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THE STATUS OF CERTAIN TRACE MINERALS IN FEEDS AND FODDERS IN KUTCH DISTRICT OF GUJARAT

M.R. Garg, B.M. Bhanderi and P.L. Sherasia
Animal Nutrition and Feed Technology Laboratory
National Dairy Development Board, Anand 388 001, Gujarat, India.

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ABSTRACT

A two dimensional survey was conducted to map the distribution of relevant micro-minerals in Kutch district, by collecting feed and fodder samples at random, taking conceptual village as a unit. The average copper content was consistently low in straws (6.13 ppm) and green fodders (9.92 ppm), whereas other concentrate ingredients like bajra grain, coconut cake, cottonseed cake, guar grain and wheat bran were better source of copper (25.95 ppm). Likewise, zinc was acutely deficient in the region (< 35 ppm) and needed to be supplemented at a level of 80 ppm in the total ration. Manganese, iron and cobalt contents in the most of feeds were adequate. Molybdenum content in feeds was within the safe limit (< 1.22 ppm) and gave Cu:Mo ratio wider than 8.0. Selenium content in most of the feeds was adequate (> 1.35 ppm). From the present survey, it was apparent that the levels of manganese, iron, cobalt and selenium were found to be adequate, while copper and zinc were inadequate and needed to be supplemented. ***(Indian J. Anim. Nutr. 2004, 21 (1): 8-12)***

Key words: Copper, Zinc, Selenium, Cobalt, Feed, Fodder

Although lack of energy and protein are the main limiting factors in livestock production, but sometime mineral deficiencies also limit production (McDowell and Conrad, 1977). The most devastating economic results of mineral deficiencies are late puberty of heifers and low reproductive rates of cows and buffaloes associated with long calving intervals. Hence, mineral surveys are essential to determine the occurrence of mineral deficiencies in feeds and fodders to draw inference for practical applications in the feeding systems of dairy animals. At the same time, it is advisable not to recommend excess of these minerals, so as to avoid the problem of toxicity. Recommending supplemental mineral elements without considering the base levels in feedstuffs may not be desirable (Hinders, 1999). Such a survey in relation to animal health may be classified as having one, two or three dimensions (Tourtelot, 1980). In this study, two-dimensional survey was adopted to map relevant mineral elements, by collecting feed samples from the district.

MATERIALS AND METHODS

The Kutch district is having annual rainfall of 250-500 mm, is located at 150 meters above sea level, having latitude of 23°50′ and longitude of 69°50′. Atmospheric temperature ranges from 4 to 45° C during different seasons. Total area of the district (45,652 sq.km) was distributed into 10 taluks, having 905 villages. At random one village from each taluk was selected for taking representative samples of feeds and fodders. Within the village help was sought from village milk producers and veterinary officer, for identification of 4 to 5 farmers, as there was no operational area of dairy cooperative societies. The recorded parameters

Table 1. Micro mineral content (ppm) in feedstuffs collected from Kutch district (DM basis)

