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A Study on Availability of Various Mineral Elements in Milch Buffaloes

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ABSTRACT

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A study was carried out to assess dietary macro and micro-minerals status of milch buffaloes in Amritsar, Ludhiana and Patiala districts, under Central Plain Zone of Punjab. Feeds and fodder samples were collected at random from various locations. The average calcium (Ca) content in straws was low (0.28%). Green fodders such as berseem (1.82%), *chikori* (1.30%), mustard (1.59%) and rye grass (0.46%) were found to be rich source of Ca. Concentrate feed ingredients were particularly low (0.13%) in Ca, except for mustard cake (0.64%) in Ca. The phosphorus (P) content in crop residues and green fodders was 0.10 and 0.43 per cent, respectively. Concentrate feed ingredients were high (0.77%) in P. The sulphur (S) content was adequate in green fodder (0.31%), whereas, crop residues (0.18%) and concentrate ingredients (0.17%) were deficient. The average copper (Cu) content was low in straws (4.46 ppm) and moderate in green fodders (13.38 ppm) and concentrate feed ingredients (10 ppm). The cobalt (Co) was deficient in the diet of animals to the extent of 26 per cent; however, iron (average level >597 ppm) and manganese (average level > 63 ppm) in most of the feed ingredients were adequate, with the prevailing feeding practices. Zinc (Zn) was deficient in most of the feedstuffs (average level<44 ppm). From the present study, it was apparent that the levels of certain minerals such as Ca, P, S, Zn, Cu and Co were inadequate, as per the prevailing feeding practices and requirement of buffalo yielding daily 10 kg milk (6% fat) in the Central Plain Zone of Punjab.

Key words: Calcium, Phosphorus, Zinc, Cobalt, Buffaloes.

INTRODUCTION

Most of the farmers in India do not supplement the ration of dairy animals with mineral mixture (Singh *et al.*, 2005; Garg, 2006). Therefore, the animals are solely dependent on feeds and fodder to meet their mineral requirements. However, feeds alone can not meet the entire requirement, as they are deficient in a number of macro and micro-minerals (McDowell and Arthington, 2005; Garg *et al.*, 2008a). The mineral

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deficiency or excess is an area specific problem and is influenced to a great extent by mineral content and its levels in feeds and fodder fed to animals. In order to avoid mineral imbalances in the ration, the study on availability of various mineral elements in milch buffaloes was carried out in Central Plain Zone of Punjab.

MATERIALS AND METHODS

At random, one centrally located village from each taluka of Amritsar, Ludhiana and Patiala districts from Central Plain Zone of Punjab was selected, for taking representative samples of feeds (n=302) and fodder (n=385). Within the village, help was sought from the village milk producers and District Cooperative Milk Producers' Unions, for identification of 4 farmers. Two dimensional survey technique was adopted by taking village as an unit for collection of feed samples in different talukas of Amritsar, Ludhiana and Patiala districts, to identify the mineral deficiency or excess, to judge the magnitude of the problem and to indicate its origin (Tourtelot, 1980). The recorded parameters were number of livestock, land area, irrigated facilities, fodder and other crops being grown. In identification of farmers, land location was considered essentially, one each from Northern, Eastern, Western and Southern directions, to cover soil types on each side of the selected village.

Further, information regarding the amount and types of feeds and fodder being offered to the animals, actual rate of daily feed intake and milk yield of individual animals was collected from individual farmer. The dry matter intake (DMI) of animals was based on actual measurements made during the sample collection. Daily DMI of animals (n=136) was ranging from 11.50 to 18.20 kg (14.0±0.11 kg). Total intake was compared against the requirement on dry matter basis (Campbell *et al.*, 1999; Kearl, 1982), so as to identify quantitative deficiency, sufficiency or even excess. The data were analysed statistically as per Snedecor and Cochran (1967).

