Research Article

# Macro and Micro Mineral Status of Dairy Animals in Coastal Zone of Kerala

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***A study was conducted in the coastal zone of Kerala to assess the status of certain macro and micro-minerals in dairy animals. Feed, 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 (0.11%), P (0.10%), S (0.067%), Cu (1.72 ppm) and Zn (8.91 ppm). Amongst green fodders, mainly local grasses and hybrid napier were available and found to be good sources of Ca (0.44%), Mg (0.38%), S (0.23%) and Mn (83-263 ppm). The feeds and fodders were found to be rich in K (1.33%) and Fe (154-2350 ppm) content. Gingely cake and copra extraction were major concentrate supplements in this area. Gingely cake was rich in Ca (2.40%), P (1.17%), Mg (0.62%), S (0.32%), Cu (31.74 ppm), Zn (88.54 ppm) and Co (0.70 ppm). Copra extraction, cottonseed cake, groundnut cake, rice bran and wheat bran were rich source of P (0.70%). Brans were also rich in Mn (130.66 ppm). Grains were poor sources of Ca (0.12%) as compared to P (0.27%). Se content in feeds and fodders was adequate (0.11-1.45 ppm), however, Co was found to be marginally deficient in feedstuffs (0.09-1.98 ppm). Average Ca (10.48 mg%), P (4.5 mg%) and Mg (2.53 mg%) levels in blood serum were higher than the critical limits. However, about 12 and 35% of the total animals (n=26) showed lower levels of serum Ca (7.11 mg%) and P (3.23 mg%), respectively. Cu (0.61 ppm) and Zn (0.89 ppm) levels in blood serum of dairy cows were below the critical limit. In this zone, 65 and 31% of the total animals showed lower levels of serum Cu (0.53 ppm) and Zn (0.69ppm) values. Supplementation of area specific mineral mixtures with highly bioavailable mineral salts or methionine-based Cu and Zn chelates could be a cost effective method to improve productive life and productivity of animals in the zone.***

***Keywords:** Calcium, Sulphur, Copper, Zinc, Selenium, Coastal zone, Cows*

## INTRODUCTION

For efficient production and reproduction efficiency, it is necessary to provide essential nutrients in appropriate quantity. Although, minerals required in small amounts play an important role in the reproductive performance and health of animals. Livestock in India do not receive regular mineral/vitamin supplements and depend mainly on feeds and fodders for their mineral requirements (Garg *et al.* 2002). A number of researchers in the world have reported a high incidence of forage samples below critical levels for different mineral elements (Miles and McDowell, 1983; Underwood and Suttle, 1999; Garg *et al.* 2005). The quantity of minerals, thus, present in forages may not be sufficient for optimum growth, milk yield and reproduction of animals. Therefore, the present study was undertaken to know the mineral status in coastal zone of Kerala, so as to suggest area specific mineral mixture, for improving productive life and productivity of animals.

## MATERIALS AND METHODS

### Sampling Procedure

In coastal zone, all talukas of Thiruvananthapuram and Kasaragod districts were selected for the collection of samples. At random, one to five societies from each taluk were selected based on the geographical distribution. From each society, four farmers were identified with the help of society milk producers' and district milk union for collection of representative samples of feed, fodder and blood serum of animals. Within the village, help was sought from northern, eastern, western and southern directions, to cover soil types on each side of the selected society. The recorded parameters were number of livestock, land area, irrigation facilities, fodder and other crops being grown etc. Further information regarding the

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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 using standard sampling procedure. Total intake was compared against the requirements on dry matter basis (Campbell et al. 1999; NRC, 2001), so as to identify quantitative deficiency, sufficiency or even excess.

**Sample Preparation and Analytical Methods**

Composite samples of green fodder, dry fodder, individual concentrate ingredients and the compounded cattle feed (concentrate mixture) were collected from all over the surveyed area. Samples were dried in oven at 80°C for 24 h, ground (1 mm) and stored in airtight bags until analyzed. Samples were prepared and digested using 5 ml concentrated $HNO_3$ plus 1 ml concentrated HCl by microwave digestion method for preventing evaporation of volatile elements and total volume of mineral extract was made to 25 ml with deionized 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 Inductively Coupled Plasma-Optical Emission Spectrometer (Perkin-Elmer, OPTIMA – 3300 RL). Blood serum samples were directly aspirated for mineral analysis. The data were analyzed statistically (Snedecor and Cochran, 1994).

