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Growth Performance and Feed Conversion Efficiency of Crossbred Heifers

Research Article

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ABSTRACT

The experiment was conducted to investigate the growth performance and feed conversion efficiency of crossbred heifer at different age level in Government Dairy Farm in Bogra, Bangladesh. Twelve female crossbred heifers were equally distributed (n=3) into four groups [Group A: (7±2 months), B: (12±2 months), C: (15±2 months) and D: (20±2 months)] according to age and fed concentrate mix, rice straw and Napier grass at the rate of 2% of live weight. Napier grass and rice straw were offered at the ratio of 1:1. The concentrate mixture was provided at the rate of 1% of their body weight. It was found that dry matter content was higher in concentrate mix and rice straw and lower in Napier grass. Organic matter content was higher in Napier grass than that of concentrate and rice straw. Crude fiber concentration was higher in rice straw than that of concentrate and Napier grass. Intake of dry matter and organic matter differed significantly among the treatment groups. Crude protein intake was higher in C group heifer than other groups. Intake of crude fiber was higher in C group followed by B, D and A group. The final live weight was higher in D group than C, B and A group. Unit feed dry matter intake was higher with the advancement of age, being lowest in younger group. The heifers of D group showed higher value of feed conversion efficiency followed by C, B and A group respectively and concluded 20 ± 2 months of heifer is more economical than the other ages.

KEY WORDS feed, feed conversion, growth performance, heifers.

INTRODUCTION

Bangladesh is a developing country based on agriculture where 85-90% of its people live in the rural area. The country is to emphasize on the industrialization of agriculture products for its economic growth and the increase of population that arable land is progressively decreasing. In the agro-based economy of the country, livestock sector contributes 3.49% to the gross domestic product (GDP) (BES, 2013). In Bangladesh, dairy cattle play an important role for improving human nutrition and national income. Livestock sector must be given priority for its development at the industrial level in order to increase its contribution to GDP and 10 million dairy cattle, including 4 million cross-breeds, produce 2.82 million tons of milk. This is much lower than in Pakistan, where only 5.5 million dairy cattle produce 25 million tons of milk (Directorate of Livestock Service, 2010; Hemme, 2010). The per capita number of cattle is 0.16. The country has one of the highest densities of livestock in the world, 145 large ruminants/km² com-

pared with 90 in India, 30 in Ethiopia and 20 ruminants/km² in Brazil. Despite the highest density of cattle population in Bangladesh the productivity of all the species is far below the world average. Milk yield per head per lactation is 206 kg, compared with the 1220 kg in Asia, 1014 kg in India and 1179 kg in Pakistan (FAO, 2005).

Dairying is nearly always part of the mixed farming system in Bangladesh. It provides about 25% full time employment and 50% of the total population partially depends on it (BES, 2013). The average milk yield per cow per day is 1.5 L for local and 2.5 L for crossbred. As per total milk production of the country is 2.82 million ton, but availability of milk per head is only 33 kg milk/year (Hemme, 2010). There are many commercial dairy farms in the country but most of the milk is produced by the rural households. The majority of the rural households have one or two cows, which are used for draught purposes and milk is considered a by-product. In the milk pocket areas particularly in Pabna, Sirajganj, Manikganj, Faridpur, Madaripur and Rangpur districts in dairy farming has been traditionally an important and major component of the farming system (Mondol *et al.* 2010). For better performance suitable breeds of cows have to be developed in our country through selection, crossbreeding and upgrading together with improved management practices. Low income people in the rural and urban areas have very much interest for small-scale dairy farming than other professions. On farm research studies conducted in the Government Dairy Farm, Bogra might generate the growth performance of growing crossbred heifers, so that we can support the socio-economic aspect of the rural farmers. Therefore, the present study was undertaken to investigate the growth performance and feed conversion efficiency of growing crossbred heifer and to find out the economic benefits at different ages of crossbred heifer.

MATERIALS AND METHODS

Experimental animal selection and management

Twelve cross breed (Holstein Friesian×local) heifer were selected according to their age and live weight. The age of animal was determined according to the birth date which was mentioned in the calf birth registration book of the farm. The entire work involving the use of animals was approved by Institutional Animal Care and Use Committee at Sylhet Agricultural University, Sylhet 3100, Bangladesh.

The experiment was conducted at Government Dairy Farm, Bogra, Bangladesh from 15th September to 15th December, 2015. The animals were randomly allocated in to four groups i.e. Group A: (7±2 month of age and 82.0±11 kg of live weight), B: (12±2 month of age and 99.20±11 kg of live weight), C: (15±2 months of age and 122.10±11 kg of live weight) and D: (20±2 months of age and 193.40±11 kg of live weight) respectively (Table 1). Before starting the experiment all the heifers were deworming against internal and external parasites. All of the experimental heifers were housed in a well ventilated and spaciously allocated with cement wall to facilitate the individual feeding and watering.

