

RESEARCH ARTICLE

Mineral status of soil, water, fodder, buffalo's milk and blood of Meerut District in Western Uttar Pradesh

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Abstract: A total of 140 feed samples, 120 fodder samples, 105 water samples, 58 milk samples, 51 blood samples and 29 soil samples were collected randomly from all the 12 blocks of Meerut districts in western Uttar Pradesh. After processing, the samples were analysed for different macro and micro elements by Inductively Coupled Plasma (ICP) instrument (instrument name MY2015CQ05 of Agilent Technologies). Among the feeds, wheat bran was found deficient in copper by 15%. Both copper and zinc content in Mustard oil cake was found marginal. Copper was deficient in bajra fodder, berseem fodder and jowar fodder by 7.5%, 30% and 29.3%, respectively. Sugarcane top, bajra fodder, berseem fodder and jowar fodder were found deficient in zinc by 7.3%, 14.67%, 5% and 2%, respectively. Copper and zinc were also found deficient in blood sample by 15.38% and 1.25%, respectively whereas animal milk samples were deficient in copper by 66.67%. It was found that most of the feed, fodders, blood, milk and soil samples were found deficient in copper and zinc content. Macro minerals were not found deficient.

Keywords: Buffalo, Mineral, Meerut, Sample

Introduction

The macro-minerals include calcium, phosphorus, sodium and chloride, while the micro-elements include iron, copper, cobalt, potassium, magnesium, iodine, zinc, manganese, molybdenum, fluoride, chromium, selenium and sulphur. (Soetan et al. 2010)

The ultra-trace elements include silicon, boron, arsenic and nickel which are found in animals and are believed to be essential for these animals (Soetan et al. 2010). The presence of mineral elements in animal feed is significant for the animal's metabolic processes. Mineral deficiencies or imbalances in soils and forages report to some extent for low animal production and reproductive problems. Plants withdraw essential elements from the soil solution in quantities to satisfy their own requirement as well as satisfy many of the requirements of grazing livestock (Fadlalla, 2022). The trace elements are key constituents of enzyme systems, hence, deficiencies of mineral elements have intense effects on metabolism and tissue structure (Soeton, et al. 2010). Minerals play a crucial role in nutrient utilization and a number of other biochemical functions concerning production and reproduction. The availability of minerals to cattle depends upon the production system, feeding practices and environment (Gupta et al. 2017). These resources do not always supply all the needed mineral requirements of dairy animals (Shekhar et al. 2020). The studies have been conducted in different parts of the country for ASMM preparation (Hedge et al. 2016 and Hedge et al. 2016). In the Indian context, there is widespread deficiency of Zn and Cu (Datt and Chhabra, 2005). In Meerut district, no such work has been conducted earlier. So, a project was taken up to formulate the area specific mineral mixture for Meerut district of Uttar Pradesh.

Materials and Methods

Samples of animal feed, fodder, water, milk, blood and soils were collected randomly from all the 12 blocks of Meerut districts in western Uttar Pradesh (Table 1).

Processing and storage of feed samples

Digestion of all kinds of feed samples (concentrate ingredients, fodder, concentrate mix etc.) was done by following process of digestion. About 1 g of previously ground and stored feed sample was taken in Kjeldahl digestion flasks and 15 mL of tri-acid mixture (HNO₃: H₂SO₄: HClO₃ = 3: 1: 1) was added to it and the contents were allowed to stay overnight. After that, flasks were heated on digestion bench. Indication of the end of digestion was disappearance of white fumes of perchloric acid and disappearance of black particles. The digested samples were

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filtered through Whatman filter paper No. 1. Repeated washing of digestion vessel and filter was done by triple distilled water. The digested samples were diluted to 25 mL final volume.

Processing and storage of soil samples

Soil samples were collected from 15 cm depth by using auger. Approximately 50 gm of soil was collected. Available phosphorus, available potassium and cationic micronutrients (Fe, Mn, Cu and Zn) in soil samples were extracted with a diethylene 30 triamine pentaacetate (DTPA) solution (0.005 M) DTPA+0.01 M CaCl₂+0.1 M triethanolamine, pH 7.3 (Lindsay and Norvell, 1978). The final volume of filtrate was made to 50 mL by triple distilled water.

