Sustainable, Proficient Fodder Influenced By Bio Diversity in Mineral Composition of Shrub Leaves of Quetta District

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Abstract

The vegetation of Balochistan is of critical value to the quality of life for the local nomadic people. Many important dominant species used for animal grazing were selected to evaluate their value as fodder during 2016-2017. These plants including Amygdalus brahuica Boiss, Prunus eburnea Aitch, Caragana ambigua Stocks, Sophora mollis Royle, Pervovskia abrotanoides Karel, and Berberis baluchistanica Ahrendt, (as because Sophora mollis were not found in Zarghoon) were collected seasonally from Hazarganji, Karkhasa and Zarghoon area of Quetta district. These were analyzed for macro and micro elemental composition such as P, Ca, Na, K, S, Fe, Zn, Sr, Al and Mn by using atomic absorption, flame photometer and X-ray fluorescence spectrophotometer. The elemental concentrations were compared with standard feed table of Pakistan Agriculture Research Council. P. eburnea and B. baluchistanica showed good amount of nutrients in their foliage, these two plants were palatable and preferred by the small ruminants, while A. brahuica and C. ambigua showed medium amounts of minerals and fulfill the requirements of the animal as fodder. The animals did not prefer to eat P. abrotanoides may due to its strong smell while S. mollis had deposition of cutin and suberin on their leaves. It was observed that there was no significant difference (P > 0.05) in the concentration of different elements of the forage due to seasonal changes.

Keyword: nomadic, cuin, subrin, ruminants, hazarganji, karkhasa, zarhoon

Introduction

Generally, plants are the most ancient friends of mankind and always played a major role in shaping the ecology of an environment, however, many efforts are continually extending to establish the potential benefits of wild herbs and shrubs in the arid environment of Quetta. Shrubs have been considered as an important source for the nutrition of grazing animals in Pakistan, particularly in those areas like Quetta, with pronounced dry season and used as a supplement in the local nomadic livestock during the harsh environmental periods. In Quetta city, very little work has been done to establish the nutritional value of dominant plants used as forage. During the last decade of prolonged drought adversely affected the delicate ecosystem of the Quetta. Therefore, this research may be valuable to animal scientists and plant breeders in selecting the suitable variety of shrubs to evaluate their comparative value regarding all seasons and their effect on ruminant’s nutritional patterns activities, growth and fruit production is expected to be high. The plant nutrient level can exceed that of soil [7]. Low amount of soil nutrients may also be due to overgrazing, cutting of foliage, branches, and whole trees for fuel [8]. Water holding capacity, organic matter of soil, salinity, conductivity, total dissolved salts, pH, and soil compaction showed marked association with the distribution and abundance of vegetation [9]. Normal growth and development of the plants depend upon the continuous supply of nutrients, topographic, and edaphic conditions cutting, harvesting, and grazing can cause disturbance of soil nutritional characteristics and their availability [10]. The plants that are growing in the same soil vary in mineral concentration has also been reported [11, 12]. Feeding value of fodder shrubs also varies depending on species or cultivars, phonological stage, plant part, site, and environmental conditions. In the arid and semi-arid areas of the Quetta region fodder shrubs used as forage plants that can fulfill the gap of feed for livestock during the harsh environmental periods. In Quetta city, very little work has been done to establish the nutritional value of dominant plants used as forage. During the last decade of prolonged drought adversely affected the delicate ecosystem of the Quetta. Therefore, this research may be valuable to animal scientists and plant breeders in selecting the suitable variety of shrubs to evaluate their comparative value regarding all seasons and their effect on ruminant’s nutritional patterns activities, growth and fruit production is expected to be high. 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Materials and Methods

The study was conducted to evaluate seasonal macro and micro mineral composition of dominant shrubs of three rangelands found in three different directions of the Quetta district for two years (2016-2017) in four different seasons. Following six shrubs were collected Amygdalus brassica Boiss, Prunus eburnea Aitch., Caragana ambiguca Stocks, Sophora mollis Royle, Perovskia abrotanoides Karel, and Berberis baluchistanica Ahrendt. While Sophora mollis was not found in the Zarghoon area. Samples were hand-plucked from three different sites of the same habitat. Vegetation analysis was done by using a complete random block design with three replicates. The elements Phosphorus [P], Calcium [Ca], Sodium [Na], Potassium [K], Sulphur [S], Iron [Fe], Zinc [Zn], Strontium [Sr], Manganese [Mn] and Aluminum [Al] were determined by atomic absorption, flame spectrophotometer AA-6105 (Schimazu) and X-ray fluorescence spectrophotometer EDX-700 HS (Schimazu), according to “A Manual of Experiment for Plant Biology Methods [13]. Analysis of samples was carried out in duplicate. Results were calculated as a percentage on a dry weight basis. The standard deviation of elemental concentration was subject to analysis of variance (ANOVA).