A healthy surrounding and proper sanitation conditions were maintained. The animals were supplied ration at the rate of 3 kg DM/100kg live weight to satisfy the appetite of the animals (Beretta and Simeme, 2010). This was adjusted every second week on the basis of live weight change of the animals in various groups. Required DM for animal was supplied by roughage and concentrate sources of the ration in the ratio of 2:1.

The ration was formulated according to Agricultural Research Council (ARC, 1980). The concentrate mixture was prepared by mixing of crushed maize (25%), wheat bran (35%), soybean meal (15.5%), khesari kalai (20%), bone powder (3%) and salt (1%).

Measurement of live weight gain

The average initial body weight of each group of heifer was recorded and the animals were weight every second week according to Shaeffer's formula stated by Sastry *et al.* (1983):

$$W = LG^2/300$$

Where:
W: live weight of animal in pounds.
G: hearth girth (linear body measurement around the thoracic cavity just behind the elbow joint with a measuring tape) in inches.
L: length from the point of shoulder to the point of pin bone in inches were taken by a measuring tape.

The live weight was converted from pound to kg. The average daily live weight gain was measured as subtracting the initial live weight from the final live weight divided by duration of experiment in days.

Chemical analysis of feed

Samples of feed were analyzed for dry matter (DM), ash, cruder protein (CP), crude fiber (CF) and ether extract (EE) following the method of AOAC (2004). Nitrogen (N) was determined by the standard Kjeldahl method and crude protein was obtained by multiplying N by 6.25. Organic matter (OM) was determine from (OM %= 100-Ash %). Nitrogen free extract (NFE) was determined as:

NFE= 100 - (CP+CF+EE+Ash) %.

Table 1 Design of the experiment

Parameters	Treatment			
	Group A (6-10 months)	Group B (10-14 months)	Group C (14-18 months)	Group D (18-22 months)
No. of heifers	3	3	3	3
Average age	7±2	12±2	15±2	20±2
Sex	Female	Female	Female	Female
Average body weight (kg±SEM)	82.0±11	99.20±11	122.10±11	193.40±11
Ration for particular group	Green grass (3.0 kg), rice straw (1.5 kg) and concentrate (1.1 kg)	Green grass (4.5 kg), rice straw (2.5 kg) and concentrate (1.65 kg)	Green grass (6.0 kg), rice straw (3.0 kg) and concentrate (2.15 kg)	Green grass (6.5 kg), rice straw (3.25 kg) and concentrate (2.4 kg)

SEM: standard error of the means.

Statistical analysis

The data of experiment were analyzed as a completely randomized design (CRD). An analysis of variance (ANOVA) table was constructed with the help of computer package Genstat for statistically significant difference among the growth performance and feed conversion of various aged group crossbred heifer. Significance differences between means were compared by using the Tukey's test at ($P<0.05$).

RESULTS AND DISCUSSION

Chemical composition of feed ingredients

The chemical composition of feed ingredients used in the diet is shown in Table 2. The DM content of Napier grass was 19.44% and CP, CF, EE, NFE, Ash and OM were 9.35, 28.8, 2.25, 49.02, 10.5 and 89.1%, respectively. Concentrate feed mixture were wheat bran, crushed maize, kheshari bran, crushed gram, and soybean meal. The DM of wheat bran, khesari bran, crushed gram, crushed maize and soybean meal were found 90.5, 89.57, 89.57, 91.75 and 89.2%, respectively. The DM of concentrate feed mixture was 90.12% and CP, CF, EE, NFE, Ash and OM were found 20.75, 7.64, 6.04, 61.02, 4.55 and 95.45%, respectively.

Daulat (1988) observed that wheat bran contained 88% DM and 12.03% CP which are slightly lower to the present research findings but the DM content of wheat bran were higher than the findings of Devendra and Mcleory (1982). The percentage of DM, OM, CP and CF for rice straw and Napier grass were in acceptable range (Akbar *et al.* 2010). The content of DM and OM of Napier grass in this present experiment varied to the reported values of Virk *et al.* (1978) and Mitra (1971).

Feed intake based on metabolic body weight (g/kg $w^{0.75}$/d) of four different group of growing heifer

Intake of Napier grass, rice straw and concentrate mixture fed by growing heifer are expressed on DM basis are shown in Table 3.

Intake of Napier grass, rice straw and concentrate mixture in DM basis was significantly different ($P<0.05$) among the four trial groups. Intake of growing heifers are also expressed as (g/kg $w^{0.75}$/d) in stall feeding condition (Table 3, intake of DM (g/kg $w^{0.75}$/d) of concentrate mixture, rice straw and Napier grass significantly differ ($P<0.01$) among group A, group B, group C and group D of heifers. Similar trend were observed in case of OM, CP and CF (g/kg $w^{0.75}$/d) intake.

