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Micronutrient status in soil, fodder, serum and haematobiochemical profile in some districts of central Uttar Pradesh

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Micro-nutrient deficiency may impair enzymatic function, cellular metabolism of reproductive organs and may induce concomitant reproductive disorders, which in turn affect the reproductive efficacy and eventually economic losses to dairy farmers. Mineral deficiency is an area specific problem (Mc Dowell *et al.* 1983), hence there is a need to assess the mineral status of soil, fodder and blood/serum of animals in different agro climatic zones to develop area specific mineral supplement for overcoming the deficiency.

Jhansi, Kanpur, Fatehpur, Etah districts of the central Uttar Pradesh were surveyed for mineral content of soil, fodder and serum (buffalo), beside haematological status. Soil samples (207) up to 15 cm depth were collected with the help of auger and were dried overnight in hot air oven at 100°±5°C. The samples were ground and stored in airtight polythene packets to analyze mineral content. Fodder samples (257) of paddy straw, wheat straw, berseem, lucerne, maize, barley, sorghum, sugarcane top, mustard, oats etc. that were being fed to animals were collected from the same field, where soil samples were taken. These were dried in a hot air oven at 100±5°C overnight, ground and stored in airtight polythene packets for analysis.

Jugular blood (3 ml) was drawn from vein and collected in clean vials containing EDTA as an anticoagulant. From jugular vein, about 10 ml blood was collected in a sterilized test tube without any anticoagulant. After centrifugation, serum samples were stored under refrigeration at – 4°C in labeled glass vials. Blood/serum samples (249) were collected.

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Soil samples (Franeck 1992), fodder samples (Trolson, 1969), and serum samples (Kolmer *et al.* 1951) were analyzed. Minerals in the samples were estimated by atomic absorption spectrophotometer.

Phosphorus in soil and fodder was estimated as per Talapatra *et al.* (1940). The serum inorganic phosphorus was estimated according to Tausskey and Shorr (1953).

Enzymes, serum aspirate aminotransferase (AST), serum alanine aminotransferase (ALT), serum alkaline phosphatase (SAP), were estimated (Bergmeyer 1983). Ceruloplasmin was determined with *p*-phenylenediamine (Wooten *et al.* 1996). Haematological estimations were done as per Jain (1986). The data were processed for statistical analyses as per Snedecor and Cochran (1994).

Soil mineral status: In the study, lowest soil calcium, concentration was observed in Kanpur followed by Fatehpur and Jhansi whereas, soil magnesium level were found significantly ($P<0.05$) deficient in Jhansi, Kanpur and Fatehpur districts, and soil phosphorus in Etah only. The lowest copper concentration was also recorded in Etah district (0.11±0.34 ppm). In Fatehpur lowest concentration of selenium (0.11±0.016 ppm) was observed, however, minimum soil iodine concentration was found in Kanpur (4.18±0.11 ppm). The minimum zinc and cobalt concentration was observed in Etah and Jhansi respectively. The level of soil iron was quiet high in all the surveyed regions but maximum in Jhansi (Table 1).

Maximum deficiency of soil calcium and magnesium was found in Fatehpur while that of phosphorus was in Kanpur (Table 2). The highest zinc, selenium and copper deficiency was observed in Jhansi, while Etah was most deficient (32.72%) in cobalt. The highest prevalence in iodine deficiency was found in Kanpur (28.21%) and Iron deficiency was not found in the region.

Mineral deficiencies and its imbalances in soil and forages have long been held responsible for production and reproduction problems among tropical grazing animals (Abdelrahaman *et al.* 1998). Under field conditions the deficiency of single element rarely occurs however

Table 1. Soil, fodder and serum (bufalo) mineral contentsfrom central uttar pradesh (mean±se)

