

*Article*

## **Influence of crushed maize and soybean cake on the growth of crossbred female calves**

Maksudul Islam Nahid<sup>1</sup>, Md. Anwar Hossain<sup>2</sup>, Azharul Bari<sup>1</sup>, Mst. Latifa Yesmin Camy<sup>3</sup>, Dipok Kumar Sarker<sup>4</sup>, Shuvendu Sarker<sup>4</sup>, Md. Hafizur Rahman<sup>4</sup>, Md. Nurul Islam<sup>1</sup> and Md. Harun-ur-Rashid<sup>1</sup>

<sup>1</sup>Department of Dairy Science, Bangladesh Agricultural University, Mymensingh, Bangladesh

<sup>2</sup>Agriculture and Environment Division, Bangladesh Academy for Rural Development (BARD), Cumilla, Bangladesh

<sup>3</sup>Department of Animal Nutrition, Bangladesh Agricultural University, Mymensingh, Bangladesh

<sup>4</sup>Department of Livestock Services, Ministry of Fisheries and Livestock, Government of the People's Republic of Bangladesh Dhaka

\*Corresponding author: Maksudul Islam Nahid, Department of Dairy Science, Bangladesh Agricultural University, Mymensingh, Bangladesh. Email: minahidbau72@gmail.com

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**Abstract:** The present research work was conducted to develop a balanced ration for crossbred high yielding calves in farm condition. For this purpose, seventy days long feeding trial was conducted with nine crossbred female calves having nearly similar body weight and age. Nine crossbred calves were equally divided into three groups such as T<sub>1</sub> (1 kg concentrate mixture of crushed maize, wheat bran, mustard oil cake, molasses, DCP and salt at a ratio of 25:45:22:5:1:2, respectively), T<sub>2</sub> (1 kg concentrate mixture of crushed maize, wheat bran, soybean cake, molasses, DCP and salt at a ratio of 27:45:20:5:1:2, respectively) and T<sub>3</sub> (Wheat bran, rice polish, mustard oil cake, DCP, Salt were supplied according to BAU routine farm feeding at a ratio of 65:18:14:1:2, respectively). All calves were supplied with *ad libitum* green grasses (German and Para) and fresh clean drinking water. From the research finding, it was observed that the average total dry matter intake, total body weight gain, body length gain and heart girth gain were in T<sub>1</sub> (2.68<sup>a</sup>±0.000 kg, 2.51<sup>a</sup>±0.21 kg, 1.83<sup>a</sup>±0.12 cm, 1.29<sup>a</sup>±0.07 cm, respectively) and T<sub>2</sub> (2.65<sup>a</sup>±0.001 kg, 2.55<sup>a</sup>±0.21 kg, 1.67<sup>a</sup>±0.12 cm, 1.25<sup>a</sup>±0.07 cm, respectively) groups significantly (p<0.05) higher than that of the T<sub>3</sub> (2.34<sup>b</sup>±0.002 kg, 0.96<sup>b</sup>±0.21 kg, 0.81<sup>b</sup>±0.12 cm, 0.64<sup>b</sup>±0.07 cm, respectively) group. The result showed that the body weight gain of T<sub>2</sub> group was higher by supplementation of balanced ration. Therefore, the feed supplementation of crushed maize, wheat bran, soybean cake, molasses, DCP and salt at a ratio of 27:45:20:5:1:2, respectively should be supplied to crossbred calves for the future development of dairy herd replacement stock for profitable dairy business.

