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Article

Effect of feed on the performance of upgraded Holstein Friesian bulls during fattening at BAPARD cattle farm in Bangladesh

MMH Mustafa[1]*, MR Islam[1] and MM Rahman[2]

[1]Bangabandhu Academy for Poverty Alleviation and Rural Development (BAPARD), Ministry of LGRD and Co-operatives, Gopalganj, Bangladesh
[2]Department of Animal Science, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh

*Corresponding author: Md. Murshed Hasan Mustafa, Deputy Director (Livestock), BAPARD, Ministry of LGRD and Co-operatives, Kotalipara, Gopalganj, Bangladesh. Phone: +8801718361072; E-mail: murshed9137@yahoo.com

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Abstract: The study was conducted to find out the effect of beef cattle diet on the performance of upgraded Holstein Friesian bulls at BAPARD cattle farm in Bangladesh. For this purpose, twelve Local x Holstein-Friesian upgraded bulls (L×F) of average 20 months of age and 213 kg live weight were divided into three equal groups. Three different diets such as (i) a mixed concentrate ration (T_1), (ii) mixed concentrate ration and UMS at a ratio of 1:1 on DM basis (T_2) and (iii) green Grass based ration without concentrate and UMS. The results found that the average daily live weight gains of three groups was 350g, 330g and 340g respectively, which were not differ significantly ($P<0.05$). Daily DM intake was significantly higher in T3 but the digestibility found lower than other treatments. In case of feed conversion ratio (FCR), the highest FCR was found in T_1 (2.96) but cost of per kg live weight gain was the lowest in T_3 (BDT 90) compared to T_1 (BDT 140) and T_2 (BDT 142). Therefore, considering the FCR and cost of per unit beef production, a beef diet of green grass might be the appropriate diet for the floodplains area for Local x Holstein-Friesian upgraded bulls.

Keywords: upgraded bull; mixed concentrate; UMS; digestibility; beef fattening

1. Introduction

Livestock being one of the four components of agriculture such as crops, livestock, fisheries and forestry play a vital role in national economy, contributing about 6.5% of gross domestic products (GDP) and 14.21% of total foreign exchange earnings, growth rate 3.21% (DLS, 2017). Livestock plays an indispensable role in the traditional agriculture and largely subsistence economy of Bangladesh (Barman *et al*., 2017; Baset *et al*., 2003; Begam *et al*., 2007; Rahman *et al*., 2002). The landless marginal farmers largely depend on livestock for their survival (Ahmed, 1992). The total livestock population in Bangladesh is estimated at 23.78, 1.47, 3.34, 25.77, 268.40 and 52.24 million cattle, buffaloes, sheep, goats, chicken and duck respectively (DLS, 2017). Cattle of Bangladesh is an inseparable and integrated part of the agricultural farming systems and it ranks 12th in the world and in the Asian countries, her position is third (Alam, 1995). The livestock sector contributes 3 percent to the Gross Domestic Product (BBS, 2015). 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). Sufficient green grass along with concentrate supplementation enhances the growth performances of cattle. Ruminant animal depends on microorganisms to digest roughages (cell wall polysaccharides) and other feedstuffs to produce energy sources, such as volatile fatty acids (VFA) and other organic acids. Numerous microorganisms from different species (bacteria, protozoa, fungi) are involved in the ruminal digestion process to digest the fibrous constituents and other feed materials. Green grass from arable and non-arable land and some concentrates are also available at a sub-normal amount. Due to inadequate production of green grasses, rice straw has become the major feed resource for the livestock production of Bangladesh (Molla *et al*., 2009). Carbohydrates represent the most dominant fractions of cattle diets (Allen and Piantoni, 2014; Das *et al*., 2015). The major dietary carbohydrates for cattle are starch, cellulose, hemicellulose, pectin, arabans and xylans. The utilization of carbohydrate by cattle varies according to type of carbohydrate and physiological condition of the animal (Noziere *et al*., 2010). 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). To overcome this shortage of feed and to provide adequate nutrition to the existing animals the conventional rice straw can be fed to the animal by somewhat modern feeding system. One of these processes is urea treatment of the straw. It is very much effective in cattle growth and also for fattening (Baset *et al*., 2002; Mazed *et al*., 2004; Kawsar *et al*., 2006; Sarkar *et al*., 2008). Cattle need minimum of 16% CP in their ration for their optimum growth, production, and reproduction (NRC, 1990). But through the conventional feeds and feeding systems cattle gets a very low amount of CP (Khalek *et al*., 2004). The true protein feeds are very much expensive and so farmers can't offer their livestock the high protein source feeds. 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 di*et al*ong 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). Cattle fattening period is 4.5 months in rural areas of Bangladesh (Baset *et al*., 2002). Therefore, the present study was undertaken to investigate the following objectives of 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 Bangabandhu Academy for Poverty Alleviation and Rural Development (BAPARD) at Kotalipara, Gopalganj in Bangladesh. There are four mandates of BAPARD viz. Training, Research, Action Research and Advisory Services. This study is an implementation part of BAPARD mandates. 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 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 or the beef cattle diet without straw and urea. This research was carried out due to a part and parcel of BAPARD training and research implementation with the following objectives: To determine the i) growth rate of upgraded bulls with different formulated diets, ii) FCR of upgraded bulls with different formulated diets and iii) cost of meat production of upgraded bulls with different formulated diets.

