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Article

Feeding calf starter: growth performance of crossbred dairy calves

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Abstract: Calf starter is a special feed preparation that is fed to calves to ensure smooth weaning of calves. The study was conducted to evaluate the growth performance of crossbred dairy calves (Holstein-Friesian crossbred, HFX and Sahiwal crossbred, ShX) feeding a readily fermentable calf starter diet. The duration of the study was 17 weeks of which the first week was for the adjustment period. Ten healthy crossbred heifer calves of average 40 days old were selected for this purpose and they were divided into two groups according to their genetic materials (5 HFX and 5 ShX) in a completely randomized design. The calves were fed initially 0.25kg/day/calf of starter feed which was gradually increased up to 1 kg/day/calf. In addition to calf starter, a predetermined amount of whole milk (2 kg/day/calf) and *ad libitum* amount of green grass were also supplied to the calves. During the experimental period, growth parameters viz. body weight gain, body length gain, wither height gain, and hip height gain was measured weekly. After the whole study period, no significant difference (P>0.05) was found in case of the average weekly body weight gain and all the body measurements. The results suggest that calves fed a balanced calf starter can grow identically overcoming any breed variations. However, to provide a clearer idea about the effect of calf starter on different crossbred dairy calves broad-scale research should be conducted on an advanced level including more crossbreds or pure breeds.

Keywords: calf starter; crossbred calves; dairy heifer calves; growth measurements; Bangladesh

1. Introduction

Dairy farming is one of the most important aspects of animal agriculture in Bangladesh and is essential for the country's economy and health (Datta *et al.*, 2019). Future dairy herds are built on calves, and healthy calves mature into healthy heifers, ensuring superior replacement stock that will yield more milk in the future (Sardoabi *et al*., 2021). Moreover, the production of calves with high weaning weights is essential for the calf-producing industry's gross income and profitability (Yuste *et al*., 2020). In this regard, several research (Chamorro *et al*., 2017; Abitante *et al*., 2024) have examined the impact of supplemental feeding on performance before and after weaning. Before weaning, solid feed supplementation is thought to be essential for rumen development (Khan *et al*., 2016; Liu *et al*., 2022), which is important for later adaption to roughage diets. It is well known that starter feed helps the calf's reticulo rumen maturation. Reducing the amount of solid feed consumption can hinder rumen development and make the calf's post weaning problems more difficult (Hill *et al.*, 2010, 2016; Ahmadi *et al*., 2022). If calves are not managed appropriately, the stressful process of weaning

can have negative impacts on a calf's behaviour, physiology, and performance; consequently (Lecorps *et al*., 2023). Moreover, stressful weaning of calves also causes a significant drop in energy intake during this time (Steele *et al.*, 2017; Scoley *et al*., 2019; Ahmadi *et al*., 2022). To sustain growth and avoid losing growth benefits during the weaning transition, farmers must employ proper management to optimize solid feed consumption before and during weaning.

Commercial starter feeds for calves are frequently expensive and might not be the most attractive and digestible feed for growing calves (Khan *et al.*, 2016; Lorenz, 2021). Pre weaning calves' digestive systems are set up to process milk as a primary source of energy effectively (Meale *et al*., 2017). Since their rumen is not fully matured, they can't digest fibrous meals, and they're mostly reliant on whole milk or milk replacer. Thus, the first few months of a calf's life are crucial and they need special care and feeding management during this time. Grain- or other readily digestible carbohydrate-containing calf starters are easily fermented in the rumen to produce volatile fatty acids (VFA), particularly propionate and butyrate, which can encourage papillary development (Sun *et al*., 2018).

Starter feeds are easier for calves to digest while the rumen is still maturing because they are more palatable and accepted by them (Parsons *et al.*, 2022). Therefore, it is predicted that feeding an easily fermentable calf starter, which is high in soluble sugar may increase calf acceptability and digestibility of solid feed, increasing feed consumption early in life. A good number of research have been done to examine the effect of different ingredients, their forms in the starter feed, energy or protein levels, combined with liquid and roughages on the growth performance of calves. However, to the best of our knowledge, very little data are available regarding the effect of the calf starter diet on different breeds of dairy calves. Hence, the study was designed to determine any effect of the breed of crossbred dairy calves when they are raised on starter diet.

2. Materials and Methods

2.1. Ethical approval and informed consent

No ethical approval was required for conducting this research.

