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Short Note

Macro-mineral profile of dairy cattle in mid hill region of Himachal Pradesh

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Abstract

Mineral element deficiencies can exert economically important effect on performance and health of animals even before clinical signs are evident. Present study was conducted to assess the macro mineral status of dairy cattle in Baijnath Block of Kangra district representing agro-climatic zone-II of Himachal Pradesh. A total of 100 blood samples from adult cross-bred dairy cattle were analysed for macro minerals. The average blood plasma concentration of Ca, P and Mg was 8.97 ± 0.1, 4.47 ± 0.05 and 2.73 ± 0.04 mg/dl, respectively, whereas the average concentration of Na, K and Cl was 138.16 ± 0.67, 4.37 ± 0.05 and 100.21 ± 0.92 mEq/L, respectively. The study revealed that 36, 9, 0, 9, 4 and 13 per cent of the animals were deficient in Ca, P, Mg, Na, K and Cl, respectively.

Key words: Mineral profile, blood plasma, dairy cattle, macro minerals.

Under-nutrition is commonly accepted as one of the most important limitation to livestock production in tropical and sub-tropical countries. Mineral deficiency exists widely in livestock of tropical countries due to exclusive dependence upon fodder/forages for their mineral requirements, which alone cannot completely satisfy the mineral requirements of livestock. Macro minerals play a significant role in maintenance of the production and reproductive performance of the animals. The concentration of these elements in animal body tissues need to be maintained within a narrow range for maintenance of functional and structural integrity of tissues and optimum production and reproduction (McDowell, 1992).

Wide ranging diversity of climate, topography, terrain and precipitation in different agro-climatic zones of Himachal Pradesh may lead to mineral imbalances. Therefore, it is essential to identify minerals which hinder in cattle production and reproduction in a particular region. Clinical signs of mineral deficiencies along with soil, water, plant and animal tissue analysis have all been used with varying degrees of success to establish mineral deficiencies (McDowell, 1985; Mills, 1987). Mineral analysis can be of tremendous help keeping in view the economic considerations as the emphasis is now turning towards disease prevention rather than therapy. However, till now limited studies have been carried out in India particularly in Himachal Pradesh although there have been reports of mineral deficiencies in livestock in most parts of the country. The present study was conducted on cross-bred dairy cows of Baijnath block in Kangra District of Himachal Pradesh which lies in agro-climatic zone-II

between an altitude of 651 and 1800 m above mean sea level. A total of 100 adult cross-bred adult dairy cows/heifers were selected randomly from five villages of Baijnath block *viz* Khatrer, Dhanag, Nanahar, Sapedu and Kunsal for assessment of macro-mineral status. Approximately 10-12 ml of blood was collected from jugular vein puncture in polypropylene centrifuge tube containing anticoagulant heparin (@ 0.1 to 0.2 mg/ml of blood) under aseptic conditions after proper restraining of animals. The polypropylene tubes were centrifuged at 3000 rpm for 30 minutes and plasma was separated and stored at -20^{0}C till analysis.

Sodium (Na) and Potassium (K) were analyzed using flame photometer, Model Mediflame 127*. Calcium (Ca), Magnesium (Mg), Zinc (Zn), Copper (Cu) and Iron (Fe) were estimated by Atomic Absorption Spectrophotometer (AAS), Model 3100, Perkin Elmer (USA) as described in Perkin Elmer analytical methods manual (1982). Phosphorus and Chloride were estimated by Blood Chemistry Analyzer, Photometer 5010 using analytical kits of Bayer Diagnostics**. The results obtained in the study were analyzed using analysis of variance (ANOVA) with the help of GraphPad Instat software given by Russel (1990).

The results of estimation of plasma macro minerals; calcium, phosphorus, magnesium, sodium, potassium and chloride have been given in tables 1 and 2. The plasma calcium concentration in the animals of Baijnath block ranged from 6.31 to 13.4 mg/dl with an overall mean of 8.97 ± 0.10 mg/dl. The mean plasma calcium concentration in animals of all the five villages in Baijnath block varied non-significantly and it was 8.71 ± 0.27 mg/dl, 9.16 ± 0.21 mg/dl, 9.15 ± 0.33 mg/dl, 8.99 ± 0.13 mg/dl and 8.83 ± 0.10 mg/dl in the animals of Khatrer, Dhanag, Nanahar, Sapedu and Kunsal villages, respectively (Table 1). In Baijnath block, 40 per cent of the animals were observed calcium deficient in each Khatrer and Nanahar villages, whereas 35 per cent of the animals were observed calcium deficient in each Dhanag and Kunsal villages. Results indicated that percentage of calcium deficient animals in Baijnath block was 36 per cent (Table 2). In majority of the animals, the plasma calcium concentration was skewed towards the lower side of normal level of 9.0-11.0 mg/dl (Underwood, 1981) with 36 per cent animals found deficient in plasma calcium. Average values of serum calcium even lower than 8 mg/dl have been reported in buffaloes and cattle (Kafil *et al.*, 2003 and Pankaj *et al.*, 2003). However, the findings of Sharma (2004) in the normal cyclic animals in the same region indicate plasma calcium concentration quite similar to the one observed in the present study.

