Elemental Composition of Some Arid Environment Fodder and Medicinal Plants of Quetta, Balochistan

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Summary: Six important herbs and shrubs of Quetta valley, commonly known for their medicinal and fodder values, were analyzed for their nutritional values. These plants included *Conyza canadensis* Bory ex DC. (Asteraceae), *Ferula oopoda* Boiss. (Apiaceae), *Lepidium perfoliatum* L. (Brassicaceae), *Nepeta bracteata* Benth. (Lamiaceae), *Vincetoxicum stocksii* Ali &Khatoon (Asclepiadaceae), *Zygophyllum fabago* L. (Zygpohyllaceae). Samples were evaluated seasonally for two years from Hazarganji, Karkhasa and Zarghoon area. Micro and macro elements including P, Ca, Na, K, Fe, Mn, S, Sr, Zn, Al were analyzed by using atomic absorption spectrophotometer, flame photometer and X-ray florescence spectrophotometer. The elemental concentrations were compared with standard feed table of PARC. All the foliage analyzed showed good amount of minerals. *L. perfolistum* and *N. bracteata* were palatable and hence preferred by the small ruminants. Significantly high potassium and calcium level was found in *V. stocksii* and *Z. fabago*, respectively. Both these plants also had high quantities of sodium and potassium and were not preferred by animals as food. Medium amounts of required elements were determined in *F. oopodo* and *C. canadensis*. No significant seasonal difference ($P > 0.05$) in the concentration of different elements was observed.

Introduction

Certain inorganic trace elements like zinc, chromium, copper, iron, potassium, sodium, and nickel play an important role in the maintenance of health of animals and human beings. Very little work has been done to establish the nutritional value of common plants of Quetta which are used medicinally and as forage. In our experiments six medicinal plants have been selected from indigenous folk medicines, Ayurvedic, Unani and Siddha systems of medicines for thorough studies of elemental composition.

Many efforts have been made to establish the potential benefits of waste land herbs and shrubs. These have long been considered as important source for nutrition of grazing animals in Pakistan, particularly in those areas with pronounced dry season [1]. Herbs, shrubs and trees generally serve not only as food, fodder and medicine but also as shade and shelter for human beings and animals. Fodder trees, shrubs and herbs provide forage for livestock through out the world, when the values of grasses are below the minimum requirements for the maintenance of livestock. In the arid and semi-arid areas of the Mediterranean regions fodder herbs and shrubs, as forage plants can fill the gap of feed for livestock during harsh environmental period. The presence of large quantity of minerals in fodder shrubs leaves may not ensure the full nutritional diet as required by the animals [2]. The concentrations of mineral elements in forage depends upon the interaction of number of factors such as soil, plant species, stage of maturity, yield and climate [3]. Difference in mineral concentration was reported by [4-6]. By the plants growing in the same soil. Minerals in leaves play a vital role for normal growth, reproduction, health and proper functioning of the animal body [7]. Minerals maintain and protect the structural components of the body, organ, and tissues and constituents of the body fluid and tissue electrolytes.

According to Food and Agriculture Organization [8], plant species of Balochistan are deficient in total digestible nutrients, digestible protein and dry matter with respect to animal requirement. Previously, research was focused only on quantifying the crude protein of range forages of

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Balochistan [1, 9]. Limited work was done on quantifying the seasonal dynamics of the nutrients. However, it is important to know the macro and micro-nutrient concentrations of unknown varieties because the animals mainly graze on the rangelands [10]. This research is valuable to plant and animal scientists in selecting the suitable variety of herbs and shrubs in all seasons and their effect on ruminant's nutritional patterns.

Result and Discussion

Results of the seasonal annual elemental composition of six species are given in tables 1-6 and are expressed in dry matter (DM %). Almost similar results were obtained through three different equipments. However, the levels of minerals recorded from plants of Zarghoon area were higher as compared to Hazarganji and Karkhsa, which may be due to availability of more water in the area.

Phosphorus

In the species tested, amount of phosphorus ranged between (0.15 % -1.90 % DM). Maximum amount of phosphorus was recorded from Zarghoon area, it was high in spring, summer, autumn and low during winter. Highest amount (1.90 % DM) was found in *V. stocksii* followed by *Z. fabago* (0.93 % DM) from Zarghoon area. Medium amounts were observed from *N. bracteata* (0.68 % DM) and *L. perfoliatum* (0.63 % DM) during summer from Zarghoon. Lowest amount was found in *F. oopoda* (0.31 % DM) from Hazarganji and Karkhasa areas.

