Effect of Cobalt Supplementation on Performance of growing Calves

V.Nagabhushana*, K.Sharma, A.K.Pattanaik and Narayan Dutta

Animal Nutrition Division,
Indian Veterinary Research Institute, Deemed University, Izatnagar-243 122, India.

Abstract

The experiment was conducted to study the effect of critical supplementation of wheat straw with cobalt on fibre utilization and nutrient utilization in growing cross-bred male calves. Twenty-one crossbred (HF X Local) male growing calves of 3-4 months age were fed with wheat straw based diet consisting without (Co0) and with 1 (Co1) and 6 (Co6) ppm cobalt as cobaltous chloride. There was no significant difference in intake of wheat straw, concentrate and DMI between the three groups and the ratio between concentrate and wheat straw was maintained at 40:60 irrespective of dietary level of cobalt. Similarly, average cumulative body weight, net gain in body weight or feed efficiency did not differ significantly between treatments. No significant effect was observed on the digestibility of dry matter, organic matter, crude protein, ether extract and fibre constituents like NDF, ADF, hemicellulose or cellulose by supplementation of 1 and 6 ppm Co to the diet of growing calves. Balance of nutrients such as Nitrogen, Calcium and Phosphorus was similar and positive in all the treatment groups. TDN and DCP values of the experimental diets remained almost similar irrespective of dietary level of cobalt.

Keywords: Cobalt, fibre utilization, calves, Supplementation, Performance.

Introduction

Fibrous crop residues especially cereal straws form an integral part of the ruminant feeding under the prevailing livestock production systems in India. The abundance of these fibrous crop residues to the tune of 425 million tonnes (Banerjee, 1998), however, is constrained by their poor nutritional quality in terms of digestible nutrients and minerals. Promising approach appears to be the critical supplementation with limiting nutrients like various macro and micro minerals, nitrogen or energy which would help in maximizing the ruminal fermentation and thereby better utilization of this low quality roughage. It has been postulated that divalent cations could act as bridges between bacteria and plant cell walls as both of them tends to be negatively charged (Somers, 1983). Therefore, the difficulty in attachment between the similarly charged rumen bacteria and plant cell walls could be overcome by providing freely available divalent cations such as cobalt and copper to serve as a link. Of these (*divalent trace elements*), cobalt appears to be a better choice because it is also an essential trace element required exclusively by rumen microorganisms for the biosynthesis of vitamin B12. The supplementation of cobalt above minimal requirement therefore may be beneficial during rapid rumen fermentation for increased growth and activity of microbes (Saxena and Ranjhan, 1978a). Further, cobalt requirement of ruminants stated to be 0.1 ppm (NRC, 1989), it is hypothesized that it could possibly increase in ruminants fed predominantly cereal crop residues in order to achieve optimal rumen fermentation (*Stangl et al*., 2000). In view of the above, the present study was conducted to evaluate the effect of cobalt as cobaltous chloride supplementation on the performance of growing calves.

Materials and Methods

Experiment was conducted for a period of 6 months to study the effects of cobalt supplementation at 1 and 6ppm as cobaltous chloride on feed intake, nutrient utilization, and body weight changes in crossbred calves.

Experimental animals and treatments: Twenty-one crossbred (HF X Local) male growing calves of 3-4 months age with a mean live weight of 51.1±1.15 kg were procured from LPR (C&B), IVRI and equally divided into three groups in a completely randomized block design. Out of the three groups, first served as control receiving basal diet consisting of wheat straw *ad libitum* with a concentrate mixture, without cobalt and any mineral supplement (Co0). The second and third group of animals were fed with same basal diet and level of concentrate supplement as fed to animals in control group but supplemented with cobaltous

chloride at two levels *viz.* 1 (Co1) and 6 ppm (Co6). The animals were housed in well-ventilated sheds with facilities for individual feeding under hygienic and uniform management conditions.

