INTERNATIONAL JOURNAL OF BIO-RESOURCE, ENVIRONMENT AND AGRICULTURAL SCIENCES (IJBEAS)
Vol. 2(2) :296-301, 2016
www.sbear.in // ISSN 2454-3551

MINERAL STATUS OF FEEDS AND FODDER AND ITS INFLUENCE ON LIVESTOCK AND ITS PRODUCTS IN RED LATERITIC ZONE OF WEST BENGAL

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Received: March 2016 Revised accepted: May 2016

ABSTRACT

A survey was carried out in red lateritic zone of West Bengal to compare the mineral status in plasma of livestock grazing over red lateritic region .Sufficient number of samples of soil, feeds, fodder and blood were collected from four districts of red lateritic zone namely, West Midnapore, Birbhum, Bankura and Purulia respectively. The samples were analysed for Calcium (Ca), Phosphorus (P), Copper (Cu), Zinc (Zn), Manganese (Mn) and Iron (Fe). Concentration of Cu, Mn and Fe in soil were above the minimum critical level, whereas, Zn deficiency is wide spread in red lateritic soil. Paddy straw is deficient in Ca, P, Zn and Mn in the region. Green fodders are also deficient in P, Cu ,Zn. Richness of iron (Fe) in soil, feeds, fodder and tree leaves is the characteristics of this region. Phosphorus is deficient in plasma of all categories of livestock with the exception of bullock. Cu is deficient in plasma of calf. Plasma Mn and Fe were higher ($p<0.01$) in the animals of red lateritic zone. The study reveals that the overall deficiency of phosphorus in different categories of livestock and there is need of dietary supplementation.

Key words: Mineral, Red lateritic zone, Grazing livestock, Plasma

INTRODUCTION

Nutritional abnormalities in domestic animals involving the trace elements may result from the inability of the soil of the affected areas to supply them in adequate, safe or in nontoxic amount (Underwood, 1981). However, the productivity of grazing animals is hampered due to the deficiency or imbalances of minerals in soil and forages. The mineral requirements of these grazing animals are not being met by the forages, which are grown on the deficient soils and therefore, needs supplementation of the minerals. The soil and forages of tropical countries contain lower concentration of minerals and thus grazing animals suffer from different mineral deficiencies (McDowell, 1985) It has become essential to know the status of the micronutrients in soil, plant and animals for sustainable dairy development in a region. Both macro and micro minerals play a vital role in augmenting production and reproduction in farm animals, and their deficiency causes impairment in body function (Corah, 1996). The present investigation was carried out in red lateritic zone of West Bengal to ascertain how the pattern of distribution of major and trace elements differs in the feeds, fodder and cattle belonging to different physiological stages.

MATERIALS AND METHODS

A detailed survey was carried out in the Red Lateritic Zone of West Bengal covering ten blocks of four districts. The names of the blocks and districts are Salboni, Jhargram and Garbeta of West Midnapore district, Bishnupur and Onda of Bankura district, Suri and Mayureswar of Birbhum district Raghunathpur, Purulia and Bara Bazar of Purulia district respectively. The undulating red lateritic sub region occupies 23851.4 sq km of the total geographical area of the West Bengal. Partial as well as advanced laterisation took place in this region both on old alluvium and on-citu formation from parent stock. Climatically the region is within tropical dry sub humid having rainfall 1427.4 mm., air temperature max 37^0 C and min 14.8^0 C(annual normal) the relative humidity ranges from 23 to 99% . The soil reaction ranges from acidic (pH 6.1 to 6.25) in valleys. The cattle under surveyed area were divided into six categories according to age and physiological parameter viz. calves (up to 1 year of age), heifers (from 1 year up to first calving), milch animals, dry (pregnant) animals, anoestrus animals and bullocks. Samples of soil, feeds, fodder and animal blood were collected from the red lateritic zone. Soil samples were collected at plough depth (15 cm to 20 cm) from different areas of grazing and cultivable land where the fodders are grown. Samples of feeds and fodder commonly being fed to animals in this zone were collected for macro and micronutrient estimation. Blood samples were collected in heparinised vials from the jugular vein of different age groups of cattle. Preserved blood samples were centrifuged and plasma was separated and preserved till further analysis. Soil samples (10 g) were extracted with 0.005 M diethylenetriaminepenta acetic acid (DTPA) solution for 2 hrs at pH 7.3 (Lindsay and Norvell, 1978). Following filtration the filtrate was analysed for Cu, Zn, Mn and Fe with atomic absorption spectrophotometer(Perkin Elmer Analyst 100).Feeds and fodder samples were subjected to dry ashing for the preparation of acid-mineral extract. Calcium (Ca), CopperCu),Zinc(Zn), Manganese(Mn) and Iron (Fe) in feed, fodder and blood plasma were estimated in atomic absorption spectrophotometer. Phosphorus (P) in feeds, fodder and blood plasma was estimated colorimetrically by Tala Patra et al.(1940) and Fiske Subba Row (1925), respectively. The data was analysed as per the method described by Snedecor and Cochran, (1967) using MS excel software package. The plasma concentration of various major and trace elements observed in different categories of cattle were subjected to ANOVA to ascertain the differences between the categories.

