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Minerals Availability from Grazing Resources to Livestock in Arid Soils

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Abstract: The present study was conducted to estimate the mineral contents of grazing resources grown on arid soils for their availability to livestock. The grazing/browse resources were mostly weeds, grasses, shrubs and trees. Under this study 20 mature and dry plant samples along with twigs, comprising 7 weeds and 4 grasses, 5 shrubs and 4 trees commonly preferred for grazing by livestock were collected by hand plucking from CAZRI farm, as well as adopted villages of Barmer and Jaisalmer districts in western Rajasthan during 2010-2012. These weeds, grasses, shrubs and trees samples were analyzed for minerals namely Ca, Fe, Zn, Cu, Co, Mn, Cr, Pb and Mo. The mineral content (µg 100 g^{-1} except Ca, which is in mg 100 g^{-1}) in weeds, grasses, shrubs and trees ranged between 105.63 (*Cenchrus setigerus* - Grass) and 412.57 (*Capparis decidua* - Shrub) for Ca, 91.67 CC-CAZRI-392 (*Cenchrus ciliaris* - Grass) and 151.50 (*Calotropis procera* - Shrub) for Fe, 202.43 CC-CAZRI-358 (*Cenchrus ciliaris* - Grass) and 583.30 (*Achyranthes aspera* - Weed) for Zn, 61.53 (*Lasiurus sindicus* - Grass) and 241.63 (*Tetrapogon tenellus* - Weed) for Cu, 27.16 (*Calotropis procera* - Shrub) and 118.63 (*Cordia gharaf* - Shrub) for Co, 26.03 (*Cordia gharaf* - Shrub) and 89.85 (*Ziziphus nummularia* - Shrub) for Mn, 42.80 CC-CAZRI-358 (*Cenchrus ciliaris* - Grass) and 289.26 (*Digera muricata* - Weed) for Cr, 19.08 (*Lasiurus sindicus* - Grass) and 130.27 (*Prosopis cineraria* - Tree) for Pb and 0.62 (*Cenchrus setigerus* - Grass) and 113.84 (*Tribulus terrestris* - Weed) for Mo. In comparison to grasses, shrubs and trees, the availability of minerals from weeds is higher.

Key words: Grasses, livestock, minerals, shrub, trees, weeds.

Indian Thar desert is mostly confined in the twelve western districts of Rajasthan and spread on about 21.9 million ha. In the regions livestock based farming system dominate the agricultural activity. The huge livestock population of the region grazed openly on the vast grazing lands and supported the farmers of this disadvantageous area consistently. The region is characterized by low and erratic rainfall, Saxena *et al*. (2016) stated that about 50% of the area is irrigated through ground water using conventional irrigation practices. Nature has bestowed with number of nutritious perennial grasses which grow during the rainy season and provided fodder to the livestock up to December. The nutrient requirement of livestock in arid region depends mainly on available grazing resources. The grazing/browse resources are mostly weeds, grasses, shrubs and trees. The dominant grasses comprised mostly *Lasiurus sindicus* in the western parts of the desert and *Cenchrus ciliaris* and *C. setigerus* in the eastern central part of the region. Beside perennial grasses many dicot weeds and/or forbs also contributed significantly to the forage availability of these grazing lands in the region. Some of the forbs are very common to all the grazing lands and are very rich in protein and other nutritional elements. In the western arid regions legumes are the dominate forbs while in the semi-arid parts non-legume formed the major portion. Legume fodders, cultivated green fodders and tree leaves are good sources of Fe, Zn, Cu, Co and Mn, and oil-cakes and bran are good sources of Zn, Mn and Cu (Prasad and Gowda, 2005). Singh *et al*. (2005a) also concluded that the range grasses, legumes and forbs are good sources of some macro and trace minerals. Though these plants are nutritionally very rich, detailed information on mineral status of local feeds and fodder are scanty.

Further, quantity and quality of fodder is directly related to the amount of milk produced by the livestock. Quality of feed is also important to maintain productive capacity as well as cow health. If cattle are not fed

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sufficiently over a longer period, both daily production and the length of lactation will be reduced. Therefore, the present study was conducted to estimate the mineral contents of grazing resources grown on arid soils for their availability to livestock and also to suggest need of mineral supplementation to optimize animal production.

