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The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.03
TPI 2019; 8(4): 942-947

www.thepharmajournal.com
Received: 22-02-2019
Accepted: 23-03-2019

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Plasma micro mineral status of dairy animals in relation to soil-plant-mineral status

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Abstract
The study was conducted in Bathinda district of Punjab to assess the micro mineral profile i.e. Mn, Cu, Zn, Fe, Mo, I and F of the dairy animals and in relationship to soil and plants. Based on plasma analysis a high incidence of sub-clinical deficiencies of Cu and Zn was observed in both cattle and buffaloes. However, the plasma Mo level was within the safe limit, and the incidence of molybdenosis was very low. Incidence of fluorosis in both cattle and buffaloes were found to be high and high fluoride levels were also observed in water samples. Mean values of Mn, Cu and Zn in the fodder samples were lower than the dietary requirement. Soil samples revealed deficiency of Mn and Fe. Based on the findings it was concluded that mineral mixture supplementation is required in these areas to prevent sub- clinical deficiencies of various micro minerals and to maintain the proper production status of dairy animals. The variation observed in the concentration of mineral elements in forages and soil samples could be due to number of factors including soil pH, plant species, stages of maturity, yield, climate and protein content of forage, which needs further study to understand the main factor causing such variation.

Keywords: Cattle, buffaloes, plasma micro minerals, fodder, soil

Introduction
The common sources of mineral nutrients for the dairy animals are forages, feed stuff, soil, drinking water and mineral supplements. Imbalances in the supply of inorganic elements from dietary sources can have an important influence on animal health and susceptibility to diseases. Cropping pattern, soil type, rainfall and feeding system varies in different agro-climatic conditions and hence the extent and type of mineral deficiency is likely to be different (Ramana *et al.* 2001; Garg *et al*. 2005) [15, 7]. Besides primary mineral deficiency, sometimes excess of certain minerals may also interfere with the availability of other nutrient causing secondary deficiency. It is now confirmed that Mo induces Cu deficiency in sheep and cattle (McDowell, 2003) [10]. Some of the minerals are toxic and excess may be fatal (McDowell and Arthington, 2005) [12]. For example, chronic fluoride exposure is a serious health hazard for both men and animal. Interaction of fluoride with other minerals possibly plays a role in pathogenesis of chronic fluoride intoxication in cattle (Ranjan *et al.* 2008) [16]. Most of the nutritional disorders are difficult to diagnose with certainty, as the cardinal signs are not manifested. Hence, by evaluating the mineral status of the soil, forages and animal, it will be possible to assess nutritional constraints limiting productivity and impairing the health of the livestock.

Materials and methods
The present study was conducted to assess the micro mineral profile of the dairy animals of Bathinda district of Punjab and in relationship to soil and plants.
A total of 227 crossbred cattle and 358 buffaloes were sampled during the period from August 2010 to June 2011. 128 fodder and 128 soil samples were also collected simultaneously from all the dairy units. Blood plasma, fodder and soil samples were analysed for Mn, Cu, Zn, Fe, I, Mo and F. Water samples were also analysed for F and I level.
For the estimation of plasma micro minerals, approximately 15 to 20 ml whole blood was collected by jugular venipuncture in heparinised mineral free glass vials (dipped overnight in 30 per cent nitric acid and then washed with double distilled water).Plasma was then separated for mineral estimation by centrifugation (3000 rpm for 15 minutes) and was stored at -10^{o}C temperature in deep freezer for subsequent analysis.
Two milliliter of plasma sample was digested on hot plate in one cycle of 10 ml double glass distilled concentrated nitric acid (E. Merck India Ltd. Mumbai) and then in one cycle of 2.0 ml

hydrogen peroxide (E. Merck India Ltd., Mumbai). The volume of the resultant digestate was made 10.0 ml with double glass distilled water. The fodder samples were air dried for few days; then dried in hot air oven at 65°C overnight. Then 0.5g of each ground fodder sample was digested on hot plates in 6ml of concentrated double glass distilled concentrated nitric acid (E. Merck India Ltd., Mumbai) and 2ml perchloric acid (E. Merck India Ltd., Mumbai). The volume of the resultant digestate was made 10.0 ml with double glass distilled water.

The soil samples were air dried and digested using Ammonium Bicarbonate DTPA Soil Extraction procedure in which 10 gm of the well dried and finely ground soil sample was added to 20 ml of NH_4HCO_3- DTPA solution filtered through medium size filter paper and 2.5 ml of concentrated HNO_3 was added to 2.5 ml of NH_4HCO_3-DTPA extract. Concentrations of various micro minerals viz., Mn, Cu, Zn, Fe and Moin plasma, fodder and soil samples were measured by Inductively Coupled Argon Plasma (ICAP) spectrometry.