**Keywords:** calf feeding; health; nutrition; maize; soybean cake

### **1. Introduction**

Feeding young dairy calves is critical to raising replacements and need special attention to meet up their energy, protein, fat, vitamin and mineral requirements. These nutrients are present in balanced feed and this type of feed can be prepared from dry fodder, green fodder, concentrates and supplemented feed. Also, mixing of appropriate amount of various ingredients in concentrate mixture is necessary to prepare a balance concentrate diet which enables the replacement stock to perform optimally (Bahashwan and Alfadli, 2016). Though, cattle rearing are a way of profitable production of milk and meat. It is also a systematic way of cattle management which deals with proper feeding, breeding, and housing of the cattle and also taking preventive measures against diseases and parasitic infestations (Bhuiyan *et al.*, 2007). However, in Bangladesh crossbred cattle is mostly reared as a component of traditional crop-based mixed farming system. Some people use both conventional and non-conventional feed ingredients for fattening yearling bull calves (Sarker *et al.*, 2015). They rear indigenous calves with tethering as well as traditional system of grazing without any supplementation. This system of

production causes reduced growth and poor reproductive performance, which in turn, results severe economic losses. As a result, a huge amount of calves does not possess the potential growth in the long run.

Crossbreds of Bangladesh include Sahiwal-Pabna cross, Friesian-Pabna cross, Sahiwal-Local cross and Friesian cross and their milk production are 1240, 1460, 728 and 1800 litres per lactation respectively (DLS, 2019). In Bangladesh, crossbred cattle cannot achieve their production potentialities properly due to harsh environmental conditions, non-availability of balanced feed and green forage, unskilled management, and lack of knowledge about health care. In fact, crossbred cattle have a higher nutritional requirement and better adaptability than pure breeds (Banglapedia, 2014). The productive performances of the crossbred cows may differ from that of the indigenous ones living in different geographical areas where harsh environmental condition exists (Alam *et al.*, 2001).

Crushed maize plays an important role for balancing diet of calves because maize is high energy rich grain which is high in starch and oil and low in fibre. Maize contains about 70% starch, 85-90% TDN, 4% oil and about 8-12% protein. It contains starch which composed of about 25% amylose and 75% amylopectin (Abdelgadir *et al.*, 2010; Eastham *et al.*, 2018). The starch of maize is more slowly digested in the rumen than that of the other grains and at high levels of feeding a proportion of starch passes into the small intestine, where it is digested and absorbed as glucose. Moreover, to develop feeding standard nutrient requirement is pre-requisite. Nutrition plays a major role in attaining the proper weight at proper time (Gerbert *et al.*, 2018). Dietary protein is essential for growth and development of tissues. However, protein receives the most attention because it is the most expensive component of the diet for the young calf (Davis and Drackley, 1998). Energy and protein are most critical nutrients influencing animal productive performance under tropical/ subtropical environment conditions (Shahzad *et al.*, 2010). The livestock production industry in Bangladesh has been using the feeding standards and management techniques prescribed by the scientific organizations of western countries which are based on data adapted to their existing climate and condition. So, a balanced feed for standard growth, particularly nutrient requirements, developed through research by using crossbred cattle is of high importance. However, reports on the nutrient requirements of crossbred calves are scanty and limited information is available particularly on the contribution of dietary energy and protein to the growth performance of these animals under Bangladesh condition.

Therefore, the present study was performed to develop a suitable balanced feed by using crushed maize and soybean cake for the better growth of crossbred female calves and to monitor their body weight gain, heart-girth, body length and wither height between treated and control groups of crossbred female calves.

## 2. Materials and Methods

The experiment was conducted on crossbred high yielding baby calves for monitoring the changes in dry matter intake, daily live weight gain and different body measurements. The entire research activities encompasses the selection of animals, collection of feedstuffs, diet formulation, management and feeding of animals, leftover recording at every morning, proximate analysis of feedstuffs and parameter studied at 7 days intervals.

### 2.1. Experimental site and duration

The experiment was conducted at Bangladesh Agricultural University Dairy Farm (BAUDF), Department of Dairy Science, Bangladesh Agricultural University (BAU), Mymensingh-2202, Bangladesh. Total duration of the experiment was 70 days from 21th June to 31th August, 2016 of which first 10 days were adjustment period.

### 2.2. Experimental animals

Nine crossbred (Friesian crossbred and Sahiwal crossbred) female calves were selected from the Bangladesh Agricultural University Dairy Farm. The average age of the calves was about 7 months and they were almost similar in age, body weight and general condition.

