Indian Journal of Animal Sciences **80** (7): 666–670, July 2010

Effect of supplementation on intake of minerals, milk yield and blood biochemical profile in lactating camels under traditional and semi intensive system

N SAINI[1], N SINGH[2] and B D KIRADOO[3]

National Research Centre on Camel, Bikaner, *Rajasthan 334 001 India*

Received: 23 October 2008; Accepted: 10 December 2009

ABSTRACT

Assessment of mineral status from feeding trial revealed that straw feeding under traditional system resulted in deficiency of Ca, P, Cu, Zn and Mn. Effect of supplementation of these minerals was evaluated in terms of intake of dry matter, milk yield and body weight as well as on blood biochemical profile in 8 Bikaneri camels. Group 1 camels were managed under traditional system with supplementary feeding of straw at evening. Camels of group 2 were fed same straw with concentrate and mineral mixture under intensive system. Strategic supplementation resulted in significant increase in dry matter (g/kg $^{0.75}$) intake and consequently higher mineral intake in respective group compared to control. The group 2 camels produced more milk (6.11 litre/day) than group 1 (5.37 litre/day) with an average of 463.63 and 408.34 litres, respectively. The dam of group 1 lost 15 kg body weight while dam of group 2 gained 16.75 kg weight with daily gain of 500 g/day with supplementation and thus indicated positive effect on body weight of dam. Similarly, the calves of supplemented group 2 had significantly faster growth with daily gain of 739.25 g/day than non-supplemented group 1 (631.72 g/day). Average blood minerals concentration was above the critical limit and values of P, Cu, Zn and Mn showed significant increase with supplementation of these minerals. Concentration of total protein was significantly higher in supplemented group (6.69 mg%) compared to control (5.95 mg%). The results indicated that in the existing traditional feeding system supplementation of Ca, P, Cu and Zn are required in diet of lactating camels and dietary supply of these nutrients improved production performance of camel.

Key words: Camels, Clusterbean straw, Mineral intake, Traditional system

Rearing of camels exclusively on grazing is a cost effective and traditional method. But day by day deterioration of grazing land adversely affects growth, production as well as reproduction of farm animals because of insufficient intake of nutrients. Such feeding system may cause deficiency of some minerals in camels (Saini *et al.* 2007). The situation may aggravate during stress of growth, lactation and pregnancy due to increase metabolic demand. Supplementation of diet with deficient nutrients particularly minerals may improve the production and performance in camels (Kuria *et al.* 2004). This experiment was therefore planned, to find out the intake of minerals, which are in short supply when clusterbean straw (*Cyamopsis tetragonoloba*) was fed as sole diet for formulating area specific mineral mixture, thereafter deficient minerals were supplemented to see the effect on milk yield, body weight of dam, blood mineral profile and calf growth under traditional vs. intensive system without and with mineral mixture feeding.

Present address: [1]Senior Scientist (e-mail: nirmala.saini @rediffmail.com), [2]Junior Research Fellow, [3]Senior Research Fellow.

MATERIALS AND METHODS

Dromedary (8) camels of Bikaneri breed of average milk yield (5 litre/day) during their mid stage of lactation were distributed equally in 2 dietary groups based on the body weight (606.50 vs 596.25 kg). Camels in both the groups were fed clusterbean straw as a source of dry roughage. Group 1 camels were managed under traditional system, i.e. 7–8 h grazing and feeding of straw at evening. Whereas, camels of group 2 were fed 2 kg concentrate mixture (containing 14% DCP and 70% TDN) to meet protein and energy requirement along with formulated mineral mixture @ 50 g/day, as shown in Table 1 under intensive system. The concentrate mixture consisted of de-oiled rice bran (24 part), rice bran (19 part), de-oiled mustard cake (12 part), *guar* korma (13.5 part), maize (23.5 part), molasses (5 part), common salt (1 part), vitamin A (5000 IU/kg) and vitamin D (1000 IU/kg). The study was started in June but actual milk recording was started in the September 2007 and continued up to November. After assessing the intake of dry matter (DMI kg/d), daily intake of each mineral by camels was calculated by multiplying level of minerals in feed and DMI. The difference between daily requirement and estimated intake was supplemented through the concentrate and mineral mixtures. The concentrate was fed individually before milking in the morning. Quantity of feed and fodder offered and refusals were recorded daily up to 1 month. Samples of concentrate and dry fodder offered and refusals were taken at weekly intervals for estimation of dry matter (AOAC 1995) and minerals. Minerals in feed and blood were estimated by ECIL AAS 4141 following manual procedure. Monthly blood samples and fortnightly body weights of camels were recorded. Camels were hand milked in the morning between 6.00 and 8.00 AM following overnight separation of calves from the dams. Half quarters udder was milked and multiplies by two to get total milk yield. Milk samples at fortnightly intervals were analyzed for milk urea content (Bector *et al*. 1998). The data were analyzed by Student t-test.