Materials and Methods

The study was conducted at ICAR-Central Arid Zone Research Institute, Jodhpur during 2010-2012. The mature and dry plant leaf samples along with twigs which are being fed to livestock as such were collected periodically from CAZRI farm, as well as adopted villages of Barmer and Jaisalmer districts. The samples were collected and pooled of each species were then analyzed for 20 species, comprising 7 weeds and 4 grasses, 5 shrubs and 4 trees commonly preferred for grazing by livestock. Weeds species collected were *Kagio* (*Tetrapogon tenellus*), *Santo* (*Trianthema monogyma*), *Lolaru* (*Digera muricata*), *Bekario* (*Indigofera cardifolia*), *Kanthi* (*Tribulus terrestris*) (Fig. 1), Aandripatha (*Achyranthes aspera*) and *Jhingali* (*Eremopogon foveolatus*). The grasses species collected were *Moda Dhaman* (*Cenchrus setigerus*), *Dhaman* (*Cenchrus ciliaris* var. CAZRI-358), *Dhaman* (*Cenchrus ciliaris* var. CAZRI-392) and *Sewan* (*Lasiurus sindicus*) (Fig. 2). Shrub species collected were *Vajradanti* (*Dicomato mentosa*), *Jangali gundi* (*Cordia gharaf*), *Ker* (*Capparis decidua*) (Fig. 3), *Aak* (*Calotropis procera*) and *Pala* (*Ziziphus nummularia*). Trees species collected were *Kumbat* (*Acacia senegal*), *Indoko* (*Anogeissus rotundifolia*), *Khejari* (*Prosopis cineraria*) (Fig. 4) and *Khara jal* (*Salvadora persica*). The samples were analyzed on dry matter basis (AOAC, 2007) for Ca, Fe, Zn, Cu, Co, Mn, Cr, Pb and Mo using Graphite furnace P.G. 990 (PG-Instruments Ltd., UK).

Fig 1. Tribulus terrestris.

Fig 2. Lasiurus sindicus.

Fig 3. Capparis decidua.

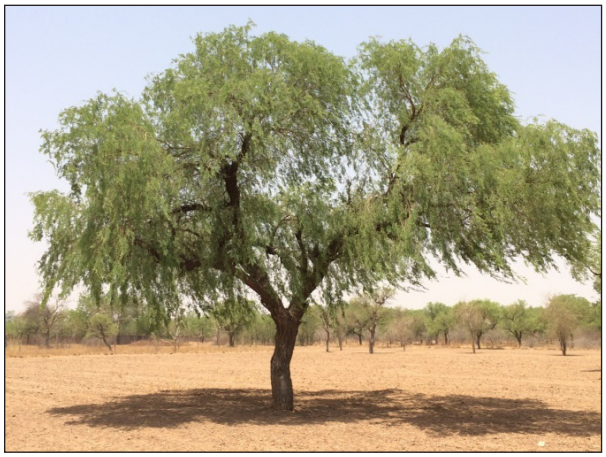

Fig 4. Prosopis cineraria.

Table 1. Availability of minerals in weeds, grasses, shrubs and trees along with twigs

Plants botanical name	Local name	Ca	Fe	Zn	Cu	Co	Mn	Cr	Pb	Mo
		mg 100 g^{-1}	μg 100 g^{-1}							
Weeds										
Tetrapogon tenellus	*Kagio*	241.09	122.08	343.24	241.63	63.97	51.76	107.09	67.11	53.31
Trianthema monogyma	*Santo*	197.47	133.86	293.61	168.86	75.09	49.74	90.82	58.15	85.67
Digera muricata	*Lolaru*	237.60	117.33	289.25	192.58	104.91	77.95	289.26	53.04	87.31
Indigofera cardifolia	*Bekario*	237.12	107.03	313.33	127.87	56.19	45.27	126.12	54.27	79.98
Tribulus terrestris	*Kanthi*	246.41	127.53	313.57	131.69	64.08	59.74	247.11	53.03	113.84
Achyranthes aspera	*Aandripadha*	268.05	130.43	583.30	157.69	27.17	55.18	137.11	65.00	97.41
Eremopogon foveolatus	*Jhingali*	231.94	120.69	405.86	100.32	34.52	39.16	108.87	38.26	59.67
Grasses										
Cenchrus setigerus	*Moda Dhaman*	105.63	135.78	477.76	64.62	49.95	84.64	55.97	42.73	0.62
Lasiurus sindicus	*Sewan*	165.33	105.05	254.16	61.53	71.34	42.94	93.30	19.08	1.44
Cenchrus ciliaris	*Dhaman* CAZRI-358	181.00	95.30	202.43	74.56	96.00	49.17	42.80	26.61	0.69
Cenchrus ciliaris	*Dhaman* CAZRI-392	209.06	91.67	297.47	92.90	107.16	51.15	58.67	21.90	0.81
Shrub										
Dicomoto mentosa	*Vajradanti*	258.85	119.79	384.86	157.19	38.95	48.36	108.12	55.09	59.76
Cordia gharaf	*Jangali Gundi*	273.77	111.86	329.09	158.53	118.63	26.03	71.32	56.07	84.69
Capparis deciduas	*Ker*	412.57	107.08	413.34	191.02	64.32	60.32	52.98	40.23	10.26
Calotropis procera	*Aak*	171.63	151.50	212.79	91.53	27.16	74.62	137.23	67.01	84.06
Ziziphus nummularia	*Pala*	132.59	121.36	407.84	83.00	104.95	89.85	128.48	33.36	15.71
Trees										
Acacia senegal	*Kumat*	299.99	118.38	400.17	110.12	47.89	32.44	98.96	51.33	93.58
Anogeissus rotundifolia	*Indoko*	279.24	105.62	327.99	130.26	38.43	44.70	81.19	32.78	57.46
Prosopis cineraria	*Khejri*	249.57	108.71	316.38	102.71	43.79	47.21	140.84	130.27	63.57
Salvadora persica	*Khara Jal*	238.90	118.95	316.33	83.41	51.03	65.84	77.97	50.59	102.97