### 2.3. Collection of feed ingredients

Feed ingredients such as wheat bran, mustard oil cake, soybean meal, crushed maize, DCP and common salt were purchased from local market of Mymensingh. Para and German grasses were cultivated in the fodder plot of BAUDF.

### 2.4. Layout of the experiment

Nine crossbred (Friesian and Sahiwal crossbred) female calves at the age of about seven months were used in this experiment. The calves were divided into three groups (Table 1). The calves of different groups were selected unbiasedly in terms of body weight and general health condition.

**Table 1. Layout of the experiment.**

Group No.	Tag No.	Initial body weight (Kg)	Initial body length (cm)	Initial wither height (cm)	Initial heart girth (cm)	Age of the animal	Average age of the animal
T <sub>1</sub>	561	73	88.9	86.86	92	08 M 06 D	07 M 18 D
	559	83	86.36	90.42	97	08 M 12 D	
	585	69	81.28	90.80	90	06 M 06 D	
T <sub>2</sub>	571	81	87.63	89.40	96	07 M 10 D	07 M 16 D
	564	95	91.44	92.71	102	08 M 01 D	
	572	67	78.74	86.36	89	07 M 09 D	
T <sub>3</sub>	560	81	81.28	88.90	96	08 M 07 D	07 M 28 D
	552	67	81.28	83.82	89	10 M 01 D	
	586	47	74.93	76.45	77	05 M 16 D	

(M= month, D= day)

## 2.5. Ration supplied to the animals

The calves of the T<sub>1</sub> group were supplied with *ad libitum* green grass and concentrate mixture (crushed maize, wheat bran, mustard oil cake, molasses, DCP and salt at a ratio of 25:45:22:5:1:2, respectively); T<sub>2</sub> group was supplied with *ad libitum* green grass and concentrate mixture (crushed maize, wheat bran, soybean cake, molasses, DCP and salt at a ratio of 27:45:20:5:1:2, respectively) and T<sub>3</sub> group was supplied according to BAU routine farm feeding (Wheat bran, rice polish, mustard oil cake, DCP, Salt at a ratio of 65:18:14:1:2, respectively) (Table 2).

**Table 2. Ingredients of the concentrate mixture used in this experiment.**

SL No.	Ingredients (%)	Treatment group		
		T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>
1.	Crushed maize	25.0	27.0	-
2.	Wheat bran	45.0	45.0	65.0
3.	Rice polish	-	-	18.0
4.	Mustard oil cake	22.0	-	14.0
5.	Soybean cake	-	20.0	-
6.	Molasses	5.0	5.0	-
7.	DCP	1.0	1.0	1.0
8.	Salt	2.0	2.0	2.0
	Total (%)	100	100	100

## 2.6. Methods of feeding

A preliminary period of ten days was observed to adjust the animals with the experimental ration. Concentrate mixture was supplied 1 kg/day/calf to the calf in equal halves to the experimental calves twice a day i.e. at 7.00 AM and 12.30 PM. Green grasses were supplied *ad libitum* at 1.00 PM to the respective group of calves. All the calves had free access to the clean normal fresh drinking water for 24 hours.

## 2.7. Management of the animals

During the whole of the experimental period, all calves were kept in a well-ventilated barn and barn was cleaned twice a day and washing of calves were done at morning and afternoon with the help of hose pipe. The water remains in the manger that supplied previous day were drained out at morning and after cleaning of manger fresh water were supplied. All the calves were allowed to go out once daily in the morning in front the house in the open ground for getting sunlight, exercise and free aeration. Regular supervision of experimental heifers shed made a better health management of animals and hygienically clean environment.

## 2.8. Variables studied

The calves were given experimental diet and leftover was collected in following morning before offering feed. Feed intake was calculated after subtracting leftover from the feed supplied. Thus, feed intake of each experimental calf was recorded in daily throughout the study period and finally the values were expressed as fresh and dry matter basis. Body weight (Kg), wither height (cm), body length (cm), heart girth (cm) gain was calculated at every 7 days interval throughout the experimental period.