F and I level in plasma and water samples were estimated by using Digital Ion-analyzer (Orion 4 Star pH. ISE Benchop) equipped with fluoride and iodide specific electrodes.

The statistical significance of the differences among mean (one way analysis of variance) was compared by using SPSS for Windows (version 16.0; Microsoft).

Results and discussion

The mean plasma Mn level in crossbred cows (Table 1) was slightly below the normal level as per Radostits *et al.* (2000) [17], this could be due to wide range in the plasma Mn level in cattle i.e. from 0.04 to 0.92ppm (0.73 to 16.74µmol/l). The Mn levels had been reported to vary considerably in normal cows due to analytical inadequacy (Hidiroglou, 1979) [8], dietary concentration and individual variability (Underwood 1981) [22]. Age wise a significant higher level of plasma Mn level was observed in mature animal (3-6 and >6 years age groups) in both crossbred cattle and buffaloes (Table 2). Das *et al.* (1997) [6] also observed higher values of Mn in adult cattle as compared to calves of <1year of age from New Alluvial zone of West Bengal. Keeping into consideration the critical level of 0.37µmol/l in plasma as recommended by Hidiroglou (1979) [8], overall prevalence of Mn deficiency recorded in the present study was 7.11 per cent among the crossbred cows and 3.52 per cent in buffaloes. Age wise higher incidence of Mn deficiency was observed in age group of <3 years in cattle, on the contrary in buffaloes a higher incidence was seen in age group of >6 years of age. The overall mean value of Mn in the fodder samples from Bathinda district was 29.84 ± 2.33ppm (Table 3), which was comparable to the critical value of 30 ppm as quoted by McDowell (2003) [10]. The incidence of Mn deficiency in fodder samples was 59.52 per cent. Overall mean Mn level in the soil samples from all the blocks of Bathinda district was 7.80ppm (Table 4) which was also below the critical limit of 10ppm.

Mean plasma copper concentration in cattle and buffaloes were within the normal range of 9.5-23.6µmol/l as stated by

Table 1: Plasma micro mineral concentration in dairy animals of various blocks of Bathinda district (Mean±SE)

Cattle							
Block	**Mn (ppm)**	**Cu (ppm)**	**Zn (ppm)**	**Fe (ppm)**	**Mo (ppm)**	**F (ppm)**	**I (ppm)**
Phul	0.73±0.01^{a}	0.53±0.05^{a}	1.63±0.24^{a}	3.79±0.22^{a}	0.15±0.03^{c}	0.15±0.02^{b}	2.03±0.08^{c}
Rampura	0.08±0.01^{a}	0.52±0.04^{a}	2.2±0.44^{a}	6.32±0.69^{ab}	0.03±0.01^{a}	0.13±0.01^{ab}	1.46±0.12^{ab}
Bhakta Bhaika	0.04±0.004^{a}	0.45±0.05^{ab}	1.36±0.11^{a}	4.61±0.58^{ab}	0.05±0.01^{ab}	0.11±0.01^{a}	1.48±0.13^{ab}
Sangat	0.07±0.01^{a}	0.45±0.07^{ab}	1.98±0.29^{a}	4.99±0.52^{ab}	0.05±0.01^{ab}	0.13±0.01^{ab}	1.92±.21^{bc}
Bathinda	0.92±0.14^{b}	3.22±0.97^{c}	0.96±0.36^{a}	7.21±0.93^{b}	0.11±0.01^{c}	0.15±0.01^{ab}	1.93±0.14^{bc}
Maur	0.07±0.01^{a}	0.45±0.07^{abc}	0.77±0.31^{a}	6.95±1.30^{b}	0.10±0.01^{ab}	0.11±0.01^{ab}	1.68±0.41^{abc}
Talwandi Sabo	0.09±0.03^{a}	0.63±0.05^{abc}	2.51±0.91^{a}	5.31±1.07^{ab}	0.06±0.01^{ab}	0.14±0.01^{ab}	1.25±0.11^{a}
Nathan	0.06±0.01^{a}	0.79±0.07$_{bc}$	1.73±0.15^{a}	7.02±1.35^{b}	0.07±0.01^{abc}	0.15±0.01^{ab}	1.23±0.17^{a}
Overall	0.17±0.03	0.88±0.13	1.73±0.19	5.73±0.34	0.08±0.01	0.14±0.01	1.61±0.06
Buffaloes							
Phul	0.09±0.03^{a}	0.55±0.04^{a}	1.70±0.19^{a}	4.24±0.55^{a}	0.16± 0.04^{b}	0.14±0.01^{ab}	0.63±0.07^{ab}
Rampura	0.09±0.01^{a}	0.68±0.03^{a}	1.57±0.10^{a}	5.36±0.27^{a}	0.02±0.004^{a}	0.16±0.01^{b}	0.43±0.04^{a}
Bhakta Bhaika	0.06±0.01^{a}	0.56±0.07^{a}	1.75±0.21^{a}	4.61±0.58^{ab}	0.07±0.02^{b}	0.12±0.01^{a}	0.60±0.10^{ab}
Sangat	0.07±0.01^{a}	0.85±0.25^{ab}	2.23±.25^{a}	4.99±0.52^{ab}	0.05±0.01^{b}	0.14±0.01^{ab}	1.24±0.22^{c}
Bathinda	0.99±0.15^{b}	1.66±0.29^{c}	0.82±0.12^{a}	7.40±1.46^{ab}	0.09±0.01^{b}	0.15±0.01^{ab}	0.71±0.07^{ab}
Maur	0.11±0.02^{a}	0.60±0.05^{a}	1.10±0.14^{a}	6.23±0.40^{ab}	0.08±0.01^{b}	0.16±0.01^{a}	1.03±0.22^{bc}
Talwandi Sabo	0.06±0.01^{a}	1.21±0.29^{bc}	3.70±1.84^{b}	6.29±1.77^{ab}	0.07±0.02^{b}	0.16±0.01^{b}	0.80±0.12^{abc}
Nathan	0.07±0.01^{a}	0.98±0.15^{ab}	1.76±0.16^{a}	5.33±0.51^{a}	0.07±0.01^{b}	0.22±0.02^{c}	1.06±0.18^{bc}
Overall	0.19±0.03	0.87±0.06	1.73±0.17	6.55±0.56	0.07±0.01	0.16±0.004	1.04±0.06^{ab}

