NUTRIENT BALANCE AND ECONOMICS OF YOUNG CALVES RAISED ON LACTOBACILLI SUPPLEMENTED MILK REPLACER

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ABSTRACT

Eighteen, day-old Jersey calves divided into three groups viz. T_1,T_2 andT_3 which were fed on milk and milk replacer up to three months of age. Group T_1 was standard (control), however group T_2 and T_3 were supplemented with *L. acidophillus* (leopard excreta) and *L. plantarum* (carrot) @ 6.8 x 10^8 cells/litre of milk, respectively. The retained calcium (g/head/day) significantly ($P \leq 0.05$) higher in T_2 (14.39 ± 0.43) and T_3 (14.28 ± 0.46) as compared to control (T_1, 13.00 ± 0.48). The retained calcium (% basis) was 66.60 ± 1.78, 72.98 ± 1.40 and 72.58 ± 1.34 in T_1, T_2 and T_3 treatments, respectively. The retained phosphorus (g/head/day) was non-significant under different groups (5.98 ± 0.33, 7.25 ±0.41 and 6.76 ± 0.43) in T_1, T_2 and T_3 treatments, respectively. The retained phosphorus (% basis) was 56.07 ± 1.86, 64.79 ± 2.05 and 61.97 ± 2.73 in T_1, T_2 and T_3 treatments, respectively. The retention of nitrogen (g/head/day) was 20.48 ± 1.02, 23.04 ± 0.32 and 23.81 ± 0.68 in T_1, T_2 and T_3 treatments, respectively. It was significantly ($P \leq 0.05$) higher in T_3 and T_2 as compared to T_1. The differences in T_2 and T_3 treatments were non-significant. As far as economic is concerned of three months old calves under different treatments, the feed cost per kg of body weight gain was 129.63 ± 1.28, 87.17 ± 1.49 and 93.97 ± 1.33 in T_1, T_2 and T_3 treatments, respectively. While comparing with standard (control T_1), treatment T_2 and T_3 had 32.18 and 27.50 per cent lower cost of feed per kg gain in body weight, respectively. Result revealed that supplementation of probiotics significantly influence the balance of nutrients viz. calcium, phosphorus, nitrogen and also reduce the feed cost in per kg body weight gain of three months old Jersey calves.

***Key words*:** Milk replacer, *L. acidophillus*, leopard excreta, *L. plantarum*, carrot

Introduction

The development of the rumen of new born calves is largely influenced by the consumption of dry feed and the products of its digestion in the rumen. Early introduction of dry feed and its intake by new born dairy calves are beneficial to their health and reduce rearing cost. It is highly desirable to obtain rapid development of ruminal function in the calf (Morrill, 1984) as prolonged milk feeding was found to delay the asset of the typical ruminal microflora (Langemann and Allen,1959). Calves can be raised successfully even at substantially reduced milk feeding provided that care must be taken in selecting the ingredients for milk replacer formulation (Razdan *et al.,*1965; Nagine *et al.,* 1969; Dave *et al.,* 1971). The lactobacillus population in rumen was directly affected by diet (Frizzo *et al.*, 2010; 2011). The interactions between nutrition and microbial flora are complex. Bacteria in gut may effect digestion, absorption and the products of bacterial metabolism may provide nutrient or affect the health of the calves. Hence feeding of probiotics to calves will improve their health and dry matter intake at their early stage of life. Probiotics are mostly lactic acid bacteria which are indigenous (natural inhabitants) of the body. During the last decade, the intestinal microbial flora balance has progressively been recognized as one of the main factor to be maniuplated in order to obtain the best growth performance in dairy calves. These microbial flora represent an ecological system which is essential to animal health. So lactobacilli (probiotics) are incorporated into diet with the purpose to improve animal health and its overall performance. The positive effect of probiotics (*L.acidophilus*) was observed (Mudgal and Bhagal, 2010) in pre-ruminant buffalo calves and it diminishes with age due to development of rumen.