### 2.9. Analysis of feed ingredients

Composition of feed ingredients which have been used in this research work was analyzed in accordingly to the recommended method. For chemical analysis, feed samples were finely grounded at 8000 rpm by lab mill type grinding machine (Christy and Norris Limited, Process Engineers Chelmsford, England). Proximate analysis of feed samples were conducted according to the procedures of AOAC (2004) for determining the moisture, crude protein (CP), crude fiber (CF), ether extract (EE), ash and nitrogen-free-extract (NFE). All the feed samples were analyzed in duplicate and mean values were recorded (Table 3). These analyses were performed at Animal Nutrition Laboratory, BAU, Mymensingh-2202, Bangladesh.

**Table 3. Proximate composition (fresh basis) of concentrate mixtures used in different ration for feeding calves of different groups.**

Parameters	Experimental group		
	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>
DM (%)	89.01	89.00	88.50
CP (%)	14.63	15.00	13.00
CF (%)	7.66	7.56	8.05
EE (%)	6.26	6.30	5.20
NFE (%)	50.94	51.25	50.57
Ash (%)	9.15	9.26	8.67

DM: Dry Matter; CP: Crude Protein; CF: Crude Fat; EE: Ether Extract; NFE: Nitrogen-Free Extract.

### 2.10. Data analysis

Repeated Measures Analysis of Variance (ANOVA) in Completely Randomized Design (CRD) was performed to investigate the effect of different treatment on dry matter intake, body weight gain, body length gain, wither height gain and heart girth gain of crossbred baby calves (Zar, 2002). Tukey's HSD test was also done to compare the treatment means.

## 3. Results and Discussion

In this experiment evaluation of balanced feed on the growth performances of dairy herd replacement stock of high yielding crossbred female calves was performed.

### 3.1. Effect of dry matter intake (DMI) on calves

The average daily dry matter intake of T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub> groups were shown in Table 4. It is revealed from the study that dry matter intake of calves increasing significantly. The highest average DMI was found in 9<sup>th</sup> week (70 days) and which were 3.05±0.29 kg, 2.9±0.11 kg and 2.45±0.15 kg in T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub> group, respectively (Table 4).

**Table 4. Effect of feeding crushed maize and soybean cake on dry matter intake of calves during the experimental period of 9 weeks.**

Dry matter intake (Kg/ week)	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>	Level of significance
1st week	2.40 <sup>a</sup> ±0.29	2.45 <sup>a</sup> ±0.06	2.2 <sup>b</sup> ±0.03	*
2 <sup>nd</sup> week	2.45 <sup>a</sup> ±0.2	2.5 <sup>a</sup> ±0.18	2.2 <sup>b</sup> ±0.15	*
3 <sup>rd</sup> week	2.45±0.1	2.5±0.15	2.5±0.2	NS
4 <sup>th</sup> week	2.60 <sup>a</sup> ±0.3	2.55 <sup>a</sup> ±0.25	2.3 <sup>b</sup> ±0.11	*
5 <sup>th</sup> week	2.65 <sup>a</sup> ±0.012	2.65 <sup>a</sup> ±0.2	2.3 <sup>b</sup> ±0.12	*
6 <sup>th</sup> week	2.80 <sup>a</sup> ±0.15	2.7 <sup>a</sup> ±0.18	2.34 <sup>b</sup> ±0.16	*
7 <sup>th</sup> week	2.90 <sup>a</sup> ±0.2	2.8 <sup>a</sup> ±0.05	2.4 <sup>b</sup> ±0.07	*
8 <sup>th</sup> week	2.90 <sup>a</sup> ±0.15	2.8 <sup>a</sup> ±0.2	2.4 <sup>b</sup> ±0.17	*
9 <sup>th</sup> week	3.05 <sup>a</sup> ±0.29	2.9 <sup>a</sup> ±0.11	2.45 <sup>b</sup> ±0.15	*

<sup>a,b,c</sup> Different superscript in a single row indicates a significant difference ; \* = Significant at 5% level; NS = Non significant