Feeds and feeding: All the calves were offered a basal diet of wheat straw *ad libitum* throughout the experiment and supplemented with a concentrate mixture (maize, 25; soybean meal, 35; wheat bran, 39 & salt, 1%)to meet their nutrient requirement for maintenance and about 250g growth (Kearl, 1982). Mineral mixture was not included in the concentrate mixture to avoid additional cobalt intake as well as to make the ration more practical and to suit village conditions. Cobalt solutions (1 or 6 ppm) were mixed daily in the concentrate mixture of Co-1 and Co-6 group, respectively.

Measurement of body weight changes and nutrient utilization: All the calves were weighed before feeding and watering at fortnightly intervals on two consecutive days to find out the live weight changes during the study period of six months. A digestion cum metabolism trial was conducted at the end of feeding trial on five animals from each group to assess the effect of critical supplementation of cobalt on plane of nutrition, digestibility of nutrients and balance of nitrogen, calcium and phosphorus. Representative samples of the feed, fodder and faeces were subjected for proximate analysis (A.O.A.C, 1995) and fibre analysis (Van Soest *et al*. 1991). Data was subjected to statistical analysis as per Snedecor and Cochran (1989).

Results and Discussion

Feed Intake: The experimental feed was having a protein content of 4.34 and 27.40%, and cobalt level of 0.36 and 0.67ppm, in wheat straw and concentrates respectively. The fortnightly feed intake of calves during feeding trial is presented in table-1. There was no significant difference in intake of wheat straw, concentrate and DMI between the three groups. By and large, in the entire feeding cum growth trial the ratio between concentrate and wheat straw was maintained at 40:60 for all the groups.

There are very few animal trials conducted so far to study the effect of cobalt supplementation on feed intake, especially no long-term studies were undertaken. However, the results of the present study are in agreement with the reports of Lopez-Guisa and Satter (1992) and Saxena and Ranjhan (1978a) indicating no change in dry matter intake of alfalfa silage diets in Holstein heifers and wheat straw-concentrate mixed diet in Hariana cattle, respectively, due to cobalt and/ or copper supplementation. Similarly, lactating cows fed silage-concentrate diet without or with supplemented organic cobalt (as cobalt glucoheptonate) had similar dry matter intake (Uchida *et al.,* 2001).

Body weight changes and average daily gain: Initial and final body weights of animals, net changes in body weights, average daily gain and feed efficiency are briefly outlined in table 1. The average daily gain (264.9-279.4 g d-1) and feed conversion ratio (7.8-8.0 kg DM kg gain-1) of the groups remained statistically similar.

Cobalt, an essential trace element required for the rumen synthesis of vitamin B12. There are no reports in the literature, which have measured the long-term effect of cobalt supplementation on growth rate. However, the results of the present study are in agreement with some of the short term observations recorded earlier indicating that growth of animals remain unaffected by additional cobalt supplementation (Lopez-Guisa and Satter, 1992; Singh and Chhabra, 1995), but are contrary to some reports testifying depression in body weight gain of heifers fed low quality forage with additional Co and copper in excess of NRC recommendations (Lopez-Guisa and Satter, 1992; Allen, 1986).

Intake and Nutrient digestibility: Digestibility coefficients of various feed components and nutrients during digestion cum metabolism trial are presented in table-2. No significant effect was observed on the digestibility of dry matter, organic matter, crude protein, and ether extract and fibre constituents like NDF, ADF, hemicellulose or cellulose by supplementation of 1 and 6 ppm Co to the diet of growing calves.

There are very few sporadic feeding trials conducted to assess the influence of Co on nutrient digestibility under varied feeding regimes. Most of the reports from various parts of the world are the out come of *in vitro* work where cellulose or cotton was used as substrate. Animals consuming concentrates are less likely to suffer from inadequate mineral supply (Mc Dowell, 1992) and thus any additional mineral supplementation may not yield any visible response. Saxena and Ranjhan (1976,1977, 1978a) observed no significant effect of supplementation of cobalt and copper (0.22 Co, 12.64 Cu) separately and in addition to other macro and microelements on digestibility of DM, OM and CP of a roughage-concentrate mixed diet, however, they reported significant increase in the digestibility of cellulose and crude fibre in fistulated Hariana calves. It is evident from the results of this trial that the Co supplementation over and above inherently available in the diet (0.48 ppm) did not impart any effect on the efficiency of nutrient utilization or intake by the animals. Similar to these findings, Tiwari *et al*., (2000) reported no change in digestibility of nutrients (DM, NDF, ADF), except OM, or intake of DCP and

TDN in Sahiwal cows given a basal diet of Para grass and standard concentrate mixture supplemented with trace mineral (Cu, Co, Mn & Zn) capsule.