Intake of CF by heifers belonged to different groups showed highly significant ($P<0.01$) of which CF intake was higher in heifers belong to group C and lower in A group. DM intake depends on the requirement of the animals and the quality of the feed.

The significant difference was in DM intake (g/kg $w^{0.75}$/d) among different age groups (Table 4) because of the amount of concentrate mixture increased with the increased in the weight (kg) of heifers. So the difference in live weight of any of the heifers caused of high concentrate DM intake (g/kg $w^{0.75}$/d) in older aged groups. The total DM intake of different age groups was higher than that reported by Das (1996). It might be due to availability of feed, body condition and environment.

Intake of CP (g/kg $w^{0.75}$/d) was higher in C group and lower in A group that's why the live weight gain was also higher in C group than A group. It might be due to better utilization of feed by heifers belong to D group. In this experiment C group can utilize CF more efficiently than other groups. Because of undeveloped rumen for the proper functioning, first trial group could not properly utilize CF.

However, more research is needed to investigate it. The FCR of D group was more efficient than other groups that might have caused higher growth rate in D group heifer than the others.

Growth performance at different ages of crossbred heifer

The average initial live weight of four age groups and the live weight changes of growing heifers at different ages during the experimental period were shown in Table 4.

Table 2 Chemical compositions of feed ingredients used in the experimental diets

Feed ingredients	DM (%) (fresh weight)	DM (%)[1]					
		OM	CP	CF	EE	NFE	Ash
Napier grass	19.44	89.05	9.35	28.88	2.25	49.02	10.5
Wheat bran	90.50	94.75	14.75	9.50	3.20	67.30	5.25
Crushed maize	91.75	98.55	8.90	1.98	5.30	82.37	1.45
Kheshari bran	89.57	95.50	30.90	6.85	1.90	55.85	4.50
Crushed gram	89.57	96.80	15.00	10.35	4.10	67.35	3.20
Soybean meal	89.20	91.65	34.20	9.50	15.70	32.25	8.35

DM: dry matter; OM: organic matter; CP: crude protein; CF: crude fiber; EE: ether extract and NFE: Nitrogen free extract.

Table 3 Feed intake by growing crossbred heifers (g/kg $w^{0.75}$/d)

Parameter	Group				SD	Level of significance
	A	B	C	D		
Napier intake in DM basis (kg)	60.40	90.60	120.70	130.90	10.08	*
Rice straw intake in DM basis (kg)	120.00	200.00	240.00	260.0	20.2	*
Concentrate mixture intake in DM basis (kg)	91.70	137.50	179.3	200.10	15.11	*
DM intake (g/kg $w^{0.75}$/d)	110.60	151.30	162.8	126.70	3.82	**
OM intake (g/kg $w^{0.75}$/d)	93.22	128.22	136.81	107.37	11.46	*
CP intake (g/kg $w^{0.75}$/d)	18.38	25.11	27.99	21.83	0.675	**
CF intake (g/kg $w^{0.75}$/d)	60.80	82.10	90.00	69.50	2.10	**

* ($P<0.05$) and ** ($P<0.05$).
SD: standard deviation.
DM: dry matter; OM: organic matter; CP: crude protein; CF: crude fiber and g/kg $w^{0.75}$/d: metabolic body weight.

Table 4 Growth performance at different ages of crossbred heifers

Parameter	Group				SD
	A	B	C	D	
Initial live weight (kg)	82.0	99.2	122.1	193.4	11.02
Metabolic live weight (kg)	27.1	31.4	36.6	51.9	2.58
Live weight at 1st month (kg)	88.0	110.5	140.7	213.5	11.46
Live weight at 2nd month (kg)	96.1	123.9	160.0	239.0	11.21
Live weight at 3rd month (kg)	106.3	146.4	191.9	276.9	11.30
Live weight gain (kg)	24.3	47.2	69.7	83.5	2.93

The means within the same row with at least one common letter, do not have significant difference ($P>0.01$).
SD: standard deviation.

The difference in initial live weight was significant ($P<0.01$) due to age variation. The live weight changes were higher in group D than the other groups of heifers. The final live weight was highest in D followed by group C, group B and group A, respectively (Table 4). As evidenced in final live weight gain among the different age groups, in terms of total live weight gain for unit feed DM intake, was found high with the advancement of age, being lowest in younger group. Live weight gain in animal is influenced by physiological condition, utilization of nutrient, environment and management of the animal. Khan (2003) and Silva and Orskov (1988) reported that cattle fed different forages and concentrate supplements achieved higher growth at different stages of growth. Haque *et al*. (2005) showed that daily gain of cattle linearly increased ($P<0.05$) with a certain stage of age and was positively related with the initial live weight of the animal. Yanar and Aydin (1999) reported that daily live weight gain at 6-9 months, 9-12 months, 12-15 months and 15-18 months was 452.0, 325.0, 325.0 and 224.0 g/d, respectively, which showed higher growth.

