Indian Journal of Animal Sciences **81** (11): 1143–1147, November 2011

Mineral profile of feeds, fodders and cattle in north-eastern coastal plain zone of Odisha

M JENA[1], S K DAS[2], S K MISHRA[3], R K SWAIN[4] and P K DEHURI[5]

Orissa University of Agriculture and Technology, Bhubaneshwar, Odisha 751 003 India

Received: 29 March 2011; Accepted: 06 May 2011

ABSTRACT

Sample of feeds and fodders and serum samples of cows in 8 villages, 2 from each block and 2 blocks from each of the 2 districts namely Jajpur and Balesore of north eastern coastal plain zone (NECPZ) of Odisha were collected and analysed for macro and micro mineral content. Among the fodders, paddy straw was deficient in calcium (Ca), phosphorus (P), copper (Cu) and manganese (Mn). Deficiency of P was observed in most of the fodders. Most of the concentrates contained higher level of the analysed minerals. The average serum Ca, P, zinc (Zn), Cu, Mn and iron (Fe) content of cows in NECPZ were found to be 6.57±0.15 mg/dl, 3.57±0.11 mg/dl, 0.86±0.02ppm, 0.68±0.01 ppm, 0.26±0.006 ppm and 2.54±0.03 ppm, respectively. The percentage of animals deficient in serum Ca, P, Zn, Cu and Mn were observed to be 75.0, 75.0, 26.6, 31.6 and 28.3 %, respectively. The mean serum mineral content of the animals of NECPZ was deficient in Ca and P. The serum glucose, cholesterol, protein, albumin and globulin content of the animals in NECPZ were 43.64±1.49 mg/dl, 65.10±2.32 mg/dl, 4.23±0.12 g/dl, 2.11±0.05 g/dl and 2.11±0.09 g/dl, respectively.

Key words: Animals, Biochemical, Feeds and fodders, Mineral, North-eastern-coastal plain zone

Availability of minerals to animals in appropriate quantities is a major factor determining the health and productivity of animals. Nutrient composition of feeds and fodders especially the minerals are dependent on the soil, which nourishes the plant. The extent and pattern of mineral deficiencies and excesses in plants vary in different agro-climatic conditions (Gowda *et aI.* 2001) as available mineral content in green vegetation depends on physical and chemical properties of soil, soil erosion, cropping pattern, fertilizers and chemical application, species and genetic differences among plants, stage of growth, presence of other minerals etc. (McDowell 1985). The efficiency of mineral uptake by plant from soil and the availability and utilization of minerals through intake of plants/feeds by the animal is variable in different agro-climatic zone. Therefore, it is necessary to generate zone-wise information on mineral status so as to identify the deficiencies or toxicities (Garg *et al.* 1999). So the present study is undertaken with the following objectives of assessment of mineral status of the feeds and fodders available in the NECPZ of Orissa and further assessment of mineral and biochemical status of the animals of the NECPZ of Odisha.

Present address: [1]Veterinary Assistant Surgeon, Government of Odisha.

[2]Professor (sushantadas57@rediffmail.com), [3]Associate Professor (sumantakmishra@gmail.com), [4]Professor and Head (rkswainovc@yahoo.com), Department of Animal Nutrition, [5]Dean (dehuripk@gmail.com), College of Veterinary Science and Animal Husbandry.

MATERIALS AND METHODS

The survey was carried out in the NECPZ of Odisha. The NECPZ comprises districts namely Jajpur, Bhadrak and Balesore. This is located between 23° 43' - 2° 59' N latitude and 86°16' - 87° 25' E longitude. To undertake the survey work, two districts of NECPZ were selected namely Jajpur and Balesore. Then 2 blocks were randomly selected from each of the selected districts and 2 villages were selected from each of the block. Representative samples of pastures grass, agricultural by products, feed ingredients, straws and compounded feed were collected either from the grazing land of the village or from the farmers. About 250 g of samples of these collected and all the samples were first air-dried in shed and thereafter, in hot air oven at 80° C for 24 h. Then ground to 1 mm particle size and stored in acid washed glass container for further analysis of major and trace elements. Twenty cattle of each surveyed villages were randomly selected for collection of blood samples and serum was harvested. The Ca and P content of feeds and fodders were estimated as per AOAC (1995). The micro minerals content of plant and serum samples were estimated by atomic absorption spectrophotometer method. The concentration of

serum Ca, glucose, cholesterol, protein and albumin were estimated by using a kit. The concentration of P was estimated by using a kit. The data were analysed statistically (Snedecor and Cochran 1973).