Balance of nutrients: The balances of various nutrients such as nitrogen, calcium and phosphorus are presented in table-3. Nitrogen intake, excretion in faeces and urine, and balance was similar in all the treatment groups. The balances of calcium and phosphorus also followed the similar pattern as observed for nitrogen balance and did not vary significantly irrespective of dietary treatment. The balance of Ca and P was in the ratio of 2.7:1, which was close to recommended ratio (Kearl, 1982) despite the fact that no additional mineral mixture was given to the animals throughout the trial.

There is no evident of direct interaction of Co with utilization of nitrogen, calcium or phosphorus although in some of the earlier studies a greater retention of nitrogen, calcium and phosphorus was reported through the supplementation of trace mineral mixture composed of Co, Cu, Mn and Zn (Demcenke *et al*., 1968; Saxena and Ranjhan, 1978).

Nutritive value and Plane of nutrition: The nutritive value of the experimental diets and plane of nutrition of calves were calculated from the digestibility values and are presented in table- 3. The percent TDN and DCP values of the experimental diets did not differ significantly between dietary treatments. Similarly, daily intake (g /Kg BW) of digestible DM, OM, CP and TDN remained similar without any significant difference between the three dietary treatments. The availability of DCP and TDN in the three sets of experimental calves was sufficient and close to those recommended by Kearl (1982) for maintenance and an average growth rate of 250g d-1. There was no significant difference between the DCP and TDN intake per kg body weight of animals irrespective of level of Co supplementation. These findings are in agreement to those reported earlier for Hariana calves and Sahiwal cows (Saxena and Ranjhan, 1978 a; *Tiwari et al*., 2000).

Conclusion

There was no significant difference in intake of wheat straw, concentrate and DMI between the three groups and the ratio between concentrate and wheat straw was maintained at 40:60 irrespective of dietary level of cobalt. Similarly, average cumulative body weight, net gain in body weight or feed efficiency did not differ significantly between treatments. No significant effect was observed on the digestibility of dry matter, organic matter, crude protein, ether extract and fibre constituents like NDF, ADF, hemicellulose or cellulose by supplementation of 1 and 6 ppm Co to the diet of growing calves. Balance of nutrients such as Nitrogen, Calcium and Phosphorus was similar and positive in all the treatment groups. TDN and DCP values of the experimental diets remained almost similar irrespective of dietary level of cobalt.

Acknowledgement

The authors are thankful to the Director, Centre for Advanced Studies in Animal Nutrition, and Director, IVRI, Deemed University, Izatnagar, UP (India) for providing facilities to conduct the present research work.

