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MINERAL STATUS OF SOILS, WATER, FEEDS AND FODDERS OF DAIRY ANIMALS IN MAHABOOBNAGAR DISTRICT OF ANDHRA PRADESH

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ABSTRACT
A survey was conducted to evaluate the mineral status of dairy animals of Mahaboobnagar district of Andhra pradesh. Four villages were selected for the survey that truly represented the animal husbandry practices of the district. The soils in the surveyed villages were adequate in Ca, Mg, Mn, Fe and Co, while deficient in P. About 32.5 % samples had Cu and Zn levels below the critical level. The supply of minerals from water was negligible. The dry and green roughages on average were deficient to marginally adequate in Ca (0.20 – 0.46 %), adequatein Mg (0.19 – 0.36 %), Co (0.20 – 0.30 ppm), reasonable in Mn (24.78 – 155.74 ppm) and quite excess in Fe (103.3 – 525.8 ppm), while deficient in Cu (1.52 – 9.91 ppm) and P (0.12 – 0.32 %). The dry roughages were deficient in Zn (16.98 – 30.28 ppm), while greens were adequate. The brans were rich in P, Fe, Mn and Co; moderate in Cu, Zn and Mg, while maize grain was deficient in most of the minerals except P, Fe and Co. Ragi straw and horse gram were good sources of Ca. The dairy animals in the district were in short supply of P, Cu and Zn, which needs strategic supplementation.

KEYWORDS: Calcium, Phosphorous, Magnesium, Iron, Copper, Zinc, Manganese, Cobalt, Homemade concentrate mixture, Atomic absorption spectro photometer.

INTRODUCTION

Nutrition play a significant role in any livestock development program and the optimum expression of genetic potential of livestock depends on adequate supply of nutrients. Micronutrients, particularly the mineral elements are considered to be inevitable for the normal metabolic and physiological processes of animal systems. Mineral deficiencies, imbalances, and toxicity have long been held responsible for low production among cattle and buffaloes grazing over tropical agro-climatic condition (McDowell *et al.*, 1984). Mineral deficiency exists widely in livestock and the severity of the deficiency depends upon the type of feed, physiological status of the animals and agro-climatic condition of the region. Regional mapping of mineral elements in feed and fodder is relatively a rapid, reliable and cost effective method of providing baseline data on the levels of macro and microelements. Keeping in view the above facts the current investigation was carried out in Mahaboobnagar district of Andhra Pradesh.

MATERIALS & METHODS

Mahaboobnagar district is located in the south-western part of Andhra Pradesh between 16^0 17 N latitude and 77^0 79 E longitude with 450 MSL. The soils are of red sandy, red earth and black soil type. The survey was conducted in four villages, which were geographically located apart in direction and truly represented the animal husbandry practices of the mandal. From each village a minimum of 40 farmers were selected and were interviewed using standard sampling procedure, on the basis of standard questionnaire developed. A minimum of 10 representative samples of soil from each village was collected from different grazing land and cultivated fodder plots from plough depth level (8''-10'') and preserved in polythene bags. These soil samples (10gms) were extracted with 0.005 M Di-ethylene tri-amine penta acetic acid (DTPA) for 2 hours at pH 7.3 as per the method of Lindsay and Norvell (1978) for Cu, Fe, Mn and Zn. For estimation of Co in soil, the procedure given by Kubota and Cary (1982) was followed. The minerals in the extractable aliquot estimated using atomic absorption spectrophotometer (AAS-4139 ECIL). The minerals Ca and Mg were analyzed by using Ethylene diamine tetra acetic acid (EDTA) (Dhyan singh *et al*., 1999) method and P content was analyzed by Ascorbic acid method (Watanabe and Olsen, 1965). The representative samples of feeds/fodder collected from different farmers, were dried at 80^0C for 24 hours and subsequently ground to approximately 1mm size and were stored in moisture free plastic bags for further analysis. A mineral extract of HCl was prepared for estimation of macro minerals like Ca, P in feeds and fodder. These were analyzed as per the methods of Talapatra *et al*. (1940) and AOAC (1980), respectively and magnesium and trace minerals (Cu, Zn, Fe, Mn and Co) were analyzed by using Di-acid digestion method using atomic absorption spectrophotometer (AAS-4139 ECIL).