## RESULTS AND DISCUSSION

**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 para grass (Brachiara mutica) were also fed to dairy animals. Some farmers were feeding leaves of tapioca (Manihot esculenta) banana (Musa paradisiaca), areca nut (Areca catechu) and jackfruit (Artocarpus heterophyllus) or banana stem. Amongst concentrates, farmers were supplementing the ration of animals with multiple unit ingredients in the form of copra (Cocos nucifera) extraction, gingely (Sesamum indicum) oil cake, groundnut cake, wheat or 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. Those farmers who did not use multiple unit concentrate ingredients, fed compound cattle feed depending upon the level of milk production. Only few progressive farmers supplemented the ration of animals with mineral supplements. The survey work revealed that paddy straw amongst the dry roughage and local grasses, hybrid napier and tree leaves among the green roughages were the most commonly used feedstuffs in this zone. As concentrate supplements, crushed grains of maize, rice, ragi, cakes/meals of gingely, groundnut, cottonseed, copra, brans of wheat and rice were offered to the animals.

**Macro and Micro Minerals Profile 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 Tables 1 and 2. The average Ca (0.11%), P (0.10%) and S (0.067%) content in paddy straw were low, which was major dry roughage available for feeding animals. Local green grasses and hybrid napier were good source of Ca (0.45%) and S (0.23%). Ca level in banana leaves (1.15%), tapioca leaves (0.34%), coconut leaves (0.41%) was high. The concentrate ingredients commonly fed to animal contained low Ca (0.17%) except sesame cake (2.40%) but high P level (0.51%). The Mg levels as estimated in the samples of crop residues were adequate (Tables 1 and 2). Local green grasses (0.38%) and hybrid napier (0.37%) had adequate Mg showing that considerable quantities of Mg were available from the requirement point of view. Paddy straw (0.11%) and grains of rice, ragi and wheat were found to contain low levels of Mg (0.14%). Gingely cake (0.62%), cottonseed cake (0.34%) and wheat bran (0.33%) were good sources of Mg (Tables 1 and 2). Compound cattle feed contained 0.52% Mg, a level, which is higher than required as a supplement, because of its sufficiency in feed ingredients.

The Na content was unduly low in all the feeds and fodders, ranging from 0.008 to 0.12%. Only sheath and leaves of areca nut contained Na as high as 0.31 per cent. Compounded cattle feed had an appropriate quantity of Na to the extent of 0.74%, because of added sodium chloride

