Journal of Animal Research: v.7 n.5, p. 827-835. October 2017

DOI: 10.5958/2277-940X.2017.00127.9

Effect of Supplementation of Area Specific Mineral Mixture on Serum Mineral Status of Cattle in Different Agro-climatic Zones of Chhattisgarh State

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Received: 13 July, 2017 **Revised:** 05 Sept., 2017 **Accepted:** 07 Sept., 2017

ABSTRACT

In the present study effect of feeding area specific mineral mixture on the serum mineral status of cattle in different agro climatic zones (plateau, plain and hills) of Chhattisgarh state was studied. The soil and fodder mineral status of different zones were analyzed. Macro minerals were below desired level in soil of hill region followed by plateau and plain whereas Mg level in soils of different zones were well above the critical level. Soil Fe, Mo concentration was above whereas Mn, Co, Zn concentration was deficient in all the three zones. Cu level was normal in hill region whereas, it was lower in Plateau and Plain. Fodder concentration of Cu, Zn exhibited direct relationship with soil mineral status whereas no direct association was observed for Ca and p concentration. In each zone fifteen cattle were selected and divided into three groups for different dietary treatments like negative control- no mineral supplementation; control – commercial mineral mixture supplementation @ 80 gm/day and treatment- area specific mineral mixture @ 80 gm/day. No significant relationship between fodder and serum mineral status could be established, indicative of unsuitability of fodder mineral status in assessing the mineral status. Serum concentration of specific minerals at different zones revealed no significant difference in response to commercial and area specific mineral mixture supplementation. Supplementation of area specific mineral mixture was not essential for agro-climatic zones of Chhattisgarh.

Keywords: Agro-climatic zones, Area specific mineral mixture, serum mineral profile

Mineral is one of the essential nutritional components in diet of cattle. They have inevitable role in normal metabolic and physiological processes of animal. Deficiency especially those of micro-minerals result in poor animal performances and reproductive problems in livestock (Sharma and Joshi, 2004). There are reports of improvements in reproductive status of anestrous and repeat breeder cows on mineral supplementation (Shah *et al*., 2003). Minerals are components of many enzymes which aid in metabolic pathways indispensable for normal functioning of animal body. Macro minerals play key role during various phases of animal growth, production and reproduction as well. Their deficiencies in high producing dairy cows arise due to their deficiency in everyday ration. Deficiency of dietary calcium in young animals leads to a failure in mineralization of new bone and retard their growth. Phosphorus is necessary to accomplish maintenance, growth, pregnancy and lactation requirements of the animal (Goff, 1998). Not only deficiency but imbalance in mineral nutrition is detrimental to animal performance as well (Akhtar *et al.,* 2011). Supplementation of all the elements in diet may not be desirable always, because many of them such as Mg, S, K, I, Co, Fe and Mn are present in required concentrations in feeds and fodders of specific areas. Mineral deficiencies or imbalances specific to region are directly related to available feed resources and feeding practices followed by the farmers and indirectly dependent on soil composition, intensity of cropping, precipitation and/or soil erosion pattern. Supplementation of area specific mineral mixture to animal might improve mineral homeostasis in body following improved health condition, excellent

reproductive performance and enhanced milk production.

So, the present study was planned to evaluate the soil and fodder mineral status of different agro climatic zones of Chhattisgarh state and effect of area specific mineral mixture on the serum mineral status in cattle.

MATERIALS AND METHODS

To evaluate effect of area specific mineral mixture on milk yield and reproductive performances in Hill, Plateau and Plain regions experiment for 90 days duration was conducted. Fifteen dairy cattle each from Hill, Plateau and Plain regions were selected from Semra, Redai and Atra villages of Surguja, Kanker and Dhamtarai districts as experimental animals. Fifteen dairy cows within 3 month of first and second calving were randomly allotted into three groups with five animals in each. All the animals were allowed to graze in their natural habitat. Control group was supplemented with common mineral mixture and treatment group was supplemented with area specific mineral mixture prepared under Rashtriya Krishi Vikas Yojna Project (RKVY) by Department of Animal Nutrition, College of Veterinary Science and Animal Husbandry, Anjora, Durg (Chhattisgarh). Another was negative control group to which no mineral mixture was supplemented. The details of experimental design is presented in the Table 1.