Results and Discussion

The availability of different minerals from weeds, shrubs, trees and grasses are given in Table 1. The mineral contents in weeds ranged from 197.47 (*Trianthema monogyma*) to 268.05 mg 100 g^{-1} (*Achyranthes aspera*) for Ca, 107.03 (*Indigofera cardifolia*) to 133.86 μg 100 g^{-1} (*Trianthema monogyma*) for Fe, 289.25 (*Digera muricata*) to 583.30 μg 100 g^{-1} (*Achyranthes aspera*) for Zn, 100.32 (*Eremopogon foveolatus*) to 241.63 μg 100 g^{-1} (*Tetrapogon tenellus*) for Cu, 27.17 (*Achyranthes aspera*) to 104.91 μg 100 g^{-1} (*Digera muricata*) for Co, 39.16 (*Eremopogon foveolatus*) to 77.95 μg 100 g^{-1} (*Digera muricata*) for Mn, 90.82 (*Trianthema monogyma*) to 289.26 μg 100 g^{-1} (*Digera muricata*) for Cr, 38.26 (*Eremopogon foveolatus*) to 67.11 μg 100 g^{-1} (*Tetrapogon tenellus*) for Pb and 53.31 (*Tetrapogon tenellus*) to 113.84 μg 100 g^{-1} (*Tribulus terrestris*) for Mo.

The mineral contents in grasses ranged from 105.63 (*Cenchrus setigerus*) to 209.06 CC-CAZRI-392 mg 100 g^{-1} (*Cenchrus ciliaris*) for Ca. The mean Ca content varied from 0.319 to 0.492% DM in forages at Leiah district, Punjab-Pakistan by Khan *et al*. (2007), however, Silvanus *et al*. (2014) found that Ca content ranged between 0.15 and 1.17 g kg^{-1} DM in forages. Fe contents ranged between 91.67 CC-CAZRI-392 (*Cenchrus ciliaris*) to 135.78 μg 100 g^{-1} (*Cenchrus setigerus*), Zn 202.43 CC-CAZRI-358 (*Cenchrus ciliaris*) to 477.76 μg 100 g^{-1} (*Cenchrus setigerus*), Cu 61.53 (*Lasiurus sindicus*) to 92.90

CC-CAZRI-392 µg 100 g^{-1} (*Cenchrus ciliaris*), Co 49.95 (*Cenchrus setigerus*) to 107.16 µg 100 g^{-1} CC-CAZRI-392 (*Cenchrus ciliaris*), Mn 42.94 (*Lasiurus sindicus*) to 84.64 µg 100 g^{-1} (*Cenchrus setigerus*), Silvanus *et al*. (2014) found that Mn contents ranged between 38.25 and 246.50 mg kg^{-1} DM in forages, Cr 42.80 CC-CAZRI-358 (*Cenchrus ciliaris*) to 93.30 µg 100 g^{-1} (*Lasiurus sindicus),* Pb 19.08 (*Lasiurus sindicus*) to 42.73 µg 100 g^{-1} (*Cenchrus setigerus*) and Mo 0.62 (*Cenchrus setigerus*) to 1.44 µg 100 g^{-1} (*Lasiurus sindicus*).

