Article
Effect of calf starter on the growth performance of dairy calves

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Abstract: Dairy calves must be fed appropriately to meet their nutritional needs, supporting optimal growth and development to achieve the recommended target age at first calving (AFC) of 24 months. Traditional restricted milk feeding practices suppress growth, contribute to negative welfare states and may result in malnutrition and immunosuppression. In this study a total of eight high yielding calves (four Holstein Friesian and four Sahiwal breed) whose average body weight was 44.8 kg and 58 kg respectively. The supplied calf starter was composed of maize crushed, rice polish, wheat bran, gram broken, mustard oil cake, vitamin mineral premix, molasses and common salt. Calf starter was supplied initially 0.25 kg/day/calf in equal halves to the experimental calves twice a day i.e. at 7.00 AM and 12.30 PM and gradually increase upto 1 kg/d/calf. Average body weight gain, wither height gain, body length gain, barrel height gain, and hip height gain in Sahiwal and Holstein Friesian calves were 65.97±1.04 Kg, 31.04±1.13 inch, 32.34±1.46 inch, 12.80±0.71 inch, 35.05±1.27 inch, and 53.61±2.41 Kg, 29.78±1.17 inch, 30.93±1.66 inch 11.78±0.66 inch, 33.44±1.41 inch respectively. Our study concluded to establish a consensus on calf feeding standards which support physiological function, facilitate weaning, support growth targets and ensure calf health and welfare is protected.

Keywords: dairy calf feeding; health; nutrition; calf starter

1. Introduction
Dairy calves must be fed appropriately to meet their nutritional needs for optimal growth and development. Diet must also support and reflect the development of calves' digestive function from the liquid-fed pre-ruminant phase through the transition into a functional ruminant (Drackley, 2008). There are also financial implications since milk feeding accounts for 40% of total rearing costs from birth to weaning, the most expensive phase of rearing replacement dairy heifers (Boulton *et al.,* 2017). Calf growth rates at least partly determine their age at first calving (AFC), with heifers calving at 23–24 months being more cost-efficient than later calving animals (Palczynski *et al.,* 2020). The recommended target AFC of 24 months achieves optimal economic efficiency resulting from increased lifetime fertility, survival and milk production compared to later calving heifers (Wathes *et al.,* 2014; Eastham *et al.,* 2018).

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A typical Holstein-type heifer must maintain a growth rate of about 750 g/day from birth to achieve adequate body weight and stature to calve at 24 months (Wathes *et al.,* 2014). Traditional feeding practices provide daily milk allowances of approximately 10% of calf bodyweight, primarily to increase solid-feed intakes to facilitate rumen development for earlier weaning. These restricted feeding practices limit the growth potential of calves (Godden *et al.,* 2005) and are likely to provide insufficient energy in temperatures below 15°C (Ollivett *et al.,* 2012). When calves are malnourished, particularly in cases of insufficient energy intakes, their immunity is impaired and they are more susceptible to disease (Gerbert *et al.,* 2018). The effect of feeding higher planes of nutrition, above maintenance requirements, on the immunocompetence of calves is less clear cut as intensive milk feeding does not appear to affect the health and immune status of calves in a consistent manner (Hengst *et al.,* 2012).

If a significant amount of starter or grain is consumed by the calf each day, the digestive system (rumen) will developed about 3 weeks with microbial population and enough absorptive capacity to allow the calf to continue normal growth after weaning (Hill *et al.,* 2013). Competition for milk exists between calf and human although milk is complete food for calf and human being and it is good source of Ca, Vita-A, D, E, thiamine, riboflavin and many essential amino acids. Huge Milk deficiency of Bangladesh is about 99.23 lakh metric ton (Sarker *et al.,* 2015; DLS, 2019) per year. In a country like Bangladesh, when milk production is very low, calf usually gets poor amount or even no allowance of milk from its dam. Therefore, feeding of dry concentrate is essential for the optimum growth and development of calves (Bahashwan and Alfadli, 2016). It can be used instead of raw milk in calf rearing to avoid human competition for milk. Moreover, calves become more susceptible to the various diseases due to the inadequate and imbalanced feed result in unable to reach optimum production level especially in a country like Bangladesh. Proper feeding may improves the performances of heifer. Due to inadequate nutrition heifer rearing period and sexual maturity becomes extended (Le-Cozler *et al.,* 2008; Diaz *et al.,* 2001; Bhuiyan *et al.,* 2007) reported that feeding milk and milk replacer may be counterproductive to early weaning if more milk and milk replacer have been fed to calves (Cowles *et al.,* 2006; Hossen *et al.,* 2012). So this study was therefore adopted to fill in this gap, with the objectives of evaluating the effects of calf starter on growth and development of dairy calves.

2. Materials and Methods
2.1. Experimental site and duration
The experiment was conducted at Bangladesh Agricultural University Dairy Farm and Department of Dairy Science, Bangladesh Agricultural University (BAU), Mymensingh during 4th July to 31th December, 2017 of which first 10 days were adjustment period.

2.2. Experimental calves' management
Eight crossbred calf (HF and Sahiwal crossbred) were selected for the experimental purpose from BAU dairy farm. Calves were average 40 days old and the average body weight of group A (Holstein Friesian-HF) and group B (Sahiwal-SS) was 44.8kg and 58kg respectively. Each calf was allotted with concrete floor stall, manger and water trough in a calf barn with well-ventilation and good sanitary conditions were maintained in the barn to keep the calf comfortable throughout the study period. The animals were previously vaccinated for the infectious disease as per the vaccination schedule of the farm.

