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Mineral Status of Dairy Buffaloes in West Godavari District of Andhra Pradesh in India

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Abstract:
A study was conducted in the coastal zone of Andhra Pradesh at west Godavari to assess the Status of Certain Macro and Micro Minerals in dairy Buffaloes. Fodder and blood serum samples were collected at random from the area under survey. Paddy straw was the Major dry roughage in surveyed area and found to be low in Ca (0.10%), P (0.10%),S (0.052%), Cu (1:32 ppm) and Zn (7.21ppm). The available green fodders were mainly hybrid napier and found to be good sources of Ca (0.45%), Mg (0.39%), S (0.23%) and Mn (88 pp m). The feeds and fodders were found to be rich in K (1.33 %) and Fe (750 pp m) Content. Groundnut cake was major Concentrate supplement in this area. Groundnut cake rich in P (0.63 %), Mg (0.33 %), S (0.29 %) , Cu (21.21 ppm) , Zn (54.50 ppm) and Co (0.70 ppm) .
Brans were rich in Mn (126.66 ppm). Grains were poor sources of Ca (0.11 %) as compared to P (0.26%). Se content in feeds and fodders was adequate (1.35 pp m). Co was found to be deficient in feed stuffs (0.09 pp m). Average Ca (10.28 mg %), P (3.50 mg %) and Mg (2.23 mg %) levels in blood serum were higher than the critical limits. About 10 and 35% of the total animals (n=25) showed lower levels of serum Ca (6.11 mg %) and P (3.23mg %), respectively. Cu (0.61 pp m) and Zn (0.89 pp m) levels in blood serum of dairy buffaloes were below the critical limit. In this zone 65 and 31 % of the total animals showed lower levels of serum Ca (0.23 pp m) and Zn (0.69 pp m) values. Supplementation of area specific mineral mixtures with highly bioavailable mineral salts or methionine based Ca, cu and Zn chelates could be a cost effective method to improve reproductive life and productivity of animals in this area .

***Key words**: Minerals, calcium, copper, cobalt, zinc, selenium, coastal Andhra zone, buffaloes*

1. Introduction

To attain the efficient production and reproduction, it is necessary to provide essential nutrients in appropriate quantity. Though the minerals required in small quantity they play an important role in the reproductive and productive performance of animals. Livestock in India not receive regular mineral supplements and depend on feeds and fodders for their mineral requirements (Gary *et al* 2002). Many researchers reported that the forage samples below critical levels for different mineral elements (Miles and Mc Dowell, 1983;Uunderwood and Suttle, 1999; Garg *et al* 2005). The quantity of minerals, present in the forages may not be sufficient for optimum growth, milk yield and reproduction of animals. There is a need to provide adequate minerals for improved productivity of the animals. Therefore the present study was conducted to know the mineral status in coastal Andhra zone of Andhra Pradesh at west Godavari, so as to suggest area specific mineral mixture for improving productivity of animals.

2. Materials and Methods

2.1. Sample Collection

In coastal Andhra Zone all talukas of west Godavari district were selected for the collection of samples. At random, one to three societies from each taluk were selected based on the geographical distribution .From each society, three farmers were identified with the help of veterinary assistant surgeon, society milk producers and district milk union for collection of representative samples of feed, fodder and blood serum of animals. With the help of the villagers at the selected society soil type on each side covered. The recorded parameters were number of livestock, land area, irrigation facilities, fodder and other crops being grown etc. Other information regarding the amount and types of feeds and fodder being offered to the animals, approximate rate of daily feed intake and milk yield

of individual animal were collected from individual farmer. Total intake was compared against the requirements on drymatter basis (campbell *et al* .1999; NRC, 2001), so as to identify the quantity.

2.2. Sample preparation and analytical Methods

Composite samples of green fodder, dry fodder, individual concentrate ingredients and concentrate mixture were collected from all over the surveyed area. Samples were dried in oven at 80^0 C for 24 hr, ground (1 mm) and stored in airtight bags until analyzed samples were prepared and digested using 5 ml concentrated HNo3 plus 1 ml concentrated Hcl by microwave digestion method for preventing evoporation of volatile elements and total volume of mineral extract was made to 25 ml with distilled water. All the samples were analyzed for calcium (Ca), phosphorus (P), magnesium (Mg),sodium (Na), potassium (K), sulphur (S) , copper (Cu), zinc (Zn), manganese(Mn), iron (Fe), cobalt (Co), molybdenum (Mo) and selenium (Se) using plasma –optical Emission spectrometer (Perkin Elmer, OPTIMA – 3300 RL). Blood serum samples directly used for mineral analysis. The data were analyzed statistically (Snedecor and cochran ,1994).

