Assessment of Mineral Status in Feed and Fodder, Soil and Blood Serum of Dairy Animals in Sindhudurg District of Maharashtra, India

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Abstract

The present investigation on mineral profile in relation to feed and fodder, soil and blood serum of dairy animals was carried out in selected blocks of Sindhudurg district of Maharashtra to identify the macro and micro minerals profile. The samples were analysed and results were compared with the critical level for particular minerals level and percentages of samples which contain macro and micro-minerals. In non-irrigated and irrigated region, the soil was found deficient in Ca and Cu, whereas P, Mg, Zn and Fe were found adequate. The minerals viz. Ca, P, Mg and Zn were observed to be deficient in all feed and fodder. However, Cu and Fe were observed at adequate level. The Ca, P and Mg were also found to be deficient in blood serum of the dairy animals, whereas Cu, Fe, Zn were adequate in the blood serum of dairy animals. Therefore, it is concluded that the proper supplementation of minerals in feed of dairy animals are necessary for this region.

Keywords : Blood serum, feed, fodder, macro and micro mineral, soil.

Introduction

The mineral profile of feeds and fodder depends upon the cropping pattern, soil type, rainfall and feeding system of that particular region of the country depending on the agro-climatic zones. Thus, deficiency and surplus of a particular mineral varies between different regions of the country and may be called as area- specific (Garg *et al.* 2005). Mineral deficiencies or imbalance in soil and forages are responsible for low productivity problems among growing cattle in tropics. Minerals are required by the body for optimum growth and proper muscle and nerve functions. In addition they are essential components of body enzymes, hormones and cells. Proper production and reproduction of animals can only be maintained by supplementing area specific mineral mixture (Bhanderi *et al.* 2014). Dietary factors usually affect mineral requirement by altering absorption of minerals from the gut. The presence of major minerals and trace minerals in the fodders mainly depend on their level in the soil on which the fodder are grown (Singh 2005). However, other factors like soil type, pH of soil, species of plant and relative content of other elements also have influence on mineral content of plants. Keeping this fact in view, the present investigation was undertaken to study the mineral status of soils, feeds grown on that soil and blood serum content of the dairy animals from selected representative locations in Sindhudurg district of Maharashtra.

Material and Methods

The present investigation was undertaken during summer, winter and rainy seasons of the year. The soil, fodder, and blood serum samples were collected from randomly selected areas in all the three taluka of the Sindhudurg district viz. Dodarnarg, Vengurla and Vaibhavwadi. In each taluka, two villages based on irrigated and non-irrigated type were randomly selected. From each village three representative farmers having ten animals as cattle or buffalo were used for collection of soils, feeds and fodders and blood samples (Table 1). Soil samples at 0–15 cm depth were taken as per standard procedure. One sample from each farmer in village was collected either from cultivated or grazing land during summer and winter seasons for mineral analysis. A total

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Table 1 : Total number of samples collected from Sindhudurg district, Maharashtra

Season	2010-11			2011-12			2012-13			Total samples		
	Feed/ Fodder	Soil	Serum	Feed/ Fodder	Soil	Serum	Feed/ Fodder	Soil	Serum	Feed/ Fodder	Soil	Serum
Summer	-	-	-	36	-	40	72	36	20	108	36	160
Rainy	-	-	-	76	-	120	108	-	120	184	-	240
Winter	18	36	6	76	36	120	-	-	-	94	42	140
Total	18	36	6	188	36	280	180	36	140	386	78	540

of 386 different types of fodder and concentrate mixture samples were collected from the farmers of the areas during summer, rainy and winter season and packed in polythene bags with proper identification for further analysis. A total of 540 blood samples were collected from three animals of each of the selected farmer's families during three seasons from where soil and fodder samples were collected. Approximately 15-20 ml blood was collected from Jugular vein of each animal in clean, sterilized glass test tubes without anticoagulant and serum was separated. The serum samples were stored in deep freezer at -20^{0}C for further mineral analysis.