RESULTS & DISCUSSION

The survey was conducted between February and August i.e. during the lean periods of the year. Most of the dairy owners kept their animals stall fed either at home or at farm nearby their cultivated lands and few small farmers allowed their animals for grazing on available grazing land. Paddy straw was the most common dry roughage, followed by stovers of jowar and maize. The sorghum especially SSG-59-3 variety was most cultivated green fodder followed by para grass, hybrid napier (CO1), *Lucerne* and local mixed grasses. The usage of concentrate ingredients rice bran, cottonseed, wheat bran, ground nut cake, gram chuni, maize grain, horse gram, homemade concentrate mixture and commercial concentrate mixtures were followed by few farmers and restricted to productive animals only.Most of the straws and stovers available in this area contained Ca above critical level (>0.3%). Among all the dry roughages, *ragi* straw was good source of Ca (0.89%). Among the cultivated green fodders, the Ca content was marginally deficient in sorghum green (0.20–0.28%), while the para grass (0.36%), hybrid napier (0.42–0.46%) were moderate in Ca and lucerne was rich in Ca (1.26%). Similarly Kalita *et al*. (2003) reported 0.34, 0.28 and 0.42% of Ca in paddy straw, para grass and napier grass, respectively. Ragi straw available in Karnataka contained 0.6% Ca (Gowda *et al*., 2002) lower than that observed in present study. The Ca content in stovers of maize and jowar, lucerne, sorghum green and grazing grasses were lower than the reported values of Garg and co-workers (2003). Among the concentrate ingredients, the horse gram available was good source of Ca (0.76%) and others like maize grain, groundnut cake, gram chuni, rice bran were marginally sufficient. The concentration of Ca in rice bran and gram chuni available in the West Bengal (Das *et al*., 2002) was similar and that in Karnataka was lower (Gowda *et al*., 2002) than the values of present study. The differences observed might be due to differences in Ca and other mineral concentration in soil which might have affected the uptake of Ca by plant. The compounded feeds are good sources of Ca. Although the Ca content of the most of the straws appeared to be above critical level, the bio-availability to the animals may be less due to presence of substantial amounts of oxalates and high silica (Gowda *et al.*, 2002 and 2005). The P in most of the dry and green roughages was lower than the critical level of 0.25% (Table). Concentrate ingredients were moderate to good sources of P. The brans of rice (1.26-1.50 %) and wheat (1.35 %) were good in P. As the rice bran was a major constituent of homemade concentrate mixtures along with cottonseed or maize and horse gram, these were high in P. Though P was adequate in the concentrate feeds, almost all samples of dry and green roughages were deficient in P. This corroborates with the characteristic feature of tropical dry forage (McDowell *et al*., 1984; Prabowo *et al*., 1990; Gowda *et al*., 2002; Das *et al*., 2003). The average Mg in dry and green roughages was well above the critical level of 0.20% (Mc Dowell *et al*., 1985). The maize grain was deficient in Mg while the other concentrate ingredients available in this region