Composite samples of green fodder, dry fodder, individual concentrate ingredients and the compound cattle feed (concentrate mixture) were collected from all over the surveyed area. Green fodder samples were dried in oven at 80°C for 24 hrs and subsequently ground (1 mm). Ground samples of concentrate and fodder were stored in airtight bags until analysis. Samples were prepared and digested using 5 ml concentrate HNO_3 plus 1 ml concentrate HCl by microwave digestion method for preventing evaporation of volatile elements and total volume of mineral extracts was made to 25 ml with deionized water. All the samples were analyzed for calcium (Ca), phosphorus (P), magnesium (Mg), sodium (Na), potassium (K), sulphur (S), copper (Cu), zinc (Zn), manganese (Mn), iron (Fe), cobalt (Co), molybdenum (Mo) and selenium (Se), using Inductively Coupled Plasma-Optical Emission Spectroscopy (Perkin-Elmer, OPTIMA–3300 RL).

RESULTS AND DISCUSSION

Feeding management

Berseem (*Trifolium alexandrium*) and oat (*Avena sativa*) were the major green fodder available and were being fed liberally to dairy animals in most of the villages in

Amritsar, Ludhiana and Patiala districts, under Central Plain Zone. In addition, green *chikori* (*Cichorium intybus*), rye grass, mustard green and bajra green were also being fed by marginal farmers, having land less than two hectares. Wheat and rice straws were the main roughage available for feeding of animals. However, the farmers were found to be reluctant to feed rice straw, it was fed only when wheat straw was not available in sufficient quantity. Among the concentrate ingredients, cottonseed and mustard cakes were the most popular protein supplements and were fed as the sole concentrate to lactating buffaloes even they were fed sufficient green berseem and oat. In addition, it was noticed that farmers were also using crushed wheat/flour, barley, wheat/rice brans (about 0.5 to 1.0 kg) as the concentrate supplements. The farmers who do not feed multiple units concentrate ingredients, were feeding compound cattle feed, depending upon the level of milk production. It was noticed that the farmers were feeding their animals with '*sanni*', a mixture of chaffed green and dry fodder along with concentrate feed ingredients.

Macro and micro-minerals profile of feeds and fodder

The profile of Ca, P, Mg, Na, K, S, Co, Cu, Fe, Mn, Mo, Se and Zn in the feeds and fodder is presented in Table 1. The average Ca content in straws of wheat and rice was low (0.28%). Berseem (leguminous fodder) contained higher Ca, to the extent of 1.82 per cent (Table 1). Green *chikori* (1.30%) being a non-legume was also a good source of Ca. Other fodders such as oat green (0.43%), bajra green (0.48%) and rye grass (0.46%) were moderate source of Ca. Phosphorus was low in crop residues (0.10%), but higher in green fodder (0.43%) and concentrate feed ingredients (0.77%). Compound cattle feed contained around 1.0 per cent each Ca and P. Crop residues were poor source of P and did not supply adequate P to meet its requirement for high yielding animals.

Magnesium content in straws of wheat and rice was adequate (Table 1). Amongst the green fodders, bajra green (0.51%) had the highest Mg content, followed by mustard green (0.42%), *chikori* green (0.41%), berseem green (0.36%), rye grass (0.28%) and oat green (0.22%), showing that considerable quantities of Mg were available from the livestock requirement point of view. Grains of barley and wheat were found to be low in Mg (0.13%). Whole cottonseed (*Gossypium herbaceum*), cottonseed cake, mustard cake, wheat bran and rice polish were good sources of Mg (Table 1). Compound cattle feed contained 0.63 per cent magnesium, a level that is higher than required as a supplement, because of its sufficiency in cattle feed raw materials. Recommended concentrations for dietary magnesium are within the range of 0.2-0.4% of total DMI (Underwood and Suttle, 1999; Goff, 2000).