RESULTS AND DISCUSSION

Camels were mainly fed crop residues without concentrate and mineral mixture at village level. Clusterbean straw is preferred over groundnut and moth straws due to its low cost and more availability. This straw contained low crude protein (6.8%) and high fibre (32.90%) content (Table 1). Mineral analysis revealed that Ca, Mg and Mn concentration was adequate and Fe was higher than the suggested requirement of McDowell (1993). Clusterbean straw, which was a major source of dry matter, had low level of P (0.15%), Cu (7.17 ppm), and Zn (17.08 ppm) than the critical level. High level of Fe in feed and fodder of Rajasthan were also reported by Garg *et al.* (2008). Shinde and Sankhyan (2008) reported that most of the traditional feed and fodder of this region contained sufficient amount of Ca, Mg and Mn and low level of Cu and Zn.

Intake of DM and minerals are presented in Table 2. In addition to grazing, the total intake of straw in group 1 was comparable to group 2 and did not differ significantly. Similar intake of straw of both groups indicated that grazing land did not provide sufficient amount of nutrients to camels. The total intake of clusterbean straw in group 1 and 2 was 11.40± 0.72 and 10.12± 0.13 kg/day, respectively. Intake was slightly lower in group 2 due to concentrate feeding (Table 2). However, the camel in group 2 fed concentrate and mineral mixture in addition to straw, consumed more dry matter (12.02 ± 0.10 kg/day) compared to group 1 (11.40± 0.72 kg/day). The dry matter intake when expressed as per kg metabolic body weight ($g/kg^{0.75}$) was significantly ($P<0.05$) higher in group 2. The total dry matter intake as% body weight was 1.71 and 1.93% in groups 1 and 2, respectively, and the values were comparatively higher than the suggested requirement (1.52%) of Wardah (1997) for lactating camels.

The average daily intake of all micronutrients was obviously low in group 1, fed straw alone as a sole diet. The level of Ca on dry matter intake basis in straw feeding although was within required level, i.e. 0.43 to 0.77% for dairy cattle. But in lactation, when requirement of Ca increased to 0.77 g/kg DM, intake of 0.73 g Ca indicated short of Ca in straw diet and in existing feeding practices. More over, Ca and P ratio was 4.86: 1 in group 1 against the optimum level of either 2: 1 and 1: 1 for efficient utilization of calcium and phosphorus. Thus supplementation in ration balances this ratio 2: 1 in group 2. Intake of Cu and Zn was respectively 7.17 and 20.32 ppm against the requirement of 10 and 40 ppm, respectively, for Cu and Zn and need to be supplemented in mineral mixture, whereas, dietary intake of Fe (464.13 ppm) was in excess of requirement (50–100 ppm). The dietary intake of Mg (0.44%) and Mn (52.52%) through straw was adequate and comparable with the suggested level of 0.30–0.40% for Mg and 40 ppm for Mn given by NRC (2001). Mn was included in mineral mixture because availability of these minerals from fibrous feeds on digestion is limited (Ammerman *et al.* 1995).

As evident from Table 2, strategic supplementation of deficient minerals through concentration and mineral mixture resulted in higher intakes of Ca (1.01vs 0.73), P (0.48 vs 0.15), Cu (17.08 vs 7.17), Zn (90.10 vs 20.32) and Mn (64.72 vs 52.26) in group 2 in comparison to group 1. Phosphorus intake was comparatively higher in group 2 due to wheat bran, which is rich source of phosphorus.