Ingredients	Cu	Zn	Mn	Fe	Co	Mo	Se
[a] Critical level	< 8.0	< 30.0	< 40.0	< 50.0	< 0.10	> 6.0	< 0.2
Bajra grain (1)	24.90	34.60	61.10	83.9	1.70	0.26	0.30
Bajra green (2)	11.86	44.45	61.9	205	0.44	0.78	1.63
	± 3.70	± 5.34	± 0.97	± 13.88	± 0.29	± 0.18	± 0.18
Bajra husk (2)	11.30	54.3	73.95	147.28	0.81	0.84	0.76
	± 0.65	± 0.57	± 28.61	± 10.20	± 0.02	± 0.27	± 0.62
Bajra straw (3)	5.41	38.83	41.76	184.3	0.29	0.25	0.51
	± 0.52	± 10.10	± 6.75	± 13.99	± 0.09	± 0.14	± 0.28
Bamboo leaves (1)	6.22	38.3	111	474	0.035	0.32	0.81
Barley grain (2)	7.27	35.0	21.5	109.3	1.14	1.10	0.25
	± 0.37	± 8.57	± 3.59	± 16.04	± 0.93	± 0.032	± 0.05
Coconut cake (3)	31.73	48.3	61.0	362.33	0.16	0.55	0.41
	± 1.32	± 2.64	± 3.65	± 44.15	± 0.017	± 0.036	± 0.26
Concentrate mix (2)	17.9	58.05	157.5	619	0.66	1.57	0.56
	± 1.95	± 12.28	± 29.8	± 343.7	± 0.20	± 0.44	± 0.46
Cowpea green (4)	11.58	43.17	79.77	1063	0.48	7.70	2.23
	± 2.54	± 8.86	± 18.41	± 458.4	± 0.23	± 5.03	± 0.49
Cottonseed cake (14)	19.50	44.38	45.15	701.5	0.69	0.44	1.01
	± 7.16	± 2.52	± 7.69	± 102.0	± 0.077	± 0.048	± 0.24
Groundnut straw (15)	7.16	24.76	69.85	1168.7	0.76	1.57	2.28
	± 0.42	± 2.04	± 6.03	± 119.6	± 0.12	± 0.40	± 0.25
Guar grain (4)	35.15	72.30	45.22	986.75	2.22	6.06	1.41
	± 6.68	± 7.90	± 10.09	± 273.8	± 0.99	± 1.44	± 0.31
Guar green (3)	14.49	42.7	54.03	471.33	0.46	2.43	3.04
	± 2.59	± 6.26	± 6.40	± 72.89	± 0.11	± 1.39	± 0.05
Hybrid napier (2)	13.53	± 42.0	78.35	304	016	0.26	1.49
	± 5.03	± 2.53	± 28.29	± 3.26	± 0.056	± 0.053	± 0.40
Local grasses (35)	7.73	41.61	84.76	848	0.56	1.13	1.26
	± 0.41	± 2.59	± 6.54	± 101.5	± 0.057	± 0.10	± 0.098
Lucerne green (11)	11.38	27.39	59.90	603.1	0.41	1.37	2.75
	± 0.74	± 1.77	± 5.03	± 83.09	± 0.061	± 0.24	± 0.53
Maize grain (3)	4.30	31.83	7.20	42.13	0.46	0.43	0.36
	± 0.10	± 3.55	± 1.03	± 1.06	± 0.20	± 0.076	± 0.20
Maize green (3)	4.64	34.25	48.60	602.5	0.34	0.79	0.57
	± 0.70	± 0.85	± 9.14	± 72.25	± 0.002	± 0.32	± 0.18
Maize straw (5)	6.29	29.04	76.82	530.4	0.19	0.77	0.73
	± 1.08	± 4.35	± 12.74	± 108.4	± 0.056	± 0.25	± 0.15
Mung pods (5)	11.49	18.02	54.54	167.4	0.018	0.93	2.53
	± 2.35	± 2.15	± 3.35	± 24.28	± 0.008	± 0.36	± 0.37
Moth green (2)	6.22	26.45	84.8	804	0.23	3.14	2.30
	± 0.74	± 0.12	± 1.22	± 315.1	± 0.19	± 1.38	± 0.98
Sorghum green (17)	6.72	33.95	59.31	374.69	0.29	0.81	0.95
	± 0.55	± 4.33	± 3.85	± 78.8	± 0.083	± 0.11	± 0.10
Sorghum straw (6)	6.82	34.7	74.0	639.5	0.48	1.04	1.28
	± 1.12	± 7.21	± 13.35	± 128.6	± 0.19	± 0.17	± 0.20
Sweet potato creepers (3)	11.09	22.65	50.4	833.5	0.51	0.59	3.48
	± 1.88	± 3.38	± 9.06	± 323.7	± 0.24	± 0.20	± 0.50
Wheat bran (17)	18.47	84.29	124.78	532.11	0.67	1.69	0.82
	± 1.29	± 2.90	± 12.89	± 125.7	± 0.16	± 0.086	± 0.17
Wheat grain (3)	9.67	29.96	74.43	162.33	0.70	0.78	0.56
	± 1.65	± 2.75	± 6.80	± 34.93	± 0.33	± 0.32	± 0.11
Wheat straw (4)	4.98	24.07	56.35	550.75	0.31	0.94	0.82
	± 0.35	± 2.17	± 1.66	± 27.33	± 0.093	± 0.25	± 0.36

Figures in parentheses indicate no. of samples analyzed.
[a]Critical level = concentrations below which are low or considered deficient or excessive in the case of Mo (McDowell et al., 1993), based on requirements for cattle (NRC, 2001).

