ISSN NO. 2320-5407

Journal homepage: http://www.journalijar.com

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH

RESEARCH ARTICLE

MACROMINERAL STATUS OF SOIL, FODDERS AND CATTLE FROM IDUKKI AND ERNAKULAM DISTRICTS OF KERALA, INDIA AND THEIR INTERRELATION

DEVI GOPINATH[1*], M. C. SHARMA[2], P. SHEKHAR[3], GURUPRIYA V. S[1], ASWATHI P.B[1], MAMTA SINGH[1]

1 PhD Scholar, I. V. R. I, Izatnagar, Bareilly, U.P, India
2 Former Director, I. V. R. I, Izatnagar, Bareilly, U.P, India
3 Asst. Professor, Bihar Veterinary College, Patna, Bihar, India

Manuscript Info

Manuscript History:

Received: 12 May 2014
Final Accepted: 25 June 2014
Published Online: July 2014

Key words:
minerals, soil, plant, fodder, cattle, serum

Corresponding Author

DEVI GOPINATH

Abstract

Minerals are inorganic dietary constituents needed for varied metabolic processes within the body. Availability of minerals to animals in acceptable quantities may be a major issue deciding the health and productivity. Keeping it in view, a baseline survey was conducted in different blocks of Idukki (Idukki, Thodupuzha and Elamdesom) and Ernakulam (Vazhakulam and Muvattupuzha) districts of Kerala state. The aim of the study was to assess the major macro-minerals i.e., Calcium (Ca), Phosphorus (P) status of soil, plant/ fodder and cattle in two districts of Kerala. Soil (n=150), Fodder (n=150) and Serum (n=160) samples from cattle were collected from two districts of Kerala. Minerals in soil, plant/fodder (composite) and serum were estimated by AAS (Atomic Absorption Spectrophotometry). The average Ca, P (%) contents of soil in two representative districts of Kerala were found to be 1.13±0.05 and 0.63±0.08 µg/gm, respectively. The percent of soil deficient in Ca and P were 20.00% and 0% respectively. Similarly, the average Ca and P (%) contents of fodder were 0.50±0.02 and 0.45±0.04 with deficiency of 23.33% and 0% respectively. The overall prevalence of Ca and P deficiency in serum samples of cattle were 34.37% and 0% respectively. Significant correlation was observed at 1% and 5% level for Ca and P concentrations in soil-fodder-bovine serum in almost all districts.

Introduction

Minerals are chemical constituents utilized by the body in many ways. Minerals are one of the necessary nutritional elements having vital role within the health, production, reproduction and immune defense of the animals. Although they yield no energy, they have important roles to play in many activities in the body factors (Soetan et al., 2010). Dairy animals most commonly suffer with the nutritional deficiencies due high production and deficient feeding ultimately leading to poor reproductive performance (Sudhir et al., 2011). The functions performed by minerals can only be fulfilled if the finite amounts ingested are sufficient to keep pace with growth and development of the body and the reproduction of the species and to replace minerals that are lost either as harvested products or insidiously during the process of living. Macrominerals includes calcium (Ca), phosphorous (P), magnesium (Mg), sulphur (S), sodium (Na), potassium (K), and chlorine (Cl). Macrominerals play vital role in production of structural components of bone and other tissues, maintenance of acid-base balance, osmotic pressure, electric potential across cell membranes and nerves and serve as chief constituent of body fluids.

Mineral deficiency remains at the top of the problem across states in India. The mineral profile of animal body is mainly influenced by mineral status of soil and fodder in a particular geographical area. Soil, plant and management factors can influence the amount of minerals in feedstuff (Sharma et al., 2002). Kerala state has

tropical type climate with temperature varying between 21°C to 36°C with minimum seasonal variation and livestock sector contributing about 40% of the agricultural GSDP. While the national level milk production is showing an ascending trend, the total milk production of the State is showing a declining trend from 27.18 lakh tonnes in 2001-02 to 20.63 lakh tonnes during 2005-06 and increased to 21.18 lakh tonnes during 2006-07 and to 26.43 lakh tonnes in 2010-11 (Economic survey, 2011). Milk fever incidence is very common in Kerala. As mineral deficiencies in animal rations varies with agro climatic conditions, mapping of such deficiencies needs to be done across such identifiable zones, to develop area specific mineral mixtures for supplementing the ration of animals for improved growth, milk production and reproductive efficiency.