Lyimo (2006) also reported that daily live weight gain of 28 wks of aged growing animals was 450 g/d. The average daily weight gain was highest in D group which might be due to that the heifer in this group can properly utilize the feed because the rumen is more functional than the other groups (Church, 1993).

Further study could be carried out including higher age of heifers to monitor at which age heifers reduce their growth. The lowest live weight gain was found in A group, it might be due to this that calves entered in a new regime of feeding and management practices cannot efficiently utilize the feed ingredients.

Feed conversion efficiency of growing crossbred heifers

The feed conversion efficiency (FCR) of growing crossbred heifer during the experimental period was shown in Table 5.

The daily live weight gain of different age groups of animal differ significantly ($P<0.01$). The heifer belongs to group D showed higher daily live weight gain followed by C, group B and group A, respectively.

The feed conversion efficiency (FCR) was statistically highest in group A and lowest in group D. The best feed conversion efficiency and lower FCR was found in group D, whereas, higher FCR and lower feed efficiency was found in group A. The growth rate was increased at the advancement of age and it also declined at a certain stage of age. The birth weight, weaning weight and weaning age also affect the growth rate at different age of heifers. The higher birth weight and weaning weight increases the growth rate.

The lowest feed conversion efficiency in A group was because they can't utilize the CF more efficiently than other groups of heifers. The capacity of feed utilization increased with the advancement of age.

In economical view, 18-22 months of heifers were also more profitable due to their higher growth rate than others.

It is concluded that feed intake, growth rate and feed conversion efficiency was higher with the advancement of certain stage of age and it could be decreased at later age which was not monitored in the present experiment. Further study is needed which should be carried out with higher age group to investigate the hypothesis. The growth rate and feed conversion efficiency might be improved by providing adequate nutritious feed and by applying proper management.

Comparative study to observe economic benefit of rearing difference age group of heifer

A comparative study was also carried out to observe economic benefit of rearing heifer in different age. From the Table 6, it was observed that farmer get more profit at later age i.e. D group.

Table 5 Feed conversion ratio of growing crossbred heifers

Parameter	Group				SD	Level of significance
	A	B	C	D		
Initial live weight (kg)	82.0	99.2	122.1	193.4	11.02	**
Final live weight (kg)	106.3	146.4	191.9	276.9	11.30	**
Live weight gain (kg)	24.3	47.2	69.7	83.5	2.93	**
Days of measurement	90	90	90	90	-	-
Average daily gain (g)	270.0	524.0	775.0	927.0	32.3	**
Total DM intake (kg)	272.0	428.0	540.0	591.0	45.4	**
DM intake (kg/day)	3.02	4.76	6.00	6.57	0.505	*
FCR (kg DMI/kg LWG)	11.28	9.13	7.78	7.12	1.144	**

* ($P<0.05$) and ** ($P<0.05$).
SD: standard deviation.
DM: dry matter; FCR: feed conversion ratio; LWG: Live weight gain and DMI: dry matter intake.

Table 6 Economic benefits of rearing different age groups of heifers

Parameter		Group			
		A	B	C	D
Napier	Total kg	270	405	540	585
	Cost (BDT 2.5/kg)	675	1012.5	1350	1462.5
Rice straw	Total kg	135	225	270	293
	Cost (BDT 1.75/kg)	236.25	393.75	472.5	512.75
Concentrate	Total kg	99	148.5	193.7	216.1
	Cost (BDT 24.42/kg)	2417.58	3626.37	4730.15	5277.16
Total cost	BDT	3328.83	5032.62	6552.65	7252.41
Live weight (kg)	Live weight gain	24.3	47.2	69.7	83.5
	Dressed weight	15.46	30.03	44.34	53.12
	Value (BDT 250/kg)	3865	7507.5	11085	13280
Profit	Total (BDT)	536.17	2474.88	4532.35	6027.59
	Per month (BDT)	178.72	824.96	1510.78	2009.2

BDT: bangladesh taka.
Heifers dressing percent= 63.62% and meat price was BDT 250/kg.

Though to grow an adult dairy cow all the stage of heifer are needed but from this experiment it was observed that farmer become more benefitted in rearing heifer in higher age (18-22 months). So the farmer would get more profit rearing heifer of 18-22 months of age.

CONCLUSION

The daily live weight gain among the different age groups of heifers was significantly different. The heifers belong to D group showed higher daily live weight gain followed by

C, B and A trial groups. Growth rate and feed conversion ratio, both are comparatively better in D group (18-22 months) of heifers than the other experimental groups. That's why the D group, i.e. 18-22 months of heifers, is more economical than the other groups.

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