Performance of dam and calves: The milk yield of experimental camels is summarized in Table 3. The average milk yield in traditional system was 5.37± 0.36 litre/day. The recorded total milk production over 76 days was 408.34 and 463.63 litre, respectively, in groups 1 and 2. Camels receiving concentrate and mineral mixture supplement produced more (6.11± 0.27 litre/day) milk than control (5.37± 0.36 litre/day) due to balancing of nutrients. And thus supplies 13.78% more milk than the traditional system. Current nutritional demand for milk production calls for extra feeding of protein, energy and mineral supplement to promote milk production, and positive response in milk after supplementation of mineral

Table 1. Chemical composition of experimental feeds

Feeds	% (percent)									ppm			
	DM	OM	CP	CF	Ash	AIA	Ca	P	Mg	Cu	Zn	Fe	Mn
Cluster bean straw	94.46	88.11	6.80	32.90	11.89	6.42	0.73	0.15	0.44	7.17	20.32	498.4	52.25
Conc.	92.48	87.02	20.00	10.00	12.98	6.50	1.98	1.72	0.58	50.0	42.00	290.0	59.00
Mineral mixture	-	-	-	-	-	2.50	22.04	17.50	-	0.08%	1.6%	-	0.12%
Critical value	-	-	-	-	-		0.3	0.25	0.30–0.40	10	50	40	40

Table 2. Average daily intake of DM and micronutrients in different dietary groups (g or mg/animal/day)

Attributes	Through straw							
	kg/d	g/d			mg/d			
	DMI	Ca	P	Mg	Cu	Zn	Fe	Mn
G 1	11.40	83.24	39.91	50.17	81.76	231.70	5682.97	595.78
G 2	10.12	73.85	35.41	44.51	72.54	205.37	5642.24	528.69
			Through concentrate					
G 2	1.86	36.76	31.94	10.77	92.84	77.99	538.47	109.55
			Through mineral					
@ 50 g/d	0.05	11.02	8.75	–	40	800	–	140
			Total mineral intake					
	%		%			ppm		
	DMI	Ca	P	Mg	Cu	Zn	Fe	Mn
G 1	11.40	83.24	17.1	50.17	81.36	231.70	5082.97	595.78
G 2	12.02	121.64	55.79	55.28	205.38	1083.56	5580.70	778.16
			% level in DM consumed		mg/kg			
G 1	–	0.73	0.15	0.44	7.17	20.32	498.40	52.25
G 2		1.01	0.48	0.46	17.08	90.14	464.13	64.72
			Recommended level					
NRC (2001)	–	0.43 – 0.77	0.25 0.49	0.20–0.25	10.00	40.00	50–100	40.00

Table 3. Intake and performance of lactating camels under different feeding regimes

Attributes	Group 1	Group 2	SEM
Dry matter intake			
Total DMI/day (30d)	11.40	11.98	0.36
DMI kg/100 kg B.wt	1.71	1.93	0.46
DMI g/kg $^{0.75}$*	95.01^{a}	100.87^{b}	1.89
Performance of dam			
Initial B. wt (kg)	606.50	596.25	20.29
Final B. wt (kg)	591.50	613.00	27.55
Avg. gain/loss (kg)	–15.00	16.75	7.20
Avg. daily gain (g/d)	–500.00	558.33	240.21
Total milk production (in litre during (76 d)	408.34	464.63	17.29
Milk production (litres)	5.37	6.11	
Performance of calves			
Initial B. wt. (kg)	169.75	179.75	15.30
Final B. wt (kg)	228.50	248.50	15.82
Weight gain (kg)	58.75	68.75	20.89
ADG (g/d) in 93d*	631.72^{a}	739.25^{b}	22.46

Different superscript small letter in rows differ significantly at P<0.05*.

indicated that minerals were in short supplies. Similar to present study, Kuria *et al.* (2004) also reported higher milk production 3.21 vs 2.30 litre/day in supplemented group than control. The findings of increase in milk production with supplementation of P (Argunov *et al*. 1991), Cu (Schonewille *et al.* 1994) and Cu and Zn in dairy cows (Sviatko *et al*. 1991) favourably support this study.

