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Assessment of growth performance of pre-ruminant crossbred calves maintained on different feeding strategies#

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Abstract

A study was conducted to assess the growth performance of pre-ruminant crossbred calves maintained on different feeding strategies. Eighteen four days old crossbred calves were selected from University Livestock Farm and Fodder Research and Development Scheme, Mannuthy. The calves were randomly allotted to three dietary treatments- T1 (fed with milk @ 1/10th of body weight during first six weeks, 1/15th of body weight during next two weeks, 1/20th of body weight during next four weeks), T2 (fed with milk at 15 per cent of body weight for first month and weaned at six weeks of age) and T3 (fed with milk replacer (22 per cent CP) at 15 per cent of body weight for first month and weaned at six weeks of age. Calf starter having 22 – 24 per cent CP and 70 per cent TDN was fed to T1 and one with 20 per cent CP and 70 per cent TDN) was fed to T2 and T3 as per standard feeding practices followed in the farm. Average daily gain and body weight gain were higher ($p<0.05$) in T2 compared to T3. However outcome of groups T2 and T1 and the comparison of the aforesaid parameters between T3 and T1 were similar. The fortnightly average daily dry matter intake of the calves did not differ between the various groups except for the fourth and fifth fortnight. The mean feed conversion ratio of experimental calves of T1, T2 and T3 were 3.46 ± 0.09, 3.11 ± 0.23 and 3.41± 0.19 respectively and the values were statistically similar ($p>0.05$).

Key words: *Calf starter, Milk replacer, Feed conversion ratio*

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The profit of dairy industry depends largely on successful rearing of replacement calves. Feeding of milk fed and transitional calves is one of the most over looked area in calf nutrition. Whole milk is an excellent, easily digestible meal for calves. It assures all the nutrients in proper quantities for healthy calf growth and development. For economic way of raising calves, whole milk can be substituted with milk replacer. Milk replacer has a higher total solid content than milk. But vegetable proteins contained in it like soya bean has to be further processed for neutralising the anti-nutritional factor present in it.

The early weaning of calves has many advantages over prolonged feeding with milk or milk replacements. Several research works have been done to compare intensified or accelerated milk feeding programs with conventional limit-fed programs. They concluded that the pre-weaning growth rates were increased by greater milk feeding rates, but the immediate post-weaning growth rates were found to be lower compared to conventional programs as the starter intake was suppressed. Hence the present study evaluates growth parameters in transition calves with respect to different feeding strategies.

Materials and methods

This study was conducted at the University Livestock Farm and Fodder Research Station (ULF & FRDS), College of Veterinary and Animal Sciences, Kerala, India.

Experimental feed

All the calves were fed with colostrum at 10 per cent of their body weight up to four days of age.

The three experimental rations were: T1-milk @ 1/10th of body weight during first six weeks, 1/15th of body weight during next two weeks and 1/20th of body weight during next four weeks; T2 - fed with milk @ 15 per cent of body weight for first month and weaned at 6 weeks of age; T3- fed with milk replacer (22 per cent CP) @ 15 per cent of body weight for first month and weaned at six weeks of age. Calf starter with (22 – 24 per cent Crude Protein (CP) and 70 per cent Total Digestible Nutrients (TDN)) was offered to T1 as per standard feeding practices followed in the farm whereas T and T3 were offered calf starter (20 per cent CP and 70 per cent TDN) *ad libitum* from the first day of feeding trial in the morning and afternoon for a period of one hour. Record of quantity given and balance were routinely maintained.

The sources of milk protein used for milk replacer were skim milk powder and whey powder. Vegetable protein used for milk replacer was soya-bean, which was heated at 100° C to for 15 min to neutralise trypsin inhibitor (Van der Ven *et al.,* 2005) using hot air oven. Milk replacer was reconstituted with cooled boiled water to obtain 20 per cent of total solids at the time of feeding.

The ingredient composition of the calf starter and milk replacer is given in Tables 1 and 2, respectively.

Feeding trial

Eighteen crossbred calves of four days old were selected, divided into three groups in a completely randomised block design and were then randomly allotted to dietary treatments: T1, T2 and T3. Feeding trial was done for a period of 120 days using milk, milk replacer, calf starter and green grass. Weighed quantities of milk, milk replacer, calf starter and green grass were fed individually to all the animals. Left over portions of the feed was collected manually and weighed twice a day, in the morning and afternoon at 8 AM and 2 PM, respectively. Samples were taken daily for analysing the moisture content and thus daily dry matter intake was calculated. The data on daily dry matter intake was recorded during the entire experimental period. Body weights of all the calves were recorded at fortnightly intervals. Clean drinking water was made available for all the calves throughout the experiment.