Materials and Methods:

A survey was conducted in two phases in 2 districts of central Kerala (India) viz., Idukki and Ernakulam to record the mineral status in soil, fodder and serum of cross bred cattle. The study area included three blocks of Idukki district namely Idukki, Thodupuzha and Elamdesom and two blocks of Ernakulam district namely Vazhakulam and Muvattupuzha. A total of 150 samples of soil and 150 samples of fodder grown in the same fields were collected. Blood samples were collected using standard protocol. In second phase, the collected samples were processed and mineral profile was analysed. Minerals viz. Calcium and Phosphorus were estimated in soil, fodder and serum samples after digestion. The samples of soil, fodder and serum were digested by the method of Franeck (1992), Trolson (1969), Kolmer et al., (1951) respectively. Mineral content in soil, fodder and serum samples was estimated by atomic absorption spectrophotometer (AAS) (ECIL 4141, Hyderabad, India). All the collected samples of soil, fodder and serum were analysed individually. Data collected from this study were analyzed as per the method described by Snedecor and Cochran (1994) for mean, standard error, analysis of variance (ANOVA) and correlation coefficient by standard‘t’ test. Prevalence percentage was estimated using critical levels of Ca and P in their respective samples.

Result

The mineral content of soil and fodders of two districts of central Kerala is presented in table 1 and their deficiency prevalence in table 2. The overall mean (±S.E) soil calcium (%) value in five blocks of Idukki and Ernakulam districts of Kerala was 1.13±0.05. The overall prevalence of soil calcium deficiency in two districts of Kerala was 20.00%. The overall mean (±S.E) fodder calcium (%) value in five blocks of Idukki and Ernakulam districts of Kerala was 0.50±0.02. The overall prevalence of fodder Calcium deficiency in two districts of Kerala is 23.33%. The overall mean (±S.E) soil phosphorous (%) and fodder phosphorus values in five blocks of Idukki and Ernakulam districts of Kerala was 0.63±0.08 and 0.45±0.04 respectively. The overall prevalence of phosphorus deficiency in soil and fodder samples from the following two districts was negligible (0%) .

The mineral content of serum of cattle of two districts of central Kerala is presented in table 3 and their deficiency prevalence in table 4. The overall mean(±S.E) concentration of serum calcium (mg/dl) concentrations in lactating, nonlactating and calf groups were 8.06±0.09, 9.17±0.21 and 8.81±0.27, respectively in cattle of different blocks of Idukki and Ernakulam districts of Kerala. The overall prevalence of serum calcium deficiency in two districts of Kerala was 34.37%, with lactating cattle (37.33%) followed by calves (35.00%) and lowest in non-lactating cattle (28.88%) amongst different physiological groups of cattle.

The overall mean (± S.E) concentrations of serum iP (mg/dl) in lactating cattle, non-lactating cattle and calves were 7.26±0.11, 7.25±0.12 and 6.50±0.15 respectively in cattle of different blocks of Idukki and Ernakulam districts of Kerala. The prevalence of Phosphorous deficiency in cattle of different blocks was found to be negligible. The overall prevalence of P deficiency in serum sample of cattle of two districts of Kerala was found to be 0%.

Table 1: Mean±S.E values of soil minerals (µg/g) and fodder minerals (µg/g) from different blocks of Idukki and Ernakulam districts of Kerala

Districts	Blocks	Fodder-Ca	Fodder-P	Soil-Ca	Soil-P
Idukki	Idukki	0.40±0.02[a]	0.45±0.08[a]	1.11±0.16[a]	0.58±0.12[a]
	Thodupuzha	0.46±0.03[a]	0.40±0.11[a]	1.13±0.10[a]	0.62±0.15[a]
	Elamdesom	0.35±0.02[b]	0.55±0.09[a]	0.93±0.08[b]	0.77±0.19[a]
Ernakulam	Vazhakulam	0.55±0.04[a]	0.48±0.08[a]	1.24±0.04[a]	0.67±0.16[a]
	Muvattupuzha	0.75±0.02[a]	0.38±0.07[b]	1.28±0.03[a]	0.52±0.11[b]
Overall mean±S.E		0.50±0.02	0.45±0.04	1.13±0.05	0.63±0.08

Mean±S.E in a column with different superscripts a,b,c differ significantly (P<0.05)

Table 2: Prevalence of soil and fodder mineral deficiency in different blocks of Idukki and Ernakulam districts of Kerala

Districts	Blocks	No. of samples	Soil-Ca	Soil-P	Fodder-Ca	Fodder-P
Idukki	Idukki	30	6 (20.00%)	0 (0%)	6 (20%)	0 (0%)
	Thodupuzha	30	4 (13.33%)	0 (0%)	5 (16.66%)	0 (0%)
	Elamdesom	30	9 (30.00%)	0 (0%)	11 (36.66%)	0 (0%)
Ernakulam	Vazhakulam	30	8 (26.66%)	0 (0%)	9 (30%)	0 (0%)
	Muvattupuzha	30	3 (10.00%)	0 (0%)	4 (13.33%)	0 (0%)
Overall prevalence±S.E		150	30 (20.00%)	0 (0%)	35 (23.33%)	0 (0%)

