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Effect of chicory root powder as prebiotic source to growth and nutrient digestibility of murrah buffalo calves

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Abstract

Twenty eight Murrah buffalo calves (7-10 d old and 31 ± 2 kg) were randomly selected and divided into four groups. All the four groups were fed as per ICAR (2013) feeding schedule except that these were additionally supplemented with 0, 8, 16 and 24 g/d chicory root powder (in the four respective groups i. e. T₀, T₁, T₂, T₃) for 90 days. Results showed that there is the final body weight, dry matter digestibility significantly higher in treatment groups as compare to control. There is no significant difference observe in the per cent digestibility of OM, CP, EE, NDF and ADF. Thus, it may be concluded that the supplementation of chicory root powder (8, 16 and 24g) may be useful for enhancing health status and performance of calves.

Keywords: Prebiotic, calf, chicory root powder, performance, body weight, digestibility

Introduction

The rural people are mostly dependent on agriculture for their livelihood and livestock provides additional support to them. For a profitable dairy industry, calves, being future replacement stock of the herd, are an important asset and key determinants of the economic future of dairy farm. Hence, healthy young stock is indispensable for a successful and profitable dairy enterprise. But, calf health is a very critical factor affecting the welfare and economics of young stock, dairy and rearing enterprises. The mortality rate of calf in India ranges from 12.5 to 30% (Singh *et al.* 2009) [22]. Mortality pattern in Murrah buffaloes and found that digestive problems accounted for 30.89%, cardio-vascular problems for 26.02%, respiratory 21.14%, parasitic diseases 8.13%, uro-genital 5.69% and miscellaneous 8.13 % of the cases. Main digestive problem in calf are the calf diarrhea that is related to an increase of Coliform bacteria counts in the intestines and a decrease in Lactobacilli and Bifidobacteria counts (Ouwehand *et al.* 2002) [16]. The increase of Coliform bacteria in the intestines may produce putrefactive substances and harm the host (Fujisawa *et al.* 2010) [4]. As a result, gut microbiota are important to the health maintenance and development of the host (Ng *et al.* 2009; Rowland *et al.* 2010) [15, 20].

Ban on the use of antibiotics as growth promoters in the European Union since January 1, 2006 (EC, 2001) [2] urged the scientist to find a suitable alternatives to antibiotics. To overcome these problems and to replace the use of antibiotics prebiotics came up as a good adjuvant to promote the health (Heinrich *et al.* 2003) [9]. Prebiotic supplementation has gained interest in recent years as a method to improve gastrointestinal health in livestock. Prebiotics, defined as non-digestible food ingredients that beneficially affect the host by selectively stimulating the growth and/or activity of colonic bacteria (Gibson and Roberfroid, 1995) [6]. Inulin type prebiotics occupies top position in the list of prebiotics because of their availability from a wide resources with minimum cost involvement and includes a group of biomolecules viz.; inulin, oligofructose and fructo-oligosaccharides (Samanta *et al.* 2013) [21]. The root of the chicory plant contains; 15-20% inulin and 5-10% oligofructose. And on dry basis. To keep all this point the objective of the study to know the chicory root powder effect on growth and nutrient utilization of murrah buffalo calves.

Material and Methods**Animal housing environment and dietary treatment**

Twenty eight Murrah buffalo calves (7-10 d old and 31 ± 2.0 kg of body weight), were

randomly assigned into four groups with seven animals in each group. All the calves were fed a similar which was nutritionally adequate diet as per the recommendations of ICAR (2013) [10] feeding standards. T0 served as control while animals in Group II (T1), Group III (T2) and Group IV (T3) were supplemented with 8, 16, 24 g chicory root powder per calf/day respectively, given orally to individual calf. The total duration of experimental period was of 120 days. The feed intake was monitored on daily basis and body weight of the animals was recorded fortnightly.

Housing and environment

The study was conducted in the individual calf sheds of ICAR - National Dairy Research Institute Karnal, India. The calves were housed individually in well-ventilated pens.

Feeding management

The diet comprised of concentrate mixture (maize, bajra, GNC, SBM, MOC, wheat bran, rice polish, mineral mixture, bran, rice polish and mineral mixture. The animals were offered green fodder containing maize and jowar. All the calves had 24 hr access to ad libitum clean water. The feeding of milk was carried out twice a day. Whole milk fed to the calves at 1/10th of actual BW up to 2 weeks, 1/15th of actual BW in the third and fourth week, 1/20th of actual BW in the fifth and sixth week, and 1/25th in the seventh and eighth week of study. Calf starter was offered from the second week onwards. All the calves were fed ad libitum concentrate mixture and green fodder (Ramaswami, Chaudhary, Agarwal, & Kamra, 2005) [18].

Experimental measurement

Body weight of individual calf was recorded at the onset of experiment and subsequently at fortnightly intervals by using digital weighing balance in the morning before feeding and watering of the animals. The animals were weighed for two consecutive days and then the average of two days was considered as the body weight for that fortnight. The feed intake of the individual calf were recorded daily. The calves were offered measured amount of diet twice a day. After determining the dry matter (DM) content of feed offered and residue left, the mean dry matter intake (DMI) of each calf was calculated.

Analytical procedure

The concentrate and fodder offered, residues left and faeces were analysed for proximate principles as per standard procedures of Association of Official Analytical Chemists

(AOAC, 1995) [1]; DM (Method-934.01), after drying at 100 ± 2 for 24 hr; crude protein (CP), determined by Kjeldahl method (954.01). The ether extraction was performed using SOCSPLUS (SC6, Pelican Equipments Pvt. Ltd. Chennai, India) by ether extraction analyser (Method 920.39). Neutral detergent fibre (NDF) and acid detergent fibre (ADF) were estimated by detergent procedures (Van Soest, Robertson, & Lewis, 1991) [23].