RESULTS AND DISCUSSION

Mineral content in feeds and fodders: The mineral contents in the feeds and fodders of NECPZ are presented in Table 1. Among all the feeds and fodders analysed, lowest Ca content in paddy straw and highest was observed in compound feed. The Ca content of the paddy straw of all the surveyed areas was low in Ca than that of critical level (0.3%) (Prabowo *et al*. 1990). The straw was deficient in Ca as they contained excess of silica, oxalates and tannins, which may interfere in the utilization of Ca and also due to accumulation of minerals in seed due to translocation. The dub grass and the mixed local grass contained higher Ca content than that of the critical level. Mishra (2006) observed marginally higher Ca content in dub grass, pasture grass, hybrid napier grass, mutha grass and sugarcane tops than the critical level. All the ingredients of concentrates available in surveyed area like groundnut oil cake, rice bran, mung chuni and compound feed contained higher Ca than that of critical level. Das *et al.* (2003) reported higher levels of Ca in concentrate mixture which corroborates with higher levels of Ca in concentrate mixture in present study. The P content of the paddy straw of NECPZ was observed to be lower than that of critical level. The lower P content in the roughages might be attributed to the lower concentration of soil P and acidic pH of the soil. The paddy straw and black gram straw were low in P, probably because as plants mature, mineral contents decline due to natural dilution process and translocation of nutrients to the root system (Underwood 1981). Among different concentrates available in surveyed area, wheat bran and maize contained marginally higher P than that of critical level. Other feed ingredients like groundnut oil cake, rice bran, and compound feed contained higher P than that of critical level. The Zn concentration of maize grain, wheat bran, groundnut oil cake, rice bran, and compound feed was marginally higher than the critical level (30ppm) (Prabowo *et al*. 1989). The reason for higher Zn content in all the feed ingredients might be due to transfer of Zn from plant segment to seeds was quite substantial (Garg *et al*. 2002). All the green grasses like dub grass, mixed grass and hybrid napier grass and dry fodders like paddy straw and black gram straws contained marginally higher level of Zn than the critical level (30ppm). This might be attributed to the higher Zn content of the soil of the surveyed zone. Except paddy straw, the Cu concentrations of dub grass, pasture grass (mixed grass), and black gram straw were found to be higher than that of critical level (8ppm). The Cu concentrations of groundnut oil cake, rice bran, and compound feed were higher than critical level (8ppm) while maize grain and wheat bran contained low levels of Cu than that of the critical level. The paddy straw and black gram straw contained lower levels of Mn than critical level (40 ppm). The green gasses contained lower level or marginally higher level of Mn than critical level (40 ppm). The variation observed in Mn concentration of some roughage samples might be due to the effect of the climate, forage management, stage of maturity and yield, which might have influenced plant mineral composition (Mc Dowell and Conrad 1990). The Fe concentrations of all the roughages were at much higher level than the critical level (50ppm) and this is obviously due to both higher uptake of Fe from the soil (Singh *et al.* 1980) and higher Fe content of soil as well. Moreover, maize and wheat crops were hardly grown in those areas of study. So the mineral composition of these ingredients as reported might not be the true reflection due to the soil status of the studied zone.

Serum mineral profile of the animals: The mineral and metabolic profile of cattle is presented in Table 2. The average serum Ca concentration of NECPZ was below critical level (8.0 mg/dl). Considering the higher percentage (75%) of animals deficient in Ca, the principal reason might be attributed to the fact that the majority of animals were dependent upon paddy straw as a staple source of fodder, and paddy straw is deficient in Ca content as evident from the earlier discussion in this research paper. Mandal *et al.*

Table 1. Mineral status of the feeds and fodders in north-eastern-coastal-plain zone of Odisha

Feeds and fodders	Ca(%)	P(%)	Mn(ppm)	Cu(ppm)	Zn(ppm)	Fe(ppm)
Paddy straw	0.26±0.01	0.09±0.005	24.55±1.09	7.04±0.33	32.16±1.30	137.14±2.14
Rice bran	0.30±0.01	0.54±0.01	44.49±1.24	21.66±0.96	44.27±1.49	172.47±2.03
Maize	0.33±0.01	0.37±0.01	18.41±0.72	7.70±0.39	31.66±1.15	134.66±1.37
Dub grass	0.45±0.01	0.18±0.007	40.78±1.16	31.50±1.16	30.02±1.00	233.20±1.63
Mixed grass	0.30±0.01	0.13±0.008	30.23±1.07	26.17±1.05	28.53±1.03	211.18±1.40
Compound feed	0.93±0.01	0.43±0.01	57.51±1.39	20.00±0.88	32.73±1.10	211.23±1.78
GNOC	0.55±0.01	0.82±0.01	50.17±1.12	35.71±1.55	49.69±1.18	222.81±1.41
Wheat bran	0.32±0.02	0.41±0.03	46.82±1.25	5.18±0.39	46.49±1.37	148.46±1.96
Blackgram straw	0.26±0.01	0.09±0.006	22.34±1.06	31.89±1.24	39.04±1.65	135.69±1.57
Critical level[#]	0.3	0.25	40	8	30	50

[#] Prabowo *et al.* (1990).

