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Studies on Mineral Status of Murrah Buffaloes in Charkhi Dadri District of Haryana

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ABSTRACT

A detailed survey was carried out to record plane of nutrition and mineral status of lactating buffaloes in Charkhi Dadri district of Haryana state during rabi season (January, 2019 - February, 2019). Samples of feedstuffs, milk, hair and blood were collected from ten farm families of 12 villages (3 villages from each of 4 blocks) thus making a total of 120 families. Farmers (73.3%) were using oat fodder (23.3%), wheat straw (90.8%), bajra kadbi (17.5%), wheat grain (76.7%), bajra grain (44.2 %), cotton seed cake (75.0%) in the dietary regimen of buffaloes. Only 17.5 and 13.3% of farmers were supplementing mineral mixture and common salt to their animals respectively. Regarding intake of minerals, it was found that animals were consuming much less Zn and Cu than their requirement while intake of Iron was more than the requirement. Only 10.8% and 15% of the animals were receiving less Ca and P, respectively, than their requirement. Average value of serum Zn in most of the samples was within normal range i.e., 0.8 to 2 ppm while that of serum Cu was below critical level (0.65). Intake of Fe was high due to high content in feed and fodders still its level in serum was within the normal range. Serum Mn was above critical value (0.20 ppm) while Ca and P were marginally deficient. Hair and milk samples were deficient in Zn and Cu. Thus, buffaloes were getting ration deficient in Zn and Cu, the same was reflected in hair Zn, Cu and serum Cu.

KEYWORDS: Buffaloes, Hair, Milk, Mineral intake, Serum

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INTRODUCTION

Livestock sector contributes 4.11% of GDP and 25.6% of total Agriculture GDP. The total livestock population is 536.76 million in the country (Livestock census, 2019). Increasing human population is putting more pressure on dairy animals to meet increasing requirement of milk production. Profit from the dairy animals depends upon the input of nutrients supplied (energy, protein and minerals) and feeding management of livestock animals (Singh et al., 1996). Minerals cannot be synthesized in the body and need to be supplemented daily. They are constituent of biomolecules and also help in the activation of many enzymes. As soluble salts in blood and other body fluids they are responsible for maintenance of osmotic and acid-base equilibrium. Mineral status of dairy animals also affects the symbiotic micro-flora of gut besides influencing milk production and reproduction efficiency (Maan, 2000). Mineral deficiencies due to imbalanced feeding are frequently encountered in the livestock rations, especially in tropical countries like India due to lack of knowledge of scientific feeding and minimal supplementation of mineral mixture. The deficiency or toxicity of minerals is an area specific problem because soil mineral status keeps on changing due to pressure on land for maximizing crop production, fertilizer application, rain and natural calamities(Gowda et al., 2000; Ramana et al., 2000). This directly alters the mineral content of feeds and fodders and, hence, their supply to the animals. The farmers can reduce feeding costs without losing milk production by adopting improved feeding practices which have immediate impact on milk production. Balanced and proper feeding along with mineral supplementation results in better utilization of nutrients and optimum milk

production (Garg et al., 2013).

Studies (Mandal et al., 1996; Yadav et al., 1998 and; Baloda, 2019) show that farmers generally do not supplement mineral mixture and common salt in animal ration. Therefore, determining mineral status of feed, fodder and animals and; advocating suitable corrective measures for optimal health is of immense importance to increase animal production. The current study on mineral status of buffaloes was conducted in Charkhi Dadri district of Haryana. The district is recently created as 22nd districts of Haryana state in northern India which is located between 28.5921° N latitude and 76.2653° E longitude respectively.

MATERIALS AND METHODS

The survey was carried out to find out feeding practices and mineral status of lactating buffaloes in Charkhi Dadri district of Haryana state. The survey was conducted during rabi season because in this period animals are less prone to diseases and green is available in abundant. Twelve villages, three from each of the four blocks of district were selected for the survey. From each village, 10 families (a total of 120 families) rearing buffaloes were selected randomly to collect samples of feedstuffs, milk, hair and blood. A questionnaire was designed for collection of information of feeds, feeding practices, milk yield, parity etc. Weight of feedstuffs offered was also recorded using weighing scale. Body weight of the animal was calculated by measuring chest girth as suggested by Nagarcenkar (1980).

Blood samples were collected by jugular venipuncture. Serum was separated in the next morning from the collected blood using centrifuge machine at 2000 rpm for 15 minutes. Vials containing serum were preserved in refrigerator for further laboratory analysis. The hair samples of the same animals were cut from different body parts i.e., neck and switch and packed in small polythene bags till further analysis.