2.3. Collection of feed ingredients
Feed ingredients such as rice polish, wheat bran, mustard oil cake, vitamin mineral premix, molasses and common salt were purchased from local market of Mymensingh. Para and German grasses were supplied from the fodder field of BAU dairy farm.

2.4. Preparation of calf starter
The calf starter was composed of maize crushed, rice polish, wheat bran, gram broken, mustard oil cake, vitamin mineral premix, molasses and common salt (Table 1). Before mixing of mustard oil cake it was grounded by a milling machine. Hand mixing was done for the preparation of calf starter. All ingredients were mixed as much uniformly as possible.

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Table 1. Composition of feed ingredients (concentrates feed) supplied to the experimental calf.

Ingredients	Amount of ingredients (Kg)
Maize crushed	2.50
Wheat bran	2.80
Rice polish	1.00
Gram broken	1.00
Mustard oilcake	2.00
Molasses	0.60
Vitamin-mineral premix	0.05
Salt	0.10
Total	10.00

2.5. Management of the experimental calf

During the experimental period all animals were properly housed and regular cleaning was performed. Regular inspection of farm veterinary assistant was also made for the better health management.

A preliminary period of ten days was observed to adjust the calves with the experimental ration. Calf starter was supplied initially 0.25 kg/day/calf in equal halves to the experimental calves twice a day i.e. at 7.00 AM and 12.30 PM and gradually increase upto 1 kg/d/calf. 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.

2.6. Data analysis

The computer program student's "t" test calf starter was used for the analysis by Microsoft Excel 2010. It was done to find out the interaction of body weight gain, body length gain, wither height gain, hip height gain and heart girth gain of dairy calves.

3. Results and Discussion

The experiment was conducted up to 17 weeks and the entire experimental period resultant average total Body weight gain, Wither height gain, Barrel height gain and Hip height gain are shown in Table 2.

Table 2. The mean value with its standard error of BWG, WHG, BHG and HHG of dairy calf at different treatment over the period of experiment.

Parameters	Group HF	Group SS	p-value	Level of sig.
BWG (Kg/17w)	53.61±2.41	65.97±1.04	<0.0001	****
WHG (inch/17w)	29.78±1.17	31.04±1.13	0.0032	**
BLG (inch/17w)	30.93±1.66	32.34±1.46	0.0134	*
BHG (inch /17w)	11.78±0.66	12.80±0.71	0.0002	***
HHG (inch /17w)	33.44±1.41	35.05±1.27	0.0040	**

*indicates significant at 5% level of probability, ** indicates significant at 1% level of probability and NS indicates non-significant effect on the parameter. BWG= body weight gain, WHG=wither height gain, BLG= body length gain, BHG= barrel height gain, HHG= hip height gain.

Calf weight gain depends on the diet fed, and it also affects age at puberty, endocrine parameters, and ovarian structures. Throughout the experiment period the average total body weight gain (BWG) was found 53.61±2.41 kg and 65.97±1.04 kg in group HF and group SS respectively. Feed intake is positively associated with body weight gain of heifers (Lents *et al.,* 2005). Shamay *et al.,* (2005) also reported that feeding grass hay supplemented with protein concentrate to heifers improved average BWG. Present research result indicates that average total BWG was significantly ($p > 0.0001$) higher in group SS than the group HF this may be due to increase calf starter or improved associative action of nutrients or improved digestibility of feed (Eastham *et al.,* 2018). These result is also agreed to (Darshan *et al.,* 2007; Talukder *et al.,* 2017) who found that the body weight of calves throughout the experimental period increased due to the increase calf starter or improved associative action of nutrient or improved digestibility.

The wither height gain (WHG) of crossbred calf is found 29.78±1.17 inch and 31.04±1.13 inch in group HF and group SS respectively which differ significantly at ($p < 0.0032$); which is similar to the result of Wathes *et al.*

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(2014). In the present study the wither height is increased in group SS, this may be the cause of protein supplementation, more calf starter intake and efficient utilization of feed.

From the experiment, there was a significant effect of calf starter on body length gain. The body length increased at 1% level of significant. The highest body length was found in group SS which was 32.34±1.46 inch than the group HF 30.93±1.66 inch. The result of present study is similar with the result of Boulton *et al.* (2017) reported that increased body length with the increase of protein concentrates.

The Barrel height gain (BHG) of crossbred calf is found 11.78±0.66 inch and 12.80± 0.71 inch in group HF and group SS respectively which differ significantly at (p<0.0002). Which is similar to the result of Palczynski *et al.* (2020) which found that the wither height of Japanese Black cattle increased steadily. In the present study the wither height is increased in group SS, this may be the cause of calf starter intake and efficient utilization of feed.

In this experiment the average mean value indicates that hip height gain (HHG) was highest in group SS and there is a significant (p<0.05) difference present with the group HF. This result may be due to feeding of calf starter along with green grass. According to Gerbert *et al.,* (2018).that the hip height gain of Holstein heifers was smaller (p<0.001) fed straw based diet than the heifers fed protein concentrate along with green grass and various types of hay.

4. Conclusions

The result of the study suggest that supplementation of calf starter with green grass be the important in calf feeding in relation to reproduction and nutritional status; especially those are kept for herd replacement. Calf starter should be fed to the dairy calf from the very early life when its digestive physiology develops enough to utilize this feed will end with a good result provided that there is no interrupted feeding and growth in the previous life.

Conflict of interest

None to declare.

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