Bang. J. Anim. Sci. 2008, 37 (1) : 44 - 52 ISSN 0003-3588

MICRO MINERAL PROFILE OF CATTLE IN FOUR SELECTED AREAS OF MYMENSINGH DISTRICT

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Abstract

The experiment was undertaken with a view to investigate the micro mineral profile of feed and cattle at four agro-ecological zones (Haluaghat, Nandail, Trishal and Karimgonj upazila) in Mymensingh district. The differences (P>0.05) of copper (Cu), zinc (Zn), iron (Fe) and manganese (Mn) in rice straw, road side grass and fallow land grasses for different land type were not found. The average mineral concentration (ppm) of straw was 6.12, 24.93, 291.3, and 224.9 for Cu, Zn, Fe and Mn respectively. The values for Fe and Mn contents were higher and Cu and Zn contents were lower than the critical value. Both the road side and fallow land grasses contained adequate amount of Cu, Zn, Fe and Mn. The Cu and Zn content of blood serum did not vary significantly (P>0.05) among the cattle of four different land types. Based on 0.65 ppm serum Cu as critical level indicated a higher percentage of samples were below the critical level. Besides, increased incidence of Zn deficiency in medium high land (42%) and very low land (35%) was observed. All samples analyzed 66% were deficient in Cu content and 23% cattle were deficient in Zn. Land type differences (P<0.05) were found for blood serum Fe and Mn. The average Fe concentration in very low land gave significantly (P<0.05) higher value than that of high, medium high and low land. Serum Fe and Mn concentrations of all samples were above the critical level of 1.0 ppm and 20 µg/ml respectively and the animals were not deficient in Fe and Mn. The liver Cu concentration was similar (P>0.05) in four different regions. The overall incidence of liver samples deficient in Cu was 53% for all land types. No significant (P>0.05) difference in liver Zn concentration was recorded among the samples collected from different land types and none of cattle liver samples was deficient in Zn as well as Fe and Mn concentration. From the results of the present study, it is evident that low concentration of Cu and Zn in rice straw reflected in the blood samples of the animals suggesting the need of extra supplementation of these two elements to the cattle feed of Mymensingh district.

Key words : Copper, Zinc, Iron, Manganese, Feed, Cattle

Introduction

Micro mineral deficiency impairs productivity in livestock. Body micro mineral profile, immunity and reproductive functions are directly related, where copper, cobalt, zinc, iodine and manganese are likely to influence these functions. Sometime mineral deficiencies also limit production (McDowell and Conrad, 1977), the most devastating economic results of mineral deficiencies are late puberty of heifers and low reproductive rates of cows associated with prolong calving intervals. Mineral imbalances in soil and forages are found to be responsible for low production and reproduction among

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(Received : June 22, 2008)

ruminants. The extent and pattern of mineral deficiencies/excess in plants vary in different agro-climatic conditions as available mineral content in green vegetation depends on physical and chemical properties of soil, soil erosion, cropping pattern, fertilizer/chemical application, species and genetic variation in plants, stage of maturation, presence of other minerals etc. (McDowell *et al.,* 1993). Mineral concentration in serum or plasma provides an indication of mineral intake by the animal (Underwood, 1977). Studies on soil-plant-animal relationship in respect of minerals are important and have great implication on animal production (Biswas and Samanta, 2002). The animals in Bangladesh are generally fed on crop residues with little or no concentrate supplementation. This could greatly imbalance the micro-nutrients availability to animals and also their utilization (Prasad *et al.,* 1995). The feeding practices vary between different agro-climatic zones (Ramana *et al,* 2000; Ramana *et al.,* 2001; Gowda *et al.,* 2001). The micro mineral contents in feedstuffs are governed by geochemical nature of soil and species of plants, besides the agro-climatic condition. Gowda *et al*. (2001) also found a widespread deficiency of micro mineral in different agro-climatic zones. A several works have been undertaken to find out the micro mineral profile of feeds and cattle in India (Ramana *et al*., 2001; Mandal *et al.,* 2004) and in Indonesia (Prabowo *et al.,* 1991). These information may or may not be appropriate to use in our country. On the other hand, no information regarding the profile of micro mineral contents of feeds and cattle is available in Bangladesh. Therefore, the present study was carried out in four selected areas of Mymensingh districts in order to evaluate the micro mineral profile in cattle of four selected areas of Mymensingh district.