Values bearing different superscripts in a column differs significantly ($p< 0.05$)

Table 2: Plasma micro mineral concentration in dairy animals of various age groups of Bathinda district (Mean±SE)

Cattle							
	Mn (ppm)	**Cu (ppm)**	**Zn (ppm)**	**Fe (ppm)**	**Mo (ppm)**	**F (ppm)**	**I (ppm)**
<3 years	0.07±0.01^{a}	0.86±0.25^{a}	2.76±1.34^{a}	4.78±0.39^{a}	0.10±0.02^{b}	0.12±0.01^{a}	1.73±0.13^{a}
3-6 years	0.24±0.04^{b}	0.95±0.10^{a}	1.62±0.29^{a}	6.64±0.70^{a}	0.07±0.01^{ab}	0.14±0.01^{ab}	1.67±0.08^{a}
<6 years	0.24±0.05^{b}	0.83±0.16^{a}	1.55±0.16^{a}	5.18±0.64^{a}	0.09±0.01^{a}	1.67±0.08^{c}	1.47±0.10^{a}
Buffaloes							
<3 years	0.1±0.01^{a}	0.55±0.04^{a}	1.62±0.17^{a}	4.53±0.30^{a}	0.10±0.02^{a}	0.13±0.01^{a}	1.11±0.21^{a}
3-6 years	0.22±0.04^{b}	0.94±0.10^{b}	1.81±0.14^{a}	7.89±1.13^{b}	0.10±0.01^{a}	0.15±0.005^{a}	0.79±0.06^{a}
<6 years	0.22±0.04^{b}	0.90±0.11^{b}	1.84±0.40^{a}	5.73±0.64^{ab}	0.10±0.01^{a}	0.17±0.01^{b}	0.76±0.09^{b}

Values bearing different superscripts in a column differs significantly ($p< 0.05$)

McDowell (1992) [11]. These values were in agreement with those of Singh *et al.* (2003) [19] and Singh *et al.* (2004) [18]. There was no influence of age on plasma Cu levels and a higher mean Cu level was observed in age group of 3-6 years in both crossbred cattle and buffaloes. Chhabra *et al.* (2007) [4] also reported no influence of age on plasma Cu levels. The overall incidence of Cu deficiency from all the eight blocks of Bathinda was 57.74 per cent in crossbred cows and 47.63 per cent in buffaloes. Age wise a higher prevalence of Cu deficiency was observed in <3years age group in both the species. The mean Cu levels in fodder samples of almost all the blocks (5 out of 8) were lower than the dietary requirement of 10ppm as recommended by NRC (1988). The overall mean fodder Cu concentration in Bathinda district (8.15±0.69 ppm) was below the critical value of 10 ppm as quoted by McDowell (2003) [10]. Incidence of Cu deficiency in fodder samples was found to be 68.25 per cent. Contrary to the fodder samples, the soil samples had a mean Cu level of 2.25 ± 0.11 ppm which was above the critical limit of 0.5ppm.