Sites description

These rangelands lie within the arid and semi-arid climatic zones of Quetta (Balochistan) district. Due to severe drought in the past seven years, these ranges are degrading very rapidly causing loss of desirable species. First locality Hazargangi Chiltan National Park is located near Quetta at a distance of 20Km on Quetta Mastung road towards N W at 30° 07’N longitude, 66° 58’ E, with an altitude of 1700 meter. The region has Mediterranean climate, cold winter, and dry summer with dry semi-arid type of vegetation, the mean maximum temperature in summer is 36°C and mean minimum temperature in winter is −10°C, while rainfall varies between 250-300 mm per year. Second habitat Zarghoon is located to the southern part of Quetta valley lies approximately between latitude 30° 39’ N and longitude 67° 15’ E. The locality has tremendous variation from hilltop to valley bottoms and gentle slopes with grasses scattered trees, dominated by these plants. Rain and snowfall is dominated in winter; the mean maximum temperature in summer is 25°C and means the minimum temperature in winter is −15°C. The third habitat Karkhass is near to the slopes of the Chiltan mountain range of Quetta. This lies at latitude 30° 09’ and longitude 66° 55’, the climate of the valley is arid with mild summer and severe winter. It is characterized by low precipitation, a high rate of evaporation, and a wide range of temperatures. The average mean maximum temperature rises to 35°C in summers and the mean minimum in winter goes down to −5°C for the month of January.

Results and Discussion

1. Phosphorus:

Phosphorus concentration in six dominated shrubs is presented in table 1-6. In shrub species studied the amount of phosphorus ranged between 1.70 - 0.06% DM. The highest amount of 1.70% DM was found in P. eburnea in summer season from the Hazargangi site. Medium amount 1.40% DM was observed in C. ambiguca in the summer season from the Zarghoon site. A low amount of 0.12% DM was found in A. brahuica, in the winter season from Karkhass and B. baluchistanica, it was an average 0.51% DM basis. High phosphorus was found during the spring season and it decreased in autumn and winter. S. mollis had a high amount of phosphorus as it is a leguminous plant, almost a similar amount was reported from other leguminous plants by Nasrullah et al. [14]. The phosphorus content found from trees and shrubs during this study was more than those reported from grasses. 0.33% phosphorus in grasses in a temperate area and 0.22% in tropical areas, it was also found that phosphorus was highly affected by seasons [15-16]. More phosphorus was observed during spring and summer than in autumn and winter while working on different shrubs of arid environment they observed phosphorus contents in plant tissues declines with increasing maturity [17]. However mature trees and shrubs are found to be a good source of phosphorus for animal health during spring and summer season and these plants are also able to provide complete nutritional requirement to animals as all trees and shrubs examined were above the deficiency level of phosphorus which is below 0.15% [14-18]. Phosphorus is a mobile element, which may be strongly reused within the plant, is translocated from the senescent tissues to the younger ones [19-20].

2. Calcium

Shrubs evaluated for calcium concentration presented in table 1-6, ranged between 1.62-0.13% DM. Maximum amount 1.62% DM was found in P. abrotanoides in autumn season from Zarghoon site, followed by P. eburnea and A. brahuica0.65% DM, the medium amount was noted in B. baluchistanica 0.39% DM in the spring season and the low amount was found in S. mollis 0.13% DM in the spring season from Karkhass. Significantly different (P < 0.05) was observed. The almost same amount was recorded from all shrubs except for P. abrotanoides, where the maximum amount of calcium was 1.62% DM, but this amount in the shrub is more than that required for animal nutrition, as a dietary level of 0.43% calcium is required [21, 22]. Accumulation in high concentrations of any element in any plant tissue without toxic effects may be a genetic characteristic and may include tolerance mechanism, although these elements are essential, they are also potentially toxic, so plant possesses complex biochemistry to control them [23]. Calcium recorded from shrubs was less than that found in trees, moreover, the low quantity from two shrubs Atriplex lampa and Prosopis alpacto in Northeastern Patagonia were also found [19, 24]. These findings were contrary to the already recorded higher calcium content (0.4-0.6%) from grasses and (1.2-1.6%) from legumes [14].