**Table 1: Macro and Micro Minerals Content in Concentrate Feedstuffs Collected from Coastal Zone of Kerala (DM Basis)**

| Feed | Ca | P | Mg | Na | K | S | Cu | Zn | Mn | 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 |
| Black gram (2) | 0.47 ±0.065 | 0.23 ±0.015 | 0.26 ±0.03 | 0.04 ±0.02 | 0.91 ±0.05 | 0.15 ±0.005 | 17.10 ±5.0 | 41.65 ±2.25 | 87.55 ±7.05 | 2350 ±140.5 | 1.98 ±0.46 | 1.45 ±0.35 | 1.66 ±0.17 |
| Copra extraction (29) | 0.11 ±0.010 | 0.73 ±0.025 | 0.31 ±0.012 | 0.074 ±0.006 | 2.14 ±0.099 | 0.19 ±0.012 | 30.37 ±1.83 | 59.16 ±3.18 | 74.15 ±3.84 | 509.94 ±42.37 | 0.92 ±0.09 | 0.23 ±0.048 | 0.43 0.081 |
| Cottonseed cake (5) | 0.19 ±0.016 | 0.62 ±0.058 | 0.34 ±0.027 | 0.028 ±0.0058 | 1.02 ±0.094 | 0.21 ±0.039 | 12.10 ±1.83 | 53.82 ±7.19 | 24.20 ±2.18 | 536.60 ±85.56 | 1.02 ±0.10 | 0.16 ±0.058 | 0.38 ±0.039 |
| Gingely oil cake (43) | 2.40 ±0.10 | 1.17 ±0.039 | 0.62 ±0.016 | 0.042 ±0.024 | 1.12 ±0.076 | 0.32 ±0.030 | 31.74 ±1.29 | 88.54 ±3.59 | 44.33 ±2.68 | 560.73 ±43.27 | 0.70 ±0.083 | 0.80 ±0.064 | 0.76 ±0.088 |
| Groundnut cake (9) | 0.19 ±0.026 | 0.63 ±0.028 | 0.30 ±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 ±202.6 | 0.99 ±0.14 | 0.32 ±0.078 | 1.21 ±0.20 |
| Maize grain (5) | 0.061 ±0.013 | 0.24 ±0.015 | 0.29 ±0.06 | 0.023 ±0.010 | 0.36 ±0.04 | 0.14 ±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 (10) | 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 ±2.48 | 9.48 ±1.40 | 155.23 ±52.49 | 0.40 ±0.18 | 0.20 ±0.044 | 0.42 ±0.16 |
| Ragi grain (3) | 0.30 ±0.085 | 0.28 ±0.01 | 0.16 ±0.015 | 0.008 ±0.002 | 0.41 ±0.03 | 0.12 ±0.005 | 6.17 ±0.66 | 32.05 ±1.75 | 79.25 ±4.26 | 188.50 ±9.52 | 0.27 ±0.04 | 0.27 ±0.11 | 0.44 ±0.10 |
| Wheat grain (2) | 0.08 ±0.010 | 0.39 ±0.01 | 0.14 ±0.025 | 0.045 ±0.005 | 0.52 ±0.03 | 0.16 ±0.04 | 7.66 ±0.66 | 37.15 ±2.15 | 38.70 ±1.30 | 225.50 ±42.37 | 0.31 ±0.16 | 0.18 ±0.09 | 0.34 ±0.24 |
| Rice bran (10) | 0.13 ±0.016 | 0.64 ±0.11 | 0.30 ±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 |
| Wheat bran (3) | 0.10 ±0.025 | 0.87 ±0.25 | 0.33 ±0.065 | 0.01 ±0.0 | 1.27 ±0.38 | 0.22 ±0.030 | 13.35 ±1.95 | 61.80 ±6.20 | 129.0 ±16.0 | 154.0 ±12.0 | 0.24 ±0.095 | 0.075 ±0.025 | 0.86 ±0.16 |
| Tamarind seed powder (9) | 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-CF1 (7) | 0.86 ±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 ±42.42 | 0.93 ±0.088 | 0.38 ±0.10 | 0.48 ±0.14 |
| Concentrate mixture-CF2 (16) | 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 | 0.65 ±0.077 | 0.51 ±0.058 | 0.95 ±0.12 |
| Concentrate mixture-CF3 (26) | 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 | 1.01 ±0.047 | 0.68 ±0.17 | 0.72 ±0.10 |
| Concentrate mixture-CF4 (13) | 1.17 ±0.074 | 1.09 ±0.036 | 0.55 ±0.016 | 0.92 ±0.071 | 1.37 ±0.049 | 0.33 ±0.020 | 16.62 ±1.22 | 51.90 ±5.22 | 127.2 ±5.12 | 910.7 ±67.52 | 0.94 ±0.068 | 0.53 ±0.068 | 1.54 ±0.35 |

Figures in the parentheses indicate number of samples analyzed.
[a]Critical level = concentrations below which are low or considered deficient (McDowell et al. 1993), based on requirements for cattle (NRC, 2001).

Table 2: Macro and Micro Minerals Content in Dry and Green Roughages Collected from Coastal Zone of Kerala (DM Basis)