Table 2. Per cent deficiency of micro-minerals* in cows and buffaloes

Village		Milk yield (kg)	Copper	Zinc
Koday	Cow	14.0	55.40	60.35
	Buffalo	6.5	48.10	52.44
Jabalpur	Cow	6.0	54.40	61.70
	Buffalo	6.0	55.10	65.40
Nanavaladiya	Buffalo	3.5	22.46	58.75
Sukhapur	Cow	6.8	40.10	55.40
	Buffalo	8.0	45.10	60.81
Deshalpar	Cow	8.0	49.75	70.40
	Buffalo	8.0	60.40	65.60
Khirai	Buffalo	5.5	55.01	61.40
Lakadia	Buffalo	5.0	48.35	52.45
Adipur	Cow	14.0	55.18	62.14
	Buffalo	12.0	42.42	62.92
Kosa	Cow	6.5	38.88	45.70
Dayapur	Cow	7.0	62.19	76.78
	Buffalo	5.0	58.11	61.46

**Mn, Fe and Co were adequate*

were number of live stock, land area, irrigated facilities, fodder and other crops being grown etc. Identification of farmers and location was considered essentially, one each from northern, eastern, western and southern directions, to cover soil types on each side of selected village. All the samples of feeds and fodder collected were dried, ground and processed for the preparation of acid extract (AOAC, 1990). These samples were analyzed for Cu, Zn, Mn, Fe, Co, Mo and Se using Inductively Coupled Plasma-Optical Emission Spectrometer (Perkin – Elmer, OPTIMA – 3300 RL).

Quantitative data on different feeds and fodders being fed to each of their milch animal was also recorded, to calculate intakes of certain mineral elements. Total intakes were compared against the requirements on dry matter basis (Campbell *et al.*, 1999; NRC, 2001), so as to identify quantitative deficiency, sufficiency or even excess. In India, hardly any information on mineral requirements for milch buffaloes is available; hence NRC (2001) was taken as a base for calculation of mineral requirements of buffaloes. The data were analyzed statistically (Snedecor and Cochran, 1967).

RESULTS AND DISCUSSION

Crop residues were found to be the main source of roughages in the ration of cows and buffaloes of the surveyed area. The concentrate ingredients were usually the conventional type and home grown. The practice of feeding compounded cattle feed and mineral supplements were rare in the area. Some farmers grew green fodders such as sorghum, Lucerne and cowpea but only in limited areas due to water scarcity and limited quantity of green fodders were fed to productive animals. Sweet potato creepers were subsidiary green fodder fed to milch animals seasonally.

Copper content was recorded consistently low in almost all the feed samples. Groundnut, wheat and sorghum straws contained low copper (6.13 ppm), whereas local grasses, lucerne green, cowpea green, sweet potato creepers and sorghum green were somewhat better source of copper (9.70 ppm). The level was very low in maize and barley grains (Table 1). Wheat bran, guar grain, bajra grain, coconut cake and cottonseed cake was relatively high in copper content. Copper content below the critical level of 8 ppm (Cuesta *et al.*, 1993) were found in bajra straw, bamboo leaves, barley grain, groundnut straw, local grasses, maize grain, maize green, maize straw, moth green, sorghum green, sorghum straw and wheat straw.

Copper deficiency was observed in cows and buffaloes (52 %) in the surveyed area (Table 2). Clinical and sub clinical syndromes occured in livestock. Sub clinically, the problems of poor growth rate; coarse hair coat and infertility was encountered in cows and buffaloes. Dietary copper requirement is 10 ppm and adequate copper content reduced the incidence of mammary gland infection (mastitis) and increased the killing ability of neutrophils (Harmon and Torre, 1994).