Dietary effect of different feed supplements on anatomical (Tomat *et al.,* 1962; McGavinand Morrill,1976; and physiological; Sutton *et al.,* 1963; Young *et al.,* 1965) development of the rumen are reviewed by various scientists. However, Studies on ruminal microbial development in calves especially as influenced by lactobacilli supplementation with milk replacer are limited. Thus, recent research has lead to development of an early weaning programme involving the use of a pre starter ration fortified with lactobacilli to stimulate dry feed consumption in calves and our objective was to compare the ruminal microbial development of new born calves raised under early weaning or conventional weaning programme when fed the milk replacer along with different lactobacilli strains. Milk replacer feeding has been developed as a cost effective way of feeding calves instead of using whole milk which can be spared for human consumption.

Materials and Methods

Eighteen, day-old Jersey calves were selected and randomly distributed into three equal groups. Group T_1, T_2 and

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T_3 which were fed on milk and milk replacer as per feeding schedule given in Table 1. In addition to this, milk in group T_2 and T_3 was fortified with *Lactobacillus acidophilus* (leopard excreta) and *Lactobacillus plantarum* (carrot) @ 6.8 x 10^8 cells/ litter milk, respectively. Calves body weights were recorded at day-old age and thereafter at fortnight interval in the morning before offering feed and water in order to assess live weight gain.

Balance of nutrients was calculated by total collection method at three month of age and calcium was estimated by the standard method proposed by Association of Official Analytical Chemists (AOAC, 1985) while phosphorus was estimated by the method proposed by Parks and Dunn (1963). The data was statistically analysed as per standard methods of Snedecor and Cochran (1994).

Results and Discussion

Calcium intake in three months old female calves was almost same 19.50 ± 0.27, 19.70 ± 0.31 and 19.68 ± 0.33 in T_1, T_2 and T_3 treatments, respectively. The excretion of calcium (g/ head/day) in faeces was significantly ($P \leq 0.05$) higher in treatment T_1 as compared to T_2 and T_3 treatments. The excretion of calcium (g/head/day) in urine was non-significant (0.54 ± 0.04, 0.58 ± 0.03 and 0.54 ± 0.02) in T_1, T_2 and T_3 treatments, respectively. The excretion of calcium (% basis) in faeces was significantly ($P \leq 0.05$) higher in control (30.62 ± 1.80 in T_1) as compared to microbial fed treatments (24.10± 1.52 and 24.78 ± 1.41in T_2 and T_3). The excretion of calcium (% basis) in urine was non-significant (2.79 ± 0.20, 2.92 0.15 and 2.73 ± 0.13) in T_1, T_2 and T_3 treatments, respectively. The retained calcium (g/ head/day) significantly ($P \leq 0.05$) higher in T_2 (14.39 ± 0.43) and T_3 (14.28 ± 0.46) as compared to control (T_1, 13.00 ± 0.48). The retained calcium (% basis) was 66.60 ± 1.78, 72.98 ± 1.40 and 72.58 ± 1.34 in T_1, T_2 and T_3 treatments, respectively. Significantly ($P \leq 0.05$) higher calcium retention was observed in microbial fed groups viz. T_2 and T_3. The differences in T_2 and T_3 groups were non-significant.

The calcium balance in three months old female calves is found to be positive in lactobacillus supplemented groups (T_2 and T_3) as compared to control (T_1). *Lactobacillus acidophillus* supplemented group has shown slightly higher retention of calcium than *Lactobacillus plantarum* supplemented group. Similar results were reported by Bhupal (1999) and Tripathi (2002) in four months old male calves.