However mature shrubs and herbs are found to be a good source of phosphorus for animal health. These plants are also able to provide complete nutritional requirement to animals, as all herbs and shrubs examined were above the deficiency level of phosphorus, which is below 0.15 % , [11]. The phosphorus content found from shrubs during this study were more then those reported from grasses [12].. He also reported 0.33 % DM phosphorus in grasses in temperate area and 0.22 % DM in tropical areas. He also found that phosphorus was highly affected by seasons. High phosphorus was observed during spring, summer and autumn season than in winter. Similar results were found by [13], while working on different shrubs of arid environment. They observed phosphorus contents in plant tissues declines with increasing maturity, and the rate and extent of decline varies with species. Phosphorus is a mobile element that may be reused within the plant, being translocated from the senescent tissues to the younger ones [14].

Calcium

Average calcium concentration in six plants ranged between 0.15-1.24 % DM. Highest amount was found in *L. perfoliatum* (1.82 % DM) from Karkhasa and *N. bracteata* had second high amount of calcium (1.41 % DM) from Zarghoon area followed by *Z. fabago* (1.30 % DM) during spring from Zarghoon. Moderate amounts (0.71 %) DM was found in *C. canadensis* and *V. stocksii* (0.60 % DM). Lowest levels were found in *F. oopoda* from Karkhsa area (0.15-0.20 % DM). The amount of calcium was significantly different in six species ($P<0.05$).

Table-1: Mineral concentration of foliage of *V. stocksii* from three localities of Quetta district.

Seasons	Phosphorus %	Calcium %	Sodium %	Potassium %	Sulfur %	Iron %	Zinc %
			HAZARGANGI				
Spring	0.65 ± 0.02	0.48 ± 0.01	1.60 ± 0.3	1.20 ± 0.1	0.21 ± 0.02	0.02 ± 0.002	0.30 ± 0.02
Summer	0.67 ± 0.03	0.65 ± 0.01	1.70 ± 0.4	1.50 ± 0.2	0.25 ± 0.03	0.01 ± 0.001	0.50 ± 0.02
Autumn	0.72 ± 0.03	0.70 ± 0.03	1.73 ± 0.4	2.00 ± 0.5	0.27 ± 0.03	0.02 ± 0.002	0.60 ± 0.01
Winter	0.60 ± 0.02	0.57 ± 0.02	1.62 ± 0.3	1.65 ± 0.4	0.30 ± 0.02	0.03 ± 0.001	0.90 ± 0.01
Mean	0.60	0.60	0.66	1.58	0.25	0.02	0.50
			ZARGHOON				
Spring	1.80 ± 0.4	0.61 ± 0.02	1.20 ± 0.4	0.39 ± 0.2	0.25 ± 0.02	0.05 ± 0.02	0.27 ± 0.01
Summer	1.90 ± 0.5	0.73 ± 0.02	1.22 ± 0.4	0.42 ± 0.2	0.27 ± 0.02	0.06 ± 0.01	0.35 ± 0.02
Autumn	1.98 ± 0.3	0.65 ± 0.03	1.26 ± 0.3	0.49 ± 0.3	0.28 ± 0.01	0.05 ± 0.01	0.22 ± 0.02
Winter	1.92 ± 0.2	0.39 ± 0.02	1.28 ± 0.4	0.42 ± 0.1	0.30 ± 0.02	0.04 ± 0.02	0.24 ± 0.01
Mean	1.90	0.59	1.24	0.43	0.27	0.05	0.27
			KARKHASA				
Spring	1.50 ± 0.4	0.48 ± 0.01	1.28 ± 0.4	0.61 ± 0.2	0.26 ± 0.03	0.050 ± 0.02	0.26 ± 0.01
Summer	1.20 ± 0.4	0.47 ± 0.03	1.24 ± 0.4	0.49 ± 0.2	0.28 ± 0.04	0.063 ± 0.02	0.28 ± 0.03
Autumn	0.52 ± 0.2	0.42 ± 0.01	1.26 ± 0.4	0.32 ± 0.2	0.29 ± 0.02	0.04 ± 0.03	0.28 ± 0.03
Winter	0.50 ± 0.2	0.42 ± 0.01	1.20 ± 0.3	0.45 ± 0.2	0.30 ± 0.02	0.04 ± 0.02	0.30 ± 0.01
Mean	0.93	0.44	1.24	0.46	0.28	0.036	0.28

Mn (0.001 % – 0.005 % DM), Al (0.001 % – 0.003 % DM) ANOVA ($P < 0.05$), ($P > 0.05$)
Each value is mean ± standard deviation of twelve determinations.