References

1. Allen, M.J., (1986): M.S. Thesis, Univ. Minnesota, Saint Paul.
2. Banerjee, G.C. (1998): In: Feeds and Principles of animal nutrition, Oxford & IBH Publication Co. Pvt. Ltd., New Delhi
3. AOAC (1995): Official methods of analysis (16th Edn. Vol. I) Association of Official Analytical Chemists. Washington, D.C.
4. Demcenke, P.V., Taranov, M.T., Samohin, V.T., Mihatlov, V.I., Kivkucan, F.R. and Vorobev, K.G. (1968): *Vest. Selkhoz Nauki* 12: 51-56 (*Fide Nutr. Abstr. Rev*. 39:1337; 1969)
5. Kearl, L. C. (1982): Nutrient requirement of ruminants in developing countries. Utah Agricultural Experimental Station, Utah State University, International Feedstuffs Institute, Logan, USA
6. Lopez-Guisa, J.M., and Satter, L.D.(1992): *J. Dairy Sci., 75*: 247-256.
7. McDowell, L.R.(1992): In: *Minerals in Animals and Human Nutrition,* NewYork, Academic Press.
8. National Research Council (NRC) (1989): In: *Nutrient Requirements of Dairy Cattle,* 7th edition. *Nutrient requirement of domestic animals*, National Academy of Sciences, Washington, D.C.New York.
9. Saxena, K.K. and Ranjhan, S.K. (1976): *Indian J. Anim. Prod.* 7: 47-52.
10. Saxena, K.K. and Ranjhan, S.K. (1977): *Indian J. Anim. Prod.* 9: 11-17.
11. Saxena, K.K. and Ranjhan, S.K. (1978a): *Indian J. Anim. Sci.* 48: 566-571.
12. Singh K.K. and Chhabra, A. (1995): *J. Nucl. Agric.Biol.* 24: 112-116.
13. Snedecor, G.W. and Cochran, W.G.(1989): Statistical Methods. (7thedn) The Iowa State University, Iowa (USA).
14. Somers, G.F. (1983): *Am. J. Bot.* 60: 987.
15. Stangl, G.I., Schwarz, F.J., Muller, H and Kirchgessner, M. (2000): *Br. J. Nutr.* 84: 645-653.
16. Tiwari, S.P., Jain, R.K., Mishra, U.K., Mishra, O.P., Patel. J.R. and Rajagopal. (2000): *Indian J. Anim. Sci.* 70: 504-507.
17. Uchida, K., Mandebvu, P., Ballard, C.S.,

Sniffen, C.J. and Carter, M.P. (2001): *Anim. Feed Sci.Technol.* 93: 193-203.
18. Van Soest, P.J., Robertson, J.B. Lewis, B.A. (1991): *J. Dairy Sci.* 74: 3583-3597.

Table 1: Effect of Cobalt supplementation on plane of nutrition

Attributes	Co0	Co1	Co6	SEM*
Growth				
Initial BW(kg)	51.80	50.49	50.88	1.15
Final BW(kg)	111.2	111.8	114.00	2.62
Net change in BW(kg)	59.38	62.87	59.61	1.83
ADG(g day-1)	274.4	279.4	264.9	7.57
Feed & Nutrient Intake				
Wheat straw intake (g day-1)	1299	1309	1276	52.21
Conc. intake (g day-1)	832	842	826	9.69
DMI (g day-1)	2132	2152	2102	60.07
FCR (Kg DM kg-1 gain)	7.81	7.72	8.05	0.23
Digestible DMI, g/kg-1BW	15.87	16.17	15.87	0.46
Digestible OMI g/kg -1BW	15.65	15.83	15.62	0.43
DCP intake, g/kg -1BW	1.86	1.86	1.76	0.07
TDN, g/kg-1BW16.43		16.62	16.4	0.45
Nutrient Density				
TDN %	55.69	58.59	55.75	2.71
DCP %	6.33	6.61	6.01	0.28

TDN calculated from DOM [1 kg digestible organic matter (DOM) = 1.05kg TDN; NRC, 1981]

Table 2: Effect of Cobalt supplementation on digestibility of nutrients (%)

Attributes	Co0	Co1	Co6	SEM*
Dry matter	53.79	56.97	53.95	0.78
Organic matter	57.15	60.13	57.21	0.72
Crude protein	55.44	57.09	51.88	2.04
Ether extract	60.93	60.60	68.68	2.50
Neutral detergent fibre	51.91	55.22	52.43	0.78
Acid detergent fibre	39.53	42.48	39.42	1.29
Hemicellulose	30.98	32.49	31.34	0.38
Cellulose	47.84	51.03	46.28	1.34

Table 3: Effect of Cobalt supplementation on balance (g/day/ animal) of nutrients

Attributes	Co0	Co1	Co6	SEM*
1. Nitrogen Intake	55.30	56.35	54.97	1.09
Excretion	41.02	36.82	40.13	1.01
Balance14.30	19.50	14.80	1.29	
2. Calcium Intake	16.63	15.58	16.29	1.61
Excretion	9.45	8.53	8.84	0.57
Balance	7.18	8.46	7.45	0.79
3. Phosphorus Intake	9.65	9.85	9.51	0.28
Excretion	7.42	6.00	5.88	0.41
Balance	2.22	3.85	3.62	0.45

* Non - Significant

* * * * * * * *