| Feed | Ca | P | Mg | Na | K | S | Cu | Zn | Mn | 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 |
| Local green grasses (37) | 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 | 2085.0 ±580.3 | 0.35 ±0.063 | 0.40 ±0.077 | 1.94 ±0.87 |
| Hybrid napier grass (5) | 0.46 ±0.053 | 0.31 ±0.055 | 0.37 ±0.043 | 0.09 ±0.020 | 3.65 ±0.17 | 0.22 ±0.016 | 13.52 ±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 (47) | 0.11 ±0.010 | 0.10 ±0.008 | 0.11 ±0.011 | 0.12 ±0.032 | 0.85 ±0.06 | 0.067 ±0.004 | 1.72 ±0.099 | 8.91 ±0.93 | 150.35 ±15.72 | 537.97 ±37.09 | 0.73 ±0.07 | 0.83 ±0.08 | 0.62 ±0.10 |
| Areca nut sheath (2) | 0.30 ±0.01 | 0.13 ±0.04 | 0.27 ±0.12 | 0.30 ±0.09 | 1.93 ±0.41 | 0.28 ±0.065 | 16.0 ±0.80 | 28.50 ±2.30 | 72.15 ±14.45 | 2145 ±275 | 0.62 ±0.16 | 0.17 ±0.065 | 0.39 ±0.36 |
| Areca nut leaves (2) | 0.34 ±0.035 | 0.16 ±0.0 | 0.27 ±0.10 | 0.31 ±0.16 | 1.37 ±0.62 | 0.29 ±0.07 | 5.91 ±0.81 | 38.40 ±5.80 | 114.90 ±58.10 | 1222 ±558 | 0.58 ±0.27 | 0.22 ±0.07 | 0.85 ±0.14 |
| Coconut leaves (6) | 0.41 ±0.064 | 0.14 ±0.009 | 0.34 ±0.026 | 0.12 ±0.009 | 0.52 ±0.15 | 0.12 ±0.008 | 4.49 ±0.64 | 19.98 ±3.13 | 52.05 ±4.19 | 426.50 ±58.37 | 0.16 ±0.051 | 0.47 ±0.12 | 0.33 ±0.083 |
| Tapioca leaves (14) | 0.34 ±0.030 | 0.33 ±0.041 | 0.36 ±0.044 | 0.12 ±0.017 | 2.13 ±0.16 | 0.18 ±0.016 | 16.46 ±1.18 | 48.71 ±3.11 | 68.16 ±5.53 | 858.11 ±96.88 | 0.43 ±0.057 | 0.53 ±0.11 | 0.53 ±0.10 |
| Banana leaves (4) | 1.15 ±0.33 | 0.27 ±0.068 | 0.56 ±0.089 | 0.06 ±0.030 | 2.34 ±0.47 | 0.18 ±0.029 | 8.27 ±3.09 | 29.16 ±2.35 | 108.66 ±7.22 | 450.66 ±14.32 | 0.34 ±0.16 | 0.68 ±0.22 | 1.17 ±0.43 |
| Banana stem (1) | 0.28 | 0.11 | 0.54 | 0.03 | 1.36 | 0.14 | 9.0 | 40.50 | 73.20 | 436.80 | 0.09 | 0.13 | 0.91 |
| Jack fruit (1) | 0.40 | 0.21 | 0.30 | 0.006 | 1.92 | 0.15 | 9.0 | 42.42 | 94.80 | 256.60 | 0.49 | 0.11 | 0.39 |

Figures in the parentheses indicate number of samples analyzed.
[a]Critical level = concentrations below which are low or considered deficient (McDowell et al. 1993), based on requirements for cattle (NRC, 2001).

(Table 1). Higher K content of feedstuffs may be due to its selective uptake from the soil and was much higher than Na content (Garg et al. 2003). K content in straws and stovers was higher than the concentrate feed ingredients (Tables 1 and 2) and seemed to be another element like Mg, which did not require additional supplementation in the ration of animals. The

S content was low in paddy straw (0.067%), whereas, local green grasses (0.25%) and hybrid napier (0.22%) was found to be good source of S. The concentrate ingredients such as cakes of cottonseed (0.21%), gingely (0.32%) and groundnut (0.29%) were good source of S as compared to grains of maize (0.14%), rice (0.12%), ragi (0.12%) and wheat (0.16%). Sulphur content in brans varied from 0.11 to 0.22% (Table 1). The S content of plants depends largely on the amount of S in plant proteins in the form of S-containing amino acids (McDowell, 1992; Garg et al. 2003).

Paddy straw (1.72 ppm) was very low in Cu content (Table 2). Local green grasses and hybrid napier contained about 13 ppm Cu. Tapioca leaves (16.46 ppm) were good source of Cu, however, leaves of coconut, banana and areca were low in Cu level. Copra extraction and gingely cake contained more than 30 ppm Cu, whereas, grains of maize, rice, ragi and wheat were poor in Cu (Table 1). Groundnut cake and rice bran contained about 21 ppm 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 (Tables 1 and 2), it was apparent that most of the feed ingredients, particularly paddy straw, were low in Zn content (8.91 ppm). Local green grasses, hybrid napier and tapioca leaves contained about 48 ppm. Zn content in concentrates varied from 17 to 88 ppm (Table 1). Zinc content was found below the critical level (30 ppm) in most of the crop residues and need to be supplemented @ 80 ppm in the total ration (Arora, 1981) of animals to overcome its deficiency.