Table 1: Experimental designs

Particulars	Hill			Plateau			Plain		
No of animal	15			15			15		
Treatment	NC	C	T	NC	C	T	NC	C	T
No of animal	5	5	5	5	5	5	5	5	5
Commercial Mineral Mix. (g/ day/animal)	–	80	–	–	80	–	–	80	–
Area specific Mineral Mix. (g/ day/animal)	–	–	80	–	–	80	–	–	80

NC: Negative control, C: Control and T: treatment

Negative control animals were reared in natural grazing without supplementation while animals of control group were supplemented with common mineral (80 gm/day/ animal) mixture along with natural grazing and animals of treatment group were supplemented with area specific Mineral mixture (80 gm/day/animal) along with natural grazing.

Preparation of area specific mineral mixture

Earlier studies done in the Department of Animal Nutrition, college of veterinary science and A.H., Anjora, Durg under RKVY project revealed that Ca, P, Zn, Mg, Co, Cu and selenium were less than desired level in animal feedstuffs and soil at different agro-climatic zone of Chhattisgarh. So, to accomplish the mineral requirement of cattle area specific mineral mixture was formulated by College of Veterinary Science and Animal Husbandry Anjora, Durg. The ingredients composition of area specific mineral mixture (ASMM) is given in Table 2. Minimum concentration of Ca, P, Mg, S, salt, Zn, Fe, I, Cu, Mn, Co and maximum F concentration in commercial mineral mixture was 16%, 9%, 4%, 1.4%, 22%, 30 ppm, 30 ppm, 2 ppm, 8 ppm, 10 ppm, 1 ppm and 5 ppm, respectively. Total ash and acid insoluble ash concentrations were 75-82% and 3% respectively.

Table 2: Composition of area specific mineral mixture used in the experiment

Region	Ca (%)	P (%)	Mg (g)	Na (mg)	K (mg)	Cu mg)	Fe (mg)	Zn (mg)	Mn (mg)
Hill	25.50	12.75	6.00	5.9	100	1200	1500	9600	1500
Plateau	22.00	11.00	4.50	5.9	100	600	1500	4800	800
Plain	18.00	9.00	3.00	5.9	100	300	1500	3200	1000

Feeding and management of animals

Animals were managed in semi intensive condition. Experimental animals during the experiment were housed in a well-ventilated cow shed with facilities for individual feeding. They were allowed for voluntary grazing on pasture grass available in the agro climatic zone for at least four hours morning and two hours evening. The feedstuffs commonly available in different agro-climatic zone were wheat straw, paddy straw and dub grass. The animals were sprayed with Butox at dose rate of 5ml/ litre water one week before start of experiment and Albendazole at the rate of 7.5 mg/ kg body weight orally. Elimination of parasitic infection was confirmed by faecal examination.

Collection of sample

Five representative samples the feedstuffs on which animal were fed viz. paddy straw, wheat straw and dub grass were collected throughout experiment at regular intervals and stored in air tight containers after drying and grinding.

Soil samples were randomly collected from experimental area from plough depth level (8"-10") and were preserved in polythene covers.

The blood samples from animals were collected at 0, 45, and 90 days of experiment. About 9 ml of blood was collected aseptically from jugular vein in without anticoagulant. The test tubes were kept in slanting position at room temperature without disturbing for 3-4 hrs, the clot was broken with the help of Pasteur pipette. The serum was centrifuged and stored at 4°C in plastic vials for further analysis.