Table 3: Fluoride and iodide level in water samples from various blocks of Bathinda district (Mean ± SE)

Blocks	Water samples	
	Fluoride level in water (ppm)	Iodide level in water (ppm)
1.Bathinda	1.23 ±0.32	0.26±0.06
2.Phul	1.07±0.27	0.044±003
3.Rampura	1.21±0.16	0.19±0.04
4.Bhakta Bhaika	1.17±0.30	0.12±0.05
5. Maur	1.75±0.26	0.19±0.03
6.Talwandi Sabo	1.40±0.26	0.10±0.02
7.Sangat	0.91±0.18	0.36±0.06
8. Nathana	1.41±0.38	0.08±0.01
Overall mean	1.26±0.27	0.17±0.02

Table 4: Micro mineral concentration in fodder samples from different blocks of Bathinda districts (Mean± SE)

Blocks	Mn (ppm)	Cu (ppm)	Zn (ppm)	Fe (ppm)	Mo (ppm)
Bathinda	52.23 ± 3.02^{de}	14.01 ± 1.92^{c}	31.21 ± 2.55^{bc}	468.73 ± 44.20^{bcd}	2.83 ± 0.39^{ab}
Rampura	40.21 ± 5.53^{cd}	11.97 ± 2.24^{c}	31.63 ± 3.42^{bc}	360.07 ± 50.66^{abcd}	2.82 ± 0.86^{ab}
Phul	13.53 ± 1.86^{ab}	4.01 ± 0.36^{ab}	20.20 ± 2.27^{ab}	159.28 ± 24.40^{ab}	0.85 ± 0.13^{a}
BhagtaBhaika	59.76 ± 14.42^{e}	11.87 ± 2.43^{c}	31.18 ± 4.02^{bc}	673.812 ± 156.65^{cd}	6.01 ± 2.07^{c}
Maur	36.38 ± 2.92^{c}	9.00 ± 1.82^{bc}	40.24 ± 10.26^{c}	540.026 ± 183.63^{d}	8.85 ± 1.02^{d}
Talwandi Sabo	21.82 ± 3.02^{b}	5.07 ± 1.16^{ab}	15.55 ± 2.17^{ab}	302.49 ± 59.72^{abc}	5.31 ± 0.65^{bc}
Sangat	10.13 ± 1.34^{ab}	5.83 ± 1.16^{ab}	21.749 ± 3.35^{abc}	137.17 ± 25.64^{ab}	1.19 ± 0.19^{a}
Nathana	1.62 ± 0.16^{a}	1.77 ± 0.45^{a}	5.56 ± 0.66^{a}	16.82 ± 3.11^{a}	0.52 ± 0.09^{a}
Overall mean	29.84±2.33	8.15±0.69	25.71±2.24	340.46±41.51	3.84±0.39

Values bearing different superscripts in a column differs significantly ($p< 0.05$)

Overall mean plasma Zn concentration was estimated to be 1.73±0.19ppm (26.46±2.9µmol/l) in cattle and 1.73±0.17ppm (26.45±2.60µmol/l) in buffaloes which were considerably higher than the normal range of 0.80-1.19ppm (12.2 to18.2µmol/l) as quoted by Radostits *et al.* (2000) [17]. Average value of plasma Zn, reported by Tiwary *et al.* (2010) [21] from Haridwar district of Uttarakhand was also similar to the present finding i.e. 1.54±0.11ppm (23.55±1.68µmol/l). There was non- significant decrease in Zn plasma level with advancing age in crossbred cattle. On contrary, in buffaloes there was increase in Zn level with advancing age although it was non-significant as well. The overall prevalence of Zn deficiency in cattle and buffaloes of Bathinda district was 19.67 and 19.06per cent, respectively. Age wise a higher prevalence of Zn deficiency was observed in <3years age group in crossbred cattle (25 %) and in buffaloes a higher incidence was observe in 3-6 years age group (47.97%). The overall mean value of Zn in the forages from Bathinda district was 25.70 ± 2.24ppm and it was below the critical value of 30 ppm stated by McDowell (2003) [10]. A significant difference in Zn level of fodder samples from various blocks was observed (Table 4). 71.43 per cent of the samples had Zn concentration below 30 ppm in the district. Similar result was observed by Mircha (2009) [13] who reported a prevalence of 73.1 per cent. The soil samples had a mean Zn concentration of 4.30 ppm which was above the critical limit of 1.5ppm.