Materials and Methods

Site of the experiment

The experiment was conducted in two phases; the first phase was the collection of feed stuffs and biological samples (blood serum and liver) and the second phase was laboratory analysis of the collected samples. In the first phase of the experiment, Mymensingh district was selected which was located at 24º 75′ N latitude and 90º 50′ E longitude at an altitude of 18 m above the mean sea level. The region occupies a large part of Brahmaputra sediments which are laid down before the river shifted into its present Jamuna channel about 200 years ago. The climate of the locality is sub-tropical in nature and is characterized by high temperature and heavy rainfall during the Kharif season (April to September) and scanty rainfall associated with moderately low temperature during the Rabi season (October to March). The total area of Mymensingh districts is 4363.48 square km.

Collection of samples

Feeds and animal tissue (Blood and liver) samples were collected from four selected areas of Mymensingh district. From each location, one village was taken randomly for sample collection. The area from which the samples were collected was classified on the land type and the characteristics in four agro-ecological zones as described by FSRDP, BAU. Location of the areas in Mymensingh district based on different land type is shown in Table 1.

Detailed survey of feeding practice followed in the experimental area was conducted. Data was collected previously made questionnaire. Representative samples of feeds commonly fed to animals were collected. Animal tissues (blood and liver) from slaughtered animals were also collected for each of the sampling periods from each location. Information about cattle from slaughter house was also collected. Samples (feed, blood, liver etc.) were collected twice during winter season i.e. mid

(December-January) and late (February-March) and the summer season i.e. early (April-May) and late (July-August) from the four agro-ecological zones of Mymensingh district.

Table 1. Sampling location and site

Land types	District	Location	Characteristics
High land	Mymensingh	Haluaghat	Land above normal flood level
Medium high land	Mymensingh	Trishal	Land flooded during monsoon
Low land	Mymensingh	Nandail	Land deeply flooded during monsoon
Very low land	Mymensingh	Karimgonj	Haor area, low lying deeply flooded area

Sample identification, collection procedure and storage

The quantitative measurement for specific mineral content was done following appropriate sampling procedures, adequate identification and application of suitable analytical techniques. Representative samples were collected by avoiding contamination. Sample containers were labeled with a permanent and water proof and smear proof ink. Cleaned containers and stainless steel instruments were used. Samples were contaminated by soil atmospheric dust, harvesting and grinding procedures. Necessary precautions were made to avoid such contamination. The containers (including caps) scrubbed with a brush and were rinsed three times in tap water and finally rinsed with distilled water.

Blood

Blood samples of cattle were collected from the slaughter house when the animal's throat was cut. The blood samples were allowed to clot and centrifuged. Serum was separated and preserved in refrigerated condition for estimation of micro minerals.

Liver

In order to prevent contamination, liver samples were removed immediately from slaughtered animals as soon as the abdomen was opened. Approximately 50-100 g of liver was cut out with stainless steel knife. Every effort was made not to touch the portion of the liver by hand that was used as the sample. The liver samples were preserved in refrigerated condition until further chemical analysis.

Determination of micro minerals

The analysis was carried out in the Animal Nutrition Laboratory of the Department of Animal Nutrition and in the Central Laboratory of Bangladesh Agricultural University, Mymensingh. For the estimation of micro mineral (Fe, Cu, Zn and Mn) contents of feedstuffs, one g of ground sample was taken in a beaker following wet oxidation method as described by Jackson (1973). In case of liver 2 g of samples was taken in the tube. Fifteen ml of nitric acid (HNO_3), 10 ml of per-chloric acid and 5 ml of hydrochloric acid (HCl) (nitric acid, per-chloric acid and hydrochloric acid 3:2:1) were added to a beaker. The beaker was then placed in a digestion chamber and was heated until dense white fume was evolved and the solution became clear. After cooling the beaker, distilled water was added and diluted digesta was filtered through the Whatman filter paper no 42 and its volume were made to 100 ml. The solution was ready for the estimation of Cu, Fe, Zn and Mn. In case of blood serum, 1 ml of serum was measured by micro–pipette and 9 ml of distilled water was added to dilute it up to 10 ml of volume. Copper, zinc, iron and manganese concentration of the digested samples (straw, grasses and biological materials i.e. blood and liver) were determined by atomic absorption spectrophotometry (Unicam, 1969) after dilution with double distilled water.

Statistical analysis

All the experimental data were analyzed using "MSTAT" statistical program to compute analysis of variance (ANOVA) for a completely randomized design (CRD). Duncan's New Multiple Range Test (DMRT) was done to identify significant variation among the treatment means.

