand urea is a NPN (non-protein nitrogen) substance which can provide 16% CP to the ruminant animals and ruminant can efficiently utilize urea. So, incorporation of urea into the ruminant's diet along with a higher carbohydrate source can provide sufficient protein and energy required for the ruminants. These urea treated feeds enhance the growth, production, and reproduction of the ruminants (Mathur and Sharma, 1985) and such type of feed materials can be used for beef fattening. Cattle fattening for beef production has become an important business of the small farmers in Bangladesh. The Department of Livestock Services (DLS) has taken beef fattening as an action program to generate income for the rural poor farmers. Detailed study is needed covering different districts of Bangladesh to recommend cattle fattening programs for the rural poor farmers as an income generating activity (DLS, 2017). Therefore, the present study was undertaken to investigate the effect of ration on beef fattening at BAPARD Cattle Farm in Kotalipara, Gopalganj, Bangladesh.

In this context, the present study of beef fattening was conducted by the Livestock Department of BAPARD at Kotalipara, Gopalganj in Bangladesh. There is an acute shortage of feeds (rice straw) and fodder has been identified in this BAPARD cattle farm surrounding areas (Kotalipara) as because of low laying land that undergoes water logging up to 8-9 months. Rural people and trainees didn't like the urea mixed feed as well as fattening with synthetic steroid hormone injection. In this perspective, the research was designed with different beef cattle diets solely of mixed concentrate, green grass and a mixture of mixed concentrate and UMS. This research was carried out due to a part and research implementation with the following objectives: To determine the i) growth rate of upgraded Shahiwal bulls with different formulated rations, ii) FCR of upgraded Shahiwal bulls with different formulated rations and iii) cost of meat production of upgraded Shahiwal bulls with different formulated ration.

Materials and Methods

Body weight measurement of the bulls and experimental design with different diets

The study was conducted at BAPARD cattle farm in Kotalipara, Gopalganj, Bangladesh for a period of 4 months from September 2019 to January 2020. The animals were selected and bought from the Cattle Breeding and Dairy Farm, Bogra under DLS (Directorate of Livestock Services). Twelve F_1 local × Shahiwal upgraded bulls of almost 19 months of age and an average body weight of 169 kg were selected from the breeding herd. At the beginning of the experiment the animals were weighted at morning before offering any types of feed by using Shaeffer's formula and the measurement was continued throughout the experiment at morning once weekly.

Body weight $W = \frac{L \times G2}{300}$ ib or, $W = \frac{L \times G2}{300 \times 2.2}$ kg

Here, L = Length of the body starting from point of the shoulder to the point of buttock in inch. G = Heart girth in inch by dividing with 2.2 to get the reading in kg (Banerjee, 1998). Figure 1 shows the packchong grass available in the BAPARD farm that is supplied to the experimental cattle.

Figure 1: Red Packchong fodder at BAPARD campus

These 12 bulls were randomly distributed into 3 groups for 3 different formulated diets (treatment) and each group consists of 4 bulls (replication). Animals of group A were supplied concentrate mixture (T_1), animals of group B were supplied urea molasses straw with concentrate mixture (T_2), and animals of group C were supplied various green grass viz. sweet jumbo, napier pakchong, red pakchong and local green grass (T_3) which were produced in BAPARD campus (Table 1). The proportion of feed ingredients for concentrate mixture was selected to fulfill the nutrient requirements of the experimental bulls (Table 2). Individual records of these upgraded bulls were kept with separate feeding and watering system at BAPARD cattle farm in Kotalipara Upazila, Gopalganj, Bangladesh.

Table 1. Design of experiment

Group of Animal	Treatment	Formulated diets
Group A	T_1	Mixed concentrate only
Group B	T_2	Mixed concentrate + UMS (1:1)
Group C	T_3	Only green grass

Table 2. Concentrate mixture for the experimental diet 1 (T_1)

Sl.	Feed Item	Percentage (%)
1	Wheat Bran	30%
2	Crushed maize	20%
3	Rice Polish	30%
4	Mustard Cake / Soybean	15%
5	DCP	2%
6	Molasses	1%
7	Limestone	1%
8	Salt	1%
9	Premix (D.B.)	0.10%

Quarantine and Deworming of the upgraded bulls: All upgraded bulls kept under quarantine for 14 days period prior to fattening and then dewormed with anthelmentics before the starting of feeding experiment. One (1) antiworm (Bol. Endex) bolas was applied for 41-70kg body wt. to all of the upgraded bulls and sufficient amount of water was supplied during this period for better effectiveness of that drug.