Overall mean plasma Fe concentration of crossbred cows and buffaloes (Table 1) was higher than that stated by Radostits *et al.* (2000) [17] i.e. 1- 2ppml. Das *et al.* (1997) [6] and Singh *et al.* (2003) [19] also reported high mean values of plasma Fe in dairy animals. No consistent pattern in the level of Fe with advancing age was observed in both cattle and buffaloes as shown in Table 2. The mean level of iron in fodder and soil samples was 340.46±41.51 and 28.21±2.28 ppm, respectively which was considerably elevated as compared with the dietary requirement of 50 ppm in fodder NRC (1988) [14] and 4.5ppm in soil (Soltanpour 1985) [20]. Observance of high plasma Fe were.

Table 5: Micro mineral concentration in soil samples from different blocks of Bathinda districts (Mean± SE)

Blocks	Mn (ppm)	Cu (ppm)	Zn (ppm)	Fe (ppm)	Mo (ppm)
Bathinda	8.33 ± 0.49^{b}	2.05 ± 0.22^{bc}	3.67 ± 0.65^{a}	38.86 ± 6.41^{de}	0.12 ± 0.01^{b}
Rampura	8.25 ± 1.20^{b}	2.15 ± 0.21^{c}	5.48 ± 1.61^{ab}	24.43 ± 3.75^{bcd}	0.05 ± 0.01^{a}
Phul	9.88 ± 0.58^{b}	3.16 ± 0.26^{d}	5.04 ± 0.50^{a}	50.71 ± 10.43^{e}	0.04 ± 0.01^{a}
BhagtaBhaika	8.60 ± 0.76^{b}	3.25 ± 0.29^{d}	5.06 ± 1.01^{a}	37.57 ± 6.54^{cde}	0.06 ± 0.01^{a}
Maur	4.39 ± 0.52^{a}	1.41 ± 0.18^{ab}	2.70 ± 0.48^{a}	16.64 ± 4.07^{ab}	0.05 ± 0.01^{a}
Talwandi Sabo	3.01 ± 0.53^{a}	0.94 ± 0.12^{a}	1.15 ± 0.17^{a}	6.72 ± 1.27^{a}	0.05 ± 0.01^{a}
Sangat	13.03 ± 2.00^{c}	2.43 ± 0.21^{c}	2.68 ± 0.36^{a}	20.96 ± 4.06^{abc}	0.16 ± 0.02^{c}
Nathana	8.73 ± 0.72^{b}	3.29 ± 0.39^{d}	9.40 ± 3.51^{b}	37.88 ± 5.19^{cde}	0.10 ± 0.02^{b}
Overall mean	7.80±0.42	2.25±0.11	4.30±0.52	28.21±2.45	0.08±0.01

Values bearing different superscripts in a column differs significantly ($p< 0.05$)

supported by observations of high incidence of hypocupraemia resulting in presences of more of unused plasma iron and also presences of considerably high iron concentration in both fodder and soil. The overall prevalence of Fe deficiency was only 1.67 per cent in crossbred cows whereas in buffaloes not even a single incidence of deficiency was observed.

The overall mean plasma I level in crossbred cattle was1.61±0.06ppm and in buffaloes it was 1.04±0.06ppm. In both cattle and buffaloes an age dependent decline in plasma I level was observed. Hence, a higher plasma I concentration was observed in <3 years age group (Table 2). Keeping >2ppm as the normal level (Carleton *et al*, 2008) [3] the overall prevalence of I deficiency in cattle and buffaloes from all the eight blocks of Bathinda district was 58.85 and 92.54 per cent. Analysis of water samples also revealed that the mean I water level in Bathinda district was 0.17±0.02ppm, Table 3. Mahesh *et al*. (1990) [9] also reported that the I content of water from East Godawari and BhaigaChak (MP) where incidence of goiter was 49 and 45 per cent, respectively had a mean I water level of 8-79 (0.008-0.079ppm) and 5-7ppb (0.05-0.07ppm), respectively.