3. Results & Discussion

3.1. Feeding Management

The survey work revealed that most of the farmers were feeding their animals on Paddy straw (*oryza sativa*) and local green grasses collected from the wasteland as basal roughage. In addition, cultivable grasses such as hybrid napier (*pennisetum purpureum*) and paragrass (*Brachiara mutica*) were also fed to dairy animals. Amongst concentrates, farmers were supplementing the ration to the animals with multiple unit ingradients in the form of groundnut, cake rice bran and tamarind seed (*Tamarindus indica*) powder. Some farmers fed ground rice (or) ragi (*Eleusine coracana*) or crushed maize mixed with concentrate mixture at the time of milking. Some farmers fed only groundnut cake. Only few farmers supplemented minerals in the ration. The survey revealed that paddy straw as dry roughage, hybrid napier as local grass as green roughage were the most commonly used feed stuffs in this zone. As concentrate supplement crushed grains of maize, bajra, ragi, cakes of groundnut, brans of rice were offered to the animals.

Feed	Ca	P	Mg	Na	K	S	Cu	Zn	M	Fe	Co	Se	Mo
	(%)						(ppm)						
Critical Level[a]	<0.30	<0.25	<0.20	<0.06	<0.80	<0.20	<8.0	<30	<40	<50	<0.10	<0.20	>6.0
Groundnut cake	0.19 ±0.026	0.68 ±0.028	0.33 ±0.011	0.037 ±0.009	1.24 ±0.026	0.29 ±0.034	21.21 ±1.33	54.50 ±3.62	45.45 ±6.05	912.50 ± 02.6	0.99 ± 0.14	0.32 ± 0.078	1.21 ± 0.20
Maize grain	0.061 ±0.013	0.24 ±0.015	0.24 ±0.06	0.023 ±0.010	0.36 ±0.04	0.13 ±0.015	4.60 ±0.015	28.16 ±0.75	14.32 ±2.54	159.80 ±16.54	0.23 ±0.093	0.50 ±0.12	0.87 ±0.28
Rice grain	0.045 ±0.031	0.17 ±0.033	0.14 ±0.014	0.010 ±0.002	0.27 ±0.04	0.12 ±0.008	5.17 ±0.41	17.39 ±02.40	9.48 ±1.40	155.23 ±52.44	0.40 ±0.18	0.20 ±0.044	0.42 ±0.16
Ragi grain	0.30 ±0.085	0.28 ±0.01	0.16 ±0.15	0.008 ±0.002	0.41 ±0.03	0.12 ±0.005	6.17 ±0.06	32.05 ±1.75	79.25 ±4.26	188.50 ±9.52	0.27 ±0.04	0.27 ±0.11	0.44 ±0.10
Rice bran	0.13 ±0.016	0.64 ±0.11	0.31 ±0.061	0.033 ±0.013	0.62 ±0.13	0.11 ±0.032	21.64 ±4.56	65.26 ±4.29	132.33 ±7.59	720.50 ±80.99	0.64 ±0.077	0.47 ±0.29	0.39 ±0.12
Tamarind seed powder	0.25 ±0.035	0.18 ±0.014	0.21 ±0.019	0.10 ±0.034	0.53 ±0.059	0.12 ±0.013	14.61 ±1.43	25.92 ±2.53	14.05 ±1.10	327.0 ±61.51	0.53 ±0.069	0.56 ±0.13	0.64 ±0.19
Concentrate mixture(CF_1)	0.17 ±0.047	0.95 ±0.059	0.48 ±0.03	0.64 ±0.032	0.97 ±0.048	0.18 ±0.011	15.72 ±1.23	33.72 ±2.46	90.32 ±7.18	744.57 ±42.92	0.93 ±0.088	0.38 ±0.10	0.48 ±0.14
Concentrate Mix (CF_2)	1.27 ±0.047	1.05 ±0.045	0.50 ±0.021	0.73 ±0.049	0.95 ±0.039	0.23 ±0.017	17.11 ±0.69	39.90 ±3.29	78.82 ±3.60	787.28 ±25.14	0.45 ±0.077	0.51 ±0.058	0.95 ±0.12
Concentrate mix (CF_3)	1.10 ±0.058	1.15 ±0.041	0.58 ±0.024	0.68 ±0.043	0.92 ±0.035	0.35 ±0.020	15.24 ±0.64	44.79 ±4.94	87.42 ±2.21	732.30 ±23.81	11.01 ±0.047	0.68 ±0.17	0.72 ±0.10

Table 1: Mineral content in concentrate feed stuffs collected from west Godavari of Andhra Pradesh (DM basis)

[a]Critical level : Concentrations below which are low or considered deficient (Mc Dowell et al. 1993), based on requirements for cattle (NRC ,2001).