were good sources of Mg. The Mg content of the sorghum green, hybrid napier, wheat bran, groundnut cake and compounded cattle feed were comparable to the reported values of Ramana *et al,*. (2000) in Southern transition zone of Karnataka, while the concentration of Mg in paddy straw was high and that in *ragi* straw and rice bran was lower to the values reported by the above workers. Copper content was consistently low in almost all the feed samples analyzed (Table). Low level of Cu in the feed stuffs might be a reflection of deficiency in the soil. Similarly, Yadav *et al.* (1999) reported that Cu content of the feed stuffs was found to be significantly correlated with the Cu content of soil. In dry and green roughages except para grass the quantities were below the critical level of 8 ppm (Mc Dowell *et al*., 1985). The picture similar to the present, was observed in Dahod and Panchamahal (Garg *et al.*, 2003), Kutch (Garg *et al.*, 2002) and Patan (Chavda, 2003) districts of Gujarat. The Cu concentration was higher in greens compared to straws. Ragi straw contained 1.52 ppm of Cu, lower than that (9 ppm) reported by Ramana *et al*. (2000) available in Southern transition zone of Karnataka. The maize grain (3.16ppm) was deficient in Cu, while cotton seed, rice bran, wheat bran and groundnut cake were relatively adequate in Cu content. The amount of Cu in cotton seed, and gram chuni observed in this present study, were comparable to the reported values of Yadav *et al*. (1998) available in Rewari district of Haryana. Zn is one element, which is reported to be most deficient in many geographical zones of India (Yadav *et al.*, 2000; Gowda *et al.*, 2002; Garg *et al.*, 2002; Ramana *et al.*, 2003; Udar *et al.*, 2003; Garg *et al.*, 2003b; Garg *et al.*, 2005). As a result, plants do not contain this element in sufficient quantity so as to meet the requirements. This type of strong relationship between Zn content of soil and plant was also reported by Mandal *et al.* (2004) in Faridabad district of Haryana. Similarly Yadav *et al.* (2000) in Jind district of Haryana observed the Zn deficiency in soils and feedstuffs. Most of the straws and stovers contained Zn well below the critical level (<30ppm) (Table) due to deficiency of the element in soil. The green roughages were moderate to good sources of Zn and comparatively higher than the reported values (14.52 – 27.00 ppm) of Garg *et al.* (2003) in Dahod and Panchamahal district of Gujarat, but lower than the reported values of Gowda *et al.* (2001) in eastern dry zone of Karnataka. Among the concentrate ingredients, except horse gram (36.93 ppm) and maize (32.80 ppm), other ingredients like rice bran, wheat bran, groundnut cake and cotton seed were good sources of Zn (45 –67.07 ppm). All homemade concentrate mixtures and compounded cattle feeds contained Zn well above the critical level. Fe is reported to be most abundant in many geographical zones of India (Ramana *et al.*, 2001; Yadav *et al.*, 2002; Garg *et al.*, 2005). The Fe content of soil ranged from 30.98 to 36.90 ppm, well above the critical level of 2.5 ppm and this resulted in higher content of the mineral in the feeds and fodders grown in this area. Even the straw samples were quite rich in Fe (103.3 to 299.6ppm).