Table 2. Mineral and metabolic profile of cattle in north-western-plateau zone of Odisha

Area	Minerals						Metabolic profile				
	Ca (mg/dl)	P (mg/dl)	Zn (ppm)	Cu (ppm)	Mn (ppm)	Fe (ppm)	Protein (g/dl)	Albumin (g/dl)	Globulin (g/dl)	Cholesterol (mg/dl)	Glucose (mg/dl)
Jajpur	6.26 ±0.26	3.37 ±0.25	1.01 ±0.06	0.65 ±0.02	0.31 ±0.01	2.72 ±0.05	4.40 ±0.31	2.22 ±0.14	2.17 ±0.21	58.82 ±4.66	40.65 ±3.00
Dharmasala	6.75 ±0.38	3.61 ±0.29	0.92 ±0.06	0.68 ±0.02	0.26 ±0.01	2.61 ±0.06	4.12 ±0.24	2.07 ±0.12	2.05 ±0.16	60.68 ±5.05	41.27 ±3.39
Average	6.51 ±0.32	3.49 ±0.27	0.96 ±0.06	0.66 ±0.02	0.28 ±0.01	2.67 ±0.05	4.26 ±0.13	2.14 ±0.06	2.11 ±0.09	59.75 ±2.41	40.96 ±1.58
Soro	6.25 ±0.26	3.44 ±0.15	0.80 ±0.04	0.68 ±0.0	0.23 ±0.01	2.32 ±0.05	3.98 ±0.20	1.92 ±0.09	2.06 ±0.17	69.58 ±4.05	42.84 ±2.53
Simulia	7.02 ±0.28	3.87 ±0.21	0.71 ±0.04	0.71 ±0.02	0.26 ±0.01	2.52 ±0.05	4.40 ±0.22	2.24 ±0.09	2.16 ±0.17	71.33 ±4.52	49.78 ±2.84
Average	6.63 ±0.27	3.65 ±0.19	0.76 ±0.041	0.70 ±0.02	0.24 ±0.01	2.42 ±0.05	4.19 ±0.10	2.08 ±0.04	2.11 ±0.08	70.45 ±2.13	46.32 ±1.37
North-eastern coastal plain zone	6.57 ±0.15	3.57 ±0.11	0.86 ±0.02	0.68 ±0.01	0.26 ±0.006	2.54 ±0.03	4.23 ±0.12	2.11 ±0.05	2.11 ±0.09	65.10 ±2.32	43.64 ±1.49
Critical level[#]	8.0	4.5	0.6	0.65	0.2	1.0	-	-	-	-	-

[#] Mc Dowell *et al.* (1984).