Sample preparation and analytical methods

Samples (soil, feed and blood serum) were collected representing the study area. Soil and fodder samples were dried in an oven at 70^{0}C, ground and sieved through 2 mm sieve. The minerals of Ca, P, Mg, Cu, Fe and Zn were estimated from all the samples following standard procedure. All minerals, except phosphorus, were estimated by Atomic Absorption Spectrophotometer (Perkin Elmer, 1996) as given by Kolmer *et al.* 1951. Phosphorus was estimated by UV molybdate method (Yee 1968). The data was analysed statistically following standard procedure (Snedecor and Cochran, 1994).

Results and Discussion

The data pertaining to average initial mineral content of soil, feed and fodders and blood serum is presented in tables 2 to 4.

Macro and micro minerals content in soil: The data on macro and micro minerals status of soil are presented in table 2. Under Indian conditions, the mineral deficiency diseases are quite common and are mainly due to non-availability of balanced diet or deficiency of minerals in the soil and fodder. The mineral contents in the soil of Sindhudurg district were higher than their respective critical levels, except Ca and Cu. Likewise, mineral contents in different feedstuffs were found sufficient to meet the requirement of the animals except Ca and Cu which were deficient in feeds and fodders. These findings are in agreement with the findings of Bhanderi *et al.* (2016) for Ca, Sharma *et al.* (2015) for Ca, P and Mg, Panda *et al.* (2015) for Ca and P, Devi *et al.* (2014) for Cu Ramesh *et al.* (2014) for Cu, and Sharma *et al.* (2006) for Ca, P, Mg, Cu and Zn were found below the critical level. The macro minerals, viz., Ca, P and Mg contents in non-irrigated and irrigated soils were estimated as 63.94, 6.91 and 16.89 ppm and 64.25, 7.78 and 16.14 ppm, respectively, whereas, micro minerals such as Cu, Fe and Zn contents were 0.54, 1.95 and 56.38 ppm and 0.47, 2.22 and 63.46 ppm, respectively (Table 2). The variation in the mineral content in different soil may be due to herbage plant species, cultivar differences, soil and climatic conditions in which plants are grown (Turner *et al.*1978). Higher concentration Fe, Mg Cu and Zn soils reported by Choudhary *et al.* (2015), Panda *et al.* (2015) and Ramesh *et al.* (2014) in Soils of Rajasthan, Odisha and Andhra Pradesh, respectively. Bhat *et al.* (2011) AND Yatoo *et al.* (2011) had also reported higher concentration of Ca, P, Mg, Cu and Zn in Kashmir soils, for Cu in Kashmir. Similar reports were also reported earlier by various workers (Shukla *et al.* 2010, Gowda *et al.* 2001. However, lower concentration of minerals in soil was also reported by Choudhary *et*

al. (2015), Panda *et al.* (2015) and Devi *et al.* (2014). Yatoo *et al*.(2011) reported lower Fe and Zn in Kashmir, and P in Assam (Kalita *et al.* 2003), which was less as compared to present investigation.

Table 2 : Minerals profile of soil under Sindhudurg district, Maharashtra.

Minerals	Critical concentration*	Soil	
		Non-irrigated	Irrigated
Calcium (ppm)	71	63.94	64.25
Magnesium (ppm)	9.10	16.89	16.14
Phosphorous ppm)	5	6.91	7.78
Copper (ppm)	1	0.54	0.47
Zinc (ppm)	1.50	1.95	2.22
Iron (ppm)	20	56.38	63.46

* Critical concentration (McDowell et al.1983)

Macro and micro minerals content of feed and fodder : Almost all the feeds and fodder were deficient in Ca, P, Mg and Zn content (Table 3). The Ca, P, Mg and Zn level ranged from 0.249 to 0.264 %, 0.138 to 0.169 %, 0.089 to 0.102 % and 16.85 to 19.82 % in feed and fodder grown in non-irrigated and irrigated soils. In the feed and fodder Cu and Fe were higher than the respective critical levels, except for Ca, Mg, P and Zn, respectively, in non-irrigated and irrigated soils. This observation corroborates with the findings of Soni et al. (2014), who reported Cu and Fe above the critical value in Jodhpur, Rajasthan. Bhat et al. (2011), also reported Ca, Mg, Cu, P and Fe above the critical value in Kashmir. The availability of minerals depends on the concentration and chemical form of these elements in the soil. The availability of minerals in the soil depends upon the effective concentration in soil solution (Hoekstra, 1973), which is influenced by pH, moisture, organic matter, leaching, presence of other elements and microbial activity of soil (Burk, 1978 and Williams, 1977). Thus in the present study higher deficiency of Zn and marginal deficiency of Ca, Mg and P can be attributed to various factors like increased crop and fodder productivity, variation in the pH, fertilization of soil and the availability of competing elements to the plant and the rate of plant growth. Lower concentration of P was reported by Sharma *et al.* (2015) in Mizoram, Ca, P, Mg, Zn and Cu by Bhanderi *et al.* (2014) in Maharashtra. In paddy straw lower concentration of minerals was reported by Devi *et al.* (2014), Indira and Samuel (2014), Soni *et al.* (2014), Garg *et al.* (2010) and Garg *et al.* (2008) as compared to required critical level. However, higher concentration of minerals was also reported by Chhabra *et al.* (2015), Sharma *et al.* (2015), Indira and Samuel (2014) in hybrid Napier and groundnut cake, respectively.