It is revealed from the study that dry matter intake of calves increasing significantly. The obtained results supported by the findings of Palczynski *et al.* (2020) and Sudhakar *et al.* (2002). Palczynski *et al.* (2020)

reported that balanced feed supplementation with UMB increased daily dry matter intake and Sudhakar *et al.* (2002) observed significant difference ( $p>0.01$ ) in average daily dry matter intake in buffaloes fed UMB supplemented ration. Prasad and Agarwal (1996) worked with 18 crossbred heifers and CP content of concentrate mixture fed to group T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub> was 24, 28 and 32% respectively. Prakash *et al.* (2006), Jadhav and Deshmukh (2001) reported that high protein diet influenced remarkably to increase CP and DCP intake that was responsible for the deposition of protein in animal body.

### 3.2. Effect on body weight gain (BWG)

Throughout the experimental period resultant average total BWG of T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub> groups are shown in Table 5. After conducting 70 days period of the experiment, it was observed that average BWG was higher in crossbred calves of T<sub>2</sub> group whereas the lowest BWG was found in T<sub>3</sub> group. The average body weight gain of T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub> groups were 2.51±0.21 kg, 2.55±0.21 kg and 0.96±0.21 kg at 7<sup>th</sup> day intervals over the period of study and significant difference ( $p>0.05$ ) existed among the groups. The body weight gain per day for T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub> groups were 0.383±0.038, 0.372±0.037 and 0.133±0.011 kg, respectively (Table 5).

**Table 5. Effect of feeding crushed maize and soybean cake on body weight gain of calves throughout the experimental Period of 9 weeks.**

Parameter	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>	Level of sig.
Initial body weight (Kg)	75±7.21	81±14	65±17.08	-
Final body weight (Kg)	98±9.54	103.33±16.26	73±17.77	-
Body weight gain/day (Kg)	0.383 <sup>a</sup> ±0.038	0.372 <sup>a</sup> ±0.037	0.133 <sup>b</sup> ±0.011	*

<sup>a,b,c</sup> Different superscript in a single row indicates a significant difference : \* = Significant at 5% level.

The results showed that there was significant differences ( $p<0.05$ ) in live weight gain due to dietary energy and protein levels. This statement was in agreement with the findings of Limea *et al.*, (2009). Many researchers (Hango *et al.*, 2007; Ayo, 2002; Ntakwendela *et al.*, 2002; Morand-Fehr, 2005) reported that growth rate of ruminant increased with increasing level of energy and protein. The present findings are similar with the findings of Sukho (2008) and Kaewpila (2010) who reported that ADG of native calves were increased with the increasing metabolizable energy and protein intake.

### 3.3. Body length gain (BLG)

The average initial and final body length of T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub> groups are shown in Table 6. Body length gain per day for group T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub> were 0.274±0.021, 0.251±0.015 and 0.122±0.039 cm respectively.

**Table 6. Effect of feeding crushed maize and soybean cake on body length of calves throughout the experimental period of 9 weeks.**

Parameter	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>	Level of sig.
Initial body length (cm)	85.51±3.88	85.93±6.52	79.16±3.67	-
Final body length (cm)	102±2.65	101±5.57	86.5±1.32	-
Body length gain/day (cm)	0.274 <sup>a</sup> ±0.021	0.25 <sup>a</sup> ±0.015	0.122 <sup>b</sup> ±0.039	*

<sup>a,b,c</sup> Different superscript in a single row indicates a significant difference : \* = Significant at 5% level.

### 3.4. Wither height gain (WHG)

The average initial and final wither height of T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub> groups are shown in Table 7. Result implies that wither height gain of T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub> groups was 0.07±0.005, 0.66±0.000 and 0.067±0.003 cm per day, respectively (Table 7).

**Table 7. Effect of feeding crushed maize and soybean cake on wither height of calves throughout the experimental period 9 weeks.**

Parameter	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>	Level of sig.
Initial wither height (cm)	89.36±2.17	89.49±3.17	83.05±6.26	-
Final wither height (cm)	93.7±1.84	93.45±3.18	87.12±6.28	-
Wither height gain/day (cm)	0.07 <sup>b</sup> ±0.005	0.66 <sup>a</sup> ±0.000	0.067 <sup>a</sup> ±0.003	*

<sup>a,b,c</sup> Different superscript in a single row indicates a significant difference : \* = Significant at 5% level.