Feed	Ca	P	Mg	Na	K	S	Cu	Zn	Mn	Fe	Co	Se	Mo
	(%)						(ppm)						
Critical Level	<o.30	<0.25	<0.20	<0.06	<0.80	<0.20	<8.0	<30	<40	<50	<0.10	<0.20	>6.0
Local green grasses	0.43 ±0.052	0.27 ±0.021	0.38 ±0.055	0.12 ±0.052	2.38 ±0.13	0.25 ±0.033	13.31 ±1.29	47.34 ±4.62	83.14 ±6.87	2085.6 ± 580.3	0.35 ± 0.063	0.40 ± 0.077	1.94 ± 0.87
Hybrid napier grass	0.46 ±0.053	0.31 ±0.055	0.32 ±0.043	0.09 ±0.020	03.65 ±0.17	0.23 ±0.016	13.53 ±0.83	49.32 ±4.12	263.40 ±41.83	892.2 ±76.06	0.59 ±0.15	0.16 ±0.076	0.68 ±0.14
Paddy straw	0.11 ±0.010	0.10 ±0.008	0.11 ±0.011	0.12 ±0.032	0.85 ±0.06	0.052 ±0.004	1.72 ±0.099	7.21 ±0.93	150.35 ±15.72	537.97 ±37.09	0.93 ±0.07	0.83 ±0.08	0.62 ±0.10

Table 2: Mineral content in Dry and Green roughages collected from west Godavari of Andhra Pradesh (DM basis)
[a]Critical level: concentrations below which are low or considered deficient (Mc Dowell at al .1993), based on requirements for cattle (NRC,2001)

3.2. Mineral profiles of feeds and fodders

The profile of Co, Cu, Fe, Mn, Mo, Se, Zn, Ca, P, Mg, Na, K and S in the feeds and fodders is presented in table 1 and 2 . The average Ca (0.10 %), P (0.10 %) and S (0.07 %) content in paddy straw were low, which was the major dry roughage available for feeding animals. Local green grass and hybrid napier were good source of Ca (0.45%) and S (0.27%). The concentrate mixture fed to animal contained low ca (0.17%). Local green grasses (0.38%) and hybrid napier (0.32%) had adequate Mg. Paddy straw (0.11%) and grains of rice, ragi were found to contain low levels of Mg (0.13%). Groundnut cake (0.33%) and rice bran (0.31%) were good sources of Mg (Tables 1 and 2). The Na content was low in all the feeds and fodders (0.10%) . Higher K content of feed stuffs due to its selective uptake from the soil and was much higher than Na content (Garg *et al* 2003). K content in straws was higher than the concentrate feed ingredients (Tables 1 and 2) .Mg also did not require additional supplementation in the ration of animals.

The S content was low in paddy straw (0.052%), where as local green grasses (0.25%) and hybrid napier (0.23%) was found to be good source of S . The concentrate ingredients such as cakes of groundnut (0.29%) was good source of S as compared to grains of maize (0.13%) rice (0.12%) and ragi (0.12%). 'S' content in brans 0.11 % (table 1). The's' content of plants depends on the amount of 'S' in plant proteins in the form of S containing amine acids (Mc Dowell, 1992; Garg *et al* 2003).

Paddy straw (1.72 pp m) was very low in 'cu' content (Table 2). Local grasses and hybrid napier contained about 14 pp m Cu. Grains of maize, rice, and ragi were poor in cu (Table 1). Groundnut cake and rice bran contained about 21pp m Cu, Zn is one element which is found to be deficient in many geographical zones of India (Udar *et al.* 2003; Garg *et al*. 2005). From this study (Table 1 and 2), it was apparent that most of the feed ingredients particularly paddy straw, were low in Zn content (7.21 pp m). Local green grasses, hybrid napier contained about 48 pp m. Zn content in concentrates 44.79 ppm (Table 1). Zinc content was found below the critical level (30 pp m) in most crop residues and need to be supplemented @80 pp m in the total ration (Arora ,1981) of animals to overcome its deficiency.

