REQUIREMENTS OF CERTAIN MINERALS FOR LARGE RUMINANTS IN MEHSANA DISTRICT OF GUJARAT

M.R. GARG, B.M. BHANDERI, P.L. SHERASIA, D.K. SINGH AND S.P. ARORA*
Biotechnology Laboratory
National Dairy Development Board, Anand -388 001, India

(Received on March 21, 1998)

ABSTRACT

An attempt was made to recommend specific quantities of each deficient mineral based on chemical composition and differences in calculated requirements of ruminants in Mehsana district of Gujarat. A buffalo yielding 10 kg milk per day with 7% fat was considered as a standard for such calculations. Calcium requirement is recommended @ 26.6% and P@ 8% in the mineral mixture. Magnesium through feeds was adequate therefore it required no extra supplementation. Extra Zn and Cu content required in mineral mixture was 107 and 5 ppm, respectively. Iron, Mn and Co did not require any further supplementation because feeds and fodders seemed to be adequate in this district.

Key words : Mineral survey, Mineral requirement, Calcium, Phosphorus, Zinc, Copper, Buffalo

Mineral imbalances are of common occurrence in livestock through out the continent affecting them in a number of ways[1-3]. It is obligatory to assess feeds and fodders for minerals which are dietary essentials, with the objective to recommend quantities needed extra in the rations, On the other hand, it is useful to avoid supplementation of those minerals which are in excess. Mehsana district of Gujarat is relatively dry area with an average rainfall of 770 mm where mineral status reveals deficiencies of some elements, whereas some seem to be adequate in feeds from nutrition point of view[4]. An attempt has been made to recommend the difference in calculated requirements accordingly[5] with an ultimate objective to optimize production performance.

MATERIALS AND METHODS

Quantitative data from fodder and feed samples were compiled for different mineral elements to calculate intakes in a single day for milch buffaloes and cows. Differences of intakes with NRC[5] standard were estimated to elucidate the status of each assessed element. On that basis, additional supplements were calculated for inclusion in the mineral mixture formulation in Mehsana district.

* *House No. 48, Sector 13, Urban Estate, Karnal - 132 001 (Haryana) India.*

Table 1 Mean mineral contents of different feeds and fodders on DM basis (Mehsana district)

	Mean±SD	F. Value	Mean±SD	F. Value
	Bajra grain (10)		**C.S. Cake (25)**	
Ca	0.03±0.01	5.13*	0.301±0.063	10.76**
P	0.30±0.06	1.12	0.583±0.038	1.22
Mg	0.15±0.06	10.47**	0.357±0.056	9.28**
Cu	8.11±3.70	35.77**	23.001±6.334	4.80**
Zn	37.14±5.42	1.02	49.442±6.499	9.79**
Mn	20.40±9.62	2.39	46.667±8.844	3.36**
Co	1.64±0.66	1.79	1.067±0.269	4.54**
Fe	46.15±5.37	0.28	438.256±110.09	1.77
	Bajra husk (7)		**Chikodi (4)**	
Ca	0.14±0.06	21.21**	1.602±0.474	1.44**
P	0.14±0.04	12.43**	0.440±0.093	4.85
Mg	0.18±0.04	1.84	0.342±0.112	0.99
Cu	7.08±4.47	1.61	34.782±6.372	0.65
Zn	13.25±4.14	1.46	43.520±22.591	-
Mn	32.37±8.79	19.09**	143.550±31.871	0.39
Co	0.69±0.24	0.19	1.090±0.330	1.78
Fe	306.68±60.31	4.08	456.000±118.49	748.36**
	Bajra straw (31)		**Hybrid napier (6)**	
Ca	0.41±0.10	3.29**	0.643±0.085	0.03
P	0.14±0.05	2.08*	0.290±0.112	16.35**
Mg	0.30±0.11	5.13**	0.356±0.254	66.57**
Cu	10.96±5.25	6.71**	16.233±6.473	29.41**
Zn	16.92±7.31	5.21**	21.816±7.785	11.24*
Mn	15.03±17.48	0.90	111.200±24.907	45.34*
Co	0.60±0.01	2.39**	1.543±0.242	0.22**
Fe	287.43±90.68	1.68	359.683±91.127	0.45
	Local Grass (16)		**Isabgol husk (4)**	
Ca	0.443±0.183	2.17	0.245±0.070	148.50**
P	0.195±0.103	0.71	0.332±0.009	0.19
Mg	0.265±0.211	10.63**	0.170±0.076	173.50**
Cu	7.783±3.995	0.52	8.400±0.616	0.44
Zn	16.797±8.219	1.99	26.725±7.377	13.63**
Mn	58.100±18.445	1.09	13.775±2.345	19.88*
Co	1.098±0.233	2.08	0.662±0.172	10.58*
Fe	436.510±225.44	0.81	74.725±5.915	61.61**