3. Sodium

The sodium concentration in shrub species ranged between 1.31-0.03% DM, this range was almost similar to that found in trees. The high concentration of sodium 1.31% DM was observed in P. abrotanoides, in the autumn season from Hazargangi. Medium amount (0.58%) DM was found in P. eburnea in the spring season from Zarghoon area. A.brahuica0.21% DM, in the spring season from Hazargangi, C. ambiguca0.28% DM, and S. mollis 0.12% DM. In the spring season from Karkhass. Low sodium 0.03% DM was recorded from B. baluchistanica in the winter season. High sodium content was found during the winter season. Sodium in shrubs is nonsignificantly different (P > 0.05) from trees of the same area [25]. Similar results are found by [26] he found 0.22% sodium from tropical crops. While low sodium content was reported from grasses and legumes (0.09 and 0.06%) as reported by [14]. The standard concentration of Na in dry matter required for animal nutrition ranges between 0.09 and 0.21%, (CommonWealth Agricultural Bureau, 1980). The critical concentration of Na 0.06% in forage is recommended by NRC [27, 28]. The highest amount of sodium in P. abrotanoides makes it less palatable to the grazing animals, therefore, this plant is not liked by the animals and is not eaten by them so this shrub remains green and present throughout the year, and similar findings were observed by the [29], in Atriplex ssp Northeastern Patagonia.

4. Potassium

The amount of potassium in shrubs ranges from 1.14-0.04% DM. A high 1.14% DM amount was found in P. abrotanoides during the summer season from Hazargangi. Medium amount 0.64% DM was noted in P. eburnean and B. baluchistanica0.52% DM from Zarghoon during...
Microelements was evaluated seasonally from three habitats and presented [Table 1-6]. Comparatively high percentages of zinc were obtained P. abrotanoides 0.024 %DM, the lowest amount was found in A. brahuica 0.003 %DM. Plant absorbed the maximum amount of zinc from Hazargangi habitat during spring and summer season. Zinc concentration found in the shrub study is lower than those recorded from wheat grains 16 mg/kg and mixed herbage 30 mg/kg [32]. Higher doses of phosphorus and zinc interacted negatively; therefore, the use of a balanced dose is necessary for better quality and productivity [33, 34].

On the other hand, in the Quetta region, the drought before these studies was one of the most important factors that also affect the shortage of moisture in the experimental area. Water availability involves the mobility of some elements such as zinc, which reduces the soil solution by decreasing soil moisture and the plant will be more encountered with deficiency of this element given the root growth restrictions [35, 36]. However when moisture is available then zinc reacts with sulphur and zinc sulfate plays a more important role in stomatal regulation and ion balance in plant systems to reduce the tensions of drought. It has also been reported the foliar application of zinc can increase the production of biomass [37]. Among the myriad of heavy metals zinc also occupies the prominent position, it plays a vital role in the growth and development of plants. Zinc is one of the essential nutrients of plants for normal growth and development [38].

5. Sulphur

Sulphur was studied seasonally in six dominant shrubs presented in Table 1-6 and it was found in low levels in A. brahuica, P. eburnea, C. ambigua, S. mollis, and B. baluchistanica the maximum amount recorded was in S. mollis from the summer season from Karkhasa. Manganese is vital for the normal functioning of several enzymes and particularly for those that regulate the oxidation and reduction phenomena. This element is necessary for nitrate reduction and protein synthesis.

6. Iron

Iron is found in plants as a microelement, the concentration of Iron of six dominated shrubs of Quetta valley were evaluated and presented seasonally [Table 1-6]. The maximum amount was found in C. ambigua 0.64 % DM from autumn season from Karkhasa, medium amount 0.06 % DM was found in A. brahuica, P. eburnea and P. abrotanoides were also recorded from three habitats. B. baluchistanica also showed a medium amount of 0.05 %DM. The lowest amount of iron 0.01 %DM was found in S. mollis from the autumn season from Hazargangi. Naturally occurring iron [Fe] content of fodder plants ranged from 18 to about 1000 µg/g (0.018-0.10 %), and various cereal grains do not differ much in their concentrations [31]. Iron deficiency causes chlorosis in leaves the excessive amount is beneficial and is stored in leaves. The amounts of iron recorded from all plants were equal or more than that required for animal nutrition therefore all plants studied to provide a good source of animal nutrition.