2.2. Experimental site and duration of the study

The feeding experiment was performed at the Bangladesh Agricultural University (BAU) Dairy Farm (24°43′46.5″N, 90°25′22.8″E), Mymensingh, Bangladesh (Figure 1). The trial lasted a total of 17 weeks, of which the first week was devoted to diet adjustment.

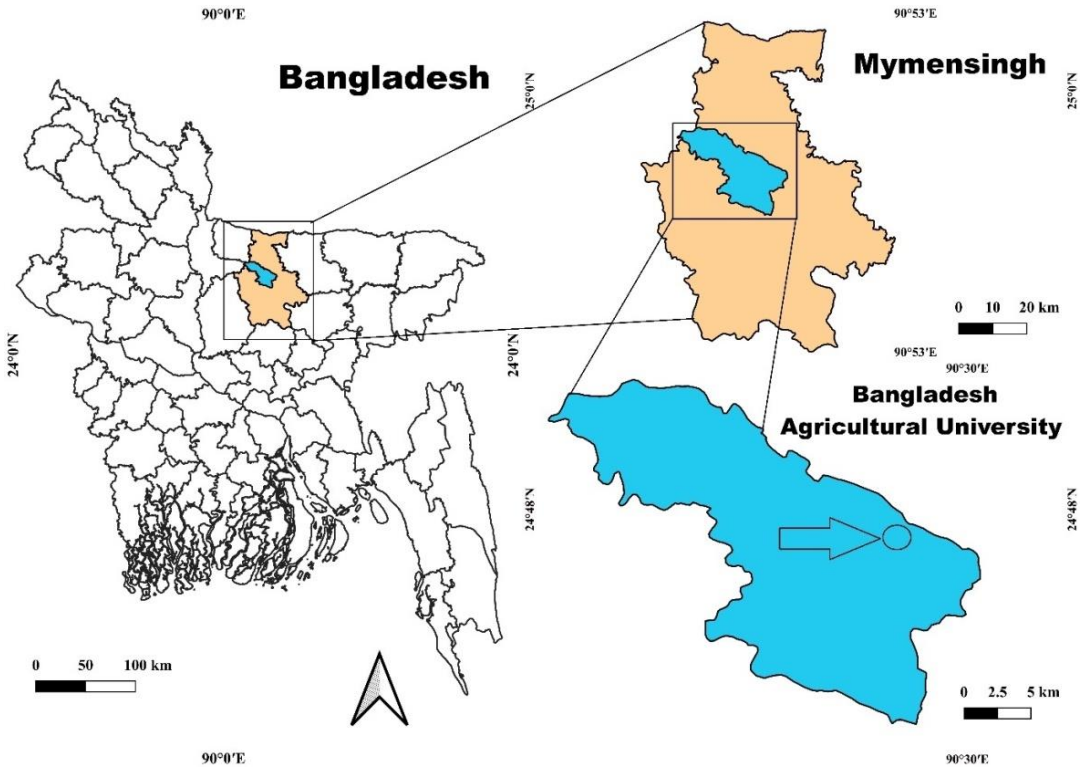

Figure 1. Location of the feeding trial of the experiment (BAU Dairy Farm, Bangladesh Agricultural University, Mymensingh, Bangladesh).

2.3. Animal and management

Ten crossbred dairy calves (Holstein-Friesian cross, HFX and Sahiwal cross, ShX) of an average 40 days old with almost similar body weight (25.0 ± 1.5) kg were selected from the BAU dairy farm herd and they were divided into two groups according to their breed. Each calf was allotted with concrete floor stall, manger and water trough in a calf barn. Additionally, the barn was kept clean and well-ventilated to ensure the calf's comfort during the study period. Every effort was made to minimize animal discomfort.

2.4. Calf starter preparation and feeding management

Calf starter was prepared by hand mixing and the ingredients were mixed until a uniformity was formed (Table 1). The required amount of molasses was mixed with the starter mixture before providing to the calves. Calf starter was supplied initially at 0.25 kg/day/calf in equal halves to the experimental calves twice a day for instance, at 9.00 am and 12.30 pm and gradually increase upto 1 kg/d/calf. The calves were fed whole milk two times per day at 7.00 AM and 4.00 PM at a fixed rate of 2 kg/day/calf for the first 8 weeks and thereafter 1 kg/day/calf for the remaining weeks. Green grasses were supplied *ad libitum* at 1.00 PM to the respective group of calves. All the calves had free access to fresh drinking water for 24 hours.

Table 1. Composition of the calf starter with their proximate components supplied to the experimental calves.