	Mean±SD	F. Value	Mean±SD	F. Value
	Lucerne green (30)		Sorghum green (24)	
Ca	1.74±0.23	2.21	0.205±0.170	2.82**
P	0.337±0.104	3.26**	0.233±0.090	0.78
Mg	0.416±0.111	2.73*	0.171±0.890	4.74**
Cu	28.574±7.826	9.18**	9.398±5.331	2.81*
Zn	35.554±5.064	0.49	25.915±7.432	1.57
Mn	84.099±19.969	4.53**	37.192±19.532	2.86*
Co	1.684±0.372	1.08	1.051±0.346	1.51
Fe	450.573±192.48	0.58	272.352±76.286	3.51**
	Oat green(3)		Sorghum straw (35)	
Ca	0.606±0.035	0.01	0.384±0.109	3.49**
P	0.446±0.096	1.56	0.143±0.60	1.09
Mg	0.210±0.113	0.59	0.309±0.115	2.56*
Cu	26.002±4.061	0.48	7.533±3.607	3.92**
Zn	21.333±2.657	4.34	14.698±7.937	1.10
Mn	170.900±1.113	1.75	64.820±22.054	2.81**
Co	1.436±0.090	2.25	0.849±0.309	1.63
Fe	492.960±138.64	16.55	222.394±84.174	4.07**
	Sagardan (28)	(Conc. mix)	Wheat Straw (19)	
Ca	1.081±0.175	0.58	0.193±0.086	0.62
P	0.934±0.076	0.84	0.076±0.034	2.41
Mg	0.535±0.083	2.68*	0.138±0.066	6.48**
Cu	36.466±5.894	4.37**	3.481±1.789	6.14**
Zn	58.271±10.061	4.66**	5.998±2.262	0.78
Mn	97.710±17.464	1.25	42.481±7.545	2.17
Co	6.170±1.446	0.79	0.668±0.238	0.61
Fe	806.729±210.22	6.42	185.847±41.185	0.37
		Wheat grain (7)		
Ca	0.057±0.016	7.21		
P	0.305±0.043	12.13**		
Mg	0.151±0.010	6.36*		
Cu	8.731±1.728	5.48*		
Zn	32.138±6.883	7.10*		
Mn	40.858±9.674	21.68**		
Co	0.878 ±0.158	5.33*		
Fe	67.345±11.138	1.77		

Note * $P<0.05$,** $(P<0.01)$

Values of Ca, P, Mg are in Percentage, While Cu, Zn Mn, Co and Fe are in ppm.

RESULTS AND DISCUSSION

Deficient minerals :

Calcium (Ca) and Phosphorus (P) : Both of these elements are usually low in most of the fodders particularly in straws and non-legumes[3]. The offered concentrates also depicted poor quantity with Ca levels far below the requirements (Table1). Both of these elements are required to be supplemented through the mineral mixture @ 3 percent in concentrate mixture (5kg) for cows and buffaloes, yielding around 10 kg milk per day per animal in that zone[6]. Out of a total requirement of Ca (64g), feed sources provide about 27.71g Ca and about 29.41g P considering 12 kg DM intake each day. The balance quantity i.e. 36.29g Ca and 12.59g P needs to be supplemented through mineral mixture (Table 2).

Table 2 Ca, P and Mg requirements for a milch buffalo (450 kg) yielding 10 kg milk (7% fat) per day

Attribute	DM (kg)	(%)	Ca (g)	(%)	P (g)	(%)	Mg (g)
Requirements							
Maintenance	12.0		18.0		13.0	-	
Milk Production			46.5		28.8	-	24.0
Total	12.0		64.5		41.8	-	24.0
Availability feeds							
Bajra grain	2.78	0.036	1.00	0.30	8.34	0.15	4.17
Cottonseed cake	2.22	0.03	6.66	0.58	12.87	0.35	7.77
Wheat straw	5.50	0.19	10.45	0.07	3.85	0.13	7.15
Hybrid napier	1.50	0.64	9.60	0.29	4.35	0.35	5.25
Total	12.00		27.71		29.41		24.34
MineralMixture required			36.29		12.59		

Compound feed : 5kg DM @ 3% mineral mixture 150g - Ca 36.29g; 24.19 % ; 5 P 12.59g; 8.39%.

Zinc (Zn): This was also recorded as deficient element in Mehsana district[4]. Its mean content did not exceed 25 ppm except in lucerne which contained 35 ppm (Table 1). Its requirement is 80 ppm for optimum metabolic activity in tissues[1]. To make up the difference, it is necessary to supplement extra 107 ppm Zn in the concentrate mixture (Table 3).

Marginally adequate minerals :

Magnesium (Mg): It is an element adequately available from feeds. Against the requirement of 24g/d for 10 kg milk yield in a buffalo, feed supplies 24.34 g showing adequacy. With straws, stovers and cereals, its supply may be less than the requirement. In the latter case, Mg supplementation may be necessary . The overall requirement is 0.24% Mg[5], which depicted adequacy in this zone with the kind of feeding systems practiced by the livestock owners (Table 3). Copper (Cu) availability through feeds varies from 6.63 to 23 ppm (Table 1). It seems that this element is marginally adeuate (Table 3). Overall requirement of Cu is 10 ppm[5] and it may be supplemented to those feeds which are low in Cu to the extent of 5 ppm, like wheat straw.