2. Materials and Methods

2.1. 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 December 2019. The animals were selected and bought from the Cattle Breeding and Dairy Farm, Bogra under DLS (Directorate of Livestock Services). Twelve F_1 Local × Holstein-Friesian upgraded bull of almost 20 months of age and an average body weight of 213 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 1a and 1b shows technique of body weight measurement.

Figure 1. Measuring a) heart girth b) length and c) packchong fodder of BAPARD farm.

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 (Figure 1c), red pakchong and local green grass (T_3) which were produced in BAPARD campus. Design of the experiment is shown in 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. No	Feed Ingredients	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	Lime Stone	1%
8	Salt	1%
9	Premix (D.B.)	0.10%

2.2. 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. Antiworm 1 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.

2.3. 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.

2.4. 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:

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

2.5. 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 (BDT/kg)	Price (Dollar/kg)
Wheat bran	32	0.40
Crushed corn	24.5	0.31
Rice polish	16	0.20
Green grass	10	0.13
Rice straw	11	0.14
Mustard plant	10	0.13
Urea	30	0.38
Molasses	28	0.35

2.6. 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. The results were expressed in body weight gain with P value for Chi-square test. Significances was determined when $P<0.05$.

3. Results and Discussion

The effects of different formulated diets on the performances of upgraded Holstein Friesian bulls were shown in Table 4. Initial body weight was little bit different at three diet treated groups and final body weight after 4 months of experimental period was also different ($p>0.05$) in T_1, T_2 and T_3. The average daily live weight gains of three groups were 350g, 330g and 340g respectively. A little higher body weight gain was found in T_1 but the differences were not significant at different treatment groups. Comparatively lower feed intake was found in T_1 (5.6 kg/head/day) than in T_2 (9.5 kg/head/day) and T_3 (9.8 kg/head/day) respectively. The digestibility of the three formulated diets was 85, 75 and 74% for T_1, T_2 and T_3 respectively. A higher digestibility of DM was found in concentrate based diet (T_1) but there was no statistical difference in the digestibility of T_2 (mixture of concentrate and UMS) and T_3 (green grass based diet). 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 waste products such as methane (CH_4) and carbon dioxide (CO_2) (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 was produced from energy and protein feeds than forages. On the contrary, 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 CH4 emissions from ruminant.