Processing and storage of milk, water and blood samples

Samples of blood and milk were collected from both organized and unorganized dairy farms. Samples of water were collected from tube well, hand pump, borings, canal, ponds and river using plastic bottles of 100 mL capacity. Milk (20 mL) was measured by an acid washed measuring cylinder. Digestion was done by above mentioned process. The final volume was made to 40 mL by triple distilled water. For blood sample, 5 mL of plasma sample was digested by adding equal volume of acid. Milk and blood samples are to be digested as soon as possible before spoiling.

Estimation of minerals

Important macro and micro minerals were estimated by Inductively Coupled Plasma (ICP) instrument (instrument name MY2015CQ05 of Agilent Technologies). Conditions of instrument were Read time (s) 5, RF power (KW) 1.2, Stabilization time (s) 10, viewing mode axial viewing height (mm) 8, nebulizer flow (L/min)

0.7, plasma flow (L/min) 12, aux flow (L/min) 12, aux flow (L/min)1, Makeup flow (L/min) 0, Oxygen (%) 0

Statistical analysis

Data were analyzed as per the standard statistical procedure statistically (Snedecor and Cochran, 1994) using IBM Statistical Package for the Social Sciences (IBM SPSS, version 20). Significant differences (P<0.05) among treatment means and separation of homogenous subset was determined as per Duncan’s multiple range test (Duncan, 1955). The analyzed data were considered to be significant at P<0.05 and declared as trend at 0.05 <P ≤0.10.

Results and Discussion

Mineral profile of feed stuffs in Meerut district of Uttar Pradesh

Mineral profile of different locally available feed stuffs samples i.e., fodders (green and dry), concentrate ingredients, compound feed (locally prepared and commercially available) collected in polythene bags from the owners of animals has been presented in Table 2. Wheat straw was found deficient of P, Cu, K, Mg and Zn. Whereas wheat bran was found deficient in Cu and Mo. Bajra fodder was deficient in Cu and Zn. Sugarcane top was deficient to the extent of 3.3% in Ca, 56% in P, 35% in Mg, 7.3% in Zn, 14% in Mn, 69.34% in Mo, 46.67% in Se, respectively. Berseem fodder was found to be deficient in Na, Cu and Zn to a level of 66.67, 30 and 5%, respectively. Jowar fodder was found deficient in Mg, Cu and Zn @ 5, 29.3 and 2%, respectively. The values were compared with recommended critical level given by researcher (Liu et al. 2021). Deficiency of Zn in wheat straw may be due to long term cropping and increased crop yield

Table 1: Details of samples collected from different blocks of Meerut district

Block	Number of samples					
	Feed	Fodder	Water	Milk	Blood	Soil
Daurala	12	08	07	04	04	02
Hastinapur	10	09	08	05	05	03
Jaani	13	10	09	07	06	02
Kharkhoda	11	07	10	03	04	03
Machhara	09	11	11	02	03	02
Mawana	13	12	07	06	04	02
Meerut	14	13	09	07	05	03
Parikshitgarh	10	10	09	07	03	02
Rajpura	13	11	10	06	04	03
Rohta	10	08	10	04	06	02
Sardhana	11	11	07	03	03	03
Saroorpur	14	10	08	04	04	02
Total	140	120	105	58	51	29

Table 2. Mineral profile of feeds and fodders in Meerut district of western Uttar Pradesh