Analysis of macro minerals and micro minerals in soil, feed and serum samples

The samples were also analyzed for calcium by precipitation method (Talpatra *et al.,* 1940) and inorganic phosphorus (Fiske and Subbarow, 1925). Magnesium, Iron, Zinc, Manganese, Copper, Molybdenum, Cobalt, Selenium in feed and fodder were estimated using Atomic Absorption spectrophotometer (Electronics Corporation of India Ltd. AAS 4141).

Digestion of serum sample

Before mineral estimation serum samples were digested as per the procedure described by Kolmer *et al*. (1951). To 0.5 ml serum sample 10 ml of Tri acid solution was mixed in the digestion tube and kept overnight at room temperature. Then low heat (70-80°C) was applied using heating bench (digestion bench) until the volume reduced to about 1ml. Tri acid solution comprised of Nitric acid, Sulphuric acid and Perchloric acid in 9: 2: 1 ratio.

Statistical analysis

For interpretation of the results, the data of above experiments were subjected to one way ANOVA for analysis of variance (Snedecor and Cochran, 1994) and significance of differences among groups were analysed by Duncan range test – 1955.

RESULTS AND DISCUSSION

Macro and micro minerals in soils of Chhattisgarh

The concentration of macro minerals like Calcium (Ca), Phosphorus (P) and Magnesium (Mg) and micro minerals like Iron (Fe), Zinc (Zn), Cobalt (Co), Manganese (Mn), Copper (Cu), Molybdenum (Mo) and Selenium (Se) of soils of different ago-climatic zones are presented in Table 3.

Bhausaheb *et al.* (2014) observed higher soil Ca level and lower P and Mg levels compared to present study in agro-climatic zones of Chhattisgarh. The variation might be due to collection of soil samples from different districts under each agro-climatic zone than present study. The state of Chhattisgarh shows wide variation in climate, geology, landform, vegetation and cropping pattern which are reflected in the development of a large variety of soils. Soil Ca was lower in hill zone (0.08%) whereas higher levels were found in plateau (1.1mg%) and plain (1.3mg%) considering critical concentration in soil as 0.1mg%. Phosphorus concentration in soil was as low as 0.06 mg%, 0.07 mg% and 0.08mg%, respectively for hill, plateau and plain zone. Critical value for P in soil is

Table 3: Soil mineral levels at different agro- climatic zones

Regions	Ca (mg)	P (mg)	Mg (mg)	Fe (ppm)	Zn (ppm)	Mn (ppm)	Cu (ppm)	Co (ppm)	Se (ppm)	Mo (ppm)
Hill	0.08 ±0.02	0.06 ±0.01	0.19 ±0.04	160.00 ±5.56	0.12 ±0.08	29.00 ±1.58	10.43 ±1.01	0.08 ±0.01	0.06 ±0.01	0.47 ±0.01
Plateau	1.10 ±0.02	0.07 ±0.01	0.23 ±0.06	136.00 ±4.98	0.04 ±0.01	45.00 ±5.78	8.87 ±1.67	0.09 ±0.01	0.08 ±0.01	0.41 ±0.01
Plain	1.30 ±0.04	0.08 ±0.02	0.28 ±0.03	203.00 ±5.01	0.14 ±0.05	52.00 ±6.23	6.50 ±1.31	0.12 ±0.01	0.11 ±0.01	0.49 ±0.01

4.5-13.0 mg%. The result revealed that macro minerals were below desired level in soil of hill region followed by plateau and plain. Mg levels in soils of all the regions of Chhattisgarh were well above the critical level.

Food and fertilizer technology centre for Asian and Pacific region has recommended critical lower and higher levels of micro minerals in soil below and above which soil is considered either deficient or toxic, respectively (Alloway, B.J. 1990). In the present study soil Fe concentration was above whereas Mn concentration was deficient in all the three zones. The manganese content of feedstuffs is quite variable and is influenced by soil types, soil pH, fertilization and plant species. Cobalt and Zn levels were much below the lower critical level that is 25ppm and 20ppm, respectively. Cu level in hill region was normal (10.43 ppm) whereas it was lower in Plateau (8.87ppm) and Plain (6.5 ppm) region. Mo level in all the soil samples were well above critical level (0.1).