The sodium content was unduly low in dry fodder, ranging from 0.05 to 0.13 per cent. Amongst the green fodders, surprisingly berseem green (1.80%) had the highest Na content, followed by *chikori* green (1.73%), oat green (1.22%), rye grass (0.94%), mustard green (0.70%) and bajra green (0.41%), showing that considerable quantity of Na was available from the green fodders, as per as requirement is concerned. Concentrate feed ingredients were again low (0.042%) in Na. However, compound cattle feed had an appropriate quantity of sodium to the extent of 0.85 per cent, because of added sodium chloride (Table 1). Higher potassium content of feedstuffs may be due to its selective uptake from the soil and due to application of K based fertilizers to the soil. Similar findings were also reported by Singh *et al*. (2002). K content in dry and green fodders were higher (3.41%) than the concentrate feed ingredients (1.02%) and seemed to be another element like Na, which did not require additional supplementation in the ration.

The sulphur content was low in most of the crop residues (0.18%), the reason being its transfer to seed proteins. The concentrate ingredients fed to livestock in this area had also low (0.17%) S, however, green fodders from various locations had around 0.31 per cent S (Table 1). The variation in S content of plants depends largely on the amount of S in plant proteins in the form of S-containing amino acids (McDowell, 1992).

The cobalt level in this zone ranged from 0.34 to 0.42 ppm in straws, 0.39 to 1.15 ppm in green fodders and 0.31 to 0.48 ppm in concentrate ingredients (Table 1). Compound cattle feed contained 1.21 ppm Co. The Co was deficient in the diet of animals to the extent of 26 per cent, therefore, its supplementation was considered essential.

Copper level was recorded consistently low in almost all the collected feedstuffs. Straws of wheat and rice contained very low level of copper (4.46 ppm). Amongst the green fodders, rye grass (17.31 ppm) had the highest Cu content, followed by chikori green (15.19 ppm), berseem green (14.04 ppm), bajra green (13.10 ppm), oat green (10.56 ppm) and mustard green (10.44 ppm). Whole cottonseeds were low (8.57 ppm) in Cu, whereas, wheat bran (13.18 ppm), rice polish (12.59 ppm), cottonseed cake (11.91 ppm) and mustard cake (10.77 ppm) were moderate source of Cu. In grains, the level was again very low (Table 1). Kumar *et al*. (2004) reported low Cu in feedstuffs available in sub-mountain zone of Punjab. Since Cu content was below the critical of 8 ppm (Cuesta *et al*., 1993) in most of the feeds and fodder (Table 1), its supplementation in the animal ration was considered necessary.

Distribution of iron was found to be unique in the sense that it exceeded the requirement in all the feedstuffs, fed to livestock (Table 1). High levels of Fe in feeds and fodder were reported (Udar *et al*., 2003; Ramana *et al*., 2001; Mandal *et al*., 2004; Garg *et al*., 2005), in different agro-climatic zones of India. Even straws were quite rich in Fe (>890 ppm). Amongst the green fodders, *chikori* green (1131 ppm) had the highest Fe content, followed by berseem green (814 ppm), rye grass (678 ppm), mustard green (545 ppm) and oat green (392 ppm). Grains of barley and wheat contained around 200 ppm Fe, while rice polish (1350 ppm) was rich in Fe. Whole cottonseeds and cottonseed cake contained 157 and 366 ppm Fe, respectively. The Fe concentration in majority of feed ingredients was very high and could probably interfere with the copper absorption (Bremmer *et al*., 1987; Youssef *et al*., 1999), which needs to be investigated. In view of very high levels of Fe in all the feeds and fodders, its supplementation was not necessary.

Straws of wheat and rice contained 55 and 116 ppm Mn, respectively. The average Mn content in green fodders was 76 ppm. Amongst the concentrate ingredients, rice polish (77.90 ppm) had the highest Mn content, followed by wheat bran (77.59 ppm), mustard cake (61.56 ppm), wheat flour (32.35 ppm), cottonseed cake (26.25 ppm) and cottonseeds (24.81 ppm). Compound cattle feed contained around 84 ppm Mn (Table 1). Similar to Fe, Mn supplementation was also not considered necessary, as overall ration of animals was adequate in Mn.