The average plasma phosphorus concentration in animals varied non-significantly among all the five villages. The plasma phosphorus concentration in the

Table 1. Average blood plasma concentration of macro-minerals in animals of Baijnath block

Minerals/ Villages	Ca (mg/dl)	P (mg/dl)	Mg (mg/dl)	Na (mEq/L)	K (mEq/L)	Cl (mEq/L)
Khatrer	8.71 ± 0.27 (6.31-11.3)*	4.50 ± 0.11 (3.60-5.80)	2.76 ± 0.08 (2.2-3.6)	141.00 ± 1.17 (130-152)	4.45 ± 0.10 (3.7-5.6)	102.72 ± 2.10 (79.8-117.7)
Dhanag	9.16 ± 0.21 (7.90-11.55)	4.74 ± 0.09 (4.08-5.41)	2.92 ± 0.13 (2.2-4.8)	138.90 ± 1.45 (124-152)	4.37 ± 0.09 (3.9-5.2)	101.35 ± 1.31 (82.19-110.2)
Nanahar	9.15 ± 0.33 (6.39-13.4)	4.29 ± 0.10 (3.65-5.20)	2.64 ± 0.05 (2.3-3.2)	134.90 ± 1.99 (116-148)	4.28 ± 0.11 (3.3-5.5)	98.88 ± 2.64 (78.91-112.7)
Sapedu	8.99 ± 0.13 (7.83-10.12)	4.33 ± 0.10 (3.50-5.13)	2.63 ± 0.09 (1.85-3.5)	139.30 ± 1.19 (124-146)	4.37 ± 0.08 (3.9-5.4)	100.87 ± 1.18 (87.27-110.2)
Kunsal	8.83 ± 0.10 (7.79-9.38)	4.50 ± 0.14 (3.61-5.94)	2.72 ± 0.06 (2.3-3.2)	136.70 ± 1.27 (130-152)	4.41 ± 0.12 (3.2-5.3)	97.24 ± 2.56 (79.8-115.5)
Mean	8.97 ± 0.10 (6.31-13.4)	4.47 ± 0.05 (3.50-5.94)	2.73 ± 0.04 (1.85-4.8)	138.16 ± 0.67 (116-152)	4.37 ± 0.05 (3.2-5.6)	100.21 ± 0.92 (78.91-117.7)

*Figures in parentheses indicate ranges for a particular parameter.

Table 2. Number of animals found deficient in macro minerals in Baijnath block

		Ca	P	Mg	Na	K	Cl
Normal level		9-11 mg/dl	4-6 mg/dl	1.8-3.2 mg/dl	132-152 mEq/L	3.9-5.8 mEq/L	90-117 mEq/L
Villages of Baijnath Block	Khatrer	8 (40.00)*	1 (5.00)	-	1 (5.00)	1 (5.00)	2 (10.00)
	Dhanag	7 (35.00)	-	-	1 (5.00)	-	1 (5.00)
	Nanahar	8 (40.00)	3 (15.00)	-	4 (20.00)	1 (5.00)	4 (20.00)
	Sapedu	6 (30.00)	3 (15.00)	-	1(5.00)	-	1 (5.00)
	Kunsal	7 (35.00)	2 (10.00)	-	2 (10.00)	2 (10.00)	5 (25.00)
	Total	36 (36.00)	9 (9.00)	-	9 (9.00)	4 (4.00)	13(13.00)

*Figures in parentheses indicate percentages; N = 20 for each village

animals of Baijnath block ranged from 3.50 to 5.94 mg/dl with an overall mean of 4.47 ± 0.05 mg/dl (Table 1).Only 5 per cent of the animals were found deficient in phosphorus in Khatrer, village, whereas in Nanahar and Sapedu villages, 15 per cent of the animals were found deficient. None of the animals of Dhanag village were found deficient in phosphorus (Table 2). The finding in the present study is in variance with the reports of Ramana *et al.* (2000), Dandopath *et al.* (2002), Kafil *et al.* (2003), Pankaj *et al.* (2003) and Sharma *et al.* (2003) but is in agreement with the findings of Sharma (2004) for anoestrous and treated animals of the same region. The possible reason for the difference with respect to reports of above workers is variation in feeding practices and region where the studies were carried out. The mean Ca: P ratio in the animals of Baijnath block was 1.97 ± 0.03. The mean Ca: P ratio in animals of all the villages except Nanahar and Sapedu villages was marginally lower than 2. In the animals of Nanahar and Sapedu villages, the mean Ca: P ratio was 2.15 ± 0.08 and 2.10 ± 0.05, respectively.