1 ml serum sample was taken in 50 ml conical flask and added 10 ml digestion mixture of acids (4 Nitric acid: 1 Perchloric acid). Thereafter, it was left overnight and in the next morning, heated the sample over hot plate until color of fumes changed. Then after cooling 10 ml final volume was made by adding distilled water into conical flask slowly, mixed properly and stored into 20 ml capped tubes until analysis. The hair samples were dusted off for extraneous contamination, cut into 1 cm length and washed with acetone again before digestion following standard procedure. For digestion, 0.2g of hair sample was taken. Milk samples were dried in silica crucibles on water bath (100°C) and dried samples were ashed at 550°C. Thereafter, HCL-extract was prepared using 50% hydrochloric acid solution for digestion.

Fully automated serum analyzer (EM 200^{TM} Erba Mannheim–Germany) was employed for estimation of serum biochemical parameters using kits produced from Transasia Biomedical Limited, Germany. Calcium in all the biological samples was estimated by Arsenazo method (Mcleans and Hastings, 1935) and Phosphorus was measured by UV phosphomolybdate method (Daly and Ertingshausen, 1972).

Proximate principles, Ca and P analysis of feedstuffs was done with the method suggested by AOAC (2007). Zn, Cu, Mn and Fe in all the samples were estimated using Perkin Elmer Atomic Absorption Spectrometer (PinAAcle 900T). Intake of different minerals was calculated for each milch buffalo using the data of dry matter intake from different roughages and concentrate sources. The data was subjected to statistical analysis using IBM SPSS Statistic software (IBM Corp. 2017) to calculate the mean and standard error.

RESULTS AND DISCUSSION

Berseem was the most preferred green fodder (73.3% farmers) fed by farmers of Charkhi Dadri followed by oat fodder (23.3%) and grasses (23.3%). Among dry roughages, wheat straw was fed by majority of farmers (90.8%) in the district. Rice straw and bajra kadbi were also being used by farmers depending on availability in the area. Comparatively higher percentage of farmers belonging to landless category were using bajra

kadbi. Wheat grain was the most popular as source of energy and was used by 76.7% of buffalo owners followed by bajra grain (44.2 %). As protein sources, cotton seed cake and cotton seed were popular among the farmers. Very few respondents were providing mineral mixture (17.5%) and common salt (13.3%) to their animals in the district. Baloda (2019), Maan et al. (2014) and Mandal et al. (2004) also reported that use of common salt and mineral mixture supplementation was not a common practice in rural area of Haryana state.

In this study only stall-fed feedstuffs were considered to calculate mineral intake for the buffaloes. Sources of minerals through water and grazing material were not considered.

The body weight of buffaloes ranged from 480.6 to 548.4 kg. There was no significant average body weight ($P<0.05$) variation among the blocks. The DM intake ranged from 8-17 kg depending upon body weight and had an average value of 13.00±0.23 kg. The average milk yield was 10.33 kg±0.27 (Table 1).

Table 1. Milk yield, intake of dry matter and minerals in different blocks of Charkhi Dadri district

Name of block	BW (kg)	DMI (kg/d)	Milk yield (kg/d)	Intake of minerals					
				Ca(g/kg)	P(g/kg)	Zn(mg/kg)	Cu(mg/kg)	Fe (mg/kg)	Mn(mg/kg)
Bond Kalan	505.7 ±5.00	12.8 ±0.44	10.2 ±0.71	47.6 ±2.37	35.3 ±2.81	27.4 ±1.47	7.29 ±0.45	183.8 ±9.85	32.4 ±1.62
Charkhi Dadri	506.6 ±5.33	13.0 ±0.47	9.50 ±0.65	50.8 ±2.68	43.6 ±3.31	31.0 ±1.86	8.02 ±0.51	204.4 ±10.83	35.4 ±1.81
Badhra	510.4 ±3.70	13.3 ±0.38	11.0 ±0.77	55.4 ±2.85	37.1 ±2.92	37.7 ±2.19	7.67 ±0.49	223.6 ±10.77	49.1 ±2.39
Jhojhu	505.6 ±8.04	12.8 ±0.59	10.5 ±0.78	57.5 ±2.88	35.4 ±3.61	32.4 ±1.96	7.30 ±0.54	197.4 ±12.19	41.0 ±2.19
Mean	507.2 ±2.85	13.0 ±0.23	10.3 ±0.27	52.8 ±1.38	37.8 ±1.60	32.1 ±0.99	7.57 ±0.25	202.3 ±5.56	39.5 ±1.15

± Standard error of the mean

Ca intake ranged from 22.59-86.10 g and the average value was 52.9 g per day per animal which is higher than the requirement as per NRC (2001) i.e., 45g/day. Only 10.80% of the animals were receiving less Ca than its requirement. Average value for P intake was 37.89 g. According to NRC (2001) on basis of 500 kg body weight and 7 kg milk yield the requirement of P was 30 g. Therefore, the animals received sufficient quantity of P. Overall 15% of animals in Charkhi Dadri district, were receiving less P than its requirement irrespective of their milk yield and body weight.