Ingredients	**% amount as fresh matter**
Crushed maize	24
Wheat bran	28
Rice polish	10
Broken gram	10
Mustard oil cake	20
Molasses	5
Vitamin-mineral premix	1
Salt	2
Total	100
Chemical composition	**(g/kg of DM)**
DM, g/kg of fresh matter	884.37
Crude protein	151.97
Crude fat	44.47
Crude fiber	100.91
Ash	79.51

2.5. Estimation of growth measurements

In the first day of every week at 7:00 AM, a portable digital scale was used to weigh each calf. From the point of the shoulder to the pin bone, the calves' body length (inches) was measured. By utilizing a measuring wooden scale, the height (inches) at the withers and hips was calculated as the distances between the plain floor and the calves' withers and hips, respectively. At intervals of 7 days, measures of body growth were taken, and gains of several growth parameters were assessed and recorded properly.

2.6. Statistical analysis

Analysis of variance was performed using IBM SPSS version 22.0 to investigate the impact of different breeds on the growth metrics of calves in a completely randomized design. The calves' groups served as the independent variable, categorized as the between-subjects factor, while the period was treated as a within-subjects component. Post-hoc analysis was conducted using Tukey's HSD test to compare mean growth parameters. Additionally, the study site map was created using QGIS.

3. Results and Discussion

3.1. Effect on body weight gain

The body weight gain of different calves is presented in Table 2 and, the trend of body weight gain of the experimental calves is depicted in Figure 2. The body weight gain of crossbred calves in both groups was found similar (P>0.05). However, the body weight gain of HFX calves was slightly higher than that of the ShX calves. Feed intake is positively associated with body weight gain (Yamano *et al*., 2023). In our study, all the calves received similar diets which might be the probable reason for a similar body weight gain of all calves. However,

Martínez *et al*. (2021) stated that breed affects the body weight of calves. They conducted their study on beef calves and this might be the cause behind this inconsistency. The within-subjects test from our study revealed that the time effect was significant (P<0.01) on the body weight gain.

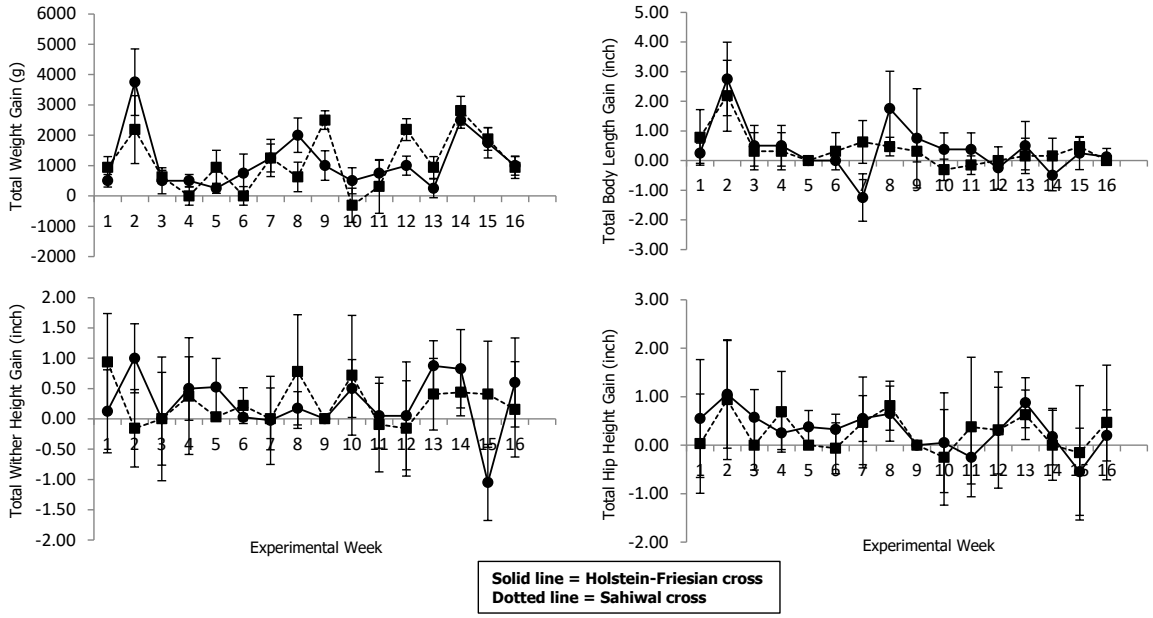

Figure 2. Trend of body weight and growth measurements gain in the experiment.