The molybdenum level in the samples of crop residues was within the safe limit (Table 1). Mo content in straws ranged from 0.79 to 0.81 ppm. Amongst the green fodders, berseem green (3.61 ppm) had the highest Mo content, followed by mustard green (2.21 ppm), rye grass (2.10 ppm), oat green (1.31 ppm) and *chikori* green (1.11 ppm). Cottonseed cake and rice polish contained 1.68 and 1.03 ppm Mo, respectively. Most of the feedstuffs contained Mo level within the safe limit and gave Cu:Mo ratio wider than 3.0. Kumar *et al.* (2004) reported high Mo level in green fodders in Punjab. Suttle (1991) stated that a Cu:Mo ratio below 2.0 would be expected to cause conditioned Cu deficiency in cattle. Mo levels of 5 to 6 ppm inhibit Cu storage and produce signs of molybdenosis (NRC, 1980). Even 2 ppm or less Mo can be toxic, if forage Cu is sufficiently low (Youssef *et al.*, 1999). In case of ruminants, Mo reacts with sulphur in the rumen and forms mono-, di-, tri- and tetra-thiomolybdates (Suttle, 1991). Thiomolybdates can cause Cu deficiency by reacting with dietary copper in the digestive tract and making it unavailable for absorption and utilization (Nelson, 1988).

On comparison of mean values of Zn in feeds and fodders with their corresponding requirement, Zn was found to be deficient in almost all the dry roughages collected from the Central Plain Zone of Punjab. Zinc deficiency in feed resources from many agro-climatic zones of the country has been reported (Ramana *et al.*, 2001; Garg *et al.*, 2002; Udar *et al.*, 2003). In the zone, Zn was found to be deficient in straws of wheat and rice (Table 1). The zinc content in green fodders varied from 31 to 60 ppm. Grains contained around 30 ppm Zn, while rice polish was an exception with higher Zn content (77.78 ppm). Wheat bran contained around 63 ppm Zn. Whole cottonseed and cottonseed cake contained around 42 ppm Zn. Zinc content was found below the critical level (30 ppm) in most of the crop residues and needed to be supplemented to reach a level of 80 ppm in the total ration (Arora, 1981) of animals, to overcome its deficiency.

None of the fodders offered was deficient in selenium rather the levels were on the higher side (Table 1). Se content of the crop residues varied from 0.56 to 1.39 ppm. Amongst the green fodders, berseem green (0.54 ppm) had the highest Se content, followed by mustard green (0.50 ppm), *chikori* green (0.35 ppm), oat green (0.31 ppm) and bajra green (0.28 ppm). Grains had around 0.17 ppm Se. Whole cottonseed and cottonseed cake contained 0.23 and 0.34 ppm Se, respectively. The minimum dietary Se requirement of all classes of ruminant livestock ranges from 0.10 to 0.30 ppm (NRC, 1980). Accepting the minimum requirements of 0.30 ppm Se, which is the level considered adequate for preventing deficiency in dairy cattle (NRC, 2001), most of the feeds and

Table 1. Macro and micro-mineral content (DM basis) in feeds and fodders in Central Plain Zone of Punjab