7. Zinc

The summer season, low amount 0.04 % DM was recorded from S. mollis in the winter season from Karkhasa C. ambigua 0.26 %DM and A. brahuica 0.23 %DM was found during summer season from Karkhasa. Similar amounts were recorded and it was found that the highest amount 0.78 % DM of potassium in summer from the leaves of a shrub Prospis alpacto [19]. Critical level for potassium is 0.60 % as recommended by NRC [27]. Therefore, all samples analyzed had less than the required levels of potassium except two shrubs P. eburnea and B. baluchistanica had enough amount that can fulfill the animal requirements and are therefore recommended as the best plants of the area P. abrotanoides had an excessive amount of potassium in Zarghoon and Hazargangi which is more than the required amount recommended by NRC [27], is therefore not much suitable for animal consumption, although it may not produce any toxic effect. All other species were potassium deficient in all habitats these amounts were less than the required amount as recommended by NRC. Reduced potassium can also affect animal productivity by reducing appetite and food intake [30]. High solubility and diffusion are fundamental characteristics of hydrated potassium [K] ions. It provides them with functional mobility through a biological membrane and easy transportation over the entire plant, it also effects on opening and closing of stomata. Potassium also plays a vital role in the plant water economy because of its easy hydration and cooperation due to its abundance and high solubility [19].

8. Strontium

Strontium is found in plants as a micro-nutrient. The amount ranges in all plants were 0.006-0.001 %DM. Highest amount of strontium was found in P. abrotanoides 0.006 %DM in the summer season and from Karkhasa and the low amount was found in A. Brahuica 0.002 %DM in all seasons from Zarghoon habitat. Strontium has been reported to act as a growth stimulant [39]. The strontium ion is similar to calcium ion, both chemically and physiologically. Strontium is metabolized similarly to calcium by animals and it can be a substituted for calcium in physiological processes.

9. Other Elements

Other microelement Aluminum [Al] and Manganese [Mn] of six shrubs were also evaluated from three habitats of Quetta. In shrub the concentration of Aluminum [Al] in A. brahuica 0.003 %DM was found, while in C.ambigua, P. eburnea, and P. abrotanoides 0.002 %DM was observed, while 0.004 % DM was found in S. mollis in B. baluchistanica 0.003 %DM was recorded from Zarghoon habitat. The concentration of manganese in B. baluchistanica was 0.006 %DM. P. abrotanoides and A. brahuica 0.005 %DM, while in C. ambigua and S. mollis 0.004 %DM was recorded. P. eburnea showed 0.003 %DM. However, the amount of these two elements was negligible in shrubs. Manganese is vital for the normal functioning of several enzymes and particularly for those that regulate the oxidation and reduction phenomena. This element is necessary for nitrate reduction and protein synthesis.
### Table 1. The concentration of foliage elements of *A. brahuica*