Macro and micro minerals in fodders of Chhattisgarh

The macro and micro mineral levels in the fodders of three agro-climatic zones of Chhattisgarh are provided in table 4. The fodder samples showed lower Ca that is below critical level. P content was low in rice straw whereas dub grass and wheat straw were optimum in P concentration. The Ca and P level in Dub grass analyzed from agro-climatic zones of Chhattisgarh by Bhausaheb *et al.* (2014) corroborated with present findings. P content in dub grass and wheat straw did not show direct relationship with soil P status in present study. Bhausaheb *et al.* (2014) analyzed natural pastures in the Chhattisgarh region to contain sufficient P, as well as alike relationship to present study was observed for soil-fodder P status. Concentration of Ca, P and Mg were reported to be 0.49, 0.27 and 0.19%; 0.31, 0.1 and 0.14 % in dub grass and wheat straw, respectively (NRC, 2001). Zn concentration was lower in all the feeds except dub grass. Co was present within normal range in rice straw and wheat straw whereas it was deficient in dub grass as per NRC (2001) recommendation for dairy cattle. Copper content was normal in all the fodders whereas Mo was present in low concentration in all the fodders. Levels of Cu, Fe, Mn and Zn in dub grass hay were 8 ppm, 224 ppm, 62 ppm and 32 ppm, respectively whereas above values in wheat straw were 6 ppm, 172 ppm, 67 ppm, 16 ppm and 1.3 ppm, respectively (NRC, 2001). Fe level in rice straw, wheat straw and dub grass ranged from 218-

Table 4: Mineral composition of the fodders available in different agro-climatic region during the experiment

Region	Ingredients	Ca (mg/ dl)	P (mg/ dl)	Mg (mg/ dl)	Fe (ppm)	Zn (ppm)	Co (ppm)	Mn (ppm)	Cu (ppm)	Mo (ppm)	Se (ppm)
Hill	Rice Straw	0.2 ±0.01	0.07 ±0.01	0.16 ±0.01	222.6 ±3.40	28.31 ±0.18	4.1 ±0.09	202.81 ±0.49	6.06 ±0.09	0.23 ±0.01	0.06 ±0.01
	Wheat Straw	0.15 ±0.01	1.05 ±0.01	0.08 ±0.01	121.6 ±1.94	10.11 ±0.02	11.12 ±0.01	36.27 ±0.23	12.4 ±0.51	0.34 ±0.01	0.06 ±0.00
	Dub Grass	0.18 ±0.01	0.23 ±0.01	0.12 ±0.01	208.4 ±1.81	42.08 ±0.14	2.7 ±0.09	37.25 ±0.29	11.2 ±0.58	0.16 ±0.01	0.03 ±0.01
Plateau	Rice Straw	0.21 ±0.01	0.06 ±0.01	0.06 ±0.01	225.4 ±1.25	28.28 ±0.24	4.18 ±0.08	202.87 ±0.30	5.9 ±0.15	0.23 ±0.01	0.04 ±0.01
	Wheat Straw	0.16 ±0.01	1.07 ±0.01	1.07 ±0.01	124 ±1.67	10.12 ±0.03	11.17 ±0.02	36.95 ±0.32	10.2 ±2.63	0.43 ±0.01	0.06 ±0.01
	Dub Grass	0.15 ±0.01	0.23 ±0.01	0.23 ±0.01	212.8 ±1.83	42.23 ±0.25	2.62 ±0.06	36.58 ±0.37	12.03 ±0.44	0.17 ±0.01	0.03 ±0.00
Plain	Rice Straw	0.21 ±0.01	0.07 ±0.01	0.17 ±0.01	218.8 ±2.15	27.91 ±0.20	4.04 ±0.11	202.97 ±0.24	6.08 ±0.10	0.24 ±0.01	0.06 ±0.01
	Wheat Straw	0.15 ±0.01	1.06 ±0.01	0.06 ± 0.01	124 ±1.79	10.12 ±0.02	11.2 ±0.03	36.27 ±0.22	13.09 ±0.68	0.36 ±0.01	0.07 ±0.01
	Dub Grass	0.17 ±0.01	0.22 ±0.01	0.14 ±0.01	209.6 ±0.75	42.2 ±0.22	2.68 ±0.07	37.25 ±0.33	13± 1.14	0.17 ±0.01	0.02 ±0.00