RESULTS AND DISCUSSIONS

Micronutrients in soil

The pH of soil in red lateritic zone is acidic in reaction and fertility status on an average is low. Uptake of certain minerals by plants is adversely affected in unfavorable /acidic pH conditions of soil (Reid and Horvath, 1980). Concentration of micronutrients (Cu, Mn and Fe) in red lateritic zone were above the respective minimum critical level (Table 1)

Table 1. Micronutrient content of soil

	pH	Cu(ppm)	Zn(ppm)	Mn(ppm)	Fe(ppm)
Critical level *	-	<0.20	<0.86	<1.0	<2.5
Soil	5.7	2.3	1.10	36.9	86.7
	(5.2-6.9)	(0.21-15.2)	(0. 4-15.0)	(1.5-223)	(4.6-438.5)

* Critical level of soil micronutrient concentration (Manual of Directorate of Agriculture, Govt. of West Bengal, 1997).Figures in parenthesis indicate ranges of respective micronutrients.

Fe (86.7 ppm) was much higher than the minimum critical level (<2.5 ppm) and it appears to be a characteristics feature of this agro climatic zone (Das et al., 1990, Das et al., 1993). Mn (36.9 ppm) was also many folds higher than the minimum critical level (<1.0 ppm) which may be related to the soil pH.

Mn solubility is very much sensitive to change in soil pH (Rojas et al., 1993). Most of the soil samples were found deficient in Zn (0.4 ppm to 15.0 ppm) and below the critical level (<0.86 ppm). Zinc deficiency in red lateritic soil of West Bengal is wide spread and the magnitude is of higher order (49-51%) (Ali, 1992).Soil properties markedly influence the uptake of minerals by plants and nutrient concentration vary inversely with the stage of plant growth (Loneragan, 1975) and more micronutrient deficiencies can be expected with increased crop production and stage of harvest.

Feeding practices

As the study was concerned with the grazing cattle in the red lateritic zone of West Bengal, so the sampling was done from those livestock owners who kept their cattle on grazing. The grazing land consisted of doob grass along with other unidentified local grasses. Paddy straw (4-5 kg per head per day) is the major dry roughages offered to the animals. During monsoon and post monsoon periods, field grasses of different species are available in relatively large amount. The cattle of resource poor farmers gain in body weight during this period and loose in the lean months Green fodder which are generally cultivated in this zone are hybrid napier, jowar, cowpea, oats etc. depending on the land availability in irrigated areas/ rain fed conditions. The tree leaves are also offered to the animals. The farmers supplied their animals with mustard cake or de oiled rice bran either singly or in combination with gram chuni or mungchuni.

Table 2.Major and trace elements content of feeds and fodder in red literati zone of West Bengal (% DM basis)

Critical level *	Ca %	P %	Cu (ppm)	Zn (ppm)	Mn (ppm)	Fe (ppm)
	<0.30	<0.25	<8.00	<30.00	<40.00	<50.00
Feeds/Fodder						
Straw						
Paddy straw	0.17	0.03	8.72	28.30	20.88	250.50
Green fodder						
Doob grass	0.46	0.23	16.88	26.88	61.75	484.07
Jowar	0.35	0.22	7.69	37.91	34.03	397.07
Hybrid napier	0.43	0.31	6.99	46.33	52.78	492.94
Cowpea	1.02	0.33	6.11	31.38	26.76	480.13
Maize	0.32	0.18	6.52	22.20	24.26	663.31
Oat	0.88	0,17	6.49	18.68	24.03	256.36
Tree leaves						
Subabul	1.51	0.24	8.03	30.25	44.20	974.26
Banana	1.83	0.25	10.19	14.22	47.61	420.62
Sugarcane tops	0.30	0.18	5.46	20.64	29.04	559.38
Compounded feed	2.42	1.80	21.39	45.51	105.31	248.65
Concentrate feeds						
Mustard cake	0.89	1.39	56.13	27.15	71.06	269.36
Rice bean	0.53	1.41	11.39	59.57	393.26	480.16
Gram chuni	0.20	0.18	17.43	11.77	67.89	698.10
Mungchuni	0.27	0.30	16.73	45.48	65.83	326.12

*Critical level of major and trace elements in feeds and fodder (Prabowo et al., 1990)

Compounded feeds or homemade concentrate mixtures used by only few farmers for productive cattle. Majority of the farmers were not supplementing mineral mixture and common salt to their animals due to unawareness and fed unsoaked concentrates.