Fig in parenthesis indicate % deficiency

Table 3: Mean±S.E values of serum Calcium and Phosphorus of cattle from different blocks of Idukki and Ernakulam districts of Kerala

Districts	Blocks	Calcium			Phosphorus		
		Lactating	Non Lactating	Calf	Lactating	Non Lactating	Calf
Idukki	Idukki	8.31±0.21[a]	9.59±0.49[ab]	8.67±0.47[ab]	7.79±0.22[a]	7.88±0.16[a]	6.64±0.30[ab]
	Thodupuzha	7.86±0.14[a]	9.83±0.63[a]	8.97±0.54[ab]	7.21±0.25[ab]	7.78±0.01[a]	6.34±0.33[ab]
	Elamdesom	7.78±0.16[a]	8.21±0.23[b]	7.62±0.33[b]	7.47±0.23[a]	7.42±0.12[ab]	7.29±0.45[a]
Ernakulam	Vazhakulam	8.23±0.18[a]	8.99±0.42[ab]	8.64±0.37[ab]	7.10±0.24[ab]	6.68±0.32[b]	6.58±0.28[ab]
	Muvattupuzha	8.01±0.23[a]	9.52±0.48[ab]	9.70±0.75[a]	6.68±0.19[b]	6.83±0.26[b]	5.93±0.35[b]
Overallmean± S.E		8.06±0.09	9.17±0.21	8.81±0.27	7.26±0.11	7.25±0.12	6.50±0.16

Mean±S.E in a column with different superscripts a,b,c differ significantly (P<0.05)

Table 4: Prevalence of serum Calcium and Phosphorus deficiency in cattle of different blocks in Idukki and Ernakulam districts of Kerala

	Districts	Idukki			Ernakulam		Overall prevalence
	Blocks	Idukki	Thodupuzha	Elamdesom	Vazhakulam	Muvattupuzha	
Ca	Lact	4/15 (26.6%)	5/15 (33.3%)	7/15 (46.6%)	6/15 (40%)	6/15 (40%)	28/75 (37.33%)
	Non-lact	3/9 (33.33%)	1/9 (11.11%)	4/9 (44.44%)	3/9 (33.33%)	2/9 (22.22%)	15/45 (28.88%)
	Calf	3/8 (37.50%)	1/8 (12.50%)	5/8 (62.50%)	3/8 (37.50%)	2/8 (25.00%)	14/40 (35.00%)
	Overall deficiency	10/32 (31.25%)	7/32 (21.87%)	16/32 (50.00%)	12/32 (37.50%)	10/32 (31.25%)	55/160 (34.37%)
P	Lact	0%	0%	0%	0%	0%	0%
	Non-lact	0%	0%	0%	0%	0%	0%
	Calf	0%	0%	0%	0%	0%	0%
	Overall deficiency	0%	0%	0%	0%	0%	0%

Fig in parenthesis indicate % deficiency

Discussion

Mineral imbalances (deficiencies or excesses) in soils and forages have long been held responsible for low production and reproductive problems among grazing ruminants in the tropics and sub tropics. The mean (±S.E) concentration of soil calcium in (%) in surveyed districts of Kerala (1.13±0.05) was found to be lower in all blocks of two districts of Kerala. This may be due to the pH of soil which was acidic in nature. Similar results were also reported by Gowda et al., (2002) and Turkar (2010) in soil of central dry zone of Karnataka and certain agro climatic zones of Madhya Pradesh, respectively. The overall prevalence of soil phosphorous deficiency of two districts was found to be negligible (0%). The mean (±S.E) concentration of soil phosphorous (%) in surveyed districts of Kerala (0.63±0.08) was higher than the critical value as described by NRC, 2001. High soil phosphorous content has been recorded in area where pH of the soil is acidic in nature.

Low concentration of a particular mineral may not result in its higher level in the plant, due to uptake mechanism existing in the roots (McDowell et al., 1993). The mean (±S.E) concentration of fodder calcium in (%) in surveyed districts of Kerala (0.50 ±0.02) was found to be lower in all blocks of two districts of Kerala. This may be due to the deficiency of calcium in soil samples and pH of the soil, which was acidic in nature. Sharma et al., (2009) reported marked deficiency of calcium in fodder samples of Central Uttar Pradesh and Bhat et al., (2011), reported the similar findings in Kashmir. The overall prevalence of fodder phosphorous deficiency in two districts was found to be negligible (0%). The mean (±S.E) concentration of soil phosphorous (%) in surveyed districts of Kerala (0.45±0.04) as against the critical limit of 0.20 % (McDowell, 1992). High fodder phosphorous content found in the present study may be due to high level of soil phosphorous recorded in study area and acidic nature of soil.