225 ppm, 121-124 ppm and 208-212 ppm, respectively in the present study. Cu and Zn levels in fodders exhibited a direct relationship with soil mineral status in present study. Yadav and Khirwar (1999) reported soil copper content to have significant ($p<0.05$) positive correlation with its content in wheat straw (+0.24). Bhat *et al*. (2011) reported no correlation between soil and forage concentration for calcium, phosphorus, magnesium, zinc, iron and manganese. Cobalt is a component of vitamin B_{12}. Feeds containing greater than 0.10 mg/kg Co have been recommended to provide adequate B_{12} concentration in dairy animals (Tiffany *et al.*, 2003). Fodders of all the agro climatic zones contained higher Co than recommended for dairy cattle.

Serum Minerals levels in animal

Calcium

Supplementation of area specific mineral mixture showed significant increase in serum Ca level on 90 days at hill and plain regions whereas no effect was observed at plateau region (Table 5). Serum Ca value was significantly ($p<0.05$) higher in control and treatment groups than negative control at hill and plain zone; however, control and treatment groups were comparable with each other. The mean Ca concentrations in serum of cattle were higher than the normal level of 9-13mg/dl (Underwood, 1977) is suggestive of efficient absorption of available Ca in fodders.

Phosphorus

Serum P showed significant difference at 90 days of experiment in all the zones. P status was significantly ($p<0.05$) higher in control and treatment group than negative control in all the agro-climatic zones except at plateau zone where treatment group did not show any significant difference to negative control (Table 5). Serum P level fell in the normal range (4-6 mg/dl) in all the regions among all the groups (Underwood, 1977). It is an indication that wheat straw and dub grass containing higher P were relished compared to rice straw by the animals.

Iron

Serum Iron values were significantly higher on 45 days at Plains and on 90 days at Hills (Table 6). Significantly ($p<0.05$) higher Iron value was obtained in control and treatment group than negative control on aforesaid days. The present observations are supported by previous findings (Garg *et al.,* 2010; Mohapatra *et al.*, 2012 and Jana *et al.,* 2015) which reported higher serum mineral levels on supplementation of area specific mineral mixture. Normal

Table 5: Macro (Calcium Phosphorus) serum mineral concentration in the cattle of different agro-climatic region during the experiment