The phosphorus intake in three months old calves was non-significant (10.64 ± 0.29, 11.17 ± 0.37 and 10.72 ± 0.29) in T_1, T_2 and T_3 treatments, respectively. The excretion of phosphorus (g/head/day) in faeces was significantly ($P \leq 0.05$) higher in T_1 (4.27 ± 0.14) as compared to T_3 (3.59 ± 0.22) and T_2 (3.54 ± 0.20). The excretion of phosphorus (g/head/day) in urine was similar in all the treatments including control (0.38 ± 0.01, 0.38 ± 0.02 and 0.38 ± 0.03) in T_1, T_2 and T_3 treatments, respectively. The excretion of phosphorus (% basis) in faeces was significantly ($P \leq 0.05$) higher in T_1 as compared to T_2 and T_3 (40.33 ± 1.78, 31.86 ± 1.97 and 33.73 ± 2.62 in T_1, T_2 and T_3 treatments, respectively). The excretion of phosphorus (% basis) in urine was non-significant among all the treatments (3.60 ± 0.12, 3.36 ± 0.25 and 3.54 ± 0.31 in T_1, T_2 and T_3 treatments, respectively). The retained phosphorus (g/head/ day) was non-significant under different groups (5.98 ± 0.33, 7.25 ± 0.41 and 6.76 ± 0.43) in T_1, T_2 and T_3 treatments, respectively. The retained phosphorus (% basis) was 56.07 ± 1.86, 64.79 ± 2.05 and 61.97 ± 2.73 in T_1, T_2 and T_3 treatments, respectively. It was significant ($P \leq 0.05$) higher in T_2 and T_3 as compared to T_1. The differences in T_2 and T_3 treatments were non-significant.

The phosphorus balance in three months old female calves is found to be positive in lactobacillus supplemented groups (T_2 and T_3) as compared to control (T_1). *Lactobacillus acidophillus* supplemented group shown slightly higher retained phosphorus than *Lactobacillus plantarum* supplemented group. The result of present investigation is in accordance with the findings of Zhang *et al.* (2015) reported that apparent digestibility of total phosphorus was significantly greater in probiotics fed 8 weeks old holisten calves. Tripathi (2002) and Bhupal (1999) who reported higher retention of phosphorus with the supplementation of combination of microbes.

Nitrogen intake (g/head/day) in three months old calves was almost similar in all treatments (32.12 0.70, 33.08 ± 0.50 and 33.75 ± 0.77) in T_1, T_2 and T_3, respectively. The excretion of nitrogen through faeces (g/head/day) was significantly ($P \leq 0.05$) higher in T_1 (8.32 ± 0.27) as compared to T_2 (6.96 ± 0.49) and T_3 (6.77 ± 0.45). The excretion of nitrogen through urine (g/ head/day) was non-significant (3.32 ± 0.35, 3.08 ± 0.41 and 3.17 ± 0.48) in T_1, T_2 and T_3 treatments, respectively. However, the excretion of nitrogen through faeces in 3 months old calves (% basis) was 25.87 ± 1.23, 20.97 ± 1.31 and 19.88 ± 1.25 in T_1, T_2 and T_3 treatments, respectively. It was significantly ($P \leq 0.05$) higher in T_1 as compared to T_2 and T_3. The excretion of nitrogen through urine (% basis) was non- significant (10.38 ± 1.19, 9.31 ± 1.20 and 9.36 ± 1.34) in T_1, T_2 and T_3 treatments, respectively. The retention of nitrogen (g/head/day) was 20.48 ± 1.02, 23.04 ± 0.32 and 23.81 ± 0.68 in T_1, T_2 and T_3 treatments, respectively. It was significantly ($P \leq 0.05$) higher in T_3 and T_2 as compared to T_1. The differences in T_2 and T_3 treatments were non-significant. Similar pattern was followed in retention of nitrogen (% basis) in three months old calves. Moreover, result revealed that the balance of nutrients viz. calcium, phosphorus and nitrogen in three months old female calves was significantly ($P \leq 0.05$) higher in microbial fed viz. *L. acidophillus* and *L. plantarum* groups.

The nitrogen balance in three months old female calves is found to be positive in lactobacillus supplemented groups (T_2 and T_3) as compared to control (milk with milk replacer, T_1). All microbial supplemented treatments support better maintenance of calves. The excretion of nitrogen through faeces is significantly ($P \leq 0.05$) higher in control group where as the differences in excretion of nitrogen through urine are non-significant in all the treatments including control. The result of present investigation is in accordance with the findings of Zhang *et al.* (2015) reported that the apparent digestibility of crude protein was significantly ($P \leq 0.05$) higher at 8 weeks old holstein calves fed on oral probiotics.