Ingredients	No. of samples	Ca%	P %	Na %	Mg %	K%	S %	Cu ppm	Zn ppm	Feppm	Mn ppm	Co ppm	Cr ppm	Mo ppm	Se ppm
Critical level*		0.30	0.25	0.06	0.20	0.60	0.20	8.00	30.0	50.0	40.0	0.10	1.00	0.75	0.15
Wheat Bran	52	0.48±0.01	0.63 ± 0.01	0.09±0.01	0.30±0.01	0.71± 0.02	1.29± 0.02	6.80±0.06	34.9± 0.15	251.1±0.64	60.9± 0.26	0.14± 0.01	1.20± 0.02	0.55±0.01	0.21±0.01
MOC	55	0.48±0.01	1.09±0.02	0.59±0.02	0.22±0.01	1.11±0.02	2.06±0.03	8.10±0.07	32.3±0.16	196.8±0.58	40.0±0.15	0.29±0.01	1.90±0.02	0.60±0.01	0.55±0.01
Concentrate/ Pellet	33	0.60±0.01	1.37±0.02	0.89±0.03	0.30±0.01	1.08±0.02	0.38±0.01	22.30±0.12	143±0.49	422.9±2.18	94.7±0.35	0.36±0.01	8.47±0.19	0.96±0.02	0.56±0.01
Wheat straw	24	0.33±0.02	0.16±0.01	0.15±0.01	0.12±0.01	0.15±0.01	1.13±0.09	3.70±0.14	11.5±0.21	175.0±0.51	65.0±0.24	0.13±0.01	0.31±0.03	1.03±0.09	0.23±0.04
Jowar fodder	26	0.48±0.04	0.51±0.04	0.35±0.03	0.19±0.02	1.73±0.08	3.36±0.11	5.66±0.14	29.4±0.18	478.1±1.95	41.7±0.25	0.18±0.02	3.68±0.09	0.90±0.05	0.80±0.04
Sugarcane Top	22	0.29±0.01	0.11±0.01	0.08±0.01	0.13±0.01	1.04±0.02	3.17±0.03	8.50±0.06	27.8±0.16	495.7±2.15	34.4±0.21	0.15±0.01	3.78±0.04	0.23±0.02	0.08±0.01
Bajra fodder	22	0.69±0.02	0.25±0.01	0.09±0.01	0.32±0.01	1.13±0.02	3.19±0.15	7.40±0.21	25.6±0.19	543.0±3.21	40.6±0.26	0.18±0.01	4.36±0.15	1.25±0.02	0.42±0.01
Berseem fodder	26	1.26±0.02	0.40±0.01	0.02±0.01	0.39±0.01	4.69±0.17	2.28±0.15	5.60±0.21	28.5±0.15	412.0±1.98	52.0±0.29	0.16±0.01	4.39±0.18	0.98±0.02	0.74±0.01

Table 3. Mineral profile of soils, blood, milk and water in Meerut district of Uttar Pradesh

Item	No. of samples	Ca	P	Na	Mg	K	S	Cu	Zn	Fe	Mn
Blood	51										
Unit		mg/dl	mg/dl	Mmol/L	mg/dl	Mmol/L	g/dl	mg/L	mg/L	mg/L	mg/L
critical value		8.0	4.5	120	2.0	3.0	0.09	0.65	0.80	1.10	0.20
Observed value		10.75± 0.12	6.3± 0.11	134± 0.35	4.1± 0.09	5.25± 0.08	0.11± 0.01	0.55± 0.02	0.79± 0.02	2.76± 0.06	1.08± 0.05
Milk	58										
Unit		g/L	g/L	g/L	g/L	g/L	g/L	mg/L	mg/L	mg/L	mg/L
Critical value		1.2	1.0	0.5	0.1	1.5	0.2	0.15	4.0	0.5	0.03
Observed value		1.89± 0.05	0.97± 0.03	0.41± 0.01	0.09± 0.01	0.12± 0.01	0.21± 0.01	0.05± 0.01	4.8± 0.09	1.25± 0.05	0.13± 0.01
Water	105										
Unit		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µg/L	µg/L	µg/L	µg/L
Observed value		12.32± 0.20	5.25± 0.69	16.89± 0.28	11.8± 0.21	4.25± 0.16	3.01± 0.11	550± 0.71	2560± 4.5	276± 0.45	156± 0.25
Soil	29										
Unit		ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Observed value		63.5± 4.01	7.89± 3.25	15.02± 9.25	15.8± 5.69	0.85± 1.65	7.33± 0.58	0.67± 0.01	1.97± 0.04	34.7± 0.18	16.67± 0.28

(Naliyapara et al. 2023). Cu deficiency in feeds and fodder was reported by Das et al. (2003) in West Bengal. Similarly, Sharma and Joshi (2004) found Cu deficiency in feeds and fodder in hilly region of Garhwal division of Uttarakhand. Cu deficiency in wheat straw (Kalwani et al. 2023) and wheat grain (Kalwani et al. 2023; Chatterjee et al. 2011) were also observed. In many geographical zones of India, Zn is found to be deficient (Demir et al. 2023). Similarly, in our experiment, wheat straw was found low in Zn content. The concentration of Fe was found high in all analyzed feedstuffs. Similar findings were also reported in other parts of country like Karnataka (Shekhar et al. 2020), Haryana (Panwar et al. 2022) and Haridwar (UK) (Tiwarly et al. 2007). Bhagat et al. (2017) found deficiency of Zn in feeds and fodder in Sindhudurg district of Maharashtra. The average Cu content was observed low in straws, green fodders and concentrate ingredients in Bharatpur district of Rajasthan (Garg et al. 2008). They also observed deficiency of Zn in most of the feedstuffs and suggested supplementation in the ration of animals for proper productive and reproductive functions. Gupta et al. (2016) also observed that wheat straw, wheat grain, barley and mustered cake were deficient in Cu and feeds contained more Fe than critical level Hedge et al. (2016) concluded that soils were deficient in Zn and plants were deficient in Zn, Cu and Co while cattle were deficient in all the minerals. Hedge et al. (2018) found that the soils were deficient in Zn and plants were deficient in Zn, Cu and Co while cattle were deficient in all the minerals. Hedge et al. (2018) found that soil, plants and dairy cattle were deficient for majority of macro minerals.