Table 4. Effect of different formulated diets on the performances of Holstein Friesian upgraded 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)	184.75^b	250.75^a	255.25^a	*
Final body weight (kg)	227.25^b	289.75^a	295.5^a	*
Body weight gain (kg/day)	0.35	0.33	0.34	NS
Feed intake (kg/head/day)	5.6^b	9.5^a	9.8^a	*
Digestibility (%)	85^a	75^b	74^b	*
FCR (kg feed/live wt. gain)	2.96^b	4.28^a	4.06^a	*
Cost of beef cattle production (BDT/kg live wt.)	140^a	142^a	90^b	*

FCR = feed conversion ratio, BDT= Bangladeshi Taka, Figures followed by same letter (s) within a row do not differ statistically, NS means not significant; *means significant at 5% level of probability

The most effective FCR was found in T_1 (2.96) compared to T_2 (4.28) and T_3 (4.06). 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 140, 142 and 90 BDT respectively for the three diets. The cost of producing beef cattle was significantly different $p>0.05$ in T3 (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 Holstein-Friesian crossbred bulls. However the difference, is not significant ($p>0.05$). 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 a important role in rumen development and voluntary feed intake (Khan *et al*., 2011).

4. Conclusions

It may be concluded from the study that cost of per unit beef production was the lowest in green grass based feed formulation (T_3). 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.

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Conflict of interest

None to declare.

References

Ahmed T, MA Hashem, M Khan, MF Rahman and MM Hossain, 2010. Factors related to small scale cattle fattening in rural areas of Bangladesh. Bang. J. Anim. Sci., 39: 116-124.

Ahmed N, 1992. Problems and prospects of livestock in Bangladesh. In: proceedings of the workshop of livestock development in Bangladesh. 16-18 July, 1991. Bangladesh Livestock Research Institute, Savar, Dhaka, Bangladesh, pp. 8-14.

Alam J, 1995. Livestock resource of Bangladesh: present status and future potential, University Press Limited.

Allen D, 1990. Planned beef production and marketing. BSP Professional Books, pp. 13-14.

Allen MS and P Piantoni, 2014. Carbohydrate Nutrition: Managing Energy Intake and Partitioning Through Lactation. Veterinary Clinics of North America: Food Animal Practice. 30: 577-597.

Assaduzzaman M, 1996. Livestock sector, economic development and poverty alleviation in Bangladesh. In: M A S Mandal (ed) Changing rural economy of Bangladesh. Bangladesh Economic Association, Dhaka. pp. 42-53.

Banerjee GC, 1998. Non-Protein nitrogen (NPN) feed stuffs, Factors affecting urea utilization, Methods of feeding urea, In: A Text Book of Animal Husbandry, 8thedition. Oxford & IBH publishing Co. PVT. LTD, New Delhi, Kolkata, pp. 405-409.

Barman TC, MM Hossain, MM Rahman, MY Ali and NR Sarker, 2017. An assessment of socio-economic conditions of the farmers related to goat fattening in Rangpur district of Bangladesh. Asian Australas. J. Food Saf. Secur., 1: 1-6

Baset MA, MM Rahman, MS Islam, A Ara and ASM Kabir, 2003. Beef cattle production in Bangladesh- A Review. Online Journal of Biological Sciences, 3: 8-25.

Baset MA, MM Rahman, ML Ali, ASM Mahbub and MN Haque, 2002. Effect of Urea Molasses Straw (UMS) on the performance of steers with supplementation of wheat bran. Pak. J. Biol. Sci., 5: 807-808.

Begum MAA, MM Hossain, M Khan, MM Rahman and SME Rahman, 2007. Cattle fattening practices of selected farmers in Panchagarh district. Bang. J. Anim. Sci., 36: 62-72.

BBS (Bangladesh Bureau of Statistics), 2015. Statistical Pocket of Bangladesh. Statistics Division, Ministry of Planning, Government of the People’s Republic of Bangladesh. Website: www.bbs.gov.bd

Das LK, SS Kundu, D Kumar and C Datt, 2015. Fractionation of carbohydrate and protein content of some forage feeds of ruminants for nutritive evaluation. Vet. World, 8: 197–202.

DLS, 2017. Department of Livestock Services. Livestock Population Report, 2017. Information website: www.dls.gov.bd

Islam MH, MA Hashem, MM Hossain, MS Islam, MS Rana and M Habibullah, 2012. Present status on the use of anabolic steroids and feed additives in small scale cattle fattening in Bangladesh. Prog. Agric., 23: 1-13.

Kawsar SM, MM Rahman, SME Rahman, MM Hossain and MA Huq, 2006. Growth, carcass and non-carcass traits of Black Bengal goats due to urea molasses block supplementation. Int. J. Biores, 2: 1-5.