| Seasons | Phosphorus % | Calcium % | Sodium % | Potassium % | Sulphur % | Iron % | Zinc % | Strontium % |
|---------|--------------|-----------|----------|-------------|-----------|--------|--------|-------------|
| **HAZARGANGI** | | | | | | | | |
| Spring | 0.37±0.02 | 0.51±0.06 | 0.21±0.02 | 0.14±0.02 | 0.24±0.03 | 0.02±0.002 | 0.002±0.001 | 0.001 |
| Summer | 0.38±0.02 | 0.52±0.08 | 0.20±0.03 | 0.13±0.02 | 0.28±0.03 | 0.01±0.002 | 0.002±0.001 | 0.002 |
| Autumn | 0.47±0.02 | 0.47±0.05 | 0.24±0.02 | 0.16±0.03 | 0.26±0.02 | 0.02±0.002 | 0.003±0.002 | 0.001 |
| Winter | 0.32±0.02 | 0.41±0.04 | 0.21±0.03 | 0.11±0.01 | 0.32±0.03 | 0.03±0.002 | 0.002±0.001 | 0.001 |
| Mean | 0.39 | 0.48 | 0.22 | 0.14 | 0.29 | 0.02 | 0.002 | 0.001 |
| **ZARGHOON** | | | | | | | | |
| Spring | 1.25±0.02 | 0.53±0.3 | 0.18±0.03 | 0.20±0.02 | 0.35±0.02 | 0.05±0.002 | 0.002±0.001 | 0.001 |
| Summer | 1.02±0.3 | 0.56±0.4 | 0.17±0.03 | 0.19±0.02 | 0.39±0.04 | 0.03±0.003 | 0.003±0.002 | 0.002 |
| Autumn | 1.39±0.2 | 0.65±0.3 | 0.17±0.03 | 0.12±0.02 | 0.39±0.03 | 0.04±0.002 | 0.002±0.001 | 0.002 |
| Winter | 1.41±0.2 | 0.49±0.2 | 0.16±0.02 | 0.12±0.02 | 0.37±0.03 | 0.05±0.002 | 0.002±0.001 | 0.002 |
| Mean | 1.27 | 0.56 | 0.17 | 0.15 | 0.37 | 0.043 | 0.002 | 0.002 |
| **KARKHASA** | | | | | | | | |
| Spring | 0.18±0.02 | 0.61±0.03 | 0.20±0.12 | 0.22±0.02 | 0.38±0.03 | 0.07±0.002 | 0.002±0.001 | 0.002 |
| Summer | 0.17±0.02 | 0.52±0.05 | 0.27±0.12 | 0.32±0.12 | 0.43±0.02 | 0.05±0.003 | 0.002±0.001 | 0.001 |
| Autumn | 0.16±0.02 | 0.57±0.06 | 0.37±0.11 | 0.34±0.12 | 0.39±0.03 | 0.06±0.002 | 0.003±0.002 | 0.001 |
| Winter | 0.12±0.02 | 0.49±0.02 | 0.28±0.11 | 0.23±0.12 | 0.37±0.02 | 0.04±0.002 | 0.002±0.001 | 0.001 |
| Mean | 0.16 | 0.55 | 0.25 | 0.27 | 0.39 | 0.06 | 0.002 | 0.001 |

*Each value is mean ± standard deviation of twelve determinations.

Mn [0.001% – 0.005%], Al [0.001% – 0.003%] ANOVA [P < 0.05], [P > 0.05]
### Table 2. Concentration of foliage elements of *P. eburnean*

| Seasons | Phosphorus% | Calcium% | Sodium% | Potassium% | Sulphur% | Iron% | Zinc% | Strontium% |
|---------|-------------|----------|---------|------------|----------|-------|-------|------------|
| HAZARGANGI |             |          |         |            |          |       |       |            |
| Spring  | 0.50 ± 0.02 | 0.39± 0.03 | 0.25± 0.02 | 0.26 ± 0.02 | 0.27± 0.002 | 0.02±0.001 | 0.02±0.001 | 0.003     |
| Summer  | 0.49 ± 0.3  | 0.30± 0.04 | 0.31±0.03  | 0.32 ± 0.02 | 0.32± 0.002 | 0.01±0.001 | 0.03±0.002 | 0.003     |
| Autumn  | 0.86 ± 0.02 | 0.39± 0.02 | 0.28± 0.02 | 0.48 ±0.02  | 0.29± 0.002 | 0.01±0.001 | 0.03±0.001 | 0.002     |
| Winter  | 0.59 ± 0.02 | 0.31± 0.02 | 0.42± 0.02 | 0.42 ± 0.02 | 0.26± 0.002 | 0.02±0.001 | 0.02±0.001 | 0.002     |
| Mean    | 0.55        | 0.34      | 0.31      | 0.37      | 0.28      | 0.01   | 0.02   | 0.002     |
| ZARGHOON |             |          |         |            |          |       |       |            |
| Spring  | 1.02 ± 0.2  | 0.61± 0.03 | 0.28± 0.03 | 0.24 ± 0.02 | 0.30± 0.002 | 0.05±0.002 | 0.03±0.001 | 0.002     |
| Summer  | 1.40 ± 0.3  | 0.71± 0.04 | 0.27±0.02  | 0.25 ± 0.01 | 0.31± 0.002 | 0.03±0.003 | 0.04±0.002 | 0.002     |
| Autumn  | 1.2 ± 0.2   | 0.65± 0.06 | 0.23±0.02  | 0.22 ± 0.02 | 0.33± 0.002 | 0.05±0.002 | 0.03±0.001 | 0.003     |
| Winter  | 1.5 ± 0.2   | 0.48± 0.02 | 0.30±0.02  | 0.24 ± 0.02 | 0.26± 0.002 | 0.05±0.002 | 0.02±0.001 | 0.002     |
| Mean    | 1.28        | 0.61      | 0.27      | 0.23      | 0.30      | 0.24   | 0.03   | 0.002     |
| KARKHASA |             |          |         |            |          |       |       |            |
| Spring  | 0.8 ± 0.02  | 0.16± 0.03 | 0.26 ±0.02 | 0.25 ± 0.02 | 0.28± 0.002 | 0.07±0.002 | 0.05±0.002 | 0.002     |
| Summer  | 0.7 ± 0.02  | 0.15± 0.05 | 0.27±0.03  | 0.26 ± 0.02 | 0.29± 0.002 | 0.09±0.003 | 0.04±0.001 | 0.003     |
| Autumn  | 0.8 ± 0.02  | 0.16± 0.06 | 0.26±0.2   | 0.24 ± 0.02 | 0.33± 0.002 | 0.64±0.002 | 0.02±0.001 | 0.003     |
| Winter  | 0.7 ± 0.02  | 0.14± 0.02 | 0.28±0.3   | 0.24 ± 0.02 | 0.25± 0.002 | 0.52±0.002 | 0.02±0.001 | 0.002     |
| Mean    | 0.75        | 0.15      | 0.26      | 0.24      | 0.28      | 0.20   | 0.03   | 0.002     |