Results and discussion

Body weight and average daily gain

The body weight and average daily gain of experimental calves maintained on the three dietary treatments, recorded during

Table 1. Ingredient composition of calf starter offered to calves maintained on three dietary treatments.

Ingredients	Percentage composition of calf starter		
	T1	T2	T3
Maize	37	38	38
Gingelly oil cake	8	15	15
Soya bean meal	11	5	5
Alfalfa	15	8	8
Wheat bran	20	27	27
Black gram husk	6.25	4.25	4.25
Mineral mixture	1.25	1.25	1.25
Salt	0.5	0.5	0.5
Calcite	1	1	1
Total	100	100	100
Vit AB2D3K, g/100kg	20	20	20

Nicomix AB2D3K (Nicholas Piramal India Ltd, Mumbai Agra Road Balkum Thane, Mumbai - 400 608).
Composition per gram: Vitamin A-82,500 I.U, Vitamin B2- 50 mg, Vitamin D3- 12,000 I.U and Vitamin K- 10 mg

feeding trial is displayed in Table 3.

The average initial body weight of the calves in T1, T2 and T3 were 29.10 ± 1.81, 29.38 ± 1.44 and 29.58 ± 1.33 kg, respectively. Final body weight of T1, T2 and T3 were 61.32 ± 3.54, 65.31 ± 3.02 and 58.65 ± 2.13 kg, respectively. The results on body weight revealed no significant difference ($p>0.05$) among calves of the three dietary treatments. Ozkaya and Toker (2012) observed that the calves weaned at fifth and eighth week fed with calf starter with 18.25 per cent and 21.93 per cent CP had similar body weight up to eighth week of age. Jini *et al.* (2015) also observed that level of CP had no effect on body weight in calves fed with calf starter containing 24.50, 21.50 and 18.5 per cent CP.

Average daily gain of calves fed with the three experimental rations were 287.68 ±16.16, 320.86 ±15.64 and 259.52 ± 13.34g, respectively for T1, T2 and T3 and the respective total body weight gain was 32.22, 35.94 and 29.06 kg. Statistical analysis of the data on ADG and total body weight gain revealed a higher ($p<0.05$) ADG and body weight gain in T2 compared to T3. However there were concurrence between the results from T2 and T1 and also between T3 and T1 ($p>0.05$). Arthington *et al.* (2005) reported that even though early-weaned (85thday) calves were lighter at the time of weaning than normal

Table 2. Ingredient composition of milk replacer offered to calves

Ingredients	Parts
Skim milk powder	10
Raggi	38
Roasted soyabean	34
Whey powder	4
Wheat	11
Salt	0.5
Mineral mixture	1.25
Calcite	1.25
Total	100
Vit AB2D3K, g/100kg	20

Nicomix AB2D3K (Nicholas Piramal India Ltd, Mumbai Agra Road Balkum Thane, Mumbai - 400 608).

Composition per gram: Vitamin A-82,500 I.U, Vitamin B2- 50 mg, Vitamin D3- 12,000 I.U and Vitamin K- 10 mg

weaned (300th day) calves, the average daily gain were similar for both at two year of age. Lee *et al.* (2009) observed that calves fed with milk gained more body weight (35.4 per cent) during the pre weaning period compared with those fed milk replacer, while post weaning body weight gain was similar for both groups. Jini *et al.*(2015) also observed similar growth rate of 324.4 and 326.90 g and a cumulative weight gain of 27.25 and 27.46 kg were observed in calves fed with calf starter with 24.50 and 21.5 per cent CP.

Table 3. Fortnightly average body weight and average daily gain[1] of the calves maintained on the three experimental rations, kg

Parameter	Dietary treatments			p value
	T1	T2	T3	
Initial body weight (kg)	29.10±1.81	29.38±1.44	29.58±1.33	0.976 ns
Final body weight(kg)	61.32±3.54	65.31±3.02	58.65±2.13	0.305ns
Total weight gain(kg)	32.22±1.80ab	35.94±1.75a	29.06±1.49b	0.037*
Average daily gain (g)	287.68±16.16ab	320.86±15.64a	259.52±13.34b	0.037*

[1]Average of six values with SE

ns-non significant at p > 0.05

* Means bearing different superscript within a row differ significantly (p < 0.05)

Table 4. Fortnightly average total daily dry matter intake[1] of the calves maintained on the three experimental rations, kg

Fortnight	Daily dry matter intake, (kg)			p value
	T1	T2	T3	
1	0.41±0.02	0.61±0.30	0.57±0.10	0.094ns
2	0.52±0.03	0.75±.038	0.81±0.13	0.057 ns
3	0.69±0.03	0.56±0.08	0.54±0.07	0.173 ns
4	0.75±0.02a	0.55±0.06b	0.34±0.04c	0.000**
5	0.97±0.03a	0.80±0.12ab	0.63±0.06b	0.030*
6	1.24±0.08	1.34±0.19	0.82±0.16	0.070 ns
7	1.43±0.12	1.78±0.22	1.47±0.16	0.142 ns
8	1.90±0.21	2.38±0.25	1.89±0.24	0.250 ns

[1]Average of six values with SE

ns-non significant at p > 0.05

**Means bearing different superscript within a row differ significantly (p < 0.01)

* Means bearing different superscript within a row differ significantly (p < 0.05)

Dry matter intake (DMI)

Data on fortnightly average daily dry matter intake of experimental calves of T1, T2 and T3 are presented in Table 4.