District	Ca (ppm)	Mg (ppm)	P (ppm)	Na (Meq/l)	K (Meq/l)	Fe (ppm)	Zn (ppm)	Cu (ppm)	Co (ppm)	Se (ppm)	I (ppm)
Soil											
Jhansi	66.34±2.19*	23.66±1.68*	9.19±1.41	0.129±0.09	0.119±0.01	35.72±10.64	1.02±0.16	1.02±0.17	0.21±0.11*	0.17±0.012*	4.21±0.01*
Kanpur	65.54±3.89*	25.19±1.78*	5.15±1.14*	0.145±0.08	0.119±0.02	7.52±7.25	0.63±0.11*	0.31±0.07*	2.34±0.08	0.29±0.011	6.38±0.10
Fatehpur	66.23±4.80*	24.66±1.87*	10.15±1.10	0.139±0.04	0.21±0.01	4.25±8.31	0.75±0.16	0.34±0.17*	2.23±0.07	0.11±0.016*	4.78±0.09
Etah	75.21±1.98	34.44±1.29	5.19±1.17*	0.165±0.01	0.120±0.02	7.77±9.52	0.67±0.07*	0.11±0.34*	2.41±0.7	0.24±0.014	4.18±0.11*
Fodder											
Jhansi	0.43±0.026*	0.25±0.08	0.22±0.011*	0.047±0.01	0.72±0.05	246.95±53.40	28.40±4.36	9.69±1.09	0.18±0.05	0.40±0.06	0.72±0.05*
Kanpur	0.66±0.029	0.33±0.019	0.22±0.09	0.048±0.03	0.76±0.04	289.69±38.31	17.11±1.87*	6.12±1.38*	0.02±0.02*	0.49±0.08	0.61±0.08*
Fatehpur	0.65±0.031	0.20±0.007*	0.32±0.029	0.050±0.02	0.75±0.02	316.99±47.72	20.09±1.45*	4.65±1.09*	0.03±0.04*	0.45±0.09	0.68±0.07*
Etah	0.40±0.021*	0.36±0.021	0.21±0.017*	0.044±0.01	0.70±0.02	244.94±28.11	23.39±1.69*	7.18±1.45*	0.02±0.01*	0.50±0.06	0.94±0.07*
Serum											
Jhansi	7.75±0.11*	1.29±0.12*	3.59±0.24	135.85±3.23	4.74±0.59	2.280±0.459	1.101±0.170*	0.521±0.085*	0.053±0.005	0.64±0.011	0.11±0.015*
Kanpur	7.00±0.13*	3.81±0.12	1.78±0.19*	141.75±3.06	4.82±0.29	1.872±0.241	1.781±0.529	0.601±0.017*	0.049±0.006	0.41±0.07*	0.21±0.017*
Fatehpur	9.52±0.09	1.58±0.08*	3.75±0.23	155.45±2.32	4.85±0.48	2.319±0.511	1.111±0.171*	0.832±0.072	0.029±0.003*	0.44±0.008*	0.10±0.012*
Etah	9.24±0.11	1.78±0.11	1.64±0.09*	138.46±2.22	4.89±0.62	2.025±0.192	1.107±0.170*	0.827±0.061	0.027±0.002*	0.52±0.019*	0.12±0.02*

* Significant at (P<0.05).

combination of multiple mineral deficiencies is much more common. When the nutritional plane does not meet the dietary requirements for an animal, its reproductive performance can also be compromised .

Fodder mineral status: The lowest level of calcium, and magnesium concentration in Etah was encountered and phosphorus in Fatehpur (Table 1). The lowest copper concentration was observed in Fatehpur, while that of zinc and iodine were in Kanpur. Similarly, cobalt concentration was minimum in Etah followed by Kanpur. The selenium concentration was above the critical level in all the surveyed districts (Table 1).

Maximum deficiency of fodder calcium and magnesium was in Etah followed by Fatehpur and Jhansi, while maximum phosphorus deficiency was in Fatehpur (27.23%). The highest prevalence of copper, selenium and zinc deficiency was observed in Jhansi. The maximum cobalt deficiency was observed in Kanpur district (22.91%). The maximum deficiency of Iodine was in Etah (Table 2). Soil and fodder mineral deficiencies were found to be co related. Mineral deficiencies in these areas may be due to excessive use of fertilizer, pesticides that interferes in the absorption of minerals by the fodder (Sharma *et al.* 2002). The pesticides also affect the assimilation and absorption of minerals in the GI tract (Sharma *et al.* 2001).

Soil leaching due to erosion, high temperature and excessive pollution in plains is the probable reason for depletion of soil minerals (Sharma *et al.* 2002). Long-term cropping and increased crop yields also remove mineral from soil at a faster rate (Mc Dowell *et al.* 1984).

Buffalo serum mineral status: Serum constituents are good indicators of the physiological condition of animals (Kalita *et al.* 2000). Various haemato-biochemical parameters can be co-related with the clinical symptoms of deficiency diseases. Buffalo serum calcium concentration was observed minimum in Kanpur district and serum magnesium concentration was significantly lower in Jhansi and Fatehpur significantly (P<0.05). Lowest value of phosphorus was found in Etah district, followed by Kanpur. These values were in corroboration with the findings of (Sharma and Joshi 2002) in Uttar Pradesh and Uttarkhand. The value of sodium and potassium was adequate in all the surveyed districts. Lowest serum copper concentration was encountered in Jhansi followed by Kanpur. The minimum concentration of serum zinc was observed in Jhansi and Fatehpur and Etah. Etah and Fatehpur districts were significantly (P<0.05) lower in concentration of serum cobalt. Several animals suffered from repeat breeding, anoestrous condition and other disorders associated with micro mineral deficiency. Significantly (P<0.05) minimum serum selenium value was estimated in Kanpur followed by Fatehpur, Etah and Jhansi districts. Iodine deficiency was observed in all the surveyed district and its lowest concentration was observed in Fatehpur. Sharma *et al.* (2001) reported that high parasitic infestation

Table 2. Prevalence of soil, fodder and serum (bufaloes) mineral deficiency (%) of central uttar pradesh