Most of the roughages offered to animals contained more than 52 ppm Mn. Mn content in paddy straw and hybrid napier were 150 ppm and 263 ppm, respectively. Amongst the concentrate ingredients, wheat bran (132.3 ppm) had the highest Mn content, followed by wheat bran (129 ppm), black gram (87.55 ppm), ragi grain (79.25 ppm) and copra extraction (74.15 ppm). Cottonseed cake and grains of maize and rice were low in Mn (Table 1). Distribution of iron was found to be unique in the sense that it exceeded the requirement in all the feedstuffs, being fed to livestock (Tables 1 and 2). Fe content in feeds and fodder varied from 154 to 2350 ppm. Thus, Fe seems to be quite rich in this zone, as also reported from other parts of the country (Ramana et al. 2001; Yadav et al. 2002). The cobalt levels in this zone ranged from 0.09 to 1.98 ppm in roughages and concentrate feed ingredients (Tables 1 and 2).

The Se content of the crop residues varied from 0.11 to 1.45 ppm (Tables 1 and 2). The minimum dietary Se requirements of all classes of ruminant livestock ranges from 0.10 to 0.30 ppm (NRC, 1980). Accepting the minimum requirements of 0.30 ppm 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). Local grasses (1.94 ppm) had the highest Mo content followed by banana leaves (1.17 ppm), areca nut leaves (0.85 ppm), hybrid napier (0.68 ppm) and paddy straw (0.62 ppm). Mo content in concentrate ingredients ranged from 0.37-1.66 ppm (Table 1). The variation in the minerals content amongst different fodders is due to species of plant, stage of maturity, rate of fertilizer application and soil characteristics (Reid and Horvath, 1980).

**Macro and Micro Minerals Intake by Animals**

The daily intake of different minerals by a cow (400 kg body weight) yielding 10 kg milk (4% fat) under the prevailing feeding system in the Thiruvananthapuram district is presented in Table 3. Since mineral mixture supplementation was not being done, so the intake of minerals through feeds and fodders was taken as the index of total dietary mineral supply and compared with the recommended requirements to know the dietary mineral adequacy/ inadequacy. 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 adequate or even in excess. Daily mineral intake as % of requirement (I/R) by a cow (400 kg body weight) yielding 8 kg milk (4% fat) from feed resources in the Kasaragod district is presented in Figure 1 and found similar trend of mineral deficiency, but the degree of deficiency varied from mineral to mineral.

Table 3: Availability and Requirement of Macro and Micro Minerals for a Milch Cow (400 kg) Producing 10 Litres Milk (4% Fat) Per Day in Thiruvananthpuram District