Minerals	Day	Hill				Plateau				Plain			
		NC	C	T	Sig.	NC	C	T	Sig.	NC	C	T	Sig.
Ca (mg/dl)	0	9.26 ±0.30	9.37 ±0.31	9.22 ±0.19	NS	9.14 ±0.34	9.49 ±0.28	9.25 ±0.41	NS	9.62 ±0.27	9.79 ±0.17	9.89 ±0.13	NS
	45	9.13 ±0.22	9.47 ±0.45	9.49 ±0.36	NS	9.05 ±0.19	9.63 ±0.19	9.47 ±0.45	NS	9.79 ±0.17	10.04 ±0.10	10.04 ±0.12	NS
	90	9.20^{b} ±0.31	9.51^{a} ±0.48	9.67^{a} ±0.17	*	9.20 ±0.31	9.96 ±0.20	9.51 ±0.48	NS	9.70^{b} ±0.20	10.23^{a} ±0.05	10.21^{a} ±0.07	*
P (mg/dl)	0	4.74 ±0.18	5.08 ±0.06	5.04 ±0.06	NS	4.64 ±0.23	5.26 ±0.22	5.08 ±0.12	NS	4.92 ±0.09	4.95 ±0.02	4.83 ±0.04	NS
	45	4.88 ±0.14	5.21 ±0.16	5.30 ±0.11	NS	4.88 ±0.14	5.42 ±0.10	5.11 ±0.18	NS	4.94 ±0.14	5.12 ±0.03	4.95 ±0.02	NS
	90	4.81^{b} ±0.13	4.65^{a} ±0.69	5.47^{a} ±0.15	*	4.73^{b} ±0.17	5.47^{a} ±0.16	5.27^{ab} ±0.20	*	4.84^{b} ±0.12	5.23^{a} ±0.03	5.17^{a} ±0.06	*

Superscripts are read row wise for comparison of means. Means in the same row with different superscript a, b, are significantly different ($p^{*}< 0.05$) NS= Non-significant

Table 6: Micro serum mineral concentration in the cattle of different agro-climatic region during the experiment

Minerals	Day	Hill				Plateau				Plain			
		NC	C	T	Sig.	NC	C	T	Sig.	NC	C	T	Sig.
Fe (mg/dl)	0	2.96 ±0.04	2.96 ±0.04	2.98 ±0.04	NS	2.98 ±0.04	2.96 ±0.04	2.96 ±0.04	NS	2.92 ±0.04	2.84 ±0.03	2.86 ±0.04	NS
	45	3.06 ±0.06	3.09 ±0.05	3.16 ±0.02	NS	3.09 ±0.07	3.05 ±0.02	3 ±0.03	NS	2.88^{b} ±0.05	3.16^{a} ±0.02	3.09^{a} ±0.05	**
	90	2.96^{b} ±0.05	3.15^{a} ±0.06	3.21^{a} ±0.03	*	2.96 ±0.05	3.11 ±0.03	3.06 ±0.05	NS	2.95^{b} ±0.05	3.20^{a} ±0.03	3.15^{a} ±0.06	**
Zn (ppm)	0	1.2 ±0.04	1.23 ±0.02	1.16 ±0.03	NS	1.04 ±0.04	1.12 ±0.03	1.15 ±0.06	NS	1.15 ±0.04	1.28 ±0.13	1.12 ±0.02	NS
	45	1.16^{b} ±0.03	1.30^{a} ±0.03	1.30^{a} ±0.03	**	1.09 ±0.02	1.23 ±0.05	1.19 ±0.05	NS	1.16^{b} ±0.03	1.34^{a} ±0.03	1.28^{a} ±0.02	**
	90	1.19^{b} ±0.03	1.38^{a} ±0.02	1.34^{a} ±0.03	**	1.11^{b} ±0.02	1.30^{a} ±0.05	1.23^{ab} ±0.04	*	1.15^{b} ±0.04	1.40^{a} ±0.02	1.37^{a} ±0.02	**
Cu (ppm)	0	1.81 ±0.05	1.79 ±0.05	1.85 ±0.04	NS	1.77 ±0.05	1.76 ±0.07	1.76 ±0.06	NS	1.77 ±0.06	1.91 ±0.04	1.94 ±0.05	NS
	45	1.78 ±0.05	1.87 ±0.04	1.92 ±0.04	NS	1.77 ±0.05	1.83 ±0.07	1.8 ±0.10	NS	1.86^{b} ±0.04	2.07^{a} ±0.03	2.07^{a} ±0.04	**
	90	1.77^{b} ±0.04	1.94^{a} ±0.05	2.03^{a} ±0.03	*	1.72 ±0.06	1.92 ±0.06	1.83 ±0.10	NS	1.77^{b} ±0.04	2.16^{a} ±0.03	2.18^{a} ±0.03	**
Co (ppm)	0	0.05 ±0.01	0.05 ±0.01	0.05 ±0.01	NS	0.06 ±0.01	0.05 ±0.01	0.06 ±0.01	NS	0.15 ±0.01	0.15 ±0.01	0.14 ±0.02	NS
	45	0.05^{b} ±0.02	0.07^{a} ±0.01	0.08^{a} ±0.01	**	0.07 ±0.01	0.07 ±0.01	0.08 ±0.01	NS	0.16 ±0.01	0.13 ±0.01	0.17 ±0.01	NS
	90	0.05^{b} ±0.01	0.10^{a} ±0.01	0.10^{a} ±0.02	**	0.05^{b} ±0.01	0.10^{a} ±0.02	0.09^{ab} ±0.01	*	0.14 ±0.01	0.15 ±0.02	0.18 ±0.01	NS
Mn (ppm)	0	0.08^{b} ±0.01	0.8 ±0.01	0.9 ±0.01	NS	0.06 ±0.01	0.06 ±0.01	0.07 ±0.01	NS	0.08 ±0.01	0.09 ±0.00	0.09 ±0.01	NS
	45	0.09^{b} ±0.00	0.13^{a} ±0.01	0.15^{a} ±0.02	**	0.07 ±0.01	0.09 ±0.01	0.09 ±0.00	NS	0.08^{b} ±0.01	0.11^{a} ±0.01	0.10^{a} ±0.01	**
	90	0.09^{b} ±0.00	0.16^{a} ±0.02	0.18^{a} ±0.01	**	0.05^{b} ±0.01	0.11^{a} ±0.02	0.10^{a} ±0.01	*	0.07^{b} ±0.01	0.15^{a} ±0.01	0.14^{a} ±0.01	**
Mo (ppm)	0	0.02	0.03	0.03	NS	0.02	0.03	0.03	NS	0.02	0.03	0.03	NS