District	Ca	Mg	P	Na	K	Fe	Zn	Cu	Co	Se	I
Soil											
Jhansi	22.22	25.65	26.55	3.65	4.82	17.50	72.50	55.00	27.50	15.55	24.25
Kanpur	23.01	29.16	29.33	5.68	7.78	11.53	40.81	36.73	21.79	12.58	28.21
Fatehpur	29.05	33.68	22.35	4.25	8.11	5.08	42.37	30.61	30.50	6.28	25.65
Etah	22.01	28.55	27.68	5.45	7.57	5.45	43.63	21.81	32.72	8.25	25.21
Fodder											
Jhansi	17.44	24.07	25.62	1.56	3.71	5.17	63.79	53.44	18.96	8.15	15.45
Kanpur	17.79	23.04	24.25	1.64	3.65	8.33	29.16	25.00	22.91	7.25	18.75
Fatehpur	19.39	23.25	27.23	2.55	3.11	1.23	38.27	37.03	17.28	4.28	20.35
Etah	21.52	29.19	25.75	3.58	1.32	4.00	33.33	28.00	20.00	7.29	23.55
Serum											
Jhansi	34.00	28.16	32.42	4.74	5.16	0.00	70.00	40.00	20.00	5.00	32.25
Kanpur	29.66	27.49	32.59	3.69	3.18	16.66	60.00	13.35	20.00	14.58	28.29
Fatehpur	31.45	22.99	27.39	4.80	3.67	10.00	50.00	7.14	25.00	12.25	30.55
Etah	34.21	31.11	35.34	3.29	3.39	25.00	54.54	7.14	27.77	23.35	32.25

Table 3. Haemato biochemical and enzymatic status in buffaloes of central uttar pradesh

District	Hb (Gram%)	TEC ($\times10^6$/µl)	TLC ($\times10^4$/µl)	AST (RE Units/ml)	ALT (RE Units/ml)	SAP (RE Units/100 ml)	Ceruloplasmin (Cp) (Mg/dl)
Jhansi	10.65±0.28	6.65±0.36	7.76±0.18	47.65±0.65*	18.68±0.29	13.52±0.56	18.75±2.34*
Kanpur	8.00±0.29*	5.28±0.27*	9.22±0.29	36.25±0.55*	11.55±0.15*	10.25±0.19*	24.28±0.39
Fatehpur	11.35±0.35	4.32±0.32*	9.84±0.26	35.52±0.15*	10.05±0.32*	10.25±0.65*	17.85±0.38*
Etah	8.35±0.25*	4.77±0.52	8.89±0.32	40.25±0.65	12.18±0.11*	11.15±0.25*	20.65±2.56*

* Significant at (P<0.05).

in animals of tarai region, which is also one of the cause of mineral deficiency.

Maximum prevalence of serum calcium, magnesium and phosphorus deficiency was observed in Etah and minimum deficiency was observed in Kanpur for Ca and in Fatehpur, for Mg and P (Table 2). Sodium and potassium were non significantly (P<0.05) deficient. The highest prevalence of serum copper and zinc deficiency was observed 40.00 and 70.00%, respectively in Jhansi. However, their minimum deficiency was observed in Fatehpur and Etah districts. Iron deficiency was within the normal range. Cobalt deficiency was observed maximum in Etah. The maximum prevalence of serum selenium deficiency was observed in Etah district and its lowest deficiency was encountered in Jhansi. The highest prevalence of serum selenium deficiency of serum iodine was found in Jhansi and Etah both and the lowest deficiency was observed in Kanpur district. Mineral contents of soil reach to serum through grazing (Baruah *et al.* 2000).

Haemato-biochemical profile: Lowest serum AST concentration was encountered in Fatehpur and lowest SAP concentration was observed in Etah (Table 3). The concentration of serum ALT and Cp was lowest in Fatehpur district. Higher level of serum alkaline phosphate related to a diet low in phosphorus has been reported by Wooten *et. al.* (1996). Increase in serum alkaline phosphatase might be required to release more P to maintain Ca and P ratio in blood (Lehninger, 1990) the significant decreased levels of haematological vales (except TLC, SAP) clearly suggested anaemia due to nutritional deficiencies.

Minimum Hb concentration was observed in Kanpur, while TEC level was the lowest in Fatehpur. The animals showed mild to moderately increased heart and respiration rates along with decreased ruminal movement. Singh *et al.* (1992) told that deficiency of copper and other minerals lead to anaemia.

SUMMARY

A survey was conducted to assess the serum mineral, haemato-biochemical, hormone and vitamin status in buffaloes in some districts of Central Uttar Pradesh. It was observed that the mainly Ca, Mg and P, Cu and Zn were deficient and below the critical levels. Haemoto-biochemical profile showed significant decrease in Hb, TEC, while the values of TLC were slightly higher in deficient buffaloes. The values of serum enzymes, viz. serum aspirate aminotransferase, serum alanine aminotransferase and ceruloplasmin were lower, whereas that of serum alkaline phosphatase was higher. The values of thyroxine hormone

(T_3 and T_4) and vitamin (A and E) were significantly lower in mineral deficient animals. It is concluded that the mineral deficient animals should be substituted by specific minerals for optimum production.

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