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TABLE I: Mineral content in soil and water samples of Mahaboobnagar district

	Ca	Mg	P	Cu	Zn	Mn	Fe	Co
Soil								
Critical level	<0.1[1]%	0.01[1]%	45-135[1] ppm	<2.5[2]ppm	<1.0[2] ppm	<5.0[2]ppm	<2.5-4.5[2]ppm	<0.50[3]ppm
	0.14±0.01	0.03±0.01	13.91±0.51	2.63±0.10	1.73±0.11	23.81±0.82	39.21± 1.26	2.56± 0.16
Water (ppm)								
	20.65±0.68	16.76±0.96	0.53±0.03	0.33±0.04	0.14±0.02	4.43±0.23	10.70±0.90	0.11±0.02

[1]Jackson 1973; [2] Viets and Lindsay 1973; [3]Walsh *et al* 1956.

TABLE II: Mineral composition (on DMB) of various feeds and fodders fed to animals by farmers of Mahaboobnagar district

Ingredient	Ca%	P %	Mg %	Cu (ppm)	Zn (ppm)	Fe (ppm)	Mn (ppm)	Co (ppm)
Critical level[1]	< 0.3	< 0.25	< 0.20	<8.0	< 30.0	< 50.0	< 40.0	< 0.1
Paddy straw (21)	0.32± 0.01	0.19± 0.01	0.31± 0.01	3.47± 0.29	28.06± 0.85	195.69± 20.92	198.37± 14.55	0.29± 0.01
Jowar stover (8)	0.29± 0.02	0.12± 0.01	0.31± 0.02	4.92± 0.21	16.61± 0.81	277.21± 25.14	35.83± 3.87	0.30± 0.03
Maize stover (8)	0.39± 0.01	0.18± 0.01	0.29± 0.01	6.03± 0.82	17.99± 0.90	254.32± 8.92	40.31± 0.86	0.21± 0.01
Ragi straw (2)	0.40± 0.02	0.20± 0.02	0.30 ± 0.02	3.45± 0.76	16.98± 0.27	10.3.31± 5.49	74.78± 7.17	0.64± 0.08
SSG-59-3 (15)	0.26± 0.01	0.17± 0.01	0.28 ± 0.01	7.14± 0.29	39.85± 0.87	318.71± 65.41	221.17± 65.23	0.26± 0.01
Para grass (12)	0.30± 0.01	0.25±0.01	0.21± 0.01	9.50±0.25	42.99±0.85	210.61±50.22	213.39±51.78	0.27±0.01
Lucerne (2)	1.24±0.03	0.24±0.01	0.38 ± 0.01	11.27±0.01	39.76±0.82	628.68±2.81	134.44±2.28	0.45±0.02
Hybrid napier(Co-I) (2)	0.43±0.02	0.31±0.01	0.35 ± 0.01	7.56±0.16	42.45±2.41	253.81±76.76	198.78±80.72	0.20±0.01
Grazing grass (11)	0.34±0.01	0.23±0.01	0.28± 0.01	7.89±2.16	36.01±4.71	250.22±53.79	356.77±79.99	0.39±0.03
Maize grain (2)	0.24± 0.03	0.32± 0.02	0.14± 0.01	2.36± 0.14	26.47 ± 0.75	67.86± 5.02	19.95± 0.17	0.42 ± 0.01
Horse gram (2)	0.79± 0.03	0.40± 0.02	0.27± 0.01	8.18± 0.22	36.26± 0.67	167.53± 3.99	28.74± 0.81	0.30 ± 0.01
Cotton seed (10)	0.19± 0.01	0.53± 0.01	0.29± 0.01	14.01± 0.50	46.36± 1.44	50.83± 0.76	217.23±1.50	0.32 ± 0.01
Gram chuni (2)	0.26± 0.01	0.30± 0.01	0.35± 0.01	11.10± 0.42	34.88± 1.33	449.94±26.30	91.48± 1.81	0.40 ± 0.01
Rice bran (16)	0.35± 0.01	1.39± 0.03	0.49± 0.02	17.49± 1.02	52.87± 2.81	213.64±22.03	187.20± 24.37	0.37 ± 0.01
Wheat bran (2)	0.23± 0.02	1.42± 0.01	0.41± 0.03	20.57± 0.72	67.07±1.51	334.01± 8.86	102.58± 4.11	0.45 ± 0.02
Groundnut cake (2)	0.43± 0.03	0.73± 0.02	0.47± 0.01	17.31± 0.62	53.37± 0.91	921.05± 35.83	45.82± 0.81	0.34 ± 0.01
HMCM-I (2)	0.31	1.06	0.41	10.23	44.36	223.64	66.30	0.34
HMCM-II (2)	0.32±0.01	1.00±0.07	0.36±0.05	10.67±0.44	43.33±1.03	221.82±1.82	76.38±10.08	0.33±0.02
HMCM-III (6)	0.25± 0.04	0.92± 0.07	0.42± 0.01	16.74± 0.04	50.65± 0.56	81.05± 0.96	410± 19.00	0.33± 0.02
Con mix (6)	1.58 ± 0.12	1.06± 0.10	0.59± 0.04	16.70± 0.87	56.92± 2.60	404.13± 85.15	201.16± 52.67	1.72± 0.12

[1] McDowell (1985); HMCM-I: Mixture of rice bran and maize; HMCM-II: Mixture of rice bran, maize and horse gram; HMCM-III: Mixture of rice bran and cotton seed; Con mix- commercial concentrate mixture. Figures in parentheses indicate number of samples analyzed.