| Attribute | Tentative daily DMI (kg) | Ca (g) | P (g) | Mg (g) | Na (g) | K (g) | S (g) | Cu (mg) | Zn (mg) | Co (mg) | Mn (mg) | Fe (mg) | Se (mg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Maintenance | 13.50 | 16.00 | 11.00 | — | — | — | — | — | — | — | — | — | — |
| Milk production | — | 32.10 | 19.80 | 27.00 | 24.30 | 121.50 | 27.00 | 135.0 | 1080 | 6.75 | 540.0 | 675 | 4.05 |
| Daily requirement | 13.50 | 48.10 | 30.80 | 27.00 | 24.30 | 121.50 | 27.00 | 135.0 | 1080 | 6.75 | 540.0 | 675 | 4.05 |
| **Feedstuffs** | | | | | | | | | | | | | |
| Local grasses | 2.00 | 5.20 | 2.80 | 4.60 | 2.40 | 47.60 | 3.20 | 16.00 | 56.80 | 0.42 | 99.70 | 2502 | 0.48 |
| Paddy straw | 5.50 | 3.68 | 2.75 | 3.57 | 6.60 | 46.75 | 2.20 | 5.66 | 29.40 | 2.36 | 495.0 | 1771 | 2.75 |
| Tapioca leaves | 0.50 | 1.05 | 0.80 | 1.10 | 0.61 | 10.65 | 0.55 | 4.93 | 14.61 | 0.13 | 20.45 | 257 | 0.16 |
| Coconut leaves | 0.50 | 1.25 | 0.36 | 1.03 | 0.60 | 2.60 | 0.36 | 1.34 | 5.98 | 0.05 | 15.61 | 128 | 0.14 |
| Tamarind seed powder | 1.00 | 1.50 | 0.90 | 1.30 | 1.00 | 5.30 | 0.72 | 8.76 | 15.55 | 0.32 | 8.43 | 196 | 0.34 |
| Copra extraction | 0.50 | 0.32 | 1.80 | 0.95 | 0.37 | 10.70 | .060 | 9.11 | 17.74 | 0.28 | 22.20 | 152 | 0.07 |
| Gingely cake | 1.00 | 14.40 | 5.80 | 3.70 | 0.42 | 11.20 | 2.00 | 19.0 | 53.0 | 0.42 | 26.60 | 336 | 0.48 |
| Cattle feed | 2.50 | 16.50 | 14.25 | 8.75 | 17.0 | 23.0 | 5.50 | 22.87 | 67.17 | 1.50 | 131.1 | 1097 | 1.02 |
| Daily availability | 13.50 | 43.90 | 29.46 | 25.0 | 29.0 | 157.8 | 15.13 | 87.70 | 260.2 | 5.48 | 819.0 | 6440 | 5.45 |

Table 4: Macro and Micro-Minerals Content in Blood Serum of Animals

| 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=26) | 10.48±0.40 (6.9-14.1) | 4.50±0.18 (2.9-6.2) | 2.53±0.11 (1.66-3.46) | 0.61±0.029 (0.41-0.94) | 0.89±0.045 (0.65-1.4) | 2.06±0.13 (0.98-3.44) |
| % of animals showing deficiency | 12 | 35 | 7 | 65 | 31 | 4 |

n= Number of animals

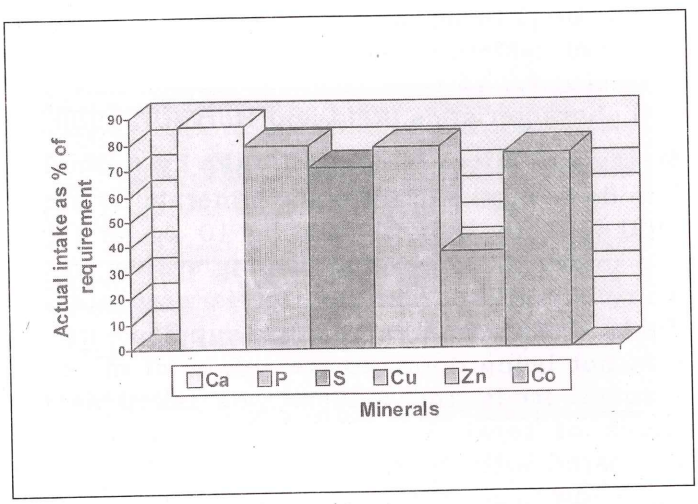


*Figure 1: Daily Minerals Intake as % of Requirement for a Cow Yielding 8 kg Milk Per Day*

## Macro and Micro Minerals Profile in Blood Serum of Animals

Blood serum of animals was also tested for certain critical macro and micro mineral elements, which are presented in Table 4. The average Ca (10.48 mg%), P (4.50 mg%) and Mg (2.53 mg%) in blood serum of animals were within the normal range. However, about 12 and 35% of the 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 the normal range, except in about 7% of the animals, which showed lower values (<2 mg%). Average serum Cu and Zn content were 0.61 and 0.89 ppm, respectively. Compared to critical level of Cu (0.65 ppm) and Zn (0.80 ppm) in blood serum (Cuesta et al. 1993), about 65 and 31% of the animals screened showed low Cu and Zn values, respectively. 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 (McDowell et al. 1993). Hence, regular supplementation of mineral mixture in the ration of animals may be necessary but not for all minerals.

## CONCLUSION

The study concluded that the ration of dairy

animals yielding 8-10 kg milk per day in the costal zone of Kerala 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 bio-available mineral salts for better productivity and reproduction of animals.

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