Majority (72.5%) of the animals of Charkhi Dadri district were consuming less Zn than its required level. while all the buffaloes were receiving diets deficient in Cu. Average dietary intake of Zn and Cu from all sources was 32.16 and 7.57 mg/kg DM against their respective requirement of 40 and 10 mg/kg DM. This short supply was due to lower Zn content in dry roughages that were the major component of feeds (Pasha et al., 2012; Mudgal et al., 2012; Bhat et al., 2011). On the other hand, overall dietary intake of Fe from all the sources was 202.39 ppm, which was higher than its requirement (50 ppm). Average intake of Mn was 39.53 mg/kg but huge variations (12.72-68.78 mg/kg) were observed among individual animals in terms of Mn intake. Highest average intake (49.15 mg/kg) was recorded in Badhra block and the lowest intake (32.48 mg/kg) was recorded in Bond Kalan block. Mn intake was falling short in 51.6% buffaloes of Charkhi Dadri. Along with composition of minerals in feed ingredients and intake of different minerals, status of different minerals was also assessed through

their analysis in blood (serum) and hair. The status of minerals in these biological samples are presented and discussed below.

Mean serum Ca concentration (Table 2) was found 8.36 mg% which lies in the ranges reported earlier. Critical level is 8 mg% for serum Ca (Mc Dowell, 1992). Thus, most of the animals of the district were having normal serum Ca level. Also, Dietary intake of Ca was found satisfactory in the district although few (10.8%) animals were getting Ca deficit diet. The mean serum P concentration was found 7.06 mg% which is normal hence, animals were not deficient in terms of P in the district. Also, Dietary intake of P was found adequate in the district. Similarly, Maan et al. (2014) reported that serum Ca ranged from 4.62 to 13.50 mg% and had mean value 8.60 mg while the mean serum P value was 6.77 mg%.

Table 2. Serum mineral composition of buffaloes in different blocks of Charkhi Dadri district

Name of Block	Ca(mg%)	P(mg%)	Zn(ppm)	Cu(ppm)	Fe(ppm)	Mn(ppm)
Badhra	8.89±0.93	6.82±0.40	2.73±0.23	0.58±0.05	3.24±0.39	0.39±0.03
Jhojhu	9.16±0.81	6.45±0.37	2.61±0.17	0.62±0.04	3.52±0.45	0.34±0.06
Bond Kalan	7.78±0.38	7.67±0.33	2.20±0.21	0.59±0.04	3.83±0.28	0.31±0.04
Charkhi Dadri	8.36±0.44	7.30±0.58	1.94±0.19	0.68±0.06	3.74±0.22	0.32±0.03
Mean	8.54±0.37	7.06±0.39	2.37±0.08	0.62±0.03	3.58±0.16	0.34±0.02
Critical level	8.00	4.50	0.60	0.65	1.00	0.20

± Standard error of mean

Serum Zn ranged from 1.15-3.39 ppm and the mean serum Zn content was found 2.37 ppm. Critical level for serum Zn is 0.80 ppm while 70% animals in the district were getting lower dietary Zn than requirement. Zn concentration in blood serum is the most widely used indicator of deficiency but also lacks certainty and sensitivity as a diagnostic criterion (Underwood, 1981). Similar observation was also reported in other studies by Yadav and Khirwar (1999). Concentration of serum copper ranged from 0.28 to 0.96 ppm with its mean value 0.62 ppm. According to Underwood (1981) lower critical value of Cu in serum has been reported as 0.6 ppm. Average value of Cu in serum was found below critical level in 80% animals. The concentration of Fe was 3.58 ppm. All the animals were getting enough Fe in their diet so none of the animal was deficient in terms of Fe. The average serum Mn value was 0.34 ppm which was above lower critical value of 0.20 ppm (Underwood, 1981).

The concentration of Ca in hair ranged from 0.06 to 0.27% with a mean value of 0.21% in present study. Similarly, the concentration of P ranged from undetected to 0.016 per cent with mean value of 0.007 per cent. Scanty information is present using hair as an indicator of Ca and P status of animal and hence hair cannot be used to assess Ca and P of buffaloes. However, a significant correlation existed between serum and wool concentration of Ca and P (Sharma, 1996).

The average value of Zn content in hair was found 60.44 mg and the values ranged from 43.5-105.7 mg/kg. All the hair samples had Zn content below normal value of 115 ppm (O, Mary et al., 1969) which indicates general Zn deficiency in feeds offered to buffaloes. Earlier reports (Mandal et al., 2004; Yadav et al., 2002; Maan 2000) also suggested similar findings.