(Cont...)

		±0.00	±0.00	±0.01		±0.00	±0.00	±0.01		±0.01	±0.00	±0.00	
	45	0.03	0.04	0.04	NS	0.03^{b}	0.04^{a}	0.04^{ab}	*	0.03	0.04	0.04	NS
		±0.01	±0.00	±0.00		±0.00	±0.00	±0.01		±0.01	±0.00	±0.00	
	90	0.03	0.06	0.05	NS	0.03^{c}	0.06^{a}	0.04^{b}	**	0.04	0.05	0.04	NS
		±0.00	±0.00	±0.00		±0.00	±0.00	±0.00		±0.00	±0.00	±.00	
Cr (ppm)	0	0	0	0	NS	0	0	0	NS	0	0	0	NS
		±0.00	±0.00	±0.00		±0.00	±0.00	±0.00		±0.00	±0.00	±0.00	
	45	0	0	0	NS	0	0	0	NS	0	0	0	NS
		±0.00	±0.00	±0.00		±0.00	±0.00	±0.00		±0.00	±0.00	±0.00	
	90	0	0	0	NS	0	0	0	NS	0	0	0	NS
		±0.00	±0.00	±0.00		±0.00	±0.00	±0.00		±0.00	±0.00	±0.00	

Note: Superscripts are read row wise for comparison of means. Means in the same row with different superscript a, b, are significantly different. ($p^{*}< 0.05$) NS= Non-significant

serums Fe level in normal cows were reported to be 0.89 – 2.53 ppm (Underwood, 1977). The serum iron was on the higher side of normal range suggesting an adequacy of Fe in fodders. There was direct relationship of fodder and serum Fe status.