Table-2: Mineral concentration of foliage of *Z. fabago* from three localities of Quetta district.

Seasons	Phosphorus %	Calcium %	Sodium %	Potassium %	Sulfur %	Iron %	Zinc %
			HAZARGANGI				
Spring	0.57 ± 0.02	0.49 ± 0.02	0.27 ± 0.02	0.62 ± 0.02	0.32 ± 0.02	0.02 ± 0.01	0.40 ± 0.02
Summer	0.62 ± 0.02	0.54 ± 0.02	0.28 ± 0.02	0.71 ± 0.03	0.41 ± 0.02	0.02 ± 0.01	0.50 ± 0.02
Autumn	0.68 ± 0.03	0.72 ± 0.03	0.32 ± 0.02	0.71 ± 0.03	0.81 ± 0.03	0.02 ± 0.02	0.80 ± 0.02
Winter	0.60 ± 0.02	0.60 ± 0.03	0.31 ± 0.02	0.65 ± 0.02	0.62 ± 0.02	0.01 ± 0.01	0.30 ± 0.02
Mean	0.61	0.58	0.30	0.67	0.54	0.025	0.50
			ZARGHOON				
Spring	0.67 ± 0.03	1.62 ± 0.04	0.18 ± 0.02	0.62 ± 0.02	0.25 ± 0.02	0.07 ± 0.02	0.40 ± 0.02
Summer	1.23 ± 0.03	1.32 ± 0.03	1.1 ± 0.02	0.62 ± 0.02	0.29 ± 0.02	0.09 ± 0.02	0.33 ± 0.02
Autumn	0.69 ± 0.04	1.41 ± 0.04	1.6 ± 0.03	0.44 ± 0.02	0.34 ± 0.02	0.06 ± 0.02	0.42 ± 0.02
Winter	1.05 ± 0.03	1.19 ± 0.03	1.00 ± 0.03	0.43 ± 0.02	0.30 ± 0.02	0.05 ± 0.02	0.28 ± 0.02
Mean	0.93	1.39	0.97	0.52	0.29	0.06	0.27
			KARKHASA				
Spring	0.52 ± 0.02	0.49 ± 0.02	1.22 ± 0.3	0.43 ± 0.02	0.24 ± 0.02	0.05 ± 0.02	0.32 ± 0.02
Summer	0.62 ± 0.03	0.67 ± 0.02	1.28 ± 0.4	0.44 ± 0.02	0.25 ± 0.02	0.06 ± 0.02	0.24 ± 0.02
Autumn	0.59 ± 0.02	0.82 ± 0.03	1.27 ± 0.4	0.68 ± 0.03	0.29 ± 0.02	0.07 ± 0.02	0.45 ± 0.02
Winter	0.57 ± 0.02	0.61 ± 0.02	1.20 ± 0.4	0.65 ± 0.02	0.26 ± 0.02	0.09 ± 0.02	0.32 ± 0.02
Mean	0.57	0.64	1.24	0.55	0.25	0.05	0.34

Mn (0.001 % – 0.003 % DM), Al (0.001 % – 0.002 % DM) ANOVA ($P < 0.05$), ($P > 0.05$)
Each value is mean ± standard deviation of twelve determinations.

Table-3: Mineral concentration of foliage of *N. praetervis* from three localities of Quetta district.