Results

Micro minerals content in feedstuffs

Micro mineral contents of straw, roadside grass and fallow land grasses related to land type are shown in Table 2. Land type differences (P>0.05) for Cu, Zn, Fe and Mn contents in rice straw, roadside and fallow land grasses were not found. In the present investigation, on an average, straw contained 6.12 ppm Cu, 24.93 ppm Zn, 291.3 ppm Fe and 224.9 ppm Mn, respectively. The values for Fe and Mn are well above the critical value while the values of Cu and Zn were lower than critical value (Table 4). The observation revealed that the roadside and fallow land grasses collected from four agro-ecological zones of this district are adequate in micro minerals (Cu, Zn, Fe and Mn).

Table 2. Micro mineral contents of rice straw and grasses collected from four selected areas of Mymensingh district

Feedstuffs	Micro-Minerals* (ppm)	Agro-ecological Zones				Level of significance
		Haluaghat (High land)	Trishal (Medium high land)	Nandail (Low land)	Karimgonj (Very low land)	
Rice straw	Cu	5.71±1.12	8.35±2.85	9.18±2.71	6.25±3.26	NS
	Zn	28.21±6.12	22.15±8.18	29.11±6.71	20.25±3.22	NS
	Fe	237.1±39.1	178.5±28.8	339.2±42.7	410.2±63.2	NS
	Mn	219.7±43.1	188.3±62.8	181.1±39.7	310.5±53.2	NS
Road side grass	Cu	12.71±3.19	18.35±3.81	15.18±6.72	19.25±4.23	NS
	Zn	19.61±8.12	28.52±2.84	39.81±12.7	40.55±8.21	NS
	Fe	691.7±38.1	1008.3±62.8	989.2±72.7	692.5±53.2	NS
	Mn	136.1±37.1	108.5±25.8	97.8±22.7	109.5±31.2	NS
Fallow land grass	Cu	29.71±3.10	28.35±4.81	23.18±1.70	30.25±3.60	NS
	Zn	33.57±5.61	25.42±8..32	38.44±4.85	26.75±10.68	NS
	Fe	804.6±27.81	1081.7±40.41	1143.1±42.1	618.9±14.52	NS
	Mn	125.4±10.40	102.17±5.67	83.15±9.92	93.41±7.84	NS

NS Non significant (P>0.05), * Average of 12 samples

Micro minerals content of blood serum

The average values for micro mineral content of blood serum as related to land type are shown in Table 3. The Cu content of blood serum was not varied significantly (P>0.05) among the cattle of different four regions. Animal slaughtered from different four selected areas showed that blood serum Cu concentration (ppm) was 0.34±0.21, 0.42±0.09, 0.51±0.11 and 0.49±0.10 in high land, medium high land, low land and very low land, respectively. Individual evaluation of samples based on the 0.65 ppm serum Cu as critical level (McDowell, 1985) indicated a higher percentage of samples below the critical concentration in all land types. The percentages for high, medium high, low and very low lands were 90, 63, 51 and 60 respectively. Of all samples analysed, 66% were deficient in Cu content (Table 4).

From the Table 3, it is evident that the average zinc content in blood serum for high, medium high, low and very low land was 0.81±0.21, 0.66±0.15, 0.91±0.21 and 0.71±0.12 ppm, respectively and the difference was not significant (P>0.05) in Zn concentration among four selected areas of Mymensingh district. The average serum Zn values in all land type were just above 0.50 ppm suggested by McDowell (1985) as the critical level. Individual evaluation of samples indicated an increased incidence of Zn deficiency in medium high land (42%) and very low land (35%). A total of 48 serum samples measured, 23% were below the critical level (Table 4).

Table 3. Micro-mineral composition of blood serum and liver samples related to land type

Trace minerals (ppm)	Agro-ecological zones				SED	Level of significance
	High land	Medium high land	Low land	Very low land		
Blood serum						
Cu	0.34±0.21	0.42±0.09	0.51±0.11	0.49±0.10	0.11	NS
Zn	0.81±0.21	0.66±0.15	0.91±0.21	0.71±0.12	0.23	NS
Fe	11.30^{b}±2.21	8.39^{c}±1.3	9.93^{bc}±2.2	14.41^{a}±3.1	0.57	*
Mn	0.51^{c}±0.21	0.69^{a}±0.39	0.61^{b}±0.21	0.71^{a}±0.19	0.02	*
Liver						
Cu	82.1±11.21	76.7±10.30	99.0±20.20	71.0±11.10	10.5	NS
Zn	168.0±24.2	160.39±30.3	141.6±26.2	147.3±13.0	9.8	NS
Fe	191.6^{c}±22.3	326.8^{a}±40.3	213^{c}±37.71	257.4^{b}±46.3	13.6	*
Mn	14.31±2.21	24.39±8.37	21.29±8.37	18.41±6.10	3.92	NS

^{NS} Non significant (P>0.05), * Significant (P<0.05)
^{abc} Means with different superscripts(s) in the same row differ significantly (P>0.05)

Land type differences (P<0.05) were found for blood serum Fe content (Table 3). The Fe concentration in very low land gave significantly (P<0.05) higher values than those in high, medium high and low land. The difference between the results of high, medium high and low land was not significant (P>0.05). None of the cattle blood sample analysed were deficient in Fe based on a critical level of 1 ppm as suggested by McDowell (1985).

