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Micro-minerals content in feedstuff, blood and hair of camels maintained in irrigated north-western plain of arid zone of Rajasthan

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Norton and Poppi (1995) reported that trace minerals values of tropical forages are more indicative of soil types and their deficiencies. Assessment of minerals concentration in feeds and fodders, blood and hair offers good tool for monitoring adequacy or inadequacy of feeds to maintain general health and production. Camel being browser obtained most of their minerals from tree leaves, bushes and shrubs and dry roughages. Concentrate mixture are rarely fed to camels.

However, there is no published information on the mineral status of camels in north-western arid and semi-arid region of Rajasthan which is home for 70.3% of camel population. In general, camels are not fed green forages but different from other districts, camel rearers of irrigated north- western plains offers green forages to their camels. Looking towards all this views, study was conducted to determine the mineral contents of feeds and fodders and also in camels reared in zone RJ-2 of Rajasthan for balancing of dietary minerals supply by strategic supplementation.

Study area: The study was conducted in Hanumangarh and Ganganagar districts of irrigated north-western plain of arid Rajasthan. Two tehsils Rawatsar, Nohar from Hanumangarh and Suratgargh, Raisinghnagar from Shri Ganganagar and two villages from each tehsil were identified for survey work. Forty farmers from each village were selected for the benchmark survey and collection of feed and fodder, blood and hair samples.

Feed and animals sample collection: Feed and fodder samples were taken in conical flasks in which concentrated HNO_3 and concentrated H_2SO_4 were added and kept overnight and then subjected to digestion under low heat at 70–80°C with di- acid mixture (concentrated HNO_3 and 70% perchloric acid $HClO_4$ in 3:1 ratio). Blood serum samples with equal volume of concentrate HNO_3 were kept overnight in a digestion tube followed by low heat (70–80°C) digestion with di-acid mixture. Hair samples of 1cm length were collected from shoulder region. After proper skirting, samples were washed with acetone and ringed with adequate deionized water and put in hot air oven. 0.5 g of dried sample was taken for further processing with nitric acid and kept as 100°C up to half volume thereafter concentrated nitric acid was added and digested again.

Analysis of feeds, blood and hair samples: Digested samples were diluted with triple glass distilled water and filtered through Whatman's filter paper No. 1 (Kolmer *et al.* 1951). The concentration of zinc (Zn), iron (Fe), copper (Cu), and manganese (Mn) in samples were estimated using atomic absorption spectrophotometer. The data on mineral contents were subjected to statistical analyses for mean and standard error.

Area status: In surveyed zone, 62.5% camel rearers kept their camels intensively. Camels were fed only dry roughages supplemented with green fodder with no concentrates. The camels were mainly stall-fed with limited or no grazing and confined within a limited area. Only 12.5% of surveyed camel owners adopted practice of rearing on grazing. In this zone, 37.5% of camel's owners fed green roughage viz. berseem (*Trifolium alexandrinumt)*, green gram (*Vigna mungo)*, green jawar (*Sorghum bicolor)* and oat (*Avina sativa)* to their camels. Dry roughages being fed to camels were somewhat different from other regions. Wheat straw, *guar* straw, ground straw and *Channa ki khar* were found most common dry roughages fed to camels. The practice of feeding concentrate and mineral mixture were negligible in surveyed area.

Chemical composition of feed samples: Data on minerals composition are presented in Table 1. The principle dry roughage source such as dry and green straws and browsed forages had comparatively low levels of zinc i.e., 27.71, 29.92 and 26.76 ppm. The values were low compared to its critical level in feed (<30ppm). The low Zn level in herbages could be due to particularly low amount of zinc in the soil as indicted by chemical analysis of soil (Anonymous 2007). Since, Zn has a strong soil-plant-animal relationship so lesser availability of Zn to animal through these sources requires its supplementation to meet out requirement. Similarly, Shinde and Sankhyan (2008) found zinc

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Table 1. Trace-mineral contents in feedstuffs collected from Shriganganagar and Hanumangarh district (DM basis)