Micronutrients in feeds and fodder

Concentration of major (Ca and P) and trace (Cu, Zn, Mn and Fe) elements in different feeds and fodder are presented in Table 2.

Paddy straw is deficient in Ca, P, Zn and Mn as compared to the critical levels (Prabowo et al.,1990) which corroborate the characteristic feature of tropical dry forage (McDowell,1984, Gowda et al., 2002). Non leguminous green fodders are severely deficient in P and below the critical level which confirmed the earlier reports(Das et al., 2003) indicating that P deficiency has been one of the most severe mineral limitations to the grazing livestock of this agro climatic zone. Marginal deficiency of Cu, Zn and Mn were observed in green fodder and below the critical level (Prabowo et al., 1990). None of the feeds, fodder and tree leaves was deficient in Fe. The high levels of Fe, which could partly be attributed to the soil and surface contamination, are in agreement with the findings of Gowda et al. (2001, 2002) and Das et al. (2003).Tree leaves like subabul and banana are moderate to good source of minerals whereas sugarcane tops is poor source of minerals analysed and below the critical level (Prabowo et al., 1990). Plants grown on the same soil under similar environmental conditions showed marked difference in mineral status due to genetic variation (Reid and Horvath, 1980). Compounded feed is the good source of minerals closer to the required levels which corroborated the results of Gowada et al. (2002).Mustard cake and gram chuni are the most common concentrate ingredients in the red lateritic zone of West Bengal, were deficient in Zn and in agreement with the findings of Das et al. (2003). Marginal deficiency of Ca was analysed both in gram chuni and mungchuni and below the critical level (Prabowo et al., 1990). Rice bran is the good source of minerals which showed highest level of Zn and Mn.

Plasma mineral profile

Major(Ca and P) and trace (Cu, Zn, Mn and Fe) elements in plasma of cattle varied with the physiological categories of the animals (Table 3).

Table 3. Mineral status in plasma of cattle

Critical level *	Ca (mg/100 ml) <8.0	P(mg/100 ml) <4.5	Cu(ppm) <0.65	Zn(ppm) <0.8	Mn(ppm) <0.2	Fe(ppm) <1.0
Category of animals						
Calf (140)	10.40^{a}	4.46^{b}	0.60^{c}	1.18^{a}	0.56^{d}	3.25^{e}
Heifer (125)	9.91^{b}	4.46^{b}	0.72^{c}	1.07^{b}	0.68^{bc}	3.63^{d}
Dry (120)	9.86^{b}	4.35^{b}	0.84^{bc}	$1,03^{bc}$	0.68^{bc}	4.31^{b}
Milch (160)	9.40^{c}	4.07^{c}	1.20^{a}	0.85^{d}	0.73^{b}	4.42^{b}
Bullock (90)	9.83^{b}	4.80^{a}	1.10^{ab}	0.99^{c}	1.00^{a}	5.06^{a}
Anoestrus (115)	9.03^{d}	3.90^{d}	0.74^{c}	0.85^{d}	0.65^{c}	3.95^{c}

*Critical level suggested for cattle (McDowell et al.,1984).Values with different superscript letters within the same column differ significantly (P<0.01).Figures in parenthesis indicate number of experimental animals.

Plasma Ca was within the normal range of variation and none of the samples was found deficient (based on minimum critical level of 8.0 mg/100ml). In cattle Ca deficiency is not likely to occur under grazing conditions (Underwood,1981). Plasma Cu level was significantly lower in calves (0.60 ppm) compared to adult cattle (1.20 ppm). It was also found that plasma Cu concentration is gradually increased with the

advancement of age. Present values of plasma Zn and Mn were within the normal range while Fe was higher than the reported values. Though the majority of the feeds and fodder samples were deficient in Zn, however, its concentration in plasma of different categories of cattle did not reflect its deficiency. Plasma Fe was higher ($p<0.01$) in the animals. Perhaps the higher Fe profile of feeds and fodder of red lateritic zone which was reflected in plasma and this is in agreement with the findings of Das et al. (2003).

It can be concluded from this study that soil of red lateritic zone of West Bengal is deficient in Zn and it was reflected in feed, fodder and tree leaves and they were also low in P, Zn and Cu content. The poor level of P influenced the plasma of cattle in this area. Thus indicating the overall deficiency of P in different categories of cattle and there is need of dietary supplementation.

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