The average gain in body weight was 17.58 ± 0.62, 26 .17 ± 1.40 and 24.25 ± 1.09 kg in T_1, T_2 and T_3, respectively. When it was compared with T_1, it was significantly ($P \leq 0.05$) higher in T_2 and T_3. The differences in T_2 and T_3 treatment were non-significant. The gain /day (g) was 195.37 ± 6.92, 290.74 ± 15.56 and 269.44 ± 12.07 in T_1, T_2 and T_3, respectively. It was

Table 1: Feeding schedule of female calves fed milk and milk replacer fortified with lactobacillus

Age (days)	Whole Milk (litres)	Milk replacer/ calf starter (grams)
1-3	Colostrum 1/10th of body wt.	-
4-8	1/10th of body wt.	-
9-18	2.0 lit./day	50 g milk replacer /day
19-22	2.0 lit./day	100 g milk replacer/day
23-26	1.5 lit./day	200 g milk replacer/day
27-30	1.0 lit./day	300 g milk replacer/day
31-90	1.0 lit./day	350 g milk replacer/ day

Table 2: Proximate composition of milk replacer (% in dry matter)

Nutrients	Percentage
Dry matter (DM)	86.14
Crude protein (CP)	22.37
Crude fibre (CF)	4.46
Either extract (EE)	15.63
Nitrogen free extract (NFE)	42.83
Total ash (TA)	14.71
Calcium (Ca)	1.81
Phosphorus (P)	0.87

Each figure is a mean of duplicate determinations

Table 3: Balance of nutrients in female calves at three months of age

Parameter	Calcium				Phosphorus				Nitrogen			
	T_1	T_2	T_3	CD	T_1	T_2	T_3	CD	T_1	T_2	T_3	CD
Intake (g/ head/day)	19.50 ±0.27	19.70 ±0.31	19.68 ±0.33	NS	10.64 ±0.29	11.17 ±0.37	10.72 ±0.29	NS	32.12 ±0.70	33.08 ±0.50	33.75 ±0.77	NS
Excretion (g/ head/day) In Faces	5.95^{a} ±0.31	4.74^{b} ±0.29	4.86^{b} ±0.25	1.03	4.27^{a} ±0.14	3.54^{b} ±0.20	3.59^{a} ±0.22	0.70	8.32^{a} ±0.27	6.96 ^{b}±0.49	6.77^{b} ±0.45	1.15
In Urine	0.54 ±0.04	0.58 ±0.03	0.54 ±0.02	NS	0.38 ±0.01	0.38 ±0.02	0.38 ±0.03	NS	3.32 ±0.35	3.08 ±0.41	3.17 ±0.48	NS
Excretion (%) In Faces	30.62^{a} ±1.80	24.10^{b} ±1.52	24.78^{b} ±1.41	5.79	40.33^{a} ±1.78	31.86^{b} ±1.97	33.73^{a} ±2.62	8.23	25.87^{a} ±1.23	20.97^{a} ±1.31	19.88^{b} ±1.25	5.61
In Urine	2.79 ±0.20	2.92 ±0.15	2.73 ±0.13	NS	3.60 ±0.12	3.36 ±0.25	3.54 ±0.31	NS	10.38 ±1.19	9.31 ±1.20	9.36 ±1.34	NS
Retained (g/ head/day)	13.00^{b} ±0.48	14.39^{a} ±0.43	14.28^{a} ±0.46	1.38	5.98 ±0.33	7.25 ±0.41	6.76 ±0.43	NS	20.48^{b} ±1.02	23.04^{a} ±0.32	23.81^{a} ±0.68	3.28
Retained %	66.60^{b} ±1.78	72.98^{a} ±1.40	72.58^{a} ±1.34	5.93	56.07^{b} ±1.86	64.79^{a} ±2.05	61.97^{a} ±2.73	3.78	63.29^{b} ±2.18	69.19^{a} ±1.57	70.55^{a} ±1.29	6.97