Feedstuf (critical levels)	Cu (ppm)<8.0	Zn (ppm)<30.0	Mn (ppm)<40.0	Fe (ppm)<50.0
		Dry roughages		
Guar straw (6) *Cyamopsis tetragonoloba*	9.78±0.46	32.18±2.60	39.66±2.91	301.20±48.25
Groundnut straw (6) *Arachis hypogaea*	10.40±1.14	42.35±4.33	53.33±5.68	432.36±28.50
Channa straw (3) *Cicer arietenum*	6.66±0.78	25.06±2.90	45.23±4.78	81.50±4.69
Wheat straw (7) *Triticum aestivum*	10.42±0.64	14.71±1.04	81.42±3.35	356.42±75.12
Jowar straw (1) *Sorghum bicolor*	5.58	23.8	56.42	407.25
Barley straw (1) *Wordeum vulgare*	4.58	22.69	40	350.2
Mustard (1) *Brassica compestris*	9.29	20.91	23.94	434
Mean±SEM (n=25)	9.34±0.48	27.71±2.43	55.45±4.00	333.00±31.71
		Tree leaves		
Khejri loong (7) *Prosopis cineraria*	*18.57±0.94*	25.72±2.69	88.94±5.68	139.50±22.65
Pala (7) *Zizyphus moritiana*	19.54±2.79	28.44±5.85	85.34±9.02	130.55±21.44
Phog (3) *Calligonium polygonoides*	9.32±0.49	25.26±7.07	24.12±3.14	172.87±3.36
Mean±SEM	17.34±1.49	26.76±2.76	76.02±7.35	141.70±12.82
		Green fodders		
Sorghum Green (3) *Sorghum bicolor*	17.28±2.05	33.03±5.72	77.10±4.40	927.66±71.26
Green Gram (3) *Vigna mungo*	4.79±0.52	26.37±2.02	81.22±3.23	611.56±279.57
Oat Green (1) *Avina sativa*	11.3	34.05	80.4	280.6
Barseem (1) *Trifolium alexandrinumt*	11.9	27.6	91.4	850
Green *Guar* (1) *Cyamopsis tetragonolobe*	21.2	41.7	57.6	79.4
Chawala (1) *Vigna anguiculate*	41.8	20.8	48.1	36.46
Mean±SEM (n=10)	15.24±3.55	29.92±2.39	75.24±4.25	586.41±132.21
Guar churi (2)	18.70±8.50	33.25±1.95	105.80±45.40	602.50±303.34
Gram *churi* (1)	10.2	34.05	65.62	580
Mean±SEM	15.86±5.66	33.51±1.15	92.40±29.43	595.00±124.06
Green sorghum +wheat straw (1)	20.76	48.5	178.8	135

deficiency in all feeds particularly in all straws and some tree leaves of semi-arid region of Rajasthan. Garg *et al.* (2008) reported zinc content 20.45 to 38.50 ppm in green forages, 30.75 ppm in grains and 17.80 ppm in crop residues of this region in ration of milch animals. Most of the straws offered to camels contained Mn around 55–73 ppm. Mn seems quite rich to meet requirement of animals (<40ppm). The tree leaves and green fodders had Mn content more than <70 ppm. *Guar churi* contained higher amount of 105.80 ppm Mn. The present values of adequate amount of Mn in feedstuffs were in agreement with the findings of Yadav *et al.* (2002) and Garg *et al.* (2008). Copper content was recorded at marginal level in collected samples of crop residues. Green *guar*, sorghum, oat, tree leaves, berseem and grains were found good source of Cu with average values 21.27, 17.28, 11.3, 11.9 and 15.96, respectively. In present study, values of Fe are seven times higher than the requirement. The boarder-line Cu deficiency in region is conditioned due to high Fe content in crop residues coupled with low levels intake from crop residues. Concentration of iron was found to exceed the requirement in all the feedstuffs being fed to livestock than the specified level of 50 ppm (NRC 1980) but less than the maximum tolerable level of 1000 ppm. Even, straw samples were quite rich in Fe (320.09 ppm) were well above the critical level of Fe <50 ppm. Thus Fe seems to be quite rich in this district as also reported from other parts of the country by many workers (Garg *et al.* 2008, Shinde and Sankhyan 2008). High level of Fe in all feeds and forages could partly be attributable to soil and surface contamination (Gowda *et al*. 2001). The higher concentration of Fe in majority of feed ingredients could probably interfere with the Cu absorption and metabolism.

Mineral status of blood serum and hair samples: Data on blood serum and hair minerals status presented in Table 2. The reference values for trace minerals status in blood and hair in relation to various physiological conditions are hardly available for camels. So reference values established for other livestock are used for guidelines. Though the majority of feed samples were deficient in Zn, but its concentration in serum did not reflect same pattern possibly due to its higher absorption under the Zn – deficient situation and decreased excretion through urine and milk (Neathery *et al.* 1973). Most of blood Zn level reported by several workers in camels fell within the general range reported for other animals (70–120 µg/100ml: Underwood, 1977). While Kuria *et al.* (2013) reported plasma concentration of zinc above and below for copper in camels than recommended threshold for grazing ruminants during dry season. The overall Zn values reported were 1.31±0.082 µg/ml. In lactating camels (0.91± 1.15 µg/ml) levels were towards lower side and were similar to those observed previously by Saini *et al.* (2010). The low zinc level in lactating camels may be due to an active transfer of Zn in camel milk (Cattaneo *et al.* 2005) coupled with low intake through feeds. Faye *et al*. (2005) reported very low

