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Elemental and nutritional values of wild fodder plants of poaceae in District Bannu, Pakistan

Alamgir Khan[1,2], Ihsan Ullah[3], Saad Ullah Khan[3], Kebin Zhang[*1], Zair Muhammad[3], Sultan Mehmood Wazir[3], Faizan Ullah[3], Sher Shah[4], Liujiang Kang[1], Manzoor Ullah[3]

[1]*School of Soil and Water Conservation, Beijing Forestry University, Beijing, China*

[2]*Department of Forestry, Shaheed Benazir Bhutto University, Sheringal, Dir Upper, Pakistan*

[3]*Department of Botany, University of Science and Technology, Bannu, Pakistan*

[4]*College of Forestry, Beijing Forestry University, Beijing, China*

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Abstract

The present study was designed to determine the elemental and nutritional values of wild fodder plants in district Bannu and its adjoining frontier region.Proximate analysis of fodder including proteins, fibers, fats, moisture, ash contents, carbohydrates and elemental composition of plant parts were determined by using atomic absorption spectrophotometer.For elemental analysis 11 elements; N, Mg, P, Pb, K, Ca, Cr, Fe, Cd, Ni,and Zn were investigated for all fodder. *Aristida adscensionis*was found with the highest percentage of gross energy (396.50%). Among the nutrients, the highest value was determined for proteins in *Rostraria cristata* (6.25%), carbohydrates in *Polypogon mospeliensis* (65.12%), fibers *in Dichanthium annulantum* (34%) and fats in both *Aristida adscensionis*and *Polypogon mospeliensis* (8%) respectively.The results indicated that these plants supplement livestock with essential nutrients and elements.

* **Corresponding Author:** Kebin Zhang ✉ kebin zhang:ctccd@126.com

Introduction

In Pakistan's economy, agriculture and livestock play an important role. Approximately 43.5% of individuals are engaged in this industry which contribute about 21% in Gross Domestic Product (GDP, 2015). Those communities which are involved in this industry possess a significant knowledge of fodder species (Geng *et al.,* 2017). Countries like India, Ethiopia, Nigeria, Mexico, China and Uganda know the value of traditional knowledge and had been documented the data about the fodder resources from several ethic groups (Geng *et al.,* 2017; Nahed *et al.,* 1997; Nunes *et al.,* 2015; Okoli *et al.,* 2003). Many studies have been conducted in Pakistan that focused on Ethno medicinal value rather than fodder importance of indigenous plants species. Furthermore, these studies were carried out on fodder trees, herbs and shrubs rather than grasses (Hussain *et al.,* 2010; Malik *et al.,* 2015; Parvaiz, 2014; Singh *et al.,* 2017; Zahoor *et al.,* 2017).

Fodder species usually lack many elements like Na, P, Ca, Cu, J, Zn and Co. Sometimes there may be an excess of some elements like Mo, F, and Se as well as deficiency of Mg, Fe, Mn and K (McDowell, 1996). These elements accumulation in plants depend on many factors like soil properties, fertilization system, plant properties and climatic conditions (Bengtsson *et al.,* 2003; Warman and Termeer, 2005).

The ability of plants to accumulate the mineral elements depends on the amount and intensity of rainfall during vegetation period, root system, soil nitrogen and PH (H. 1995). Plants accumulate more mineral elements in light and acidic soil than heavy and alkaline soil, due to a shortage of Mn, Fe and Zn in alkaline soil.

The fodder is given to the animals for a specific purpose, therefore the importance of any fodder species depends on its palatability and nutritional value. So it is necessary to have a knowledge of constituents animal feed for the production and productivity of animal. Animals must, therefore, be fed the whole year as the nutrient fodder is converted into an animal protein that serves as human food.

The human body needs a number of complex organic and inorganic components in food to fulfill their activities. The most important ingredients of diet are minerals fats, vitamins, carbohydrates, water and proteins (Kononov *et al.,* 2005). Every element plays an important role in the body and the deficiency of any element may lead to the abnormality in the body(Zafar *et al.,* 2010). Plants act as a rich source of all these essential elements. There always exists a relationship between plant elemental contents and nutritional status. Every element has a specific function, for example in growth, reproduction and structure formation, biological activities etc. have a specific element function (Newall *et al.,* 1996).

The mineral elements present in the plant are playing important role in the quality of food. Plant mineral elements analysis is important because the type and concentration of minerals present must often be stipulated on the label of food. Quality of good food is dependent on the type and concentration of mineral contents. The quality of several medicines also dependson mineral contents (Bahadur *et al.,* 2011).