Table 3. Mineral composition of hair of buffaloes in different blocks of Charkhi Dadri district

Name of Block	Ca(%)	P(%)	Zn(ppm)	Cu(ppm)	Fe(ppm)	Mn(ppm)
Badhra	0.22±0.02	0.005±0.01	65.3±2.77	4.84±1.65	312.7±7.74	8.75±1.32
Jhojhu	0.24± 0.04	0.006±0.02	62.7±3.22	5.81±0.94	295.7±8.34	8.26±1.16.
Bond Kalan	0.19±0.03	0.010±0.01	57.9±4.71	5.72±1.14	238.9± 4.82	6.85±0.57
Charkhi Dadri	0.21±0.02	0.008 ±0.01	55.7±3.64	6.94±1.38	186.4±4.16	6.59±0.49
Mean	0.21 ±0.02	0.007±0.01	60.4±2.04	5.82 ±0.74	258.4±4.55	7.61±0.68
Critical level	0.17	0.09	115.00	8.00	40.00	8.00

± Standard error of mean

The mean value for Cu concentration of hair was 5.82 mg/kg. Like Zn, copper concentration in hair was also found below its lower critical level i.e., 8 ppm (Underwood, 1977). Iron content of hair ranged from 146.56 to 346.23 mg/kg and the mean value was 258.47 mg/kg. On comparing with lower critical value of Fe in hair i.e., 40 ppm (Underwood, 1977) none of the hair samples was deficient in Fe. The mean concentration of Mn was 7.61 ppm. The hair concentration is correlated with the level of Mn in diet (Georgeiveskii et al., 1982). Similarly, Underwood (1981) stated that hair apparently reflects the dietary status of animals and 8 ppm was the lower critical level in adult cattle (Underwood, 1977). The values obtained from Badhra and Jhojhu blocks under present investigation were in the normal physiological range but values from Bond Kalan and Charkhi Dadri blocks were below 8 ppm of Mn in hair.

Composition of different minerals in milk samples of buffaloes in Charkhi Dadri district has been shown in table 4. Average value of Ca and P in milk was 0.08 and 0.06%, respectively. The Zn content of the milk varied from 1.07 to 4.68 ppm with mean value of 2.20 ppm. Out of total, 66.0% of the milk samples had values lower than the specified value of 3-5 ppm (Underwood, 1981) indicating deficient dietary intake. Zn deficiency was also ascertained through its concentration in ration and hair.

Table 4. Mineral composition of milk of buffaloes in different blocks of Charkhi Dadri district

Name of Block	Ca (%)	P (%)	Zn (ppm)	Cu (ppm)	Fe (ppm)	Mn (ppm)
Badhra	0.11±0.02	0.07±0.02	2.53±1.64	0.17±0.62	3.81±1.18	0.14±0.02
Jhojhu	0.10± 0.01	0.05±0.01	2.22±2.11	0.21±0.45	3.35±2.52	0.17±0.01
Bond Kalan	0.05±0.03	0.07±0.01	1.94±1.13	0.19±1.07	2.91±1.36	0.11±0.03
Charkhi Dadri	0.08±0.01	0.07±0.02	2.14±1.64	0.23±0.58	2.85±0.94	0.08±0.02
Mean	0.08 ±0.01	0.06± 0.01	2.20±1.26	0.20±0.18	3.23±1.12	0.12±0.01
Critical level	0.12	0.09	3.50	0.40	0.30	0.04

± Standard error of mean

The concentration of milk Cu ranged from 0.04 to 0.55 ppm and mean value was 0.20 ppm. Mean value of Cu in milk samples of all blocks was found below 0.4 ppm i.e., critical level of Cu in milk. About 30% milk samples were indicating Cu deficiency. Same was evident in dietary intake and serum concentration. Fe concentration in milk ranged from 1.84 to 5.31 ppm with mean value of 3.23 ppm. All the samples had milk Fe concentration above the critical level i.e., 0.3 ppm (Underwood, 1981). Mn content of milk ranged from 0.06 to 0.21 ppm and mean content was 0.12 ppm.

CONCLUSION

In the study, it was found that almost all the animals were consuming much less Zn and Cu than their requirement while intake of iron was more than the requirement. Only 10.8% and 15% of the animals

were receiving less Ca and P, respectively, than their requirement. Average value of serum Zn in most of the samples was within normal range i.e., 0.8 to 2 ppm while that of serum Cu was below critical level (0.65ppm). Intake of Fe was high due to high content in feed and fodders. Serum was marginally deficient in Ca and P which might be cause of lactation drainage. Hair and milk samples were deficient in Zn and Cu which is indicative of their general deficiency in animal feeds while none of the samples were deficient in Fe. Based on the findings of current study, it was inferred that there is scope of manipulating feeding pattern through strategic supplementation of minerals for better animal performance.

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