Seasons	Phosphorus %	Calcium %	Sodium %	Potassium %	Sulfur %	Iron %	Zinc %
			HAZARGANGI				
Spring	0.23 ± 0.02	0.72 ± 0.02	0.20 ± 0.01	0.22 ± 0.02	0.28 ± 0.2	0.02 ± 0.01	0.20 ± 0.02
Summer	0.24 ± 0.01	0.83 ± 0.03	0.27 ± 0.02	0.32 ± 0.03	0.20 ± 0.01	0.05 ± 0.01	0.50 ± 0.01
Autumn	0.44 ± 0.02	0.74 ± 0.04	0.28 ± 0.02	0.34 ± 0.03	0.27 ± 0.02	0.06 ± 0.02	0.40 ± 0.01
Winter	0.32 ± 0.01	0.32 ± 0.01	0.24 ± 0.01	0.23 ± 0.03	0.25 ± 0.01	0.05 ± 0.01	0.40 ± 0.01
Mean	0.30	0.65	0.24	0.27	0.25	0.05	0.40
			ZARGHOON				
Spring	0.63 ± 0.01	1.25 ± 0.4	0.21 ± 0.01	0.14 ± 0.01	0.63 ± 0.04	0.05 ± 0.01	0.70 ± 0.02
Summer	0.82 ± 0.01	1.5 ± 0.4	0.20 ± 0.01	0.13 ± 0.01	0.72 ± 0.04	0.03 ± 0.01	0.80 ± 0.02
Autumn	0.56 ± 0.03	1.7 ± 0.5	0.24 ± 0.02	0.16 ± 0.01	0.56 ± 0.03	0.05 ± 0.01	0.50 ± 0.01
Winter	0.14 ± 0.02	1.2 ± 0.5	0.21 ± 0.01	0.11 ± 0.01	0.37 ± 0.02	0.04 ± 0.01	0.50 ± 0.01
Mean	0.68	1.41	0.21	0.13	0.57	0.043	0.625
			KARKHASA				
Spring	0.18 ± 0.01	0.61 ± 0.03	0.27 ± 0.03	0.20 ± 0.02	0.39 ± 0.03	0.05 ± 0.01	0.60 ± 0.01
Summer	0.17 ± 0.01	0.49 ± 0.01	0.26 ± 0.02	0.19 ± 0.02	0.46 ± 0.03	0.05 ± 0.01	0.70 ± 0.02
Autumn	0.16 ± 0.01	0.52 ± 0.20	0.24 ± 0.02	0.12 ± 0.01	0.47 ± 0.03	0.07 ± 0.02	0.40 ± 0.01
Winter	0.12 ± 0.01	0.57 ± 0.02	0.21 ± 0.01	0.12 ± 0.01	0.42 ± 0.03	0.06 ± 0.01	0.50 ± 0.02
Mean	0.15	0.54	0.24	0.15	0.43	0.05	0.55

Mn (0.001 % – 0.004 % DM), Al (0.001 % – 0.002 % DM) ANOVA ($P < 0.05$), ($P > 0.05$)
Each value is mean ± standard deviation of twelve determinations.

Table-4: Mineral concentration of foliage of *L. perfoliatum* from three localities of Quetta district.

Seasons	Phosphorus %	Calcium %	Sodium %	Potassium %	Sulfur %	Iron %	Zinc %
			HAZARGANGI				
Spring	0.55 ± 0.02	0.82 ± 0.03	0.25 ± 0.02	0.44 ± 0.02	0.25 ± 0.02	0.06 ± 0.02	0.27 ± 0.02
Summer	0.57 ± 0.03	1.09 ± 0.05	0.42 ± 0.02	0.43 ± 0.02	0.29 ± 0.02	0.06 ± 0.02	0.62 ± 0.02
Autumn	0.63 ± 0.03	1.50 ± 0.05	0.31 ± 0.02	0.62 ± 0.02	0.41 ± 0.02	0.05 ± 0.02	0.64 ± 0.02
Winter	0.52 ± 0.03	0.86 ± 0.04	0.25 ± 0.02	0.62 ± 0.02	0.38 ± 0.02	0.07 ± 0.02	0.54 ± 0.02
Mean	0.55	1.06	0.30	0.52	0.33	0.06	0.51
			ZARGHOON				
Spring	0.65 ± 0.03	1.01 ± 0.05	0.30 ± 0.02	0.60 ± 0.02	0.42 ± 0.02	0.051 ± 0.02	0.42 ± 0.02
Summer	0.70 ± 0.04	1.82 ± 0.05	0.28 ± 0.02	0.61 ± 0.02	0.59 ± 0.02	0.032 ± 0.02	0.60 ± 0.02
Autumn	0.64 ± 0.04	1.63 ± 0.05	0.28 ± 0.02	0.70 ± 0.02	0.62 ± 0.02	0.049 ± 0.02	0.64 ± 0.02
Winter	0.55 ± 0.03	1.37 ± 0.05	0.27 ± 0.02	0.70 ± 0.02	0.60 ± 0.02	0.10 ± 0.02	0.59 ± 0.02
Mean	0.63	1.45	0.28	0.65	0.55	0.055	0.56
			KARKHASA				
Spring	0.60 ± 0.02	1.12 ± 0.4	0.22 ± 0.02	0.32 ± 0.02	0.32 ± 0.02	0.04 ± 0.02	0.39 ± 0.02
Summer	0.62 ± 0.02	1.73 ± 0.5	0.26 ± 0.02	0.49 ± 0.02	0.46 ± 0.02	0.04 ± 0.02	0.43 ± 0.02
Autumn	0.67 ± 0.03	1.70 ± 0.4	0.28 ± 0.02	0.61 ± 0.02	0.49 ± 0.02	0.03 ± 0.02	0.42 ± 0.02
Winter	0.62 ± 0.02	1.48 ± 0.5	0.27 ± 0.02	0.42 ± 0.02	0.42 ± 0.02	0.03 ± 0.02	0.30 ± 0.02
Mean	0.62	1.50	0.26	0.46	0.42	0.030	0.38