Fodder	Ca (%)	P (%)	Mg (%)	Na (%)	K (%)	S (%)
Critical level[†]	<0.30	<0.25	<0.20	<0.06	<0.80	<0.20
Wheat straw (n=98)	0.13-0.50 (0.30±0.027)	0.04-0.20 (0.064±0.012)	0.02-0.88 (0.35±0.053)	0.01-0.85 (0.13±0.05)	0.69-2.38 (1.50±0.11)	0.08-0.60 (0.20±0.027)
Paddy straw (n=46)	0.12-0.40 (0.27±0.042)	0.04-0.35 (0.15±0.067)	0.16-0.45 (0.25±0.048)	0.02-0.09 (0.05±0.01)	0.77-1.43 (1.20±0.094)	0.08-0.24 (0.16 ±0.027)
Berseem green (n=87)	1.08-3.40 (1.82±0.081)	0.19-0.47 (0.34±0.011)	0.22-0.86 (0.36±0.027)	0.60-2.84 (1.80±0.12)	1.32-4.30 (2.64±0.14)	0.18-0.50 (0.34 ±0.013)
Chikori green (n=39)	1.10-1.60 (1.30±0.068)	0.2-0.53 (0.40±0.037)	0.28-0.95 (0.41±0.068)	0.4-2.89 (1.73±0.31)	1.15-4.90 (3.54±0.60)	0.16-0.48 (0.31±0.028)
Mustard green (n=28)	0.70-2.39 (1.59±0.021)	0.32-0.74 (0.46±0.045)	0.31-0.50 (0.42±0.021)	0.04-1.17 (0.70±0.14)	1.59-4.46 (3.30±0.38)	0.26-0.71 (0.49±0.061)
Oat green (n=67)	0.29-0.57 (0.43±0.019)	0.11-0.57 (0.34±0.034)	0.14-0.45 (0.22±0.022)	0.20-4.19 (1.22±0.19)	1.60-5.19 (3.04±0.31)	0.11-0.41 (0.24±0.028)
Bajra green (n=11)	0.35-0.62 (0.48±0.012)	0.21-0.44 (0.33±0.04)	0.32-0.68 (0.51±0.03)	0.23-0.51 (0.41±0.10)	2.50-4.21 (3.64±0.14)	0.10-0.19 (0.15±0.06)
Rye grass (n=9)	0.35-0.57 (0.46±0.054)	0.45-0.80 (0.71±0.06)	0.15-0.37 (0.28±0.05)	0.68-1.21 (0.94±0.09)	3.09-4.84 (4.32±0.11)	0.22-0.37 (0.31±0.03)
Cottonseed cake (n=59)	0.14-0.64 (0.23±0.077)	0.27-0.86 (0.68±0.03)	0.33-0.94 (0.52±0.039)	0.04-0.41 (0.079±0.018)	0.61-2.31 (1.34±0.081)	0.17-0.50 (0.28±0.019)
Cottonseeds (n=19)	0.11-0.28 (0.20±0.08)	0.56-0.81 (0.72±0.02)	0.25-0.45 (0.38±0.04)	0.03-0.07 (0.05±0.017)	1.10-1.65 (1.37±0.17)	0.08-0.15 (0.11±0.05)
Mustard cake (n=47)	0.50-0.83 (0.64±0.04)	0.86-1.25 (1.03±0.057)	0.33-0.67 (0.47±0.05)	0.02-0.09 (0.047±0.01)	0.91-1.47 (1.17±0.076)	0.15-0.48 (0.33±0.049)
Wheat flour (n=35)	0.04-0.24 (0.10±0.033)	0.29-0.41 (0.36±0.019)	0.12-0.21 (0.16±0.013)	0.01-0.09 (0.04±0.012)	0.42-0.66 (0.51±0.039)	0.08-0.18 (0.12±0.015)
Wheat bran (n=68)	0.05-0.17 (0.11±0.016)	0.36-1.20 (0.73±0.11)	0.22-0.72 (0.45±0.069)	0.01-0.06 (0.032±0.01)	0.44-1.55 (1.07±0.14)	0.02-0.24 (0.12±0.034)
Rice polish (n=21)	0.08-0.16 (0.11±0.017)	1.31-2.12 (1.57±0.20)	0.34-0.68 (0.54±0.07)	0.01-0.03 (0.02±0.001)	0.90-1.39 (1.20±0.15)	0.11-0.25 (0.15±0.06)
Barley grain (n=8)	0.04-0.06 (0.05±0.008)	0.21-0.39 (0.33±0.02)	0.08-0.15 (0.12±0.04)	0.02-0.04 (0.03±0.002)	0.36-0.65 (0.53±0.12)	0.08-0.15 (0.11±0.008)
Compound feed (n=45)	0.18-3.0 (0.97±0.14)	0.30-1.80 (1.20±0.092)	0.21-0.86 (0.63±0.075)	0.10-2.94 (0.85±0.16)	0.73-1.72 (1.19±0.066)	0.17-0.50 (0.35±0.024)

Figures in the parentheses indicate mean±SE values of individual mineral elements.

[a]Critical level= concentrations below which are low or considered deficient (McDowell *et al.,* 1993), based on requirements for cattle (NRC, 2001).

Table 1 continued…..