As indicated in Table 3, the serum Mn content in high, medium high, low and very low land were 0.51±0.21, 0.69±0.39, 0.61±0.21, 0.71±0.19 ppm respectively. The highest value was observed at very low land and lowest in high land. The results showed that there was a significant (P<0.05) difference among the regions in serum Mn content. Serum Mn concentration of all samples were above the critical level of 20 µg/ml (McDowell, 1985) and the animals were not deficient in Mn.

Micro mineral contents in liver

The liver micro mineral (Cu, Fe, Mn and Zn) concentrations and the percentages of liver samples deficient in micro mineral concentration are presented in Table 3 and 4. The Cu concentration did not vary significantly (P>0.05) among the four regions of Mymensingh district. The values showed that the Cu concentrations of liver of high, medium high and low land were higher than the critical level. The average liver Cu concentration in very low land was below the critical level of 75 ppm (McDowell, 1985). Individual evaluations of samples from high, medium high, low and very low land indicated that 40, 87, 21 and 65% of the samples analysed were deficient. The overall incidence of liver samples deficient in Cu was 53% for all land types (Table 4).

Table 4. Percentage of blood serum and liver samples deficient in micro minerals related to land type

Trace minerals	Critical level*	Agro-ecological zones				Overall
		High land	Medium high land	Low land	Very low land	
Blood serum						
Cu (ppm)	<0.65	90[c]	63[c]	51[c]	60[c]	66[c]
Zn (ppm)	<0.50	10[c]	42[c]	15[c]	35[c]	23[c]
Fe (ppm)	<1.0	0.0	0.0	0.0	0.0	0.0
Mn (µg/ml)	<20	0.0	0.0	0.0	0.0	0.0
Liver						
Cu (ppm)	<75.0	40[c]	87[c]	21[c]	65[c]	53[c]
Zn (ppm)	<84.0	0.0	0.0	0.0	0.0	0.0
Fe (ppm)	<180.0	0.0	0.0	0.0	0.0	0.0
Mn (ppm)	<6.0	0.0	0.0	0.0	0.0	0.0

* Concentration below which is deficient (McDowell, 1984)
[c] Concentration below the critical level indicates deficiency (McDowell, 1985)

From the Table 3, it is evident that the highest value (168 ppm) of Zn content of liver was found in high land followed by 160.39±30.3, 147.3±13, 141.6±26.22 ppm in medium high, very low and low land, respectively. Zinc concentration was not significantly (P>0.05) different among the land types. None of cattle liver samples analysed was deficient in Zn (Table 4). The results showed that there was significant (P<0.05) difference among the regions in Fe content of liver. The Fe concentration was significantly (P<0.05) higher in medium high land than other land type. High and low land did not differ (P>0.05) significantly in terms of Fe content. The incidence of samples below the critical level of 180 ppm (McDowell, 1985) for all land type was not found.

The mean values of Mn in liver samples were 14.31±2.21, 24.39±8.37, 21.29±8.37 and 18.41±6.10 ppm in high land, medium high land, low land and very low land respectively. However, liver Mn concentration was similar (P>0.05) in all land type. The average values for all land type were much greater than the critical level of 6 ppm suggested by McDowell (1985). No samples were deficient in Mn content (Table 4).

Discussion

The present study was designed to provide information about the micro mineral content of some common feedstuffs and cattle at four agro-ecological zones in Mymensingh district. Detailed survey of feeding practice followed in the selected area was conducted. The survey of feeding practice in the selected area revealed that cattle were maintained on grazing for 7-8 h/day. The grazing land includes fallow land, roadside etc. Feeding of dry roughage like rice straw is common practice. Samples of feed fed to animal and animal tissue (blood and liver) from four agro-ecological zones were collected for estimation of micro minerals (Cu, Fe, Zn and Mn).