Mineral profile of soil, blood, milk and water in Meerut district of Uttar Pradesh

Mineral profile of soils, blood, milk and water has been presented in Table 3. Level of major and trace mineral indicated deficiency of 3% P, 18% Na, 10% Mg, 92% K and 66.67% Cu in milk and 15.38% Cu, 1.25% Zn in blood, respectively. The levels of Ca, P, Mg and S water samples were 12.32 ± 0.20 , 5.25 ± 0.69 , 11.89 ± 0.21 and 3.01 ± 0.11 mg/L, respectively in water samples collected from different locations of Meerut district. Cu, Zn, Fe and Mn content in water samples were found to be 550 ± 0.71 , 2560 ± 4.5 , 276 ± 0.45 and 156 ± 0.25 µg/L, respectively while soil samples contained Ca, P, Mg and S at levels of 63.59 ± 4.01 , 7.89 ± 3.25 , 15.89 ± 5.69 , 7.33 ± 0.58 ppm, respectively. Cu, Zn, Fe and Mn content in soil samples were found to be 0.67 ± 0.01 , 1.97 ± 0.04 , 34.76 ± 0.18 , 16.67 ± 0.28 ppm, respectively. The values were compared with recommended critical level (Gupta et al. 2019). Blood plasma levels of different minerals were found above the critical level except in case of Cu and Zn. Low dietary Cu in feed stuffs than requirement of animals leads to low Cu concentration in blood serum (Demir et al. 2023). Hypocuprosis in animals might be attributed to copper deficiency in feedstuffs. Shekhar et al. (2020) observed lower Cu concentration in blood plasma in anoestrous cows. Present finding is in accordance with Udari et al. (2003), who reported Cu deficiency in cattle of Vidharbha region of Maharashtra. High Fe

content in fodder samples could be another possible reason for low level of Cu in blood plasma as Fe interferes in copper metabolism in the body. Fe deficiency is rarely observed in animals because Fe is quite abundant in all feeds (Demir et al. 2023). The average concentrations of plasma Fe (ppm) in animals' plasma samples were found above the critical limit of 1.1 mg/L as suggested by Gupta et al. (2019). Panda et al. (2015) observed that cattle blood serums were severely deficient in Ca, Zn, and Cu and marginally deficient in P and Mn. Our present study showed 66.67% Cu deficiency in milk samples. Kumar et al. (2011) conducted a survey to find the status of copper, zinc and iron in milk and hair of animals of all the districts of Haryana state where deficiency of zinc and copper were observed in milk samples. Critical concentration of Ca, Mg, P, Cu, Zn and Iron was reported as 71, 9.10, 5, 1, 1.50 and 20 ppm, respectively (Liu et al. 2021). In our present experiment, we found deficiency of Cu in soil. There was marginal deficiency of Ca. Fe content was found higher than the critical concentration. Similar to our observation, Bhagat et al. (2017) found deficiency of Ca and Cu, whereas P, Mg, Zn and Fe contents were found to be adequate in non-irrigated and irrigated region of Sindhudurg district of Maharashtra. Gupta et al. (2019) indicated that P, K, Ca, Zn and Mg were moderate in the soils, where Fe and Cu levels in all the soils were adequate in Banswara district of Rajasthan. Yatoo et al. (2011) showed that soil has adequate Cu, Fe and Co but deficient in Zn. Panda et al. (2015) found all the macro and micro minerals of the soil was below the critical level except Fe at Kashmir valley. Sarma et al. (2015) investigated that the soil Ca, P and Mg were found to be below critical levels; but Cu, Zn and Fe were optimum in all studied locations at Mizoram.

Conclusion

Most of the feed, fodders, blood, milk and soil samples were found deficient in copper and zinc content. Macro minerals was not found deficient.

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