	Co (ppm)	Cu (ppm)	Fe (ppm)	Mn (ppm)	Mo (ppm)	Se (ppm)	Zn (ppm)	Cu: Mo
	<0.10	<8.0	<50.0	<40.0	>6.0	<0.20	<30.0	
	0.12-0.79	1.14-8.01	248-2152	36.6-82.4	0.02-2.12	0.13-2.0	4.63-35.10	
	(0.34±0.047)	(2.94±0.39)	(899.09±143.0)	(55.13±2.97)	(0.79±0.10)	(0.56±0.11)	(19.65±2.54)	3.72
	0.15-1.12	2.29-8.24	542-3434	88.87-190	0.43-1.07	0.09-3.0	9.90-29.35	7.38
	(0.42±0.14)	(5.98±0.87)	(1097.4±468.1)	(116.94±23.25)	(0.81±0.09)	(1.39±0.52)	(14.30±3.08)	
	0.14-1.26	6.16-21.48	185-3631	31.5-150	0.34-11.81	0.21-2.5	7.0-84.3	3.88
	(0.62±0.041)	(14.04±1.55)	(814.25±123.2)	(65.78±5.09)	(3.61±0.47)	(0.54±0.06)	(51.03±2.61)	
	0.63-1.58	6.88-21.84	249-1953	38-130	0.30-2.04	0.0-0.59	23-81	13.68
	(1.15±0.16)	(15.19±1.43)	(1131.1±205.8)	(92.20±10.73)	(1.11±0.25)	(0.35±0.06)	(59.58±6.25)	
	0.22-0.76	6.91-17.28	222-831	36.1-59.7	0.38-10.63	0.24-0.83	42.56-84.72	4.72
	(0.54±0.061)	(10.44±1.19)	(545.87±74.23)	(48.11±3.21)	(2.21±0.22)	(0.50±0.07)	(54.92±4.59)	
	0.05-1.07	5.61-22	167-985	32.96-109	0.25-3.70	0.07-1.0	23.41-62.41	8.06
	(0.39±0.06)	(10.56±1.40)	(390.69±52.39)	(55.37±6.06)	(1.31±0.20)	(0.31±0.07)	(31.38±3.87)	
	0.26-0.45	7.12-19.87	234-432	65.2-124	0.45-0.92	0.17-0.36	27.35-51.1	17.94
	(0.40±0.07)	(13.10±1.54)	(392.60±60.34)	(93.19±7.12)	(0.73±0.14)	(0.28±0.05)	(36.80±2.45)	
	0.35-0.81	9.78-22.89	432.1-876	76.9-144	0.9-3.45	0.14-0.32	36.7-78.4	8.24
	(0.69±0.05)	(17.31±1.12)	(678.4±44.36)	(105.0±9.23)	(2.10±0.40)	(0.22±0.012)	(60.40±2.11)	
	0.13-1.58	6.98-25.1	118-1588	15.50-80	0.96-8.78	0.07-0.72	29.49-59	7.08
	(0.48±0.072)	(11.91±1.04)	(366.04±96.80)	(26.25±3.67)	(1.68±0.39)	(0.34±0.05)	(42.93±1.91)	
	0.25-0.53	6.98-11.21	135.1-211	18.9-36.3	0.98-1.45	0.14-0.31	32.3-56.6	6.75
	(0.39±0.01)	(8.57±1.02)	(157.40±21.51)	(24.81±0.077)	(1.27±0.077)	(0.23±0.077)	(42.87±0.077)	
	0.10-0.87	5.21-15.64	198-982	45.3-79.5	0.24-1.07	0.01-0.42	20.48-69.21	15.83
	(0.36±0.10)	(10.77±1.32)	(407.74±102.5)	(61.56±5.17)	(0.68±0.10)	(0.17±0.05)	(52.79±6.10)	
	0.26-0.78	5.67-8.06	86-1789	24-44.79	0.11-0.64	0.09-0.35	26.92-38.48	14.93
	(0.47±0.086)	(7.02±0.46)	(246.80±11.71)	(32.35±3.31)	(0.47±0.08)	(0.14±0.05)	(33.06±2.20)	
	0.11-1.14	6.83-16.05	157-642	27.98-110	0.42-1.84	0.14-0.77	31.14-97.70	13.31
	(0.36±0.10)	(13.18±1.09)	(332.85±58.95)	(77.59±10.38)	(0.99±0.18)	(0.30±0.11)	(63.96±9.40)	
	0.21-0.55	9.51-15.73	788-1875	58.9-91.2	0.75-1.20	0.45-0.78	61.39-102	12.22
	(0.37±0.19)	(12.59±1.12)	(1350±70.01)	(77.90±7.15)	(1.03±0.08)	(0.55±0.10)	(77.78±4.92)	
	0.25-0.41	6.5-11.25	121-181.2	21.8-35.9	0.39-0.65	0.15-0.25	19.8-35.5	14.68
	(0.31±0.04)	(8.37±0.92)	(158.6±9.42)	(27.81±1.91)	(0.57±0.05)	(0.20±0.07)	(28.69±2.72)	
	0.11-4.56	4.63-19.92	118-1568	41-159	0.40-2.25	0.08-1.94	21.98-145	10.32
	(1.21±0.26)	(12.39±1.21)	(611.47±154.2)	(84.35±7.04)	(1.20±0.11)	(0.51±0.12)	(64.35±8.07)	