*Each value is mean ± standard deviation of twelve determinations.

Mn [0.001% – 0.003%], Al [0.001% – 0.002%] ANOVA [P < 0.05], [P > 0.05]

### Table 3. Concentration of foliage elements of *C. ambigua*

| Seasons | Phosphorus% | Calcium% | Sodium% | Potassium% | Sulphur% | Iron% | Zinc% | Strontium% |
|---------|-------------|----------|---------|------------|----------|-------|-------|------------|
| HAZARGANGI |             |          |         |            |          |       |       |            |
| Spring  | 0.96± 0.2   | 0.9±0.1  | 0.32±0.01 | 0.15±0.02 | 0.22±0.02 | 0.02±0.01 | 0.06±0.02 | 0.002     |
| Summer  | 1.2±0.2     | 0.37±0.1 | 0.31±0.02 | 0.13±0.02 | 0.26±0.03 | 0.02±0.02 | 0.07±0.02 | 0.002     |
| Autumn  | 1.0±0.3     | 0.55±0.1 | 0.25±0.03 | 0.14±0.03 | 0.26±0.02 | 0.01±0.03 | 0.04±0.01 | 0.002     |
| Winter  | 0.9±0.1     | 0.31±0.2 | 0.23±0.02 | 0.11±0.02 | 0.25±0.02 | 0.02±0.02 | 0.04±0.01 | 0.002     |
| Mean    | 1.02        | 0.40     | 0.27     | 0.13      | 0.24      | 0.01   | 0.05   | 0.002     |
| KARKHASA |             |          |         |            |          |       |       |            |
| Spring  | 0.8±0.3     | 0.13±0.3 | 0.12±0.03 | 0.06±0.01 | 0.27±0.1  | 0.02±0.01 | 0.04±0.02 | 0.002     |

*Each value is mean ± standard deviation of twelve determinations.

Mn [0.001% – 0.004%], Al [0.001% – 0.002%] ANOVA [P < 0.05], [P > 0.05]
### Table 4. Concentration of foliage elements of *S. mollis*

| Seasons | Phosphorus% | Calcium% | Sodium% | Potassium% | Sulphur% | Iron% | Zinc% | Strontium% |
|---------|-------------|----------|---------|------------|----------|-------|-------|------------|
| **HAZARGANGI** |             |          |         |            |          |       |       |            |
| Spring   | 1.00±0.1    | 1.10±0.3 | 1.3±0.3 | 1.12±0.02  | 0.24±0.01| 0.031±0.01| 0.02±0.01| 0.004      |
| Summer   | 0.9±0.1     | 1.23±0.4 | 1.23±0.04| 1.14±0.02  | 0.28±0.02| 0.02±0.001| 0.02±0.01| 0.004      |
| Autumn   | 0.82±0.1    | 1.5±0.2  | 1.31±0.03| 1.13±0.03  | 0.27±0.01| 0.02±0.002| 0.02±0.01| 0.005      |
| Winter   | 0.62±0.2    | 1.05±0.2 | 1.25±0.4 | 1.12±0.02  | 0.27±0.02| 0.02±0.001| 0.02±0.01| 0.004      |
| Mean     | 0.83        | 1.22     | 1.27     | 1.12       | 0.26     | 0.02   | 0.02   | 0.004      |