Table: 3 Minerals profile of feed and fodder under Sindhudurg district, Maharashtra

Minerals (%)	Critical concentration*	feed and fodder samples	
		Non-irrigated	Irrigated
Calcium	0.30	0.264	0.249
Magnesium	0.12	0.089	0.102
Phosphorous	0.20	0.138	0.169
Copper	10	11.74	11.45
Zinc	30	19.82	16.85
Iron	30	93.96	85.56

* Critical concentration (McDowell *et al.,*1983)

Macro and micro minerals content of blood serum: The average Ca, P and Mg content in blood serum of non-irrigated and irrigated condition was 5.87 mg/dl, 6.14 mg/dl and 1.83 mg/dl and 2.64 mg/dl, 2.65 mg/dl and 1.67 mg/dl, respectively (Table 4). The present results in the district when compared with the critical level suggested by McDowell *et al.* (1983), was found below the critical level. These findings are in agreement with Sharma *et al.* (2015), Panda et al. (2015) where critical level in blood serum of dairy animals were below the except Fe. It was optimum which might be due to very high Fe status in fodders analyzed in the present study. Bhat *et al.* (2011) also reported 37.5 per cent Ca and P deficiency in Kashmir soils, and Ramana *et al.* (2000) reported Ca deficiency in Karnataka soils.

Low serum Ca, P and Mg was probably due to their low content in locally available feedstuffs. In present investigation Cu, Zn and Fe content of blood serum of dairy animals reared on non-irrigated and irrigated condition was 1.83 and 1.67 $mgdl^{-1}$, 0.89 and 0.97 $mgdl^{-1}$, 3.18 and 2.87 $mgdl^{-1}$, and 1.14 and 1.15 $mgdl^{-1}$, respectively which is above the critical concentration. The findings indicating adequate Cu level in serum, which corroborated with Rajora and Pachauri (1993) in Tarai region**.** Devi *et al.* (2014) had also observed lower Cu, Zn and Fe concentration in blood serum of animals in Kerala, similarly Indira and Samuel (2014) also reported Cu and Zn in blood serum of animals in Andhra Pradesh. However, higher concentration of Zn and P was reported by Chhabra *et al.* (2015) and Ca and Mg by Indira and Samuel (2014).

Table 4 : Status of serum minerals in dairy cattle under Sindhudurg district, Maharashtra

Minerals ($mg\ dl^{-1}$)	Critical concentration*	Blood serum samples	
		Non-irrigated	Irrigated
Calcium	8.00	5.87	6.14
Magnesium	2.00	1.83	1.67
Phosphorous	4.50	2.64	2.65
Copper	0.65	0.89	0.97
Zinc	0.50	1.14	1.15
Iron	1.0	3.18	2.87

*Critical concentration (Yee, 1968)

Conclusion

From the study, it can be concluded that the content of Ca and Cu were found deficient in soil and blood serum (Ca, P and Mg) in dairy animals of the Sindhudurg district. Whereas, Mg, P, Fe and Zn were observed to be adequate in soils. However, the soils were observed to be deficient (Ca, Mg, P and Zn) in feed and fodder of the region. The average Ca, Mg and P were deficient in blood serum, whereas Cu, Zn and Fe were adequate in blood serum of dairy animals. Hence, proper supplementation of minerals through feed of dairy animals is necessary.

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