In the present study, among the macro elements, the prevalence of serum calcium deficiency was more in lactating cattle (37.33%) as compared to non-lactating (28.88%) and calf (35%). This is probably due to the requirement of these minerals depending on the level of productivity and the physiological status (McDowell, 1992). The overall mean serum Calcium in lactating cattle and calves was slightly less than the normal physiological range of 9-12 mg/ dl (Underwood and Suttle, 1999). The present study also revealed slightly lower plasma Ca concentrations in lactating cattle and calves compared to their counterpart non-lactating cattle. The lower serum levels of Ca in lactating cattle might be observed due to high demand of absorbed Ca per litre of milk produced. As per NRC (2001) lactating cattle needs 1.37 gm of Ca/kg of milk produced in addition to maintenance requirement. The low concentrations of plasma Ca in lactating cattle of Idukki and Ernakulam districts of Kerala suggest the need of extra supplementation to enhance the productivity and to reduce the lactational osteoporosis in cattle due excess mobilization of Ca from bones. The average value of serum P in all physiological group of cattle was within the normal range. This may be attributed to adequate level of P in soil and fodder. This may also be attributed to acidic soil pH (5.5-6.5) in respective districts studied.

It can be concluded that soil, fodder and cattle are highly deficient in Calcium. Also the status of macro-minerals was found to be interrelated.

Acknowledgement:
Authors are highly thankful to the Director of the Institute for providing necessary facilities.

REFERENCES

Bhat, M. S., Shaheen M., Zaman, R. and Muhee, A. 2011. Mineral Interrelationship among Soil, forage and Dairy cattle in Kashmir. India.Vet. World., **4**: 550- 553.

Economic Survey, 2010-2011 2011. Agriculture and Food Management.Oxford University Press- Publishers: 204

Franeck, M.A. 1992. Soil lead value in small town environment.A case study from Mt. Pleasant Michigan. Environ. Poll.,**76:** 251-257.

Gowda, N. K. S., Prasad, C.S., Ramana, J.V. and Srivaramiah, M.T. 2002. Assessment of mineral status in hilly and central dry zones of Karnataka and ways to supplement them.Indian J. Anim. Sci., **72(2):** 165-170.

Kolmer, J.A., Spanbling, E.H. and Robinson, H.W. 1951.Approved Laboratory Technique.Appleton Century Crofts, New York.

McDowell, L.R, Cornad, J.H. and Hembry, E.G. 1993. Minerals for Grazing Ruminants in Tropical Regions. Animal Science Department, University of Florida, Gannesvilli,USA.

McDowell, L.R. 1992.Minerals in Animal and Human Nutrition. Academic Press, New York. NRC 2001.Minerals. In: Nutrient Requirements of Domestic Animals. Nutrient Requirements of Dairy Cattle.(7th edn.).Natl. Acad. Press, Washington, DC.pp. 105-161.

Sharma, M.C., Joshi, C. and Das, G. 2009. Soil, fodder and serum mineral (cattle) and haematobiochemical profile in some districts of central Uttar Pradesh. Indian J. Anim. Sci., **79(4):** 411-415.

Sharma, M.C., Joshi, C. and Sarkar, T.K. 2002. Status of macrominerals in soil, fodder and serum of Kumaun hills.Indian J. Anim. Sci., **73**(3): 308-311.

Snedecor, G.W. and Cochran, W. G. 1994. Statistical methods, Iowa State University ress,Ames, Oxford and IBH, New Delhi.

Soetan, K.O., Olaiya, C.O. and Oyewole, O. E. 2010.The importance of mineral elements or humans, domestic animals and plants: A review. Afr. J. food Sci., **4**(5): 200-222.

Sudhir, K., Anil, K. P., Waquar, A.R., Dinesh, K. D. 2011. Importance of micro minerals in reproductive performance of livestock Veterinary World, **4(5):** 230-233.

Trolson, J.E. 1969. Outline for in vitro digestion of forage samples. Res. Stn. Shift Current,Saskatchewan, Canada.

Turkar, S. 2010. Studies on status of minerals in soil-plant-animal in relation to oxidative damage in bovines in certain agro-climatic regions of Madhya Pradesh and evaluation of area specific mineral mixture. Ph.D. Thesis, IVRI, Izatnagar.

Underwood, E.J. and Suttle, N.F. 1999. The Mineral Nutrition of Livestock,3rd edition. CABI Publishing (UK).