The results of the present experiment agree with the findings of Firoza (2009) and Mukai (1990) reported that the heart girth and withers height of Japanese Black Cattle increased steadily during 1914-1985 by feeding rice straw or wild grass with concentrates.

### 3.5. Heart girth gain (HGG)

The highest heart girth gain was found in calves of T<sub>1</sub> groups by receiving *ad libitum* green grass and concentrate mixture. Throughout the experimental period resultant average heart girth gain of T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub> groups are shown in Table 8.

**Table 8. Effect of feeding crushed maize and soybean cake on heart-girth of calves throughout the experimental period of 9 weeks.**

Parameter	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>	Level of sig.
Initial heart-girth (cm)	93.00±3.61	95.66±6.51	87.33±9.61	-
Final heart-girth (cm)	104.66±3.4	107±6.61	93.16±9.22	-
Heart-girth gain/day (cm)	0.194 <sup>a</sup> ±0.003	0.189 <sup>a</sup> ±0.001	0.097 <sup>b</sup> ±0.006	*

<sup>a,b,c</sup> Different superscript in a single row indicates a significant difference : \* = Significant at 5% level.

This result was similar with the findings of Ferdous *et al.* (2010) who conducted an experiment on comparative study of the performance of buffalo calves and cow calves by feeding urea molasses block with straw based diet and found heart girth gain of cow and buffalo calves were 0.24±0.02 and 0.30±0.03 cm, respectively. The correlation between height and body weight is 0.97 reported by James (2002). Some authors reported a correlation of 0.605-0.97 between the heart girth and body weight. Moreover, Khan *et al.* (2009) also found a statistically non-significant higher heart girth value by using different energy level with animals aged above 2 years.

### 3.6. Effect of feeding crushed maize and soybean cake on DMI, BWG, WHG, BLG and HGG during the experimental period

Highest DMI was found in T<sub>1</sub> group followed by T<sub>2</sub> group. Best BWG was observed in T<sub>2</sub> group followed by T<sub>1</sub>. During the experimental period maximum BLG, WHG and HGG were found in T<sub>1</sub> group (Table 9).

**Table 9. Effect of feeding crushed maize and soybean cake on DMI, BWG, WHG, BLG and HGG at different treatment groups of calves during the experimental period of 9 weeks.**

Parameters	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>	Level of sig.
Dry matter intake (Kg/W)	2.68 <sup>a</sup> ±0.000	2.65 <sup>a</sup> ±0.001	2.34 <sup>b</sup> ±0.002	*
Body weight gain(Kg/W)	2.51 <sup>a</sup> ±0.21	2.55 <sup>a</sup> ±0.21	0.96 <sup>b</sup> ±0.21	*
Body length gain (Cm/W)	1.83 <sup>a</sup> ±0.12	1.67 <sup>a</sup> ±0.12	0.81 <sup>b</sup> ±0.12	*
Wither height gain (Cm/W)	0.48±0.01	0.44±0.01	0.45±0.01	NS
Heart girth gain (Cm/W)	1.29 <sup>a</sup> ±0.07	1.25 <sup>a</sup> ±0.07	0.64 <sup>b</sup> ±0.07	*

<sup>a,b,c</sup> Different superscript in a single row indicates a significant difference : \* = Significant at 5% level; NS = Non significant.

## 4. Conclusions

The obtained results revealed from this study that dry matter intake, body length gain, wither height gain and heart girth gain were vary significantly among the experimental groups. So, it can be concluded that the concentrate mixture which contains crushed maize and soybean cake supplied with *ad libitum* green grass had positive effect on the growth of female baby calves than other types of ration. So, concentrate mixture containing crushed maize and soybean cake could be used for feeding crossbred female calves.

## Conflict of interest

None to declare.

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