The mineral contents in shrubs ranged from 132.59 (*Ziziphus nummularia*) to 412.57 mg 100 gm^{-1} (*Capparis decidua*) for Ca, 107.08 (*Capparis decidua*) to 151.50 µg 100 gm^{-1} (*Calotropis procera*) for Fe, whereas Singh *et al*. (2005b) found 269.5-940 ppm iron contents in Shrubs and trees, Zn 212.79 (*Calotropis procera*) to 413.34 µg 100 gm^{-1} (*Capparis decidua*), Cu 83.00 (*Ziziphus nummularia*) to 191.02 (*Capparis decidua*), Co 27.16 (*Calotropis procera*) to 118.63 µg 100 gm^{-1} (*Cardia gharaf*), Mn 26.02 (*Cordia gharaf*) to 89.85 µg 100 g^{-1} (*Ziziphus nummularia*), Cr 52.98 (*Capparis decidua*) to 137.23 µg 100 g^{-1} (*Calotropis procera*), Pb 33.36 (*Ziziphus nummularia*) to 67.01 µg 100 gm^{-1} (*Calotropis procera*) and Mo 10.26 (*Capparis decidua*) to 84.69 µg 100 gm^{-1} (*Cordia gharaf*).

The mineral contents in trees ranged from 238.90 (*Salvadora persica*) to 299.99 mg 100 gm^{-1} (*Acacia senegal*) for Ca, 105.62 (*Anogeissus rotundifolia*) to 118.95 µg 100 gm^{-1} (*Salvadora persica*) for Fe whereas Shinde and Sankhyan, (2008) found 555 to 801 ppm Fe content in tree leaves at eastern plains of Rajasthan, Zn 316.33 (*Salvadora persica*) to 400.17 µg 100 gm^{-1} (*Acacia senegal*), Cu 83.41 (*Salvadora persica*) to 130.26 µg 100 gm^{-1} (*Anogeissus rotundifolia*) whereas Devi *et al*. (2014) found 8.13 to 10.41 µg gm^{-1} in fodder at Idukki and Ernakulam districts of Kerala, Co 38.43 (*Anogeissus rotundifolia*) to 51.03 µg 100 gm^{-1} (*Salvadora persica*), Mn 32.44 (*Acacia senegal*) to 65.84 µg 100 gm^{-1} (*Salvadora persica*), Cr 77.97 (*Salvador apersica*) to 140.84 µg 100 gm^{-1} (*Prosopis cineraria*), Pb 32.78 (*Anogeissus rotundifolia*) to 130.27 µg 100 gm^{-1} (*Prosopis cineraria*) and Mo 57.46 (*Anogeissus rotundifolia*) to 102.97 µg 100 gm^{-1} (*Salvadora persica*) µg 100 g^{-1}. Ramana *et al*. (2000) reported that copper, zinc and iron were present in appreciable quantities in cultivated fodders, leguminous fodders, local grasses and top feeds in southern transition zone of Karnataka. In the present study also it has been observed that grazing/browse resources have appreciable quantities of minerals.

Conclusions

As compared to other grazing/browsing resources weeds contain higher quantity of Fe, Zn, Cu, Cr and Mo and thus supply more minerals to livestock. Trees had higher quantity of Ca and Pb and grasses had higher quantity of Co however, while Mn was more in shrubs. Sheep and goat are range managed and meet their nutrient requirements particularly minerals by grazing/browsing on weeds, grasses and shrubs and occasionally on tree lopping. However, in cattle deficiencies of minerals viz., Ca, Cu, Co and Mn can be overcome by supplementary feeding of specific mineral rich fodder viz. among weeds: *Achyranthes aspera* (Aandripada) for Ca, *Tetrapogon tenellus* (Kagio) for Cu, *Digera muricata* (*Lolru*) for Co and Mn, Grasses: *Cenchrus* species (*Dhaman*) for Ca, Co, Cu, Mn; Shrubs: *Capparis deciduas* (*Ker*) for Ca and Cu, *Cordia gharaf* (*Jangli gundi*) for Co and *Zizypus numularia* (*Ber*) for Mn and Tree : *Acacia senegal* (*Kumat*) for Ca, *Anogeissus rotundifolia* (Indoko) and *Salvadora persica* (*Khara jal*) for Co and Mn.

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