Preparation of UMS: Firstly, all the ingredients were measured using manual balance and kept in safe place for feeding the animals. The required amount of urea, molasses and rice straw following the ratio of 3:15:82 on dry matter basis (Khandakar and Reza, 1993) were weighted and kept separately. The weighed amount of urea and molasses was dissolved in water (55% of the weight of fresh straw) and mixed thoroughly in a container and a half of the total volume was sprayed on the total weighed amount dry and chopped straw kept spread on a polythene sheet, mixed thoroughly and turned completely upside down. The rest of the solution was sprayed on the straw and mixed thoroughly again without allowing any seepage of the urea molasses solution. The UMS was prepared as and when it was required and kept on a concrete floor covered by a polythene sheet to protect from the sun or rain for feeding the bulls.

Feeding and digestibility trial: The formulated diets were fed *ad libitum* and calculated the total DM intake of the diets of the respective dietary components was maintained throughout the feeding period. The animals were fed twice daily once at 7.00 h and again at 15.00 h. Clean and fresh water was offered twice daily to all animals. The same amount of mineral supplements (di-calcium phosphate and salt) was supplied to all treatment groups to minimize mineral deficiencies. Daily feed offered to and refused by an individual animal were recorded and the animals were weighed every seven days for a total period of 120 days including a seven days digestibility trial after sixty days of growth trial. The digestibility of the diets was calculated by the following formula:

$$\% \text{ digestibility} = \frac{\text{Intake} - \text{excreted}}{\text{Intake}} \times 100$$

Analysis of Cost of Feeding: Cost of feeding was analyzed considering the present market price of feed ingredients and cost of diets shown in Table 3.

Table 3. Price of the Ingredient of the Experimental Diets

Feed ingredients	Price (TK/kg)	Price (Dollar/kg)
Wheat bran	32.00	0.40
Crushed corn	24.50	0.31
Rice polish	16.00	0.20
Green grass	10.00	0.13
Rice straw	11.00	0.14
Mustard plant	10.00	0.13
Urea	30.00	0.38
Molasses	28.00	0.35

Statistical Analysis

The obtained information was collected, stored and coded accordingly using Microsoft Excel-2013 to WASP-1.0 (Web Agri. Stat Package) by ICAR (Central Coastal Agricultural Research Institute) for analysis. Then the data were analyzed through Completely Randomized Design (CRD). Significant mean values were tested with DMRT (Duncan's Multiple Range Test).

Results and Discussion

The effects of different formulated rations on the performances of upgraded Shahiwal bulls were shown in Table 4. Initial body weight was little bit different at three different treatment groups. It was also found a significant difference in final body weight after 4 months of experimental period among T_1, T_2 and T_3 ($p>0.05$). The average daily live weight gains of three groups were 320g, 315g and 314g respectively. A little higher body weight gain was found in T_1 but the differences were not significant at different treatment groups. Mustafa *et al*. (2020) found a higher body weight in upgraded Holstein bulls with the similar types of feeding strategy. This might be due to higher genetic potentials of Holstein cattle. Comparatively lower feed intake was found in T_1 (4.4 kg/head/day) than in T_2 (7.2 kg/head/day) and T_3 (8.1 kg/head/day) respectively. The digestibility of the three formulated rations was 85, 74 and 72% for T_1, T_2 and T_3 respectively. A higher digestibility of DM (85%) was found in concentrate based diet (T_1) compared to the digestibility of T_2 (74%) and T_3 (72%). The differences were significant ($p>0.05$) in T_1 with T_2 and T_3, but no significant difference was found between T_2 and T_3. Concentrate feeds have higher digestibility than fibrous feed materials and efficiently utilized for body growth and milk production (Tareque, 1991). Lower digestibility of grass based ration was also found by Mustafa et al. (2020). Ruminant animals depend on plant source feeds that are digested anaerobically in their rumen through microbial enzymes. Volatile fatty acid (VFA) and other organic acids are the primary energy sources in rumen fermentation. Microbial fermentation in the rumen also produces methane (CH_4) and carbon dioxide (CO_2) that are the waste products of anaerobic digestion (Kim *et al*., 2012; Rahman *et al*., 2013). Rahman *et al*. (2013) examined the VFA (acetate, propionate and butyrate) production pattern of different types of feed ingredients and found that a comparatively higher propionate production from energy and protein feeds compared to forages. On the other hand, acetate production was comparatively higher in forages (63.16%) than energy (60.19%) and protein rich (60.79%) feeds. Higher acetate: propionate ratio was found in forages compared to energy and protein feeds might be due to presence of structural carbohydrates (cellulose, hemi-cellulose) in forages. Forages contain more acid detergent fiber (ADF) and neutral detergent fiber (NDF) that helps to increase A:P ratio during anaerobic fermentation, and the molar proportion of different fatty acid production depends on the structural composition of the feed ingredients. Readily degradable carbohydrates produced relatively higher propionate as compared to acetate, and cell wall containing fibrous carbohydrate (cellulose) produced more acetate than propionate. Rahman *et al*., (2012) formulated a ration with selected feed ingredients to optimize production by reducing CH_4 emissions from ruminant.