Mn (0.001 % – 0.004 %), Al (0.001 % – 0.002 %) ANOVA ($P < 0.05$), ($P > 0.05$)
Each value is mean ± standard deviation of twelve determinations.

Table-5: Mineral concentration of foliage of *F. oopoda* from three localities of Quetta district.

Seasons	Phosphorus %	Calcium %	Sodium %	Potassium %	Sulfur %	Iron %	Zinc %
			HAZARGANGI				
Spring	0.25 ± 0.02	0.31 ± 0.01	0.26 ± 0.02	0.24 ± 0.02	0.42 ± 0.03	0.07 ± 0.02	0.34 ± 0.02
Summer	0.32 ± 0.03	0.30 ± 0.03	0.26 ± 0.03	0.24 ± 0.03	0.39 ± 0.02	0.09 ± 0.03	0.37 ± 0.02
Autumn	0.39 ± 0.02	0.39 ± 0.04	0.27 ± 0.02	0.25 ± 0.04	0.31 ± 0.04	0.04 ± 0.02	0.55 ± 0.02
Winter	0.31 ± 0.02	0.39 ± 0.03	0.28 ± 0.03	0.22 ± 0.01	0.30 ± 0.04	0.04 ± 0.04	0.50 ± 0.03
Mean	0.31	0.34	0.26	0.23	0.35	0.06	0.44
			ZARGHOON				
Spring	0.41 ± 0.02	0.25 ± 0.02	0.28 ± 0.02	0.26 ± 0.02	0.48 ± 0.02	0.05 ± 0.02	0.55 ± 0.02
Summer	0.48 ± 0.03	0.35 ± 0.02	0.28 ± 0.01	0.42 ± 0.02	0.61 ± 0.03	0.05 ± 0.02	0.57 ± 0.02
Autumn	0.30 ± 0.02	0.32 ± 0.02	0.30 ± 0.03	0.48 ± 0.02	0.71 ± 0.02	0.03 ± 0.03	0.61 ± 0.03
Winter	0.28 ± 0.02	0.18 ± 0.02	0.23 ± 0.02	0.32 ± 0.02	0.65 ± 0.01	0.02 ± 0.01	0.53 ± 0.01
Mean	0.36	0.27	0.27	0.37	0.61	0.04	0.56
			KARKHASA				
Spring	0.25 ± 0.03	0.14 ± 0.03	0.23 ± 0.02	0.24 ± 0.03	0.28 ± 0.04	0.03 ± 0.04	0.39 ± 0.03
Summer	0.31 ± 0.02	0.16 ± 0.03	0.31 ± 0.02	0.25 ± 0.02	0.34 ± 0.03	0.04 ± 0.01	0.42 ± 0.04
Autumn	0.42 ± 0.02	0.16 ± 0.02	0.28 ± 0.02	0.22 ± 0.04	0.37 ± 0.02	0.04 ± 0.02	0.56 ± 0.03
Winter	0.28 ± 0.03	0.15 ± 0.01	0.27 ± 0.02	0.23 ± 0.02	0.31 ± 0.02	0.20 ± 0.02	0.37 ± 0.02
Mean	0.31	0.15	0.27	0.23	0.32	0.038	0.43

Mn (0.001 % – 0.003 %), Al (0.001 % – 0.002 %) ANOVA ($P < 0.05$), ($P > 0.05$)
Each value is mean ± standard deviation of twelve determinations.