Table 2. Minerals status in blood serum and hair samples of camels

Trace minerals		Cu	Mn	Fe	Zn
Critical value					
Blood serum (µg/ml)		<0.65	<0.20	<1.0	<0.60
Wool (µg/g)		<4.0	<4.0	<50.0	<115
Serum (µg/ml)					
Adult camels (F+M)	(30)	0.85±0.042	0.44±0.90	21.18±1.82	1.17±0.072
		(0.50–1.40)	(0.15–0.90)	(6.70–39.60)	(0.50–2.7)
Pregnant camels	(6)	1.53±0.14	0.91±0.06	10.68±0.30	1.75±0.20
		(1.00–1.90)	(0.70–1.10)	(10.02–11.88)	(1.20–2.60)
Lactating camels	(12)	0.75±0.10	0.56±0.03	11.37±0.94	0.91±0.05
		(0.40–1.70)	(0.40–0.80)	(7.50–18.70)	(0.70–1.20)
Adult Females	(8)	1.03±0.093	0.77±0.05	9.92±0.52	2.50±0.50
		(0.73–1.50)	(0.60–1.00)	(7.30–12.00)	(0.80–5.10)
Calves	(18)	0.87±0.062	0.42±0.035	12.59±0.59	1.60±0.062
		(0.30–1.30)	(0.20–0.70)	(8.80–17.50)	(0.70–1.00)
Over all mean± SE	(74)	0.91±0.03	0.53±0.25	15.43±0.94	1.31±0.082
		(0.30–1.90)	(0.15–1.10)	(6.70–39.60)	(0.50–5.10)
Wool (µg/g)	(23)	4.68±0.30	28.44±2.8	243.37±14.61	57.35±1.08
		(2.03–4.60)	(10.80–63.40)	(130.80–384.80)	(49.40–71.24)

*Values in parenthesis represent No. of observation and range.

concentrations of Zn 8.0 µg/dl in Arabian lactating camels. Muna *et al*. (2003) observed that both macro-and micro-minerals elements in the blood of camels depend on the physiological state.

Concentration of Cu (0.91±0.03 µg/ml) is well above than the minimum critical level. Faye *et al.* (2005) reported Cu level 58.9 µg/dl in camels as deficient level. Therefore the Cu status in present study can be termed as normal. Concentration of Fe and Mn in blood serum was within the normal range and it may be attributed to the adequate Fe and Mn supply through the available feed stuffs. Similar to these observations, deficiency of Fe in Indian animals was not detected in several studies (Yadav *et al.*2002. Kumar *et al*. 2008). The values of Fe (6.70– 39.60 µg/ml) are higher than reported values for other livestock but fall in range of (60–139 µg/ml) Bogin (2000).

Hair, which is considered a better indicator of Mn status, almost all samples had much higher levels than minimum required level i.e. (8ppm; Underwood 1999). Cu levels in hair however lower than the values reported by Mandal *et al.* 6.0–9.8 µg/g in buffalo hair but were found within the range 2–14 ppm by Underwood (1997). Similar to feed and blood, values of Fe was more than the minimum required value of iron in hair (<50ppm). The normal hair Zn concentration is 115–135 ppm (O' Mary *et al.* 1969) and in this study the mean values observed were 56.63±1.15 µg/g was lower than the normal values of Zn. Though, the serum Zn concentration was within the normal range but its concentration in hair indicated inadequacy of its dietary supply. Zn and Cu are specific activators of enzyme systems involved in production, reproduction, skin protection and immunity.

In camels, deficiency of zinc may be one of the regions for skin problems (dermatitis, skin necrosis and ecthyma) observed in surveyed areas. These results suggested that the ration of camels in zone 3 of arid region of Rajasthan were imbalanced in term of minerals particularly Zn and Cu and need supplementation to optimizing the productivity and health.

SUMMARY

Micro-mineral profiles of feed and fodder, blood serum and hair of camels in 2 villages each from 2 Tehsils of Hanumangarh and Ganganagar districts of irrigated North -Western plain of arid Rajasthan were studied. The most of dry and green roughages and tree leaves were found deficient in Zinc. Crop residues contained copper at marginal level whereas tree leaves, green fodders and protein rich concentrate *guar* churi were found good source of Cu. Mn level in all feed stuffs were found adequate. Crop residues generally fed to camel contained adequate amount of Mn to meet requirement of camels. The all feed ingredients contained iron concentration in excess of requirement. Serum concentration of all trace minerals were within normal range. The blood serum Cu, Zn, Mn and Fe were well above than critical levels. The mean values of Zn observed in hair were lower than the normal values indicated inadequacy of its dietary supply. Mn in all hair samples was much higher than critical level <4.0 ppm. Cu level in hair was also marginal. Similar to feed and fodders and serum, iron concentration in hair was also much more than the normal minimum values. The study indicated that there is need of dietary supplementation of deficient minerals as area-specific mineral mixture for improving the productive and reproductive efficiency of camels of this region.

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