(2004) and Mishra (2006) reported deficient serum Ca levels in animals. The average serum P concentration (3.57±0.11 mg/dl) of cows in NECPZ was below critical level (4.5 mg/dl). It was observed that 75% of the surveyed animals showed the deficiency of serum P. Yadav *et al.* (2002) reported 38% buffaloes had lower serum P concentration than the critical level. Mishra (2006) observed that all the anoestrus heifers, 98% of anoestrus cows and 72% of cyclic cows were below the reported critical level (4.5 mg/dl) in Dhenkanal district of Odisha. The soil of NECPZ was observed to be deficient in P (Singh 2010) and this might be the reason of low level of P in feed ingredients and roughages. Also higher Fe concentration was observed in the feeds and fodders of all the zones. Higher Fe concentration in the soil, feeds and fodders causes precipitation of inorganic P, making it unavailable to plants and subsequently to animals (Prabowo *et al*. 1989). One of the reasons of P deficiency was that the basal feed available for the animals was mainly paddy straw which was found almost deficient in the P content. The average serum Zn concentration (0.86±0.02 ppm) of cows in NECPZ was above the critical level (0.6 ppm). This may be due to higher availability of Zn from the feed and fodder as evident from the Zn content in the available feeds and fodder of the zone. In spite of higher Zn content in the feeds and fodders, nearly one-fourth population of the surveyed animals showed the deficiency of serum Zn content. Mishra (2006) also observed low serum Zn content in 46% of anaoestrus cows of Dhenkanal district of Odisha. The reason might be the effect of season, physiological state of the animals and availability of feeds and fodders. Similar observations were reported by Sarkar *et al*. (1994) and Kawitkar (2004). The average serum Cu concentration of cows in NECPZ was above the critical level (0.65 ppm). Though the average concentration of serum Cu was above the critical level, still 31.6% of the surveyed animals in NECPZ showed lower level than that of the critical level. Although the Cu content in the feeds and fodders of all the zones was at marginally higher level than critical level, deficiency of Cu was observed in the serum of some cows. This might be due to poor biological availability of Cu, which was mostly due to increased lignifications in the fodders of tropical countries and the susceptibility of Cu to form biologically unavailable complexes (Cu-Fe, Cu-Zn, and Cu-phytase), which is also responsible for high incidence of Cu deficiency syndrome, particularly in grazing ruminants (Smith and Akinbamijo 2000). In addition to this, grazing animals may receive substantial amount of Fe by soil ingestion, which could negatively affect absorption of Cu and other elements (Prabowo *et al*. 1989). However, deficiency that observed in present study was reported by various workers in different locations of India. Singh *et al.* (2004) and Tiwary *et al.* (2007) reported deficiency of serum Cu up to some extent in the animals similar to the present findings. The average Mn concentration in the serum of cows in NECPZ was observed to be higher than the critical level. The higher concentration of Mn in feed ingredients and roughages might have been reflected in the serum of animals under investigation. Similar higher levels of serum Mn were reported by Mandal *et al*. (2004) and Tiwary *et al*. (2007). Serum Fe concentration in all the animals of NECPZ was above the critical level even with or without any additional mineral supplementation. This might be due to the abundance

of element Fe in feeds and fodders grown on naturally Fe rich soil. Similar observations were reported by Tiwary *et al.* (2007) and Sukla *et al.* (2010). They reported higher serum Fe concentration of the animals well above the critical level at different locations in India. The higher serum Fe content of the animal is attributed to the reason that temperature (high) and pH (acidic) are among the primary factors affecting Fe availability and uptake by plants. The absence of primary Fe deficiency is a reflection of high Fe content of posture and forages (Underwood 1981). Majority of the tropical soils are acidic, resulting in forage level of Fe in excess of requirement. In addition to this, grazing animals may receive substantial amount of Fe by soil ingestion, which could negatively affect absorption of Cu and other elements (Probowo *et al.* 1989). Thus the serum mineral status of the animals of NECPZ was found to be deficient in P and Ca. Though the mean serum level of Zn and Cu in cattle was observed to be higher than the critical level, still deficiency of these minerals was noticed in the serum of some of the cattle.

Serum biochemical profile of the animals: The average serum glucose level of animals in NECPZ was 43.64±1.49 mg/dl. The average serum glucose content of animals of NECPZ was found lower than the normal range (Kaneko *et al*. 1997). Mishra (2006) also observed low serum glucose level in the anoestrus cows of Dhenkanal district of Orissa. The blood glucose concentration is affected by energy status and reproductive efficiency of animals (Arosh *et al*. 1998). The average cholesterol level of animals in NECPZ was 65.10±2.32 mg/dl. The serum cholesterol content of the animals of NECPZ varied greatly. The probable reason for this might be the type of animals from which blood was collected and with the available feeds and fodders. The average protein level of animals in NECPZ was 4.23±0.12g/dl. The average serum protein level of the animals in NECPZ was observed to be below the normal range (Kaneko *et al*. 1997) with wide range of variation. The low level of serum protein was greatly influenced by the amount of protein intake; therefore, the low level of serum protein in cows might have been induced by the low level of protein fed to these animals (Singh *et al*. 2004). Variations in total protein content might be attributed to differences in feeding practices of animals.

ACKNOWLEDGEMENT

Authors are highly obliged to the All India Coordinate Research Project on "Improvement of feed resources and nutrient utilization in raising animal production" of ICAR, New Delhi, for providing all financial support to carry out this research work.

REFERENCES

AOAC 1995. *Official Methods of Analysis.* 16th edn (Eds). Patricia, AOAC International, USA.

Arosh A J, Kathiresan D, Devanathan T G, Rajasundaram R C and Rajasekharan J 1998. Blood biochemical profile in normal cyclic and anoestrus cows. *Indian Journal of Animal Science* **68**(11): 1154–56.