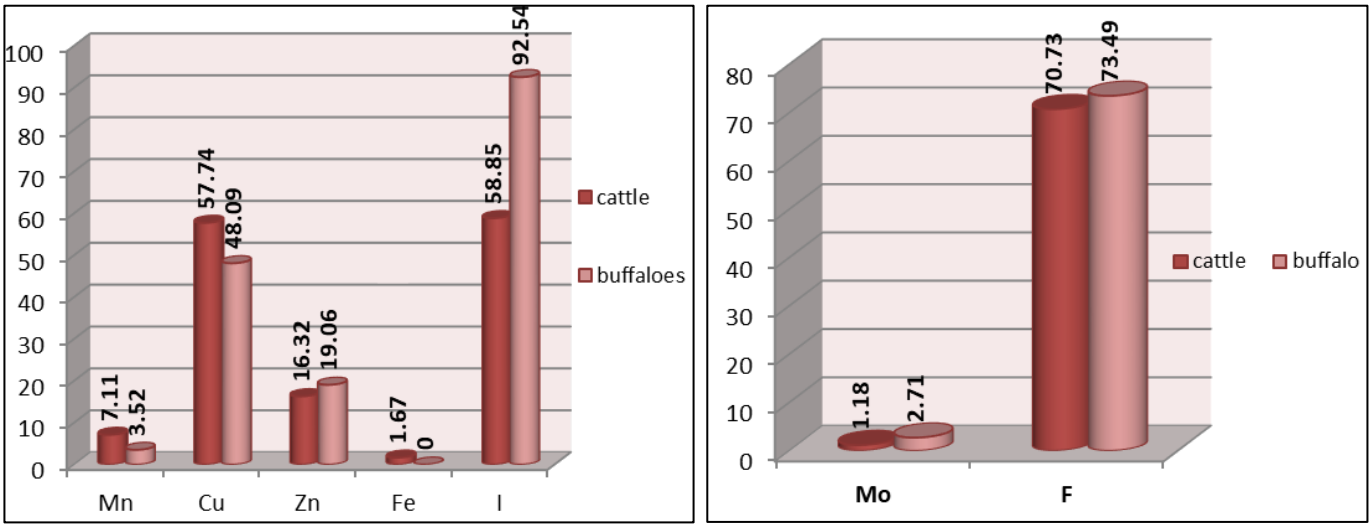

Fig 1: Prevalence of Mn, Cu, Zn, Fe and I deficiencies and Mo and F toxicities in dairy animals of Bathinda

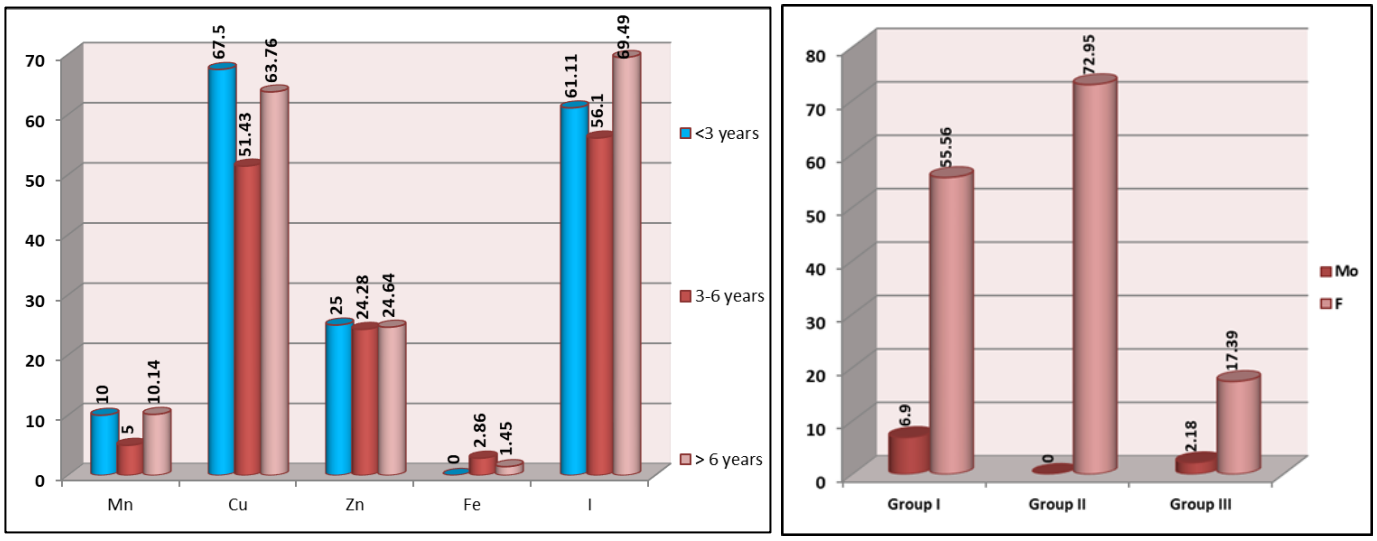

Fig 2: Prevalence of Mn, Cu, Zn, Fe and I deficiencies and Mo and F toxicities in crossbred cattle of various age groups of Bathinda

The mean plasma Mo level from all the blocks was observed to be 0.08±0.01ppm in cattle and in buffaloes it was 0.07±0.01ppm. Both the levels were within the normal range of 0.01-0.15pp as stated by Cook *et al.* (1966) [5]. Comparable value (0.08ppm) was also reported by Baruah and Baruah (1997) [2] from Assam. No consistent pattern in the level of Mo with advancing age was observed in crossbred cattle and in buffaloes the mean Mo levels of different age groups was almost the same, Table 2. Considering > 0.3ppm as toxic level in plasma, the prevalence of Mo toxicity in crossbred cattle and buffaloes was only 1.18 and 2.71 per cent, respectively.