The roughages offered to animals contained more than than 52 pp m Mn. Mn content in paddy straw and hybrid napier were 150 pp m and 263 pp m respectively. Amongst concentrate ingredients Mn content of ragi grain (79.25 pp m). Grains of maize and rice were low in Mn (Table 1). The Iron was found to be exceeded the requirement in all the feed stuffs being fed to the livestock (Tables 1 and 2). Fe content in feed and fodder varied from 537 to 2085 pp m. Thus Fe seems to be quite rich in this Zone. The cobalt levels in this zone ranged from 0.35 to 0.73 pp m in roughages and concentrate feed ingredients (Tables 1 and 2).

These content of the crop residues varied from 0.11 to 0.32 pp m (Tables 1 and 2). The minimum dietary Se requirements of all classes of ruminant livestock ranges from 0.10 to 0.30 pp m (NRC, 1980). Accepting the minimum requirements of 0.30 pp m Se which is the level considered to be adequate for preventing deficiency in dairy cattle (NRC, 2001), most of the feeds and fodders studied would satisfy requirement of Se. Therefore its supplementation in mineral mixture may not be advocated. The Mo levels in crop residues were within the safe limit (Tables 1 and 2). The 'Mo' content of local grasses (1.94 pp m), hybrid Napier (0.68 pp m) and paddy straw (0.62 pp m). Mo content in concentrate ingredients ranged from 0.48 to 0.72 pp m (Table 1). The variation in the mineral content amongst different fodders is due to species of plant, stage of maturity, rate of fertilizer application and soil characteristics (Reid and Horvath, 1980).

3.3. Minerals intake by Animals

The daily mineral intake as % of requirement for a buffalo yielding 8 kg milk per day Ca 85%, P 80%, S 75%, Cu 80% , Zn 30% , Co 75% in the west Godavari district of Andhra Pradesh. Since mineral Mixture supplementation was not being done, so the intake of minerals through feeds & fodders was taken as the index of total dietary mineral supply and compared with the recommended requirements to know the dietary mineral deficiency. Ration of animals was found to be deficient in Ca, P, S, Cu, Zn and Co. Hence it is necessary to supplement these minerals in the ration. It was observed that Mg, K, Mn, Fe and Se in the ration of animals were found to be adequate (or) even excess.

Particular	Ca (mg %)	P (mg %)	Mg (mg %)	Cu (ppm)	Zn (ppm)	Fe (ppm)
Normal Range	8-12	4-6	1.9-3.2	0.65-1.2	0.8-2.0	1.1-2.0
Average and range of zone (n=25)	11.23±0.30 (6.9-14.1)	4.20±0.18 (2.9-6.2)	2.32±0.09 (1.66-3.46)	0.63±0.022 (0.41±0.94)	0.81±0.032 (0.65±1.4)	2.06± 6.13 (0.98-3.44)
% of animals showing deficiency	13	37	6	52	29	3

Table 3: Mineral content in blood serum of animals (n =number of animals)

3.4. Mineral profile in blood serum of animals

Blood serum of animals was also tested for certain mineral elements which are presented in table 3. The average Ca (10.48 mg %) , P (4.50 mg %) and Mg (2.53 mg %) in blood serum of animals were with the normal range about 10 and 35 % of screened animals showed lower serum Ca and P respectively . Prasad and Gowda (2005) reported that cattle fed on paddy straw based ration showed lower Ca in blood plasma. The Mg content of blood serum was within normal range, except in about 7% of the animals, which showed lower values (< 2 mg %). Average serum Cu and Zn content were 0.59 and 0.82 ppm , respectively . Compared to critical level of Cu (0.65 ppm) and Zn (0.80 ppm) in blood serum (Cuesta *et al*.2005) , about 65 and 31% of the animals screened showed low Cu and Zn values respectively (Garg *et al*.2010). The lower concentration of these minerals in feeds and fodders and complex interrelationships might have resulted in lower level in serum (Bhattacharya *et al.* 2004). The Fe content of serum was within the normal range, except in about 4 % of the animals, which showed lower values (< 1.1 ppm). However blood serum minerals content is not always true indicators of mineral deficiency, as minerals may be mobilized from the target tissue, during low dietary intake and complex mineral interrelationships (Mc Dowell *et al*. 1993). Hence regular supplementation of mineral mixture in the ration of animals may be necessary but not for all minerals.

4. Conclusion

The study concluded that the ration of dairy animals yielding 8-10 Kg milk per day in the west Godavari of Andhra Pradesh was deficient in Ca, P, S, Cu, Zn and Co. Therefore it is necessary to supplement these minerals by formulating area specific mineral mixture using highly bioavailable mineral salts for better productivity and reproduction of animals.

5. References

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