Each figure is a mean value of six calves.
Mean bearing different superscripts in a column differ significantly ($P \leq 0.05$)

significantly ($P \leq 0.05$) higher in T_2 and T_3 as compared to T_1. The overall results revealed that the calves fed *L. acidophillus* (T_2) and *L. plantarum* (T_3) have shown significantly ($P \leq 0.05$) higher body weight gain, improved dry matter intake along with better FCR as compared to milk replacer fed control group (T1). These results are in agreement with the findings of Bhupal (1999) who reported significantly ($P \leq 0.05$) higher DMI (kg) in lactobacillus fed groups as compared to control. The total cost of feeding up to 90 days of age was Rs. 2278.82, 2281.13 and 2278.82 in T_1, T_2 and T_3 treatments, respectively. It was almost similar in all the treatments. The feed cost/kg body weight gain was 129.63 ± 1.28, 87.17 ± 1.49 and 93.97 ± 1.33 in T_1, T_2 and T_3 treatments, respectively. It was significantly ($P \leq 0.05$) higher in T_1 as compared to T_2 and T_3. Feed cost per kg of body weight gain was significantly lower in microbial fed calves under treatment T_2 (*L. acidophillus*) and T_3 (*L. plantarum*) as compared to standard control. While comparing with standard control (T_1), treatment T_2 and T_3 had 32.18 and 27.50 per cent lower cost of feed per kg gain in body weight, respectively. Economics of rearing of day-old female calves upto three months of age under different treatments have been presented in Table 4, respectively. The result of present study is positively correlated with Zhang *et al.* (2015) observed that Holeisten calves fed on oral administration of probiotics showed that FCR was improved in *L. acidophillus* fed group similarly Devchand *et al*. (2013) match the result in the cost of feeding per kg body weight gain in Mehasana bulffalo calves was lower in probiotics supplemented group than than control. Jatkauskas and Vrotniakiene (2010) reported that the body weight and daily weight gain were significantly improved and average feed conversion rate was improved by 12.9% in the probiotic fed calves. Tripathi (2002), who reported that cost/kg body weight gain is lowest in *S. cerevisiae* (yeast) as compared to control. The other findings supporting the present investigation was reported by Abe *et al.* (1995) and Cruywagen *et al*. (1996) who reported that lactobacilli fed calves resulted in improved body weight gain. Wolter *et al.* (1987) also reported that combination of probiotics enhances growth performances. However, Choudhary *et al.* (2007) reported that no further improvement in the performance of male cross calves by supplementation of lactic acid producing bacteria. Frizzo *et al. (*2008) showed no significant effect on calf rearing due to the excellent health status of the animal. They recommended the advantages of using probiotics be more easily detected in the farms having high morbidity and mortality rates mainly produced by diarrhoea syndrome.

The result of the present experiment indicated that

Table 4: Comparative economics of feeding of day old calf up to three months of age under different treatments

Parameter	T_1	T_2	T_3	CD
Av. birth wt. (kg)	18.67 ± 0.67	19.33 ± 0.71	18.67 ±0.49	NS
Av. wt. at three months of age(kg)	36.25 ±1.27	45.50 ±2.09	42.58 ±1.49	NS
Metabolic body size ($W^{0.75}$)	14.79^b ±0.39	17.53^a ±0.60	16.66^a ±0.44	2.53
Gain in body wt. (kg)	17.58^b ±0.62	26.17^b ±1.40	24.25^a ±1.09	5.66
Av. daily body wt. gain(g/d)	195.37^b ±6.92	290.74^a ±15.56	269.44^a ±12.07	62.92
Milk fed (lit)	107.34	107.50	107.34	--
*Milk replacer fed (kg)	23.90	23.90	23.90	--
Cost of milk (Rs. 14.00/lit)	1502.76	1505.00	1502.76	--
Cost of milk replacer (Rs. 30.00/kg)	717.00	717.00	717.00	--
Cost of culture(Rs. 0.45/ml)	59.06	59.13	59.06	-
Total cost of calf feeding (Rs.)	2278.82	2281.13	2278.82	--
Feed cost/kg body wt. gain (Rs)	129.63^a ± 1.28	87.17^b ± 1.49	93.97^b ± 1.33	16.35

*Milk replacer fed up to 90 days of age

supplementation of *L. acidophilus* in the diet of calves have positive influence on nutrient balance viz. calcium, phosphorus and nitrogen retention and reduce the feed cost per kg body weight gain.

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