Age wise it was observed that in 3-6 years age group of crossbred cattle the prevalence of Mo toxicity was nil. Considering >10 ppm as the toxic levels in fodder, it was observed that Mo in fodder samples from all the blocks was within the safe limit (Table 4). Mean Mo level in the soil samples was 0.08ppm which was also below the critical level 0.2ppm.

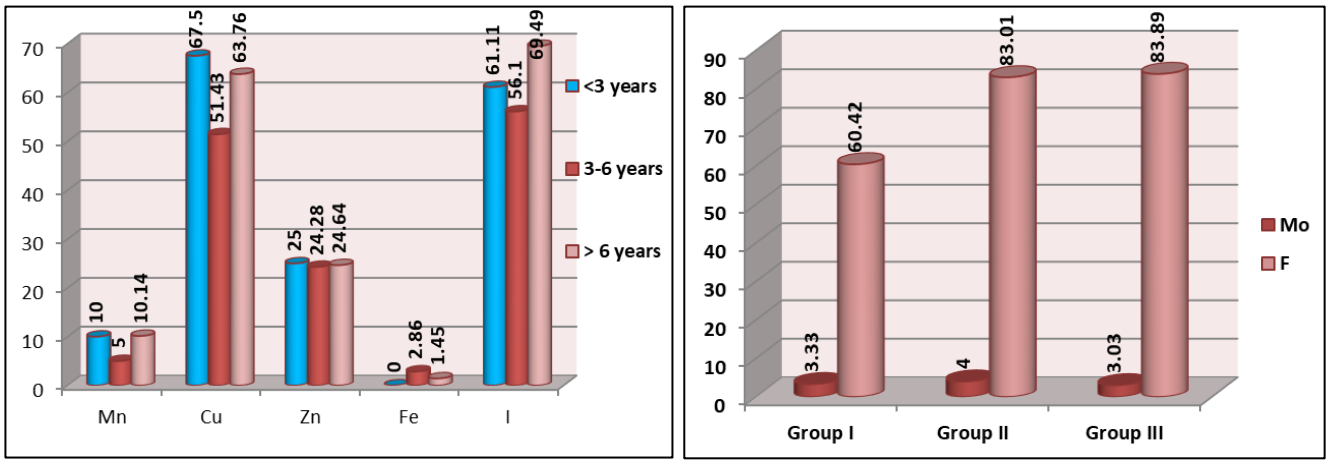

Fig 3: Prevalence of Mn, Cu, Zn, Fe and I deficiencies and Mo and F toxicities in buffaloes of various age.

The mean F level in crossbred cattle and buffaloes was 0.14±0.01 and 0.16±0.004ppm, respectively. Both the levels were slightly above the critical safe limit of 0.1ppm. There was an age dependent increase in the plasma F level of dairy animals. As such dairy animals of >6 years were having a significantly higher mean level of plasma F than those of 3-6 years and <3 years. By considering >0.1ppm as the toxic level in plasma, the overall prevalence of fluorosis in both cattle and buffaloes were very high. In cattle the prevalence of fluorosis was 70.73 per cent and in buffaloes it was 74.79 per cent. In crossbred cattle a higher incidence of fluorosis was seen in 3-6 years age group where the incidence was 72.95 per cent, whereas in buffaloes higher incidence was seen in age group of >6 years where the incidence was 83.89 per cent. On analyzing the water samples, F concentrations of more than 1ppm was observed in almost every region (Table 3). It was also reported by Aulakh *et al.* (2009) [1] that 66 per cent of the water samples collected from Bathinda district had F concentrations of more than 1ppm. Hence, the high fluoride level in water was responsible for high incidence of fluorosis in dairy animals of Bathinda district.

From the finding of the study, it was concluded that there were deficiencies of Cu and Zn in both plasma and fodder samples and Mn deficiency in fodder and soil samples. High incidence of fluorosis was found in both cattle and buffaloes and the fluoride level was also high in the water samples. Hence, proper supplementation of area specific mineral is required.