Kim MJ, JS Lee, S Kumar, MM Rahman, JS Shin and CS Ra, 2012. Indirect estimation of CH_4 from livestock feeds through TOCs evaluation. Asian-Aust. J. Anim. Sci., 25: 496-501.

Khalek MA, GM Mahmud and MA Mozammel, 2004. Conventional feeds and feeding systems of indigenous cattle. Trop. Ani. Prod., 6: 272-277.

Khan MA, DM Weary and MAG Von Keyserlingk, 2011. Hay intake improves performance and rumen development of calves fed higher quantities of milk. J. Dairy Sci., 94: 3547–3553.

Khandakar ZH and A Reza, 1993. Effect of urea feeding on the fattening of local emaciated cattle of Bangladesh, Bang. J. of Anim. Sci., 22: 101-106.

Molla SM, SG Beolb and SS Motin, 2009. Intensive dairy cattle production. Indian Vet. Journal, 2: 12-15.

Mathur MC and VV Sharma, 1985. Feed intake, digestibility and nitrogen retention in crossbred heifer fed water soaked straw rations. Indian J. Anim. Sci., 55: 218.

NRC, 1990. National Research Council, Canada.

Mazed MA, MS Islam, MM Rahman, MA Islam and MA Kadir, 2004. Effect of urea molasses multinutrient block on the reproductive performance of indigenous cows under the village condition of Bangladesh. Pak. J. Biol. Sci., 7: 1257-1261.

Noziere P, I Ortigues-Marty, C Loncke and D Sauvant, 2010. Carbohydrate quantitative digestion and absorption in ruminants: From feed starch and fibre to nutrients available for tissues. Animal, 4: 1057–1074.

Oba M and Allen MS, 1999. Evaluation of the importance of the digestibility of neutral detergent fiber from forage: Effects on dry matter intake and milk yield of dairy cows. J. Dairy Sci., 82: 589–596.

Prins RA and DA Kreulen, 1991. Comparative aspects of plant cell wall digestion in insects. Anim. Feed Sci. Technol., 32: 101–118.

Rahman MM, MAM Salleh, N Sultana, MJ Kim and CS Ra, 2013. Estimation of total VFA from TOCs assessment through in vitro fermentation of livestock feeds. African J. Microb. Res., 7: 1378-1384.

Rahman MM, MAM Salleh, A Ahsan, JE Lee and CS Ra, 2012. In vitro fermentation, methane emission and global warming. J. Anim. Vet. Advances, 11: 3717-3723.

Rahman MM, S Habib, MA Kadir, MN Islam and MS Islam, 2002. Participation of rural people in cattle management practices in a selected area of Bangladesh. J. Anim. Vet. Advances, 1: 196-199.

Rahman MM**,** S Akhter, MS Rabbani and MM Hossain, 1999. Indigenous knowledge on livestock practiced by the farmers in Mymensingh district of Bangladesh. Bang. J. Anim. Sci., 28: 97-103.

Rahman MM, S Akther and MM Hossain, 1998. The availability of the livestock feeds and feeding practices followed by the farmers of some areas of Mymensingh District. Bang. J. Anim. Sci., 27: 119-126.

Rahman MM, S Akther and MM Hossain, 1997. Socio economic aspects of the farmers for livestock keeping in Mymensingh town adjacent areas. Prog. Agriculture, 8: 153-157.

Refat B and P Yu, 2016. Maximizing Fiber Utilization of Silage in Ruminants In:, Advances in Silage Production and Utilization, pp. 1-25.

Sarkar MM, MM Hossain, MM Rahman and SME Rahman, 2008. Effect of feeding urea molasses block on the productive and reproductive performances of Black Bengal doe. Bang. J. Agril. Univ., 6: 39-46.

Traque AMM, 1991. Feeds and fodder resources in Bangladesh and pattern of Utilization, ADB, Second Livestock Project, TA No. 668-BAN.

Wilkins RJ, 2009. Forages and their role in animal systems. In:, Forage evaluation in ruminant nutrition., 1–14.