In the present investigation, micro mineral concentration of rice straw, road side and fallow land grasses were not significantly different (P>0.05) among the four agro-ecological zones. The average micro mineral concentrations of straw were 6.12, 24.93, 291.3 and 224.4 ppm for Cu, Zn, Fe and Mn, respectively. These results are in conformity with the work conducted in India by Samanta and Samanta (2002). They showed that the rice straw contained 9.68, 33.12 405.1 and 296 ppm of Cu, Zn, Fe and Mn, respectively. In case of Fe, higher value was obtained by Ramana *et al*. (2001) who found 447 ppm of iron in straw. Similar results were also reported by Kalita *et al*. (2003) who found 7.53, 27.54, 88.11 and 224.58 ppm of Cu, Fe, Zn and Mn, respectively in rice straw. In the present study straw is found to be deficient in Cu and Zn content.

Micro minerals content of road side and fallow land grasses collected from four different selected areas of Mymensingh district showed a higher concentration of micro mineral and no significant (P>0.05) difference was observed among the four agro-ecological zones. Road side grasses contained on an average value of 16.37 ppm of Cu, 32.12 ppm of Zn, 845 ppm of iron and 113 ppm of Mn, respectively. The average micro mineral concentration of fallow land grasses was 27.9, 31.0, 987.0 and 101.0 ppm of Cu, Zn, Fe and Mn, respectively. The concentration recorded in this experiment coincides with the work conducted by Ramana *et al*. (2001). They observed that mixed local grasses contained 63.05, 88 and 2242 ppm of Cu, Zn and Fe, respectively, which were above the normal critical level. Higher concentration of Cu (52.40 ppm), Zn (39 ppm) and Fe (211 ppm) in local weeds were also recorded. In another experiment, Ramana *et al*. (2000) reported that local weeds contained 40, 74 and 1066 ppm of Cu, Zn and Mn respectively.

Blood serum of cattle collected from four different selected areas of Mymensingh district was observed. No significant (P>0.05) difference were observed among the land type for Cu and Zn. However, cattle from medium high land had lower (P<0.05) serum Fe concentration, while that of high land had lower (P<0.05) Mn content than those from other zones (Table 3). Individual evaluation of samples based on the critical levels (McDowell, 1985) indicated a higher percentage of samples were below the critical levels in high land. Out of total samples analysed, 10, 42, 15 and 35% were deficient in Zn content in high, medium high, low and very low land, respectively (Table 3). From the blood serum analysis, it was observed that Cu and Zn were deficient in all four different areas. These results are in line with the results on roughage analysis. Where, the highest incidence of low Cu and Zn concentration was found. Serum Cu and Zn deficiency were also reported by Prabowo *et al.* (1991). Conrad (1978) indicated that serum micro mineral concentration markedly reduced with severely deficient diets, although concentrations were not greatly influenced by marginally deficient diets. Fe and Mn were not deficient in any land types. Incase of serum Fe and Mn, it has been observed that the individual sample variation is too high. This variation may be due to a small numbers of samples collected. This may be minimized if a large number of samples are collected for analysis.

Micro mineral deficiency is associated with a decline of the element in liver. So, liver mineral concentration could provide a useful index of the micro mineral profile of the animals. Liver Cu and Zn concentration were similar (P>0.05) for all four agro-ecological zones. Cattle from very low land had apparently low liver Cu. The average liver Cu concentration in the very low land was below the critical level of 75 ppm (McDowell 1985). The overall percentage of Cu deficient in liver samples was 53. None of the cattle liver samples analyzed were deficient in Zn based on a critical level of 84 ppm (McDowell 1985). The Fe and Mn concentration of the present experiment were higher than the critical level (180 and 6 ppm, respectively). However, land type difference (P<0.05) was observed for liver Fe concentration. There was no significant (P>0.05) difference among the regions in terms of Mn contents. Prabow *et al*. (2000) studied the micro mineral concentration in liver in western regions of Indonesia. They showed liver contained 72, 363, 9.2, and 119 ppm of Cu, Fe, Mn and Zn, respectively. From the results of the liver analysis for micro mineral concentration only liver Cu was deficient in all land types of Mymensingh district.

Rice straw was found to be the main sources of roughages in the ration of cattle in four selected areas of Mymensingh district. Cu and Zn content was recorded consistently low in straw in four selected areas of Mymensingh district. Low concentration of Cu and Zn in rice straw reflected in blood samples of the animals suggesting the need of extra supplementation of these two elements to the cattle of Mymensingh district. If the feed containing high concentration of Zn and Cu i.e. are fed to the cattle along with straw of that area, the deficiency of Zn and Cu in the blood may not be observed. Therefore, supplementation of Cu and Zn either in feed containing higher amount of these two elements (Cu and Zn) or in synthetic form may be suggested of those selected areas of Mymensingh district.

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