Table 4. Effect of different formulated diets on the performances of upgraded Shahiwal bulls

Parameters	Group of Animals and treatments			Level of Significance
	Animal Group A, diet T_1	Animal Group B, diet T_2	Animal Group C, diet T_3	
Initial body weight (kg)	172.5[a]	165[b]	169.5[b]	*
Final body weight (kg)	212.25[a]	205.75[b]	209.5[b]	*
Body weight gain (kg/day)	0.320	0.315	0.314	NS
Feed intake (kg/head/day)	4.4[b]	7.2[a]	8.1[a]	*
Digestibility (%)	85[a]	74[b]	72[b]	*
FCR (kg feed/live wt. gain)	2.63[b]	4.30[a]	4.32[a]	*
Cost of meat production (TK/kg live wt.)	135[a]	137[a]	85[b]	*

Figures followed by same letter (s) within a row do not differ statistically; NS means not significant; *means significant at 5% level of probability; FCR means food conversion ratio.

The most effective FCR was found in T_1 (2.63) compared to T_2 (4.30) and T_3 (4.08). Concentrate based diet (T_1) showed a significant difference ($p>0.05$) with T_2 and T_3 but, there was no statistical difference between T_2 and T_3. The feed cost of producing one kg live weight was calculated to be 135, 137 and 85 TK respectively for the three diets. The cost of producing beef cattle was significantly different $p>0.05$ in T_3 (green grass based diet) compared to T_1 and T_2. Considering the FCR and cost of producing per kg live weight, a beef diet of green grass is the comparatively appropriate diet for the floodplains area for F_1 Local x Shahiwal upgraded bulls. Khan *et al*. (2004) found a lower feed intake and FCR in Red Chittagong cattle compared to Hostein cross cattle, but Holstein cross cattle showed higher growth rate than Red Chittagong cattle. Forage to concentrate ratio (F:C) may alter dry matter intake (DMI) in ruminants since DMI is associated with the amount of neutral detergent fiber (NDF) in diet, the digestibility of NDF, the proportion of NDF that is slowly digested, lignin contents and the passage rate of the undigested feed residues from the digestive tract (Oba and Allen, 1999). In addition to NDF, the other cell wall components being the dominant part (55 to 60%) of the forage materials and having variable fractional passage rate may also limit DMI by occupying gut fill (Wilkins, 2009). Forages represent the most dominant parts of cattle diets that are the source of starch, cellulose, hemicellulose, pectin, arabans and xylans (Das *et al*., 2015; Rahman *et al*., 1998). Forages comprise up to 40 to 100% of the cattle diet and are vital for maintaining health and productivity of animal (Prins and Kreulen, 1991). The higher the fiber content of the forage materials, the lower is the digestibility and the nutritive value (Baset *et al*., 2002; Mazed *et al*., 2004; Refat and Yu, 2016). However, fiber plays an important role in rumen development and voluntary feed intake (Khan *et al*., 2011).

Conclusion

It may be concluded from the study that cost of per unit beef production was the lowest in green grass based feed formulation. Although the DM intake was higher and digestibility was lower in T_3, it seems to be profitable for rural poor who were engaged in beef fattening. Concentrate feeds ingredients were expensive and UMS preparation was found difficult for the rural poor. Therefore, considering all of these factors green grass based beef fattening was found suitable in this rural area for Shahiwal upgraded bulls.

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