Das A, Haldar S, Biswas P and Ghosh T K. 2003. Distribution of some major and trace elements in soil, feed, fodder and livestock in red laterite zone of West Bengal. *Indian Journal of Animal Nutrition* **20**(2): 136–42.

Garg M R, Bhanderi B M, Sherasia P L and Singh D K. 1999. Mapping of certain minerals in feeds and fodders in the Mehsana district of Gujarat state. *Indian Journal of Dairy Science* **52**(2): 69–77.

Garg M R, Bhandari B M and Sherasia P L. 2002. Mineral contents of feeds and fodders in Junagarh district of Gujarat. *Indian Journal of Animal Nutrition* **19**(1): 57–62.

Gowda N K S, Prasad C S, Ramana J V and Shivaramaiah M T. 2001. Mineral status of soil, feeds, fodders and animals in coastal agri-eco zone of Karnataka. *Animal Nutrition and Feed Technology* **1**: 97–104.

Kaneko J J, Harvey J W and Bruss M L. 1997. *Clinical Biochemistry of Domestic Animals*. 5th edn. Academic Press. A division of Harcourt Brace & Co., 525 B Street, San Diego, Carlifornia, USA.

Kawitkar S B. 2004. 'Mineral status of Deoni animals in relation to soil feed and fodders in Udgir Taluka of Maharashtra State.' Ph D thesis, MAFSU, Nagpur.

Mandal A B, Yadav P S and Vanita K. 2004. Mineral status of buffaloes under farm feeding condition of Haryana state. *Indian Journal of Animal Nutrition* **21**(2): 104–10.

McDowell L R. 1985. *Nutrition of Grazing Ruminants in Warm climates*. Academic Press. Orlando, Florida.

McDowell L R, Conrad J H and Ellis G L. 1984. *Proceeding of Symposium on herbivorous nutrition in sub-tropics and tropics, problems and prospects*. Pretoria, South Africa. Pp. 67–88.

Mishra S K. 2006. 'Effect of supplementation of minerals on the reproductive performance of cows in Dhenkanal district of Odisha.' Ph.D. thesis, Orissa University of Agriculture and Technology, Bhubaneswar, Odisha.

Prabowo A, Mc Dowell L R, Wilkinson N S, Wilcox C J and Conrad J H. 1990. Mineral status comparisons between grazing cattle and water buffalo in South Sulawesi, Indonesia. *Buffalo Journal* **1**: 17–32.

Prabowo A, Salam R, McDowell L R, Wilkinson N S and Kawashima T. 1989. Effects of soil ingestion and mineral supplementation on performance and mineral utilization in lambs. *Proceeding of international meeting on mineral nutrition and mineral requirements in ruminants*. Kyoto, Japan, 1989.

Senedecor G W and Cochran W G. 1980. *Stastical Methods*. Oxford and IBH publishing Company, Calcutta.

Singh R K. 2010. 'Survey on macro and micro mineral status in industrial belt of Odisha.' Post graduate thesis, Orissa University of Agriculture and Technology, Bhubaneswar, Orissa.

Singh B, Rawal C V S and Singh J P. 2004. Studies on certain serum constituents in anoestrus and repeat breeder buffaloes. *Indian Veterinary Medical Journal* **28**: 261–63.

Singh P, Gupta P C, Sharda D P and Singh P. 1980. Studies on soil-plant-animal relationship of iron in buffaloes of Haryana region. *Indian Journal of Animal Science* **50**(2): 1056–59.

Smith O B and Akinbamijo O O. 2000. Micronutrients and reproduction in farm animals. *Animal Rreproduction Science*

60–61: 549–60.

Sukla S, Tiwar, D P, Mondal B C and Kumar A. 2010. Mineral inter-relationship among soil, plant and animals in Pithoragarh district of Uttarakhand. *Animal Nutrition and Feed Technology* **10**: 127–32.

Tiwary M K, Tiwari D P, Mondal B C and Kumar A. 2007. Macro and micro mineral profile in soils, feeds and animals in Haridwar district of Uttarakhand. *Animal Nutrition and Feed Technology* **7**: 187–95.

Underwood E J. 1981. *The Mineral Nutrition of Livestock* 2nd.edn, Commonwealth Agricultural Bureau, London.

Yadav P S, Mandai A B and Dahiya D V. 2002. Feeding pattern and mineral status of buffaloes in Panipat district of Haryana state. *Animal Nutrition and Feed Technology* **2**: 127–38.