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Mineral profile of high altitude dairy cattle of Himachal Pradesh

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Abstract

Mineral elements play an important role in physiological activities of the animals and deficiency of any of these affects production and reproduction of animals. Investigations were undertaken to find out the mineral status in dairy cattle of Theog and Jubbal blocks of Shimla district under agro-climatic zone-III of Himachal Pradesh. Estimation of plasma mineral status revealed deficiency of Ca in animals of Jubbal (7.48 ± 0.34mg/dl) and Theog (8.58 ± 0.34mg/dl) blocks whereas P level was high in both the blocks. Na and Cl concentration was higher in the animals of Theog block (164.73 ± 7.00mEq/L), while K level was skewed towards the lower side in Jubbal block (3.92 ± 0.09mEq/L). Zn concentration (0.83 ± 0.06ppm) was towards lower side of normal level in Theog block while other microelements were within normal range. Significantly higher ($p<0.05$) Na and Cl concentrations were found in animals of Theog block as compared to Jubbal block whereas, K concentration was significantly lower in Jubbal block. Cu concentration was significantly lower in Jubbal block in comparison to Theog block, while Zn level was significantly lower in animals of Theog block. Feed and fodder samples showed high levels of Fe, Zn and K, while the other elements were within normal critical range.

Key words: Mineral status, macro elements, micro elements, dairy cattle, feed and fodder.

Introduction

The livestock rearing practices in North West Himalayan region expose the animals to diverse climatic conditions, which may lead to mineral imbalance. In routine practice, farmers hardly provide mineral mixture to their livestock. Therefore, the animals most frequently suffer from primary deficiency, which can impair maintenance, growth and production of the animals. Since animals in this part of the country predominantly are reared on grazing, such animals are principally dependent on native forage for their nutrients. Parent soil type, rainfall patterns, calcification, salinization, pH and forage type affect the availability of trace elements to the plants and thus to the animals (Reid and Horvath, 1980). Since minerals are essential for normal functioning of body and they play a significant role in maintaining optimum reproductive and productive performance of animals, the present investigation was carried out with the aim to study the macro and micro mineral profile in high altitude dairy cattle of Himachal Pradesh.

Material and Methods

Sample collection

The present study was conducted on dairy cattle of Theog and Jubbal blocks of district Shimla under agro-climatic zone III of Himachal Pradesh, which is located at an altitude of 1800-2200 meters above the mean sea level. The blood samples were collected randomly from the dairy cattle and simultaneously feed and fodder samples were also taken for mineral analysis.

Plasma separated from the blood samples was used for the estimation of various minerals. Feed and fodder samples were processed and digested with double acid (1part 70% perchloric acid and 3 parts conc. nitric acid) for estimation of minerals.

Sample analysis

Sodium and potassium level in plasma and feed/fodder samples was determined using flame photometer (Systronics, Mediflame 127). Calcium, magnesium, iron, copper and zinc concentrations were estimated with an atomic absorption

spectrophotometer (Model 3100, Perkin Elmer, 1982). The plasma inorganic phosphorus and chloride were estimated by the photometric method. The results were statistically analyzed using software 'Graphpad Instat' (Russel, 1990).

Results and Discussion

The results of various macro and micro elements estimated in the blood plasma of dairy cattle have been presented in table 1.

Calcium and phosphorus

The mean plasma calcium concentration in dairy cattle of both Theog (8.58±0.34 mg/dl) and Jubbal (7.48±0.34 mg/dl) blocks was observed to be lower than normal level. The difference between the two blocks was non-significant ($p>0.05$). In majority of the animals, the plasma calcium concentration was skewed towards the lower side of normal level. Low levels of calcium in the present investigation might be due to high demand of calcium in dairy cattle and lack of calcium supplementation in the feed. Our results are similar to the findings of Kafil *et al.* (2003). The mean plasma phosphorus concentration in the animals of Theog and Jubbal blocks was skewed towards the higher side of the normal range as indicated by Underwood (1981) and varied non-significantly ($p>0.05$) between the two blocks. High phosphorus concentration in plasma might be due to disturbed Ca : P ratio, as calcium concentration was lower in the animals of both the blocks in the present investigation.