3.2. Effect on body measurements

Similar to body weight gain, the body length gain of the HFX calves was higher than that of ShX calves but the difference in body length gain between the groups was statistically insignificant (P>0.05) (Table 2).

Table 2. Effect of genetic variations on growth performance of crossbred dairy calves.

Parameters	HFX	ShX	*P*-value
BWG (kg/week)	1.141±0.364	1.113±0.406	0.961
BLG (inch/week)	0.383±0.091	0.352±0.102	0.826
WHG (inch/week)	0.261±0.076	0.254±0.085	0.952
HHG (inch/week)	0.320±0.061	0.266±0.068	0.566

HFX= Holstei-Friesian cross; ShX= Sahiwal cross; BWG= body weight gain; BLG= body length gain; WHG= wither height gain; HHG= hip height gain

Similar to this study, Beiranvand *et al.* (2014) reported no significant effects of dietary treatments on the body length gain of dairy calves. In our study, although time has a significant (P<0.01) effect on the body length gain of the calves (Table 3), it was not influenced by the interaction of time and treatment (breed).

Table 3. Tests of within-subjects effects on body growth parameters of crossbred dairy calves

Parameters	Source	F values
BWG	Time	2.802**
	Time × Treatment	0.715^{NS}
BLG	Time	3.090**
	Time × Treatment	0.889^{NS}
WHG	Time	1.220^{NS}
	Time × Treatment	1.240^{NS}
HHG	Time	1.330^{NS}
	Time × Treatment	0.355^{NS}

BWG= body weight gain; BLG= body length gain; WHG= wither height gain; HHG= hip height gain; NS= not significant; **= highly significant

Again, per week wither height gain of the crossbred dairy calves remained similar (P>0.05) between the two groups (Table 2). Time and interaction of time and treatment had also no effect on wither height development (Table 3). This finding is consistent with the findings of Beiranvand *et al.* (2014). Consistent with other parameters, identical (P>0.05) hip height gain was observed in both groups. Neither time nor the interaction of time and treatment significantly (P>0.05) impacted the hip height gain of the experimental calves. Beiranvand *et al.* (2014) and Liu *et al*. (2021) concluded with similar results and stated that the hip height gain of the experimental calves did not change regarding the treatments. The pattern of growth measurements of calves is presented in Figure 2. Similarities in the growth parameters in different breeds might be justified because of growth of calves often have a low heritability (h^2=0.12 to 0.27) and consequently breed or genetic variation has small or insignificant effects on claves' growth and development (Martínez *et al*., 2021). Rather growth is generally controlled by several factors such as the age of the dam, season and year of birth, the sex of the calf, and importantly plane of nutrition (Koçak *et al*., 2023). In addition to nutritional variation, dissimilarities in structure or forms in the calf starter could also affect the growth of dairy calves (Ghaffari and Kertz, 2021) and it might be told that an identical form of calf starter or similar plane of nutrition during the experiment prompted the calves to gain similar development in body structure. Therefore, no or little variations were seen in the gain of average body weight or other body measurements like body length; wither height, and hip height of crossbred dairy calves.

4. Conclusions

The findings suggest that nutrition played a vital role in maintaining similar growth conditions. This study revealed that calf starter feeding to crossbred dairy calves improves the growth performance almost similarly of Holstein-Friesian cross, HFX and Sahiwal cross, ShX. However, further researches need to investigate the nutritional status and rumen development of the calves and any variations in their subsequent productive and reproductive performance entailing more delegated calves from different crossbreds and pure breeds.

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Data availability

Data are contained within the article.

Conflict of interest

None to declare.

Authors' contribution

Conceptualization: Mohammad Shohel Rana Siddiki; Methodology: Mohammad Shohel Rana Siddiki and Md. Mehedi Hasan Khandakar; Experiment management and data collection: Md. Mehedi Hasan Khandakar, Rezaul Mahmud Nahid, Md. Sumon Hossain and Md. Sadakatul Bari; Data analysis: Md. Mehedi Hasan Khandakar and Md. Abunaser; Writing-original draft preparation: Mohammad Rashidul Haque, Md. Abunaser and Md. Abid Hasan Sarker; Writing-review and editing: Md. Harun-ur-Rashid, Mohammad Shohel Rana Siddiki; Supervision: Md. Harun-ur-Rashid, Mohammad Shohel Rana Siddiki. All authors have read and approved the final manuscript.

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