Table-6: Mineral concentration of foliage of *C. canadensis* from three localities of Quetta district.

Seasons	Phosphorus %	Calcium %	Sodium %	Potassium %	Sulfur %	Iron %	Zinc %
			HAZARGANGI				
Spring	0.42 ± 0.02	0.19 ± 0.02	0.32 ± 0.10	0.45 ± 0.02	0.27 ± 0.02	0.02 ± 0.002	0.10 ± 0.02
Summer	0.47 ± 0.02	0.18 ± 0.04	0.31 ± 0.03	1.2 ± 0.02	0.39 ± 0.02	0.02 ± 0.002	0.20 ± 0.02
Autumn	0.53 ± 0.02	0.17 ± 0.02	0.24 ± 0.02	1.4 ± 0.02	0.32 ± 0.02	0.03 ± 0.002	0.40 ± 0.03
Winter	0.52 ± 0.02	0.18 ± 0.02	0.23 ± 0.03	0.7 ± 0.02	0.32 ± 0.02	0.02 ± 0.002	0.27 ± 0.02
Mean	0.48	0.45	0.25	0.93	0.30	0.02	0.24
			ZARGHOON				
Spring	0.55 ± 0.02	0.9 ± 0.03	0.15 ± 0.03	0.40 ± 0.02	0.31 ± 0.02	0.01 ± 0.002	0.25 ± 0.02
Summer	0.59 ± 0.02	0.6 ± 0.04	0.13 ± 0.03	0.43 ± 0.01	0.37 ± 0.02	0.02 ± 0.003	0.27 ± 0.02
Autumn	0.57 ± 0.02	0.8 ± 0.03	0.12 ± 0.02	0.60 ± 0.02	0.39 ± 0.02	0.02 ± 0.002	0.27 ± 0.02
Winter	0.54 ± 0.02	0.9 ± 0.02	0.14 ± 0.02	0.57 ± 0.02	0.36 ± 0.02	0.02 ± 0.002	0.24 ± 0.02
Mean	0.56	0.80	0.13	0.50	0.35	0.015	0.25
			KARKHASA				
Spring	0.36 ± 0.02	0.20 ± 0.03	0.27 ± 0.02	0.39 ± 0.02	0.41 ± 0.02	0.01 ± 0.002	0.29 ± 0.02
Summer	0.42 ± 0.02	0.23 ± 0.04	0.29 ± 0.02	0.51 ± 0.02	0.49 ± 0.02	0.03 ± 0.003	0.26 ± 0.02
Autumn	0.49 ± 0.02	0.21 ± 0.03	0.29 ± 0.02	0.42 ± 0.02	0.42 ± 0.02	0.02 ± 0.002	0.28 ± 0.02
Winter	0.38 ± 0.02	0.18 ± 0.02	0.24 ± 0.02	0.41 ± 0.02	0.45 ± 0.02	0.02 ± 0.002	0.24 ± 0.02
Mean	1.41	0.20	0.27	0.43	0.44	0.02	0.26

Mn (0.001 % – 0.003 %), Al (0.001 % – 0.002 %) ANOVA ($P < 0.05$), ($P > 0.05$)
Each value is mean ± standard deviation of twelve determinations.

The critical level of calcium required for ruminants is 0.43 % DM [15]. The calcium observed in all plants during this study was remarkably higher than those of wheat grains (0.04 % DM) and almost equal to mixed herbage 0.93 % DM [16, 17]. Recorded low calcium content (0.4-0.6 % DM) from grasses and high (1.2 -1.6 % DM) from legumes. Almost same amount was recorded from all shrubs with the exception of *F. oopoda*, where the maximum amount of calcium was very low 0.33 % , but this amount in shrub is almost equal to that required for animal nutrition. Calcium recorded from shrubs was less than that found in trees. Similar results were found by H. F. Del Valla *et al.*[14], they found low quantity from *Atriplex lampa* and *Prosopis alpacto* in Northeastern Patagonia.