Table 3 Fe, Cu, Zn, Mn and Co requirements of a buffalo (450 kg) producing 10 kg milk/dav (7% fat)

Attribute	DM (kg)	Fe		Cu		Zn		Mn		Co	
		Rate (ppm)	Qty. (mg)	Rate (ppm)	Qty. (mg)	Rate (ppm)	Qty. (mg)	Rate (ppm)	Qty. (mg)	Rate (ppm)	Qty. (mg)
Requirement	12.0	50	600	10	120	80	960	40	480	0.5	6.00
Sources:											
Concentrate											
Bajra grain	2.78	46	128	8	22	37	103	20	56	1.65	4.59
Cottonseed cake	2.22	438	972	23	51	49	109	46	102	1.06	2.35
Fodder											
Wheat Straw	5.50	185	1017	3	16	6	33	42	231	0.67	3.68
Hybrid napier	1.50	359	538	16	24	21	31	111	166	1.50	2.25
Total	12.0		2655		113		276		555		12.87

Adequate minerals :

Iron (Fe) : In the surveyed area, feeds are exceptionally high in this element and far above the requirments. The mean values of Fe in straws and green fodders are 216.4 ppm and 446 ppm, respectively and grains contained 57.7 ppm (Table 1).

The requirement of Fe is 50 ppm i.e. for 12 kg DM intake, its quantity should be 600 mg per day per animal, whereas, intake is far above the requirement for this region, therefore, its extra supplementation is unnecessary (Table 3).

Manganese (Mn) : The range of Mn revolves around 35 ppm in grains and 73 ppm in fodders and straws (Table 1). Against the requirement of 480 mg, feed and fodder resources can provide 555 mg per day per animal in this zone (Table 3).

Cobalt (Co) : This element in most of feeds and fodders is about 1 ppm (Table 1) in this area against the requirement of 0.5 ppm which is about double and therefore it does not need any extra supplementation through mineral mixture.

Though optimal allowances have been recommended for achieving full genetic potential, yet it may not be possible critically to fix a particular allowance because of several factors. Even if certain mineral concentrations are marginally beyond the optimal level, it may be of no consequence because homeostatic regulations tend to buffer marginally the deficient of excessive intakes by controlling the absorption and excretion rates. Furthermore, mineral requirements may also vary depending upon the level of productivity and kind of function as for example Zn requirement for reproduction in male sheep is higher than for growth[7].

Other important factors which need to be considered in fixing the requirements are the chemical form, bio-availability and mineral inter-relationships. In fact, mineral requirements may be a little more in tropics because of their losses in sweat and saliva[8]. The problems are likely to be more acute when a deficient condition is confounded with effects of more than one element or with some other deficient nutrient or parasitism or as a result of toxicity problem.

Traditional feeding systems as evident in Mehsana district, do require supplementation of Ca, P, Zn and Cu in the mineral mixture whereas Fe, Mn and Co are adequate from the available feeds.

REFERENCES

1 ARORA, S.P. (1988) Effects of some trace element deficiencies and toxicities on animal health in India. In second Intern. Symp. on Geochemistry and health. *Ed. I. Thronton*, pp. 139 Sci. Rev. Northwood

2 ANNON, (1992) Centre for Tropical Vet. Medicine (CTVM) Edin. Univ. Report on the mineral status of animals in some tropical countries and their relationship to drainage geochemical maps of minerals in those countries. *British Geological survey Tech. Report* WC/92/62

3 McDOWELL, L.R., CONRAD, J.H., ELLIS, G.L. and LOOSLI, J.K. (1983) Minerals for grazing ruminants in tropical regions. *Bulletin, Dept. Anim. Sci. Univ. of Florida*, Gainesvilla, Florida, pp 89

4 GARG, M.R., BHANDERI, B.M., SHERASIA, P.L. and SINGH, D.K. (1998) Mapping of certain minerals in feeds and fodders and their requirement status in livestock in the state of Gujarat. *Indian J. Dairy Sci.*, 51:1

5 NRC. (1988) *Nutrient Rquirements of Dairy Cattle.* 6th Ed. *National Academy of Sciences - NRC,* Washington, D.C.

6 SINGH, D.V., TRIPATHI, V.N., PATHAK, B.L. and DAVE, A.S. (1996) Factors influencing 305 - day first lactation milk yield in Mehsana buffaloes. *Indian Vet. J.*, 73 : 584

7 UNDERWOOD, E.J. (1981) *The Mineral Nutrition of Livestock. Commonwealth Agricultural Bureaux.*, London, pp. 381

8 McDOWELL, L.R. (1997) Minerals for grazing ruminants in tropical regions. Third ed. Anim. Sci. Dept. Univ. of Florida, *Co-operative Extension service*, Gainesvilla, FL. 32611, pp.9