The initial body weight of group 1 dam was 606.50 kg and at the end of study period (30 days) was 591.50 kg with a loss

Table 4. Serum mineral profile of lactating camels under different dietary treatment

Attributes	Days	Group 1	Group 2
Calcium (%)	0 Day	8.12±0.34	9.43±0.41
	90 Day	9.20±0.30	10.67±0.53
Phosphorus (%)	0 Day	4.33±0.45	4.21±0.47
	90 Day**	5.05^{A}±0.17	5.75^{B}±0.18
Magnesium (%)	0 Day	2.35±2.5	2.49±2.8
	90 Day	2.53±0.28	2.54±0.09
Sodium (meq/litre)	0 Day	156.75±2.7	159.00±1.87
	90 Day	161.12±4.6	163.18±1.45
Potassium (meq/litre)	0 Day	4.69±0.27	4.65±0.21
	90 Day	4.90±0.14	5.00±0.89
Manganese (ppm)	0 Day	0.55^{a}±0.05	0.60^{a}±0.07
	90 Day*	0.77^{Ab}±0.05	1.09^{Bb}±0.06
Copper (ppm)	0 Day	0.90±0.26	0.88±0.07
	90 Day*	0.86^{A}±0.05	1.03^{B}±0.04
Zinc (ppm)	0 Day	0.79±0.04	0.97±0.09
	90 Day*	0.86^{A}±0.05	1.03^{B}±0.04
Iron (ppm)	0 Day	1.19±0.23	1.09±0.11
	90 Day	1.31±0.18	1.36±0.10
Total protein (mg%)	0 Day	5.62±0.38	5.81±0.33
	90 Day*	5.95^{A}±0.17	6.69^{B}±1.00
Blood urea N (mg%)	0 Day	9.18^{a}±0.54	9.26±1.40
	90 Day	12.51^{b}±0.21	12.27±1.98
Milk urea N (mg%)		12.78±0.25	13.03 ±0.41

Different superscript capital in rows and small letter in columns differ significantly at P<0.01** and P<0.05*.

of body weight of 500 g/day. A total 15 kg body weight loss indicated that straw diet cannot fulfill the requirement of the lactating dams and supplementation in terms of protein, energy and mineral mixture is needed. On the other hand, dam of group 2, gained on an average of 16.75 kg weight with daily gain of 500 g/day and thus indicated clear cut effect of supplements on body weight of dam.

The total body weight gain of calves of supplemented group 2 was higher than the group 1. The calves of supplemented group 2 grew significantly faster with daily gain of 739.25±41.95 g/day than non-supplemented group 1 (631.72±16.05 g/day). In accordance to this, Wangoh *et al.* (1998) also reported similar higher daily body weight gain of calves with supplementation of dam diet due to improved quality of milk.

Effect on blood minerals profile: The adequacy of the diet in essential minerals can also be determined by nutrient concentration in blood. The blood mineral profile of experimental groups (Table 4) before and after supplementation revealed more or less similar values in both groups except Mn and urea. The concentration of Ca ranged from 8.12 to 10.67 mg% and was above the critical need, i.e. 8 mg%. After supplementation, the concentration of calcium increased in group 2 but effect was nonsignificant. The blood P level in group 2 increased significantly ($P<0.01$) due to concentrate and mineral feeding compared to group 1 fed only straw. Similarly, Onjaro *et al.* (2006) also reported increase in serum concentration of phosphorus with increase in dietary phosphorus level. The serum magnesium level did not showed significant difference between 2 groups. Increase in Ca, P and Mg concentration in blood with feeding of mineral mixture has been also reported by Sharma *et al.* (2002) in cattle. The estimated values of Na and K were within the normal range.

In trace minerals, Cu (0.65ppm) and Zn (0.8ppm) values in control group were within normal level. In this study, though the Cu and Zn intake in group was suboptimal but it was not reflected in blood, which could be due to homeostatic mechanism or due to sub clinical deficiency. Similarly, camel of group 1 had blood P level above critical requirement in spite of low forage P. The levels of Cu and Zn ($P<0.05$) and Mn ($P<0.01$) were significantly higher in group 2 compared to group 1 due to supplement. Increase serum concentration with Cu supplementation was also reported by Essamadi *et al.* (1998). The values of Mn and Fe in study were within normal range suggested by Mc Dowell (1985), i.e. 0.20 ppm and Fe 1.00 ppm. With regards to biochemical parameters, concentration of total protein in both the groups differed significantly ($P<0.05$), and were higher in supplemented group (6.69 mg%) compared to control (5.95 mg %). Milk urea N was also estimated and values were comparable with the reference values, i.e. 11–17 mg/dl.

Our results indicated that in existing traditional system Ca, P, Cu and Zn were most limiting in diet of lactating camels, and production performance of camel can be improved by dietary supply of these nutrients. This study also helps in the formulation of area specific mineral mixture.