Sodium

The sodium concentration in shrub species ranged between 0.13-1.24 % DM, Maximum concentration (1.24 % DM) of sodium was found in *V. stocksii* from HazarGangi its highest amount was recorded during autumn season. High concentration of sodium (1.24 % DM) was also observed in *Z. fabago* at Karkhasa only, while low amounts were recorded from *L. perfoliatum* (0.28 % DM), *C. canadensis* and *F. oopoda* (0.27 % DM), *N. bracteata* (0.23 % DM) from Zarghoon habitat. Lowest level was recorded from *C. canadensis* (0.13 % DM). Similar results were reported from tropical crops (0.22 % DM) [18]. Low sodium content was reported from grasses and legumes (0.09 and 0.06 %

DM) as reported by [17]. Standard concentration of Na in dry matter required for animals nutrition ranges between 0.09 and 0.21 % as given by Commonwealth Agricultural Bureau, [19].. Critical concentration of Na 0.06 % DM in forage is recommended by NRC (1996), Anonymous (1996). The high amount of sodium in *V. stocksii and Z. fabago* makes it less palatable to the grazing animals therefore these medicinally important plants are not liked by the animals and is not much eaten by them so this shrub stays through out the year. Similar findings were observed by Silva *et al.* [20] while working on *Atriplex sp* of Northeastern Patagonia.

Potassium

Average potassium concentration ranged between 0.13-1.58 % DM. Highest amount was observed in *V. stocksii* (1.58 % DM) from Hazarganji its highest amount was recorded duringduring autumn. Medium potassium was found from Zarghoon and Karkhasa areas (0.45 % DM). High potassium was also recorded from *C. canadensis* (0.93 % DM) during summer from Hazargangi. While *Z. fabago* and *L. perfoliatum* had an average of 0.58 % and 0.54 % DM respectively. Low amounts were recorded from *F. oopoda* (0.37 % DM) and *N. praetervis* (0.13 % DM). Significant difference in the values ($P< 0.05$) was observed. Potassium in all the species was higher than potassium in wheat grains and mixed herbage (0.37 % and 2.09 % respectively) [20]. Critical level for potassium is 0.60 % as recommended by NRC [21]. Similar amounts have been observed in another study [14] and found highest (0.78 % DM) value of potassium in summer from the leaves of a shrub *Prosopis alpacto.*

Therefore, all samples analyzed possessed sufficient potassium that can fulfill the animal requirements and are therefore recommended as the best plants of the area, except two shrubs *F. oopoda* and *N. praetervis* which are potassium deficient in all habitats, so are not recommended for animal consumption. Reduced potassium can also depress animal productivity, by reducing the appetite and the food intake [22]. Therefore, these two species must be supplemented with some other diet to fulfill animal requirement. *V. stocksii* had excessive amount of potassium in Hazargangi which is more then the required amount recommended by NRC [21].

Sulfur

Sulfur was found in the lower ranges between 0.25-0.61 % DM. Highest average amount of sulfur was found in *F. oopoda* (0.61 % DM), and *N. praetervis* (0.57 % DM), followed by *L. perfoliatum* (0.55 % DM) from Zarghoon and *Z. fabago* (0.54 % DM) from Hazargangi. Levels of sulfur in all plants were enough to fulfill animal's requirement as these amounts are more than the critical level needed for animal nutrition. Similar levels of sulfur were recorded from grasses of Trans-Himalayan grasslands of Pakistan [23] and from mixed herbage [16].

Iron

The amount of iron in foliage ranges between 0.01-0.06 % DM. High levels of Iron were found in *L. perfoliatum* from all localities through out the year. Highest amount was (0.06 % DM) from Hazarganji during summer, followed by (0.05 % DM) in *N. praetervis*, and *F. oopoda.* Medium levels were found in *Z. fabago* and *V. stocksii.* Lowest amount of iron (0.02 % DM) was recorded from *C. canadensis*, throughout the year from all sites.