The average daily DMI of calves at fortnight intervals ranged from 0.41 to 1.9 kg for T1, 0.61 to 2.38 kg for T2 and 0.57 to 1.89 kg for T3. Data on fortnightly average of daily DMI revealed similar DMI by the calves between the various groups except for the fourth and fifth fortnight. A significantly higher (p<0.01) daily DMI at fourth fortnight in T1 compared to T2 and T3 may be due to the immediate effect of weaning. Increase in DMI was observed in T2 in the subsequent fortnight which was comparable to T1 in fifth fortnight, but the increase in DMI was slow in T3 which was comparable with T1 in sixth fortnight. Even though the dry matter intake diminished immediately after weaning, it became comparable after 14-28 days to milk and calf starter fed calves. A significantly higher (p<0.05) daily DMI was observed in the fifth fortnight in T1 compared to T3, however comparable results were obtained in T1 and T2, T2 and T3.

From the feeding trial, it was observed that for milk replacer feeding, there should be an adapting time. During the initial study time, milk replacer accounted for five per cent of total liquid feed, with milk accounting for the remainder. In the fourth week, the milk replacer percentage was gradually raised until it reached 70 per cent of the total liquid feed intake. Milk replacer had a higher total solid content than milk. So a numerical increase in DMI was observed in T3 calves in the second fortnight when compared to those in T1. Arthington *et al.* (2005) also observed similar DMI for both early-weaned (85thday) and normal weaned (300thday) calves during the finishing period. Jasmine *et al.* (2007) observed that average daily dry matter consumption of early weaned and conventional weaned calves were statistically similar and that a significant drop occurred in the percentage

Table 5. Mean feed conversion ratio[1] of the calves maintained on the three experimental rations, kg

Parameters	T1	T2	T3	p value
Total dry matter consumed (kg/animal)	111.21±5.93	113.17±12.44	99.25±9.68	0.562[ns]
Total body weight gain (kg)	32.22±1.80[ab]	35.93±1.75[a]	29.07±0.49[b]	0.039*
Feed to gain ratio (kg Feed/kg body wt. gain)	3.46±0.09	3.11±0.23	3.41±0.19	0.405[ns]

[1]Average of six values with SE

ns-non significant at p > 0.05

* Means bearing different superscript within a row differ significantly (p < 0.05)

dry matter consumption after weaning which in the subsequent weeks reached comparable level to that of other groups. Azevedo *et al*. (2016) opined that the intake of whole milk along with milk replacer increased the DMI in the liquid feed. Rani *et al.* (2016) observed that DMI ranges from 0.51 to 1.75 kg in calves from first to third month of age maintained as per standard feeding practices followed in the farm. De Paula *et al*. (2017) reported that high milk replacer intake resulted in lower starter intake during the pre-weaning period which led to inadequate solid feed intake at the time of weaning at eighth week.

Feed conversion ratio (FCR)

Data on the FCR of experimental calves of T1, T2 and T3 are presented in Table 5.

Statistical analysis of the data revealed a similar average FCR (p>0.05) among the treatment groups. Present results are in agreement with Jasmine *et al*. (2007), who observed a FCR of 3.59 in calves weaned at eighth week. Yanar *et al*. (2015) observed that the feed conversion efficiency in a period between birth and six months of age were not significantly affected in calves weaned at second and third month of age. Kamalahasan (2018) observed a FCR of 2.61, 3.50 and 2.59 respectively for calves fed with milk, commercially available milk replacer and formulated milk replacer. Vinu *et al*. (2012) reported a FCR of 3.33 and 3.15 respectively for calves fed as per BIS with and without selenium supplementation. In contrary to the present study, Tao *et al.* (2018) observed that the feed efficiency was higher in calves weaned at fourth and sixth week compared to the weaned at eighth and tenth week.

Conclusion

From the observations made in the present study, the level of dietary protein and early weaning were not having any significant effect on growth parameter studied under the present work. Any of the growth parameters such as body weight, total dry matter intake and feed conversion efficiency were similar among the groups, but the average daily gain of milk fed group was higher than milk replacer fed groups even though they were weaned at same age.

Conflict of Interest:

The authors declare that they have no conflict of interest.

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