Green roughages (316.62 to 525.8 ppm) and other concentrates ingredients (223.61 to 571.14 ppm) of this area had higher level of Fe, which indicated Fe seem to be quite rich in all the feed resources available in this district, similar to the reports from other parts of the country such as Gujarat (Garg *et al.,* 1999; Garg *et al.,* 2002; Garg *et al.,* 2003), Rajasthan (Garg *et al.,* 2005), West Bengal (Das *et al.,* 2002; Das *et al.,* 2003; Mandal *et al.,* 2003), Karnataka (Ramana *et al*., 2001, Gowda *et al*., 2001, Gowda *et al*., 2002), Assam (Kalita *et al.,* 2003). Most of the green and dry roughages except sorghum green, stovers of maize and jowar offered to the animals contained good amounts of Mn. The Mn content of sorghum green, stovers of maize and jowar were comparable to the reported values of Garg *et al* (2003) in Dahod and Panchamahal district of Gujarat. The Mn in maize grain, rice bran and hybrid napier was in agreement with those available in hill zone of West Bengal (21.74, 103.76 and 62.99 ppm, respectively) (Das *et al.,* 2003) but with lower content in paddy straw (25.19 ppm) compared to the values obtained in present study. Kalita *et al.* (2003) reported higher values in paddy straw (224.58 ppm) and para grass (170.0 ppm) in comparison to present results. The Mn content of cotton seed (50.12 –51.15 ppm) was comparable to the reported value (44.6 ppm) of Maan *et al.* (2003) in Rohtak district of Haryana. On overall, Mn content in the feed stuffs was enough to meet the requirement of animals with the conventional feeding system of the farmers in the surveyed villages. Adequate Mn availability from feeds and fodder was recorded in other parts of the country (Garg *et al*., 2000; Yadav *et al.*, 2002; Garg *et al*., 2005).Soils containing more than 0.25 ppm cobalt will produce good pastures (Walsh *et al*., 1956). In the present study, the cobalt content of soil was well above the critical level (Table) which was reflected in the feeds and fodders of this area (Table). The cobalt content in most of the feeds and fodders was found to be above the critical level of 0.1 ppm (NRC, 2001).

CONCLUSION

Analysis of soils of these villages revealed Ca, Mg, Mn, Fe and Co were found to be adequate and ranged from 0.13 - 0.16%, 0.3 - 0.4%, 22.15-25.04 ppm, 36.20-41.93 ppm and 2.21-2.86 ppm respectively. While the phosphorus content of soil (13.50 - 14.21 ppm) was below the critical level (45-135 ppm) and 32.5% of soil samples were analysed were deficient in Cu and Zn. The analysis of water samples from these villages for minerals indicated that mineral content was negligible except Ca (19.89 - 22.17 ppm) and Mg (12.23 - 20.82 ppm). The dry and green roughages on average were deficient to marginally adequate in Ca (0.20 – 0.46 %), adequate in Mg (0.19 – 0.36 %), Co (0.20 – 0.30 ppm), reasonable amount of Mn (24.78 – 155.74 ppm) and quite excess in Fe (103.3 – 525.8 ppm), and deficient in Cu (1.52 – 9.91 ppm) and P (0.12 – 0.32 %). Similar trend was observed for grazing grass being deficient in P (0.21 – 0.26 %), Cu (3.16 – 7.38 ppm), Zn (24.0 – 49.01 ppm). The home made concentrate mixtures and compounded feeds were adequate to high in all minerals. The brans (Rice and Wheat) was rich in P (1.26 – 1.50 %), Fe (270.87 – 334.01 ppm), Mn (102.58 – 117.5 ppm) and Co (0.35 – 0.45 ppm), moderate in Cu (16.33 – 20.57 ppm), Zn (51.31 – 54.96 ppm), Mg (0.41 – 0.51 %). The maize grain was deficient in most of the minerals except P, Fe, and Co. Among the roughages and concentrate ingredients, *ragi* straw (0.89 %) and horse gram (0.76 %) were rich source of Ca..The dairy animals in the district were in short supply of P,Cu and Zn, which needs strategic supplementation.

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