| **ZARGHOON** |             |          |         |            |          |       |       |            |
| Spring   | 0.55±0.3    | 0.50±0.10| 0.3±0.01| 0.18±0.02  | 0.20±0.01| 0.05±0.002| 0.024±0.02| 0.003      |
| Summer   | 1.55±0.3    | 1.61±0.3 | 0.20±0.02| 0.13±0.02  | 0.24±0.01| 0.04±0.001| 0.023±0.02| 0.004      |
| Autumn   | 1.04±0.1    | 1.62±0.5 | 0.22±0.01| 0.13±0.03  | 0.26±0.02| 0.03±0.01 | 0.012±0.01| 0.004      |
| Winter   | 1.07±0.2    | 0.48±0.4 | 0.24±0.02| 0.16±0.02  | 0.23±0.02| 0.04±0.001| 0.010±0.01| 0.003      |
| Mean     | 1.05        | 1.22     | 0.23     | 0.5        | 0.23     | 0.04   | 0.17   | 0.003      |

| **KARKHASA** |             |          |         |            |          |       |       |            |
| Spring   | 0.28±0.02   | 1.20±0.03| 0.30±0.02| 0.19±0.02  | 0.018±0.01| 0.06±0.002| 0.023±0.01| 0.003      |
| Summer   | 0.26±0.02   | 1.30±0.01| 0.33±0.02| 0.15±0.02  | 0.019±0.01| 0.04±0.002| 0.026±0.02| 0.006      |
| Autumn   | 0.26±0.03   | 1.29±0.01| 0.31±0.2 | 0.15±0.02  | 0.021±0.02| 0.05±0.001| 0.027±0.02| 0.004      |
| Winter   | 0.23±0.04   | 1.38±0.02| 0.32±0.2 | 0.13±0.02  | 0.020±0.02| 0.042±0.001| 0.020±0.02| 0.005      |
| Mean     | 0.25        | 1.29     | 0.31     | 0.15       | 0.020    | 0.04   | 0.024  | 0.004      |

*Each value is mean ± standard deviation of twelve determinations. Mn [0.001% – 0.004%], Al [0.001% – 0.004%] ANOVA [P < 0.05], [P > 0.05]

### Table 5. Concentration of foliage elements of *P. abrotanoides*

| Seasons | Phosphorus% | Calcium% | Sodium% | Potassium% | Sulphur% | Iron% | Zinc% | Strontium% |
|---------|-------------|----------|---------|------------|----------|-------|-------|------------|
| **RGHOON** |             |          |         |            |          |       |       |            |
| Spring   | 1±0.1       | 2±0.2    | ±0.003  | ±0.03     | ±0.02    | ±0.002| ±0.01 | ±2        |
| Summer   | 1±0.16      | 2±0.1    | ±0.003  | ±0.02     | ±0.02    | ±0.003| ±0.01 | ±3        |
| Autumn   | 1±0.2       | 2±0.1    | ±0.002  | ±0.01     | ±0.03    | ±0.001| ±0.02 | ±3        |
| Winter   | 1±0.2       | 2±0.1    | ±0.002  | ±0.01     | ±0.02    | ±0.002| ±0.01 | ±3        |
| Mean     | 1±0.2       | 2±0.1    | ±0.002  | ±0.01     | ±0.02    | ±0.002| ±0.01 | ±3        |

*Each value is mean ± standard deviation of twelve determinations. Mn [0.001% – 0.006%], Al [0.001% – 0.003%] ANOVA [P < 0.05], [P > 0.05]

### Table 6. Concentration of foliage elements of *B. baluchistanica*
Conclusion

In summary, all macro and micro elements such as P, Ca, Na, K, S, Fe, Zn, Sr, Al and Mn are useful tool to rank the forage according to their nutritive quality. All subjected shrubs Amygdalus brahuiaca Boiss, Prunus eburnea Aitch, Caragana ambiguus Stocks, Sophora mollis Royle, Pervaokstia abrotanoides Karel, and Berberis baluchistanica Ahrendt shows that these could have greater nutritional value. Maximum shrub consider to be palatable and preferred by the small ruminants. While A.brahuiaca and C.cambigua medium amount of minerals for animal food. P.abrotanoidesmy and S.mollis use as fodder in very less amount for considered to be palatable and preferred by the small ruminants. While

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