Sodium and chloride

The mean plasma sodium and chloride concentration in dairy cattle of Theog block was significantly higher ($p<0.05$) than in dairy cattle of Jubbal block. Sodium and chloride are electrolytes that regulate cellular osmotic pressure, Na^+/K^+ pump activity, and acid base balance (Underwood and Suttle, 1999). These minerals are closely regulated via kidney/hormonal systems and must be supplemented daily (White *et al.*, 1978). Deficiency of sodium and chloride was not observed during present study possibly due to the fact that common salt is usually supplemented by the farmers to their livestock and their deficiency in blood is rarely reflected.

Potassium

The plasma potassium concentration was observed to be marginally lower than the normal level in the animals of Jubbal block (3.92±0.09 mEq/L). A significant difference ($p<0.05$) was also observed in the mean concentration among the animals of the two blocks. In the feed/fodder samples also, potassium was found to be well above the critical level and thus may

Table 1. Blood plasma concentration of macro and micro minerals in dairy cattle

Minerals	Theog Block (n=22) Mean ± S.E	Jubbal Block (n=24) Mean ± S.E	Overall mean Mean ± S.E	Normal Level*
Ca (mg/dl)	8.58^a±0.34	7.48^a±0.34	8.03 ± 0.25	9 -12
P (mg/dl)	7.15^a±0.43	6.90^a±0.33	7.02 ± 0.27	4 -6
Na (mEq/L)	164.73^a±3.00	145.08^b±0.99	154.91 ± 0.87	130 -150
Cl (mEq/L)	122.94^a±7.59	112.26^b±2.37	117.60 ± 2.23	90 -110
K (mEq/L)	4.68^a±0.37	3.92^b±0.09	4.29 ± 0.19	4 -6
Mg (mg/dl)	2.33^a±0.75	2.53^a±0.91	2.44 ± 0.06	1.8 -3.2
Cu (ppm)	1.11^a±0.11	1.02^b±0.07	1.07 ± 0.06	0.62 -1.5
Zn (ppm)	0.83^a±0.06	0.96±0.04^b	0.89 ± 0.04	0.8 -1.2
Fe (ppm)	2.11^a±0.16	1.88^a±0.16	1.99 ± 0.11	0.89 -2.5

The values with different superscripts within the rows differ significantly from each other
*Underwood (1981)

be able to meet the animals' requirements (Table 2). 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 sufficient potassium level in fodder (Table 2) consumed by the animals could be one of the possible reasons for relatively low incidence of potassium deficiency in the animals under study.

Magnesium

The mean plasma magnesium concentration in animals of Theog (2.33± 0.75 mg/dl) and Jubbal (2.53± 0.91 mg/dl) blocks did not differ ($p>0.05$). The concentration was within the normal physiological range (Underwood, 1981) and none of the animals was found to be deficient. 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). In the present study magnesium was adequate in the feed and fodder samples (Table 2) which might be responsible for normal magnesium levels in the animals of this region.

Copper

The mean plasma copper concentration differed significantly ($p<0.05$) in the animals of the two blocks, however, the values were within normal range. The copper levels in feed and fodder samples were adequate (Table 2) except dry fodders of Theog block which directly reflects the normal plasma copper concentration in the animals of both the blocks.

Table 2. Concentration of macro and micro minerals in feed and fodder samples

Minerals (normal critical range)	Samples	Block		Overall mean
		Theog	Jubbal	
Na (0.06 g%)	Green	0.09	0.12	0.11
	Dry	0.05	0.06	0.06
	Concentrate	0.09	0.03	0.06
K (0.60 g%)	Green	1.88	1.22	1.55
	Dry	1.13	0.80	0.97
	Concentrate	0.69	0.65	0.67
Ca (0.30 g%)	Green	0.78	1.44	1.11
	Dry	0.53	0.40	0.47
	Concentrate	0.08	0.21	0.15
Mg (0.20 g%)	Green	0.23	0.35	0.29
	Dry	0.26	0.20	0.23
	Concentrate	0.25	0.24	0.25
Cu (10 ppm)	Green	11.30	21.25	16.28
	Dry	8.95	10.83	9.89
	Concentrate	11.50	14.00	12.75
Zn (30 ppm)	Green	35.70	43.18	39.44
	Dry	26.83	23.80	25.32
	Concentrate	48.50	38.50	43.5
Fe (30 ppm)	Green	611.98	408.13	510.06
	Dry	378.58	280.50	329.54
	Concentrate	52.62	96.75	74.69

Zinc

Although the mean plasma zinc concentration in the dairy cattle of Theog (0.83± 0.06 ppm) and Jubbal (0.96± 0.04 ppm) blocks was within the normal range but it was skewed towards the lower side in dairy cattle of Theog block. Zinc concentration was within normal critical range in green fodder and concentrate samples but below normal critical levels in dry fodder samples of both the blocks (Table 2). One possible reason for low levels of zinc could be that the animals were usually fed upon dry roughages for most part of the year. Our findings are in agreement with McDowell (1992) who reported that mineral deficiencies, particularly trace mineral deficiencies, in the tropics were due to poor roughage quality and negligible supplementation of these minerals in the diet. The present findings are also in accordance with those of Pradhan *et al.* (1995) attributing lower serum zinc values to the inadequate availability of mineral in the feed stuffs.