Zinc is one element, which is found to be deficient in many geographical zones of India. From this surveillance, it was apparent that most of the feed ingredients, particularly straws, were unduly low in Zn content (30.45 ppm). Amongst the green fodders, bajra green had the highest Zn content (44.45 ppm), followed by cowpea green (43.17

ppm), sorghum green (33.95 ppm), lucerne green (27.39 ppm) and sweet potato creepers (22.65 ppm) showing that levels of Zn were not adequate for optimum metabolic functions. In grains, Zn levels were similar to green fodders, whereas wheat bran was good source of Zn (Table 1). It seemed that Zn transfer from plant segment to seeds was quite substantial as apparent from the figures in grains of bajra, barley, guar, maize and wheat. Zinc content was found below the critical level (30 ppm) in groundnut straw, lucerne green, maize straw, mung pods, sweet potato creepers and wheat straw. For milch cows and buffaloes, deficiencies of Zn were recorded to the extent of 75 per cent (Table 2). Mastitis, night blindness, parakeratosis and reproductive failure are the ailments, which may result from its deficiency (McDowell, 1992; Singh and Pachauri, 2001). To overcome Zn deficiency, its level should be 80 ppm in the total ration (Arora, 1981), so as to avoid sub clinical and clinical problems.

Manganese was adequate in most of the feeds and fodder samples, a picture very similar to Kaira district of Gujarat (Garg *et al.*, 2000). Most of the straws fed to livestock contained 63.75 ppm Mn, whereas concentrate ingredients particularly grains were low in Mn. Green fodders were also good source of Mn (65.27 ppm), whereas wheat bran was extra-ordinarily rich in Mn (124.78 ppm). The Mn content in most feedstuffs was found above the critical level (40 ppm) except grains. It was apparent from the prevailing feeding systems in villages, that the requirement of Mn was being met without feeding compounded cattle feed or green fodder.

Most of the feeds and fodders offered to livestock contained reasonable amount of iron (>300 ppm), except grains. In grains, the level was very low in comparison to wheat bran, coconut cake and cottonseed cake. The iron concentration in the majority of feeds and fodders was very high and could probably interfere with the copper absorption and metabolism (Youssef *et al.*, 1999). Feed ingredients usually contained sufficient levels of cobalt (Table 1), whereas, guar grain exceptionally rich in Co (2.22 ppm). Cobalt and iron requirement for dairy animals is 0.5 and 50 ppm, respectively. Adequate Co and iron levels were also reported earlier in Mehsana district (Garg *et al.*, 1999). Therefore, there is no need to supplement Co and Fe through the mineral mixture.

The molybdenum levels as estimated in the samples of crop residues were within the safe limit (0.90 ppm). Amongst the green fodders, cowpea (7.70 ppm) had the highest Mo content, followed by moth green (3.14 ppm), guar green (2.43 ppm), lucerne green (1.37 ppm) and sorghum green (0.81 ppm). High Cu supplementation was needed when cowpea green alone was fed as green fodder due to high Mo content. Most of the feedstuffs contained Mo level within the safe limit and gave Cu:Mo ratio wider than 8.0. Miltimore and Mason (1971), stated that a Cu:Mo ratio below 2.0 would be expected to cause conditioned Cu deficiency in cattle. Mo levels of 5 to 6 ppm inhibit Cu storage and produce signs of molybdenosis (NRC, 1980). Even 2 ppm or less Mo can be toxic, if forage Cu is sufficiently low (Youssef *et al.*, 1999; Tiffany *et al.*, 2000).

The selenium content of the crop residues varied from 0.25 to 3.48 ppm. Its level was recorded ranging from 1.63-3.48 ppm, in green fodders. Grains had around 0.36 ppm Se, whereas guar grain was an exception (1.41 ppm). Selenium content in coconut cake, cottonseed cake and wheat bran were 0.41, 1.01 and 0.82 ppm, respectively. The minimum requirements, of dietary Se, for all classes of ruminant livestock ranges from 0.10 to 0.30 ppm (NRC, 1980). Accepting the minimum requirements of 0.3 ppm Se, which was the level considered adequate for preventing deficiency in dairy cattle (NRC, 2001), most of the feeds and fodders studies would satisfy requirement of Se. Overall, milch cows and buffaloes in various taluks of Kutch district were able to meet their mineral requirements, except zinc and copper. Other minerals such as manganese, iron, cobalt and selenium were adequate in the ration of milch cows and buffaloes. Therefore, supplementation of these minerals in mineral mixture was not advocated.

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