fodders would satisfy requirement of Se. Therefore, its supplementation in the ration is not advocated.

Macro and micro-minerals intake by buffaloes

Daily intake and requirement of different minerals by milch buffalo (450 kg body weight) yielding 10 kg milk (6% fat) in villages of Amritsar, Ludhiana and Patiala districts are presented in Table 2. Since mineral mixture supplementation was not being practiced by most of the farmers, intake of minerals through feeds and fodders, considering 60% bio-availability, was taken as the index of total dietary supply and compared with the recommended requirement to know the dietary mineral status. The maintenance requirement of buffalo for Ca and P was considered 18 and 13 g, respectively, whereas, 4.65 and 2.98 g of Ca and P per litre milk yield was taken for the calculation of requirement (Kearl, 1982).

A buffalo yielding 10 kg milk per day would need 64.50 g Ca, whereas, feeds and fodders available in the area when fed as per diet formulation given in Table 2, would provide 58.87 g Ca, showing deficiency. Calcium was found to be severely deficient in the ration of animals, when green berseem was not available. Under such conditions, milk production is likely to be affected and freshly calved animals may suffer from milk fever (McDowell *et al.*, 1993). The estimated value of P availability from feedstuffs was 36.73 g against the requirement of 42.80 g per day for a milch buffalo yielding 10 kg milk, showing a deficiency of 6.07 g per day (Table 2). Singh *et al.* (2005) found deficiency of P in dairy animals and suggested mineral supplementation in different agro-climatic zones of Punjab. Furthermore, bioavailability of P from plant sources has been reported to be low due to phytic acid-P (McDowell, 1992), leading to problems of pica, infertility and haemoglobinuria in animals (Garg *et al.*, 2005).

The Mg requirement of a milch buffalo yielding 10 kg milk per day was 28.0 g (Table 2), whereas, feeds and fodders fed in that area provided 30.94 g of Mg per day, showing adequacy. The availability of Na and K from feed sources was adequate for a buffalo yielding 10 kg per day (Table 2). However, Na was found to be deficient in the diet of animals, when green oat and berseem fodder were not available.

The availability of S from feed sources was 21.33 g and the requirement was 28.0 g per day, showing a deficiency of 6.67 g per day, for milch buffalo yielding 10 kg milk per day. Hence, sulphur supplementation was necessary in the ration of animals (McDowell, 1992; Garg *et al.*, 2003).