Acknowledgement

The authors are thankful to Guru Angad Dev Veterinary and Animal Science University for all the facilities and support provided to accomplished the study. The first author is also very thankful to all the field veterinarians, technical stuffs and dairy farmers of Bathinda district for their help and cooperation in the collection of samples.

References

1. Aulakh MS, Khurana MP, Singh D. Water pollution related to agriculture, industrial, and urban activities, and its effect on the food chain: Case studies from Punjab. Journal of New Seeds. 2009; 10(2):112-37.
2. Baruah A, Baruah KK. Studies on serum micro-minerals in Jersey heifers during different seasons. Indian Journal of Animal Health. 1997; 236:155-16.
3. Carleton CL, Threlfall WR, Schwarze RA. Iodine in milk and serum following *intra uterine*lugols solution. International Journal of Applied Veterinary Research Medicine. 2008; 6(2):121-29.
4. Chhabra S, Randhawa SS, Dhaliwal PS, Dhillon SK. Trace mineral profile in dairy cattle. Indian Veterinary Journal. 2007; 84(8):878-79.
5. Cook GA, LesperanceA L, Bohman VR, Jensen EH. Interrelationship of molybdenum toxicity syndrome. Journal of Animal Science. 1966; 25:96-101.
6. Das U, Roy S, Roy S, Roy BN, Ghosh SP, Desarkar MK. Some blood constituents of crossbred cattle in two agro-climatic zones of West Bengal. Indian Journal of animal Health. 1997; 36:11-13.
7. Garg MR, Bhanderi PM, Sherasia PL. Assessment of adequacy of macro and micro mineral content of feedstuffs for dairy animals in semi-arid zone of Rajasthan. Animal Nutrition and Feed Technology. 2005; 5:9-20.
8. Hidiroglou M. Manganese in ruminants nutrition. Canadian Journal of Animal Science. 1979; 59:217.
9. Mahesh DL, Deasthale YS, Naransinga Rao BS. Iodine content of feeds and water from goitre endemic and non-endemic areas in environmental, genetics and thyroid disorders ED. karmakar M G, Pandava C S and Ahuja M M S. Thyroid Association of India. 1990, 127-132.
10. McDowell LR. Minerals in Animal and Human Nutrition. Academic Press Inc, New York, 2003.
11. McDowell LR. Minerals inanimalnutrition, Academic Press Inc., San Diego, USA, 1992.
12. McDowell LR, Arthington D. Minerals for Grazing Ruminants in Tropical Regions, 5th Ed: 86 University of Florida, Gainesville, USA, 2005.
13. Mircha R. Baseline survey and therapeutic studies on mineral deficiencies in cattle and buffaloes in relation to soil and plant mineral content in Moga district of Punjab. MVSc thesis. Guru Angad Dev Vetrerinary and Animal Sciences University, Ludhiana, Punjab, 2009.
14. NRC. Nutrient requirements of dairy cattle. 6th ed. Washington, DC, National Academy of Science Press. 1988.
15. Ramana JV, Prasad CS, Gowda NKS, Ramachandra KS. Levels of micro-nutrients in soil, feed, fodder and animals of North East transition and dry zones of Karnataka. Indian Journal of Animal Nutrition. 2001; 18:235-42.
16. Ranjan R, Swarup D, Bhardwaj B, Patra C. Level of Certain Micro and Macro Minerals in Blood of Cattle from Fluoride Polluted Localities of Udaipur, Indian

Bulletin of Environmental Contamination Toxicology. 2008; 81:503-07.
17. Radostits OM, Gay CC, Blood DC, Hinchcliff KW. (Ed). Veterrinary Medicine: A Textbook of Disease of Cattle, Sheep, Pig, Goat and Horses W B Sanders Harcourt Publishers Ltd, London, 2000, 1505-08.
18. Singh R, Randhawa SS, Kumar A. Trace element status of buffaloes from sub-mountainous region of Punjab. Indian Journal of Veterinary Medicine. 2004; 24(1):23-27.
19. Singh R, Randhawa SS, Randhawa CS. Trace element status of crossbred cattle from sub-mountainous belt of Punjab in relation to soil and fodder. Indian Journal of Animal Science. 2003; 73:1072-76.
20. Soltanpour PN. Use of ammonium bicarbonate DTPA soil test to evaluate the elemental availability and toxicity. Commun Soil Science and Plant Analysis. 1985; 16:323-38.
21. Tiwary MK, Pandey A, Tiwari DP. Mineral status of animals in relation to different physiological stages in Haridwar District of Uttarakhand. Food Science and Technology. 2010; 1:1-9.
22. Underwood EJ. The mineral nutrition of livestock (2nd Ed) Slough, England, Commonwealth Agricultural Bureaux, 1981, 180.