The amount of iron observed during this study was less than that of wheat (0.37 % DM), and was remarkably lower than iron in mixed herbage (2.09 % DM) [16].. Naturally occurring Iron (Fe) content of fodder plants ranged from 18 to about 1000μg/g or (0.018-0.10 % DM), and various cereal grains do not differ much in their concentrations. [24]. found the common average iron content of different cereal ranges from 25 to around 80μg/g. The amount of iron recorded from all plants was equal or more than that required for animal nutrition. Therefore, all plants studied provide a good source of iron for animal nutrition [4].

Zinc

Average concentration of zinc ranged between 0.24-0.56 % DM. Comparatively high percentages of zinc were obtained from *F. oopoda* and *L. perfoliatum* (0.56 % DM) and *V. stocksii* (0.50 % DM). Lowest amount was found in *C. canadensis* 0.24 % DM. Plant absorbed maximum amount of zinc from Hazargangi and Zarghoon areas. Zinc concentration of *V. stocksii* found in this study is

lower than those recorded from wheat grains 16 mg/kg and mixed herbage 30 mg/kg. These are lower than the critical value required by the ruminants [16]. Almost similar values were reported (88.5 µg/gm) from Bahia grass [6]. Zn concentration may some time fluctuate in plant [25].

Manganese

Only trace amounts of manganese was recorded from all plants ranged between (0.001-0.005). Highest amount of Mn was found in *V. stocksii* (0.005 % DM) and low in *C. candensis* and *Z. fabago* (0.003 % DM). Although it is present in higher percentage in soil, but is recorded in low percentage in healthy higher plants (Ting, 1981). No significant seasonal difference was found. in different localities during all seasons. Khan et al., (2007) recorded 115-250 µg/gm from four grasses. However, the negligible amounts of these two toxic elements in shrubs are not harmful for animal health. These values are also lower than the critical values of forage and are also less than those reported from other forage [6, 25].

Strontium and Aluminum

Strontium and aluminum are found in plants as micro-nutrient The amount of strontium ranged in all plants from 0.001-0.004 % DM. Highest amount of strontium was found in *Z. fabago* (0.004 % DM) in spring and from Zarghoon and lowest amount was found in *F. oopoda* (0.001 % DM). Strontium has been reported to act as a growth stimulant [4]. The strontium ion is similar to calcium ion both chemically and physiologically. Strontium is metabolized similarly as calcium by animals and it can substitute for calcium in physiological processes [15]. The concentration of Aluminum (Al) in plants studied ranged between 0.001-0.004 % DM. However, the negligible amounts of this toxic element in shrubs are not harmful for animal health [26].

Experimental

In the present study, leaves of six traditional medicinal and common herbs and shrubs were evaluated for their macro and micro elemental composition from three protected areas of Hazarganji, Karkhasa and Zarghoon. The overall climate is semi arid with hot dry summers and cool winters, received less than 200 mm average annual rainfall during the study period. In 2005-2006 fresh leaves from *Conyza canadensis*, *Ferula oopoda*, *Lepidium perfoliatum*, *Nepeta bracteata*, *Vincetoxicum stocksii*, *Zygophyllum fabago* were collected seasonally from three localities of Quetta district, 30-50 km away from each other. Complete Random Block Design with three replicates was used for analysis. Leaves samples were hand plucked from 5-7 plants of each species and made a unit sample. The vegetative samples were brought to the laboratory washed and dried in shade at room temperature, and ground with a mill to pass through 1mm sieve, thoroughly mixed and stored in plastic bottles. Each unit sample 5gm was kept in furnace at 800 °C. The ash obtained was dissolved in aqua regia (6 ml HCl + 2 ml HNO_3), this was kept in aluminum block over night for digestion at 180 °C. The digested samples were cooled and diluted with 20 ml of 10 % HCL, till the transparent color appeared. These were than analyzed through atomic absorption spectrophotometer (AA-6105 Schimdzu). 1 gm of dried leaves samples were also directly analyzed through X-ray fluorescence spectrophotometer EDX-700 Hs Schimadzu. The ash samples were evaluated for Phosphorus (P), Calcium (Ca), Sodium (Na), Potassium (K), Sulfur (S), Iron (Fe), Zinc (Zn), Strontium (Sr), Manganese (Mn) and Aluminum (Al). Analyses of samples were carried out in duplicate. Results were calculated as percentage dry weight basis. Standard deviation of elemental concentration was subject to analysis of variance (ANOVA).

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