Iron

The mean plasma iron concentration in the animals of Theog and Jubbal blocks was 2.11± 0.16 ppm and 1.88± 0.16 ppm, respectively and did not differ ($p>0.05$). The iron content was also found to be high in feed/fodder samples (Table 2). Therefore, the normal iron concentration in blood plasma of animals is possibly due to high intake of iron in the diet.

To conclude, amongst the macro elements, calcium was found to be the most limiting nutrient in the animals of Theog and Jubbal. The status of various trace minerals was within normal range except zinc, which was marginally lower in the blood plasma of the animals. The analysis of feed and fodder samples of region indicated that the dry fodders fed to the animals were deficient in sodium, copper and zinc. Deficiency of these minerals in cattle have earlier been reported in many parts of India (Ramana *et al.*, 2000; Dandopath *et al.*, 2002; Kafil *et al.*, 2003; Pankaj *et al.*, 2003 and Sharma *et al.*, 2003) but in different proportions which may be due to variations in breeds, seasons, analytical procedures and most importantly the areas under study.

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References

Dandopath, S.K., Ghosh, T.K., and Biswas, S. 2002. Trace and macro element status of cattle in red laterite zone of West Bengal. *Indian Journal of Animal Sciences* 72 (9): 817-819.

Greene, L.W., Fontenot, J.P., and Webb, K.E. Jr. 1983. Site of magnesium and other macromineral absorption in steers fed high levels of potassium. *Journal of Animal Science* 57: 503-510.

Kafil Hussain, Sharma, M.C., Chinmay Joshi and Pankaj Kumar 2003. Mineral profile of cattle in certain areas of Bareilly. *In:* Proceedings National Symposium and XXI ISVM convention, Anand.

McDowell, L.R. 1992. *Minerals in Animal and Human Nutrition.* Academic Press, Inc. San Diego, California.

Pankaj Kumar, Sharma, M.C., Chinmay Joshi and Kafil Hussain 2003. Studies on macro and micro mineral profile of buffaloes in Bareilly district. In: Proceedings National Symposium and XXI ISVM convention, Anand.

Perkin Elmer 1982. *Analytical Method Manual.* Philadelphia, USA.

Pradhan, J., Mohanty, B.N., Ray, S.K.H., and Mohanty, D.N. 1995. A comparative study of haemaglobin, copper and zinc concentration of post partum anoestrous cows. *Indian Journal of Animal Reproduction* 16 (1): 28-31.

Ramana, J.V., Prasad, C.S., and Gowda, S.K. 2000. Mineral profile of soil, feeds, fodders and blood plasma in Southern Transition zone of Karnataka. *Indian Journal of Animal Nutrition* 17 (3): 179-183.

Reid, R.L. and Horvath, D.J. 1980. Soil chemistry and mineral problems in farm livestock- A review. *Animal Feed Science and Technology* 5: 95.

Russel, P. 1990. GraphPad Instat. GraphPad software V 2.05a. Royal Veterinary College, London.

Sharma, M.C., Chinmay Joshi, Shalini Gupta, Joshi, C., and Gupta, S. 2003. Prevalence of mineral deficiency in soil, plants and cattle of certain districts of Uttar Pradesh. *Indian Journal of Veterinary Medicine* 23 (1): 4-8.

Underwood, E.J. 1981. *The Mineral Nutrition of Livestock.* CAB Farnham Royal Slough LS 23 BN, England.

Underwood, E.J., and Suttle, N.F. 1999. *The Trace Mineral Nutrition of Livestock,* 3rd ed. Commonwealth Agricultural Bureau International (CABI) Publishing, Wallingford, Oxfordshire, U.K.

White, A., Handler, P., Smith, E.L., Hill, R.L., and Lehman, I.R. 1978. *Principles of Biochemistry.* 6th ed. McGraw Hill, New York.