The mean plasma magnesium concentration in the animals of Khatrer,

Dhanag, Nanahar, Sapedu and Kunsal villages of Baijnath block varied non-significantly and it was 2.76 ± 0.08 mg/dl, 2.92 ± 0.13 mg/dl, 2.64 ± 0.05 mg/dl, 2.63 ± 0.09 mg/dl and 2.72 ± 0.06 mg/dl, respectively (Table 1). The plasma magnesium concentration varied from 1.85 to 4.80 mg/dl with an overall mean of 2.73 ± 0.04 mg/dl. The plasma magnesium concentration was well within the normal level of 1.8-3.2 mg/dl in all the animals and none of the animals were found to be deficient in magnesium (Table 2). The plasma magnesium concentration in all the animals of the villages under study was observed to be within the normal physiological range of 1.8-3.2 mg/dl (Underwood, 1981). None of the animals in all the villages under study were found to be deficient in magnesium. Magnesium is generally present in appreciable amounts in the green fodder. So, its deficiency is rare under normal conditions, except when green fodder is high in potassium (Greene *et al.*, 1983). Mahan (1990) has also reported that the requirement of magnesium is so low that its deficiency rarely occurs.

The plasma sodium concentration ranged from 116 to 152 mEq/L with an overall mean of 138.16 ± 0.67 mEq/L. The average plasma sodium concentration in the animals of all the five villages of Baijnath block varied non-significantly among each other (Table 1). In Nanahar village of Baijnath block, 20 per cent of the animals were found below the critical level of plasma sodium concentration, while 5 per cent of the animals were below critical level in each of rest of the villages except Kunsal village where 10 per cent of the animals were below the critical level (Table 2). The plasma sodium concentration in majority of animals of all the villages under study was found to be more towards the lower side of normal physiological range. This may be attributed to low level of sodium in the diet or due to lack of regular supplementation of sodium in the diet of animals under study.

The plasma potassium concentration ranged from 3.2 to 5.6 mEq/L with an overall mean of 4.37 ± 0.05 mEq/L. A non-significant difference was observed in mean plasma potassium concentration in animals of all the five villages of the Baijnath block. There was a non-significant difference in mean plasma potassium concentration in animals of all the five villages of the block. The mean plasma potassium concentration (4.28 ± 0.11 mEq/L) in the animals of Nanahar village was lowest in the block. The percentage of animals below the critical level of plasma potassium concentration was 5, 5 and 10 in Khatrer, Nanahar and Kunsal villages, respectively. In Dhanag and Sapedu villages, none of the animals were observed below the critical level of plasma potassium concentration. The plasma potassium concentration was observed to be below the normal level (<3.9 mEq/L) in only 4 per cent animals of the region (Table 2). Feed/fodder offered to the animals might be containing adequate potassium, thus able to meet the animal's requirements and could be one of the possible reasons for relatively low incidence of potassium deficiency in the animals under study. Potassium deficiency is not likely to occur in cattle consuming actively growing forages, but it can create problem if it

is too high (>2.5%) as it can cause reduction in magnesium availability in cows (Greene *et al.*, 1983).

The mean plasma chloride concentration in the animals of Baijnath block was 100.21 ± 0.92 mEq/L. The average values of mean plasma chloride concentration varied non-significantly among animals of different villages. The mean plasma chloride concentration in the animals of Khatrer, Dhanag, Nanahar, Sapedu and Kunsal villages was observed as 102.72 ± 2.10 mEq/L, 101.35 ± 1.31 mEq/L, 98.88 ± 2.64 mEq/L, 100.87 ± 1.18 mEq/L and 97.24 ± 2.56 mEq/L, respectively (Table 1). The plasma chloride concentration in majority of the animals was found to be within the normal range (NRC, 2001), except in 13 per cent of the animals, where it was observed below the normal level (<90 mEq/L). Highest incidence (25 per cent) of chloride deficiency in animals was recorded in Kunsal village followed by Nanahar village where 20 per cent of the animals were found below the critical level.

All the macro elements, except calcium were found to be largely within the normal physiological range but skewed towards lower side in most of the animals. Calcium was found to be most limiting macro mineral in the animals of the region. Some animals were found to be deficient in other macro minerals also except in magnesium in which none of the animals were found to be deficient. The present findings shall help in suitable supplementation of minerals for augmentation of production and reproduction in these animals.

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