Similarly, the buffalo yielding 10 kg milk day, would need 7.0 mg cobalt per day, as per the standard requirements, whereas, feeds and fodders available in the area when fed, provide only 5.33 mg Co, showing a deficiency of cobalt (Table 2). Copper status from traditional feeds and fodders fed to a buffalo, with this level of milk production, was 74 mg against the requirement of 140 mg per day (Table 2). Randhawa and Randhawa (2002) also reported Cu deficiency in dairy animals in Punjab. Supplementation of Cu,

Table 2. Availability and requirement of minerals for a milch buffalo (450 kg BW) yielding 10 kg milk (6% fat) per day

Attribute	Daily DMI (kg)	Daily intake (g)					Daily intake (mg)						
		Ca	P	Mg	Na	K	S	Co	Cu	Fe	Mn	Zn	Se
Availability from feeds and fodder													
Wheat straw	5.0	9.25	1.94	10.63	4.03	45.20	6.10	1.05	8.82	2697	165	58.96	1.70
Rice straw	0.5	0.81	0.46	0.74	0.15	3.60	0.49	0.13	1.80	329	35	4.29	0.25
Berseem green	3.0	32.76	6.15	6.58	32.44	47.54	6.11	1.13	25.29	1465	118	91.86	0.98
Oat green	0.5	1.29	1.03	0.67	3.68	9.14	0.72	0.12	3.17	117	17	9.42	0.09
Cottonseed cake	0.5	0.70	2.05	1.57	0.24	4.05	0.86	0.15	3.58	109	8	12.88	0.10
Mustard cake	0.5	4.79	1.41	1.28	2.11	9.93	1.47	0.16	3.31	164	14	16.48	0.15
Wheat bran	1.0	0.68	4.38	2.72	0.20	6.42	0.75	0.22	7.91	199	47	38.38	0.18
Cattle feed	3.0	12.00	21.00	11.34	15.44	21.44	6.46	2.19	22.31	1100	165	115.80	0.93
Total daily availability	14.00 ±0.11	58.87 ±1.55	36.73 ±1.29	30.94 ±1.76	49.67 ±3.58	140.78 ±3.45	21.33 ±0.72	5.33 ±0.21	74.00 ±2.12	5739 ±193	552 ±5.6	369.52 ±13.63	4.60 ±0.06
Requirements				@0.2% of DMI	@0.18% of DMI	@0.9% of DMI	@0.2% of DMI	@0.5 ppm	@10 ppm	@50 ppm	@40 ppm	@80 ppm	@0.3 ppm
Maintenance	14.00	18.00	13.00	—	—	—	—	—	—	—	—	—	—
Milk production	—	46.50	29.80	28.00	25.20	126	28.0	7.0	140	700	560	1120	4.20
Total daily requirement	14.00 ±0.11	64.50	42.80	28.00	25.20	126	28.0	7.0	140	700	560	1120	4.20

Zn and Mn in the form of chelates reported to be more bio-available and helped in curing problems of infertility in dairy animals (Garg *et al.*, 2008b).

Availability of Fe from feed resources was 5739 mg and the requirement was only 700 mg per day (Table 2). The milch buffalo yielding 10 kg milk per day, require 560 mg Mn per day, whereas, feed sources provided 552 mg (Table 2), showing adequacy of Mn. Adequate Mn availability from feeds and fodder was also recorded in other parts of country (Garg *et al.*, 2000; Yadav *et al.*, 2002).

For the milch buffalo with 10 kg milk per day, availability of Zn from feed resources was 369.5 mg and the requirement was 1120 mg, showing deficiency of 750.5 mg per day (Table 2). The milch buffalo yielding 10 kg milk per day, require 4.20 mg Se per day, whereas, feed sources provided 4.60 mg (Table 2), showing adequacy of Se. Excess Se availability from feeds and fodder was recorded in other parts of country (Garg *et al.*, 2005).

CONCLUSION

From the present study, it was apparent that the milch buffaloes yielding 10 kg milk per day in various talukas of Amritsar, Ludhiana and Patiala districts under Central Plain Zone of Punjab were deficient in calcium, phosphorus, sulphur, copper, zinc and cobalt, with the available feed resources in that zone. Therefore, it is necessary to supplement these deficient minerals in the ration of dairy animals by formulating area specific mineral mixture, having highly bio-available mineral salts.

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