Statistical analysis

The experimental data generated were analysed by ANOVA using the statistical software program SPSS (SPSS Inc., Chicago, Illinois, USA). Data on the digestion trial and body weight were analysed using one-way ANOVA. The effects were considered to be significant at $p < 0.05$.

Result

Body weight

The data of body weight at different fortnight are presented in Table 1. There was no significant difference observe between treatment and control in the first three fortnight. It was only after the 4th fortnight supplementation of chicory root powder showed positive effect on body weight which was significant at $P < 0.01$. Though no difference existed between three treatment groups. Numerically the highest body weight was observed in group PRE1 followed by PRE2, PRE3 and control. The results are in accordance with those reported by Ghosh and Mehla (2012) [5] who also found significant ($P < 0.01$) increase in BW gain (about 22%) on supplementation of 4 g prebiotic/d/calf. Similar to our findings, Roodposhti and Dabiri (2012) [19] and Krol (2011) [12] also observed consistently higher ADG in calves supplemented with 4 g Tipax (polysaccharides of *saccharomyces cereviciae* cell wall) or inulin 6 g/d /head, respectively. Our results are also supported by the findings of study conducted by Grela *et al.* (2014) [8] who reported considerably higher daily body weight gain ($P \leq 0.05$) in piglets given chicory root powder @ 4% in dry matter. Contrary to our findings, Morrison *et al.* (2010) [13] and Kara *et al.* (2015) [11] reported no significant effect on body weight gain and feed conversion efficiency, though the values were higher numerically in groups supplemented with prebiotic in the form of MOS. However, Newman and Newman (2001) [14] observed that calves which were fed MOS showed no change in ADG during the first 2 weeks, but after six weeks a significant difference ($P < 0.05$) was observed in ADG (0.94 kg treatment vs. 0.74 kg control).

Table 1: Effect of dietary supplementation of chicory root powder on growth performance of Murrah buffalo calves

Body wt	CON	PRE1 (8gm)	PRE2 (16gm)	PRE3 (24gm)	SEM	P value
Initial	31.37±0.45	32.50±0.52	30.89±0.67	31.26±0.68	0.30	0.272
Fortnight 1	34.11±0.43	35.23±0.66	33.06±0.71	33.26±0.68	0.34	0.09
Fortnight 2	37.23±0.59	38.66±0.71	36.75±0.78	36.12±0.60	0.37	0.079
Fortnight 3	43.40±0.79	46.26±0.71	43.84±0.89	45.01±0.98	0.45	0.105
Fortnight 4	49.90 ^a ±0.78	53.34 ^b ±0.56	52.18 ^{ab} ±1.08	53.39 ^b ±0.90	0.48	0.026
Fortnight 5	56.78 ^a ±1.00	61.06 ^b ±0.53	59.89 ^{ab} ±0.93	60.03 ^{ab} ±1.12	0.53	0.019
Final	63.39 ^a ±0.85	67.66 ^b ±0.40	66.78 ^b ±0.61	67.42 ^b ±1.29	0.52	0.005
Net gain	32.01 ^a ±0.72	35.16 ^b ±0.47	35.89 ^b ±0.28	36.15 ^b ±0.90	0.44	<0.001

Basal diet with no supplementation (CON) or supplemented with chicory root powder 8g (PRE1), 16 g (PRE2), and 24g PRE3

^{a,b,pqrs} Means bearing different superscripts in a row (a, b) differ significantly ($P < 0.05$)

Nutrient utilization in calves

The apparent digestibility of various nutrients is also presented in Table 2. The per cent digestibility of OM, CP, EE, NDF and ADF did not vary ($p>.05$) among the groups during digestibility trial, but there was a significant difference ($p<.01$) in DM digestibility. The DM digestibility was higher ($p<.05$) in PRE3 followed by PRE2 and PRE1 then control. Increased dry matter digestibility might be due to improved

digestive enzymes activity in the intestinal tract as suggested by Similar results were also found by Fleige *et al.* (2009) [3] who also reported that there was increased CP and energy intake in lactulose supplemented calves. In disagreement to our results Quigley *et al.* (2002) reported that DM, CP and fat intakes were unaffected by the oligosaccharide supplementation.

Table 2: Effect of dietary supplementation of chicory root powder on nutrient utilization and digestibility of Murrah buffalo calves

Parameter (cm)	T ₀	T ₁ (8g)	T ₂ (16g)	T ₃ (24g)	SEM	P value
Apparent digestibility of nutrients (%)						
DM%	70.35 ^a ±1.72	72.62 ^{ab} ±0.87	74.05 ^b ±0.70	75.73 ^b ±0.77	0.58	0.01
OM%	78.98±0.99	79.21±0.52	79.59±0.64	81.29±0.48	0.34	0.08
CP%	70.34±1.32	72.60±1.54	74.82±0.64	75.37±2.32	0.83	0.188
ADF%	50.52±1.32	52.35±1.26	52.36±1.63	53.58±1.10	0.68	0.598
NDF%	64.02±0.60	66.05±0.83	66.27±1.12	66.99±0.59	0.46	0.239
EE%	80.07±1.82	83.95±1.26	85.75±1.17	86.68±2.41	0.88	0.378

Conclusion

It chicory root powder has potential for improving body weight. There was significant increase in the body weight at 4th fortnight. There was significant increase in dry matter digestibility in treatment group. Although there is no significant difference observe in treatment group. So it could be conclude that 8g/d chicory root powder supplementation can reasonably be recommended for the calves for the overall health.

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