ACKNOWLEDGEMENT

Authors are thankful to the Indian Council of Agricultural Research, New Delhi, for financial support under the AICRP on "Improvement of feed resources and nutrients utilization in raising animal production", and Director of the Institute for extending research facilities to carry out the research work.

REFERENCES

Ammerman C B, Baker D H and Lewis A J. 1995. *Bioavailability of Nutrients for Animals: Amino-acids, Minerals and Vitamins.* Academic press, San Diego. *CA*. pp. 83.

AOAC. 1995. *Official Methods of Analysis*. Association of Official Analytical Chemists, 16th edn, Washington DC, USA.

Argunov M L, Golubeva and Baranukov K H. 1991. A new supplement. Molochone I. *Myasnoe Skotovodstvo* **1**: 33–36.

Bector B S, Motiram, Singhal O P. 1998. Rapid plateform test for the detection of added urea in milk. *Indian Dairyman* **50**: 59–62.

Essamadi A K, Bengoumi M, Charcornac J P and Faye B. 1998. Relationship between plasma copper concentration and caeruloplasmin activity in camel. *Comparative Biochemistry and Physiology* **5**: 211–20.

Garg M R, Bhandari B M and Sherasia P L. 2008. Assessment of macro and micro minerals status of milch animals for developing area specific mineral mixture for Bharatpur district of Rajasthan. *Animal Nutrition Feed Technology* **8**: 53–64.

Kuria S G, Gachuri C K, Wanyoike and Wahome R G. 2004. Effects of mineral supplementation on milk yield and calf growth of camels in Marsabti district of Kenya. *Journal of Camel Practice and Research* **11** (2): 87–96.

McDowell L R. 1985. *Nutrition of Grazing Ruminants in Warm Climates*. (Ed.) McDowell L R. Academic Press, Orlando, Florida.

McDowell L R, Conard J H, and Glen Hembry F. 1993. *Mineral of Grazing Ruminants in Tropical Regions*. Animal Science Department, Centre for Tropical agriculture, University of Florida. The U.S. Agency for international Development and Caribbean Basin Advisory Group (CBAG).

NRC. 2001. *Nutrient Requirement of Dairy Cattle*. 7th Revised edn. National Academy of Sciences,Washington, D.C.

Onjaro P A, NjokaNjiru E N, Ottaro J M, Simon A and Schwartz H J. 2006. Effects of mineral supplementation on milk yield of free- ranging camels (*Camelus dromedarius*) in northern Kenya. *Asian Australian Journal of Animal Science* **19** (11): 1597–1602.

Saini N, Kiradoo B D, Singh N and Sahani M S. 2007. Micronutrient content of certain conventional and unconventional camel feeds of arid western zone of Rajasthan. *Proceeding of International camel conference held at Bikaner from 16 to 17 Feb,* pp.141–43.

Schonewille J T, Klooster A T, Dirkzwager A, Beynen A C and Van-t-Klooster. 1994. Stimulatory effect of an anion (chloride)-rich ration on apparent calcium absorption in dairy cows. *Livestock Production Science* **40**: 233–40.

Sharma M C, Chinmay J T, Sarkar K and Joshi C. 2002. Therapeutic efficacy of minerals supplements in macro-minerals deficient buffaloes and its effect on haemato biochemical profile and production. *Asian-Australian Journal of Animal Science* **15**: 1278–87.

Shinde A K and Sankhyan S K. 2008. Mineral contents of locally available feeds and fodders in flood prone eastern plain of

Rajasthan and dietary status in ruminants. *Animal Nutrition Feed Technology* **8**: 35–44.

Sviatko P E, Chandogova F, Federic M, Hiscakova M, Anke B, Groppel H, Gurtler M, Gruhn I Lombek and Schneider H J. 1991. Modification of microelement nutrition of dairy and its relation to production and reproduction. Mengenund Spurenelemente: 12. Arbeitstagung, Leipzig, 12–13 December, pp. 26–40.

Wangoh J, Farah Z and Puhan Z. 1998. Composition of milk from three camel breeds in Kenya during lactation. *Milchwissenschaft* **53** (3): 136–39.

Wardah M F. 1997. The nutrient requirements of the dromedary camels. *The Arab Centre for the studies of Arid Zones and Dry Lands. Damascus, Syrian Arab Republic.*