Zinc

Serum zinc was significantly higher on 45 days at hill and plain zones. Control and treatment group showed significantly ($p<0.05$) higher Zn levels than negative control (Table 6). Area specific mineral mixture showed significant effect on serum Zn levels on 90 days in animals of all the agro climatic zones. Concentrations of zinc in serum are normally between 0.7 and 1.3 ppm whereas concentration below 0.4 ppm is often considered deficient in dairy cattle (NRC, 2001). The present finding is similar with observation of (Olson *et al*., 1999 and Hatfield *et al*., 2001) who reported that supplementation of trace mineral containing Cu, Zn and Mg in organic and inorganic form raised the serum level of respective mineral compared to the control.

Copper

Serum copper showed significant difference on 45 days at plain region and on 90 days at hill and plateau regions (Table 6). There was significantly ($p<0.05$) higher serum concentration on 45 and 90 days in control and treatment groups at plain zone, whereas at hill zone on 90 days significant increase was observed. Interaction of supplemental Cu with other minerals in plateau zone might be the cause for no variation in serum levels of control and treatment groups from negative control. Reports suggest dietary molybdenum to antagonise absorption of Cu and Cu absorption coefficient varies based on dietary molybdenum concentration (Bremner *et al*., 1987; Phillippo *et al*., 1987). Bhat *et al.* (2011) observed significant positive correlations (r=0.463) among forage and serum and non-significant ($P<0.05$) positive correlation (r=0.08) between soil and serum concentration of Cu.

Cobalt

The serum cobalt value was significantly higher in control and treatment group than negative control group on 45 and 90 days at hill zone and 90 days at plateau zone(Table 6). At plateau zone cobalt values in treatment was similar with both control and negative control. Interaction of supplemental Co in control and test group with other minerals might be the cause for non significant variation in serum Co status in animals in plain zone. Djokovic *et al*. (2014) reported serum level of Co to be 0.018 ppm in dairy cattle in 90-120 days of lactation. Mudgal *et al*. (2012) reported serum concentration of Co to be 0.56 ppm and 0.51 ppm in Sahiwal and crossbred cattles, respectively. In the present study serum concentration above normal (0.05 - 0.18 ppm) suggested an optimal level in the feed of cows.

Manganese

The serum manganese value revealed significant ($p<0.05$), difference among the groups on 45 and 90 day at hill and plain zones and on 90 day at plateau zone(Table 6). Mn concentration in 90-120 days lactation dairy cows was reported to be 0.206 ppm (Djokovic *et al*., 2014). Similar concentrations were reported by Mudgal *et al*. (2012) in sahiwal (0.18 ppm) and crossbred cattle (0.21 ppm). In the present study Mn level was lower compared to other experiments whereas in control and test group of Hill region it approached normal figure on 90days of feeding. Rice straw was higher in Mn content, might be relished more by animals of hill region compared to other fodders. High concentrations of dietary calcium, potassium or phosphorus might reduce absorption of manganese.

Chromium

The supplementation of area specific mineral mixture and common mineral mixture did not exert significant effect on serum chromium level throughout study period at different agro climatic zones (Table 6). Chromium is necessary for normal glucose metabolism as a component of glucose tolerance factor. But Blood Cr concentration cannot be used as an indicator of Cr status, because it is not balanced with tissue Cr stores (Underwood 1977).

CONCLUSION

The non-significant relationship between fodder and serum mineral indicated that fodder mineral status was not useful in assessing mineral status of cattle of Chhattisgarh. Supplementation of area specific mineral mixture exhibited similar response on serum mineral profile as that of commercial mineral mixture in all the agro-climatic zones. In hill region serum Cr, Mo levels and in plateau region serum Ca, Fe, Cu and Cr levels and in plain region serum Co, Mo and Cr levels remained statistically similar throughout the experiment in all the groups (negative control, control and treatment). As revealed supplementation of area specific mineral mixture was not beneficial for different agro-climatic zones of Chhattisgarh.

ACKNOWLEDGEMENTS

The authors acknowledge the support of Department of Animal Nutrition, College of Veterinary Science and A.H, Anjora, Durg for providing all necessary facilities for undertaking research work.

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