Fodders in the tropical and developing countries prevent malnutrition. Many diseases are caused by the deficiency of mineral elements, for example, Iron deficiency leads to the Anemia (Leterme *et al.,* 2006)and Zn deficiency can accelerate the pathogenesis of lungs cancer (Yagi *et al.,* 2013). Similarly, the patients of breast cancer had low levels of Zn, Mn, Fe, Ca, Cu and Mg in their hair (Joo *et al.,* 2009).

Bannu is the southern district of Khyber Pakhtunkhwa where the provision of fodder plants to livestock is the sole mean of most people. Among these fodder plants, many species belong to family Poaceae. Therefore, the aim of this study was to assess the elemental and nutritional value and to highlight the importance of the fodders of family Poaceae in the maintenance of livestock in district Bannu.

Materials and methods

Study area

Bannu is one of the Southern districts at a distance of 197.5 km from the capital of Khyber Pakhtunkhwa, Peshawar, Pakistan. It is located between 32.43° to 33.06° North latitude and from 70.22° to 70.57° East longitude as shown in Fig. 1.

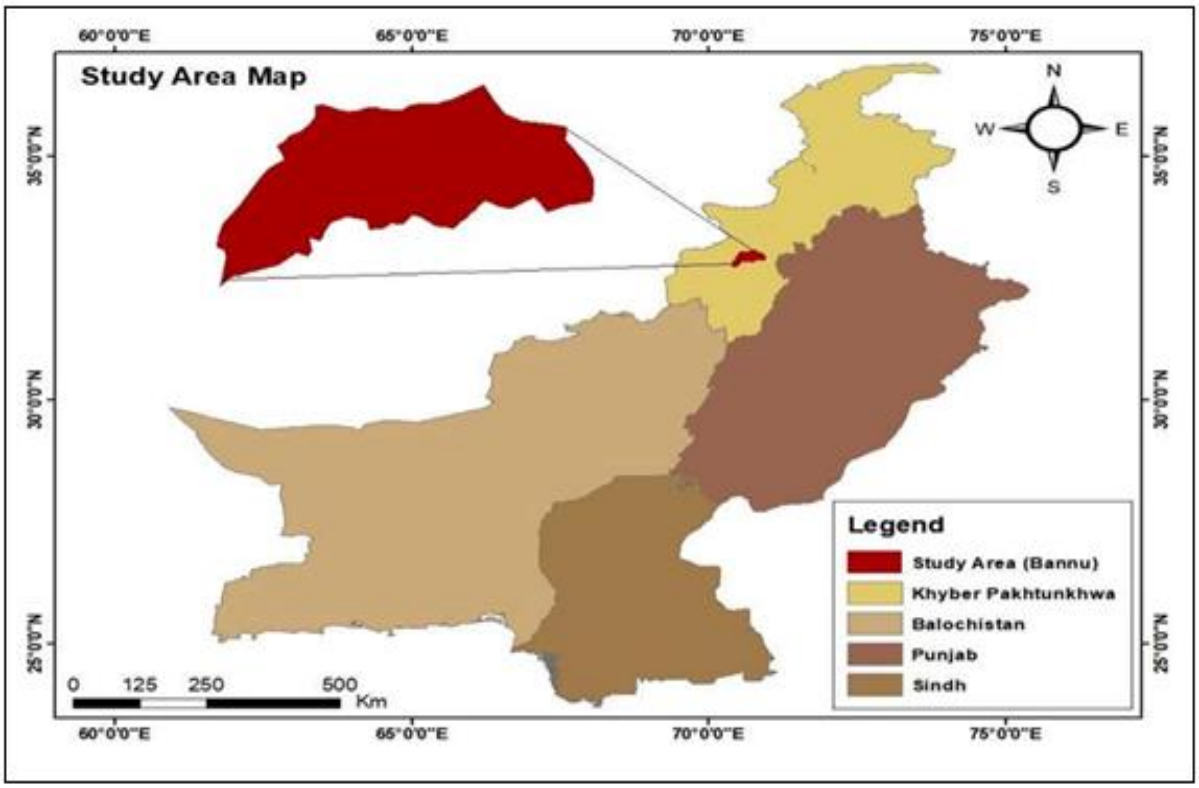

Fig. 1. Map of the Study Area.

The total area of Bannu is 1,227 Km² and a total population of the area is 677,346 (Population Census report, 1999). The general slope of the area is from North to the South-west side. There exists the patchy type of vegetation having severe climatic conditions i.e. colder in winter and warmer in summer.

Plants selection

*Aristida adscensionis*L., *Bromus pectinatusn*Thunb., *Dichanthium annulantum* Forssk., *Polypogon mosnpeliensis* L., *Rostraria cristata* L. were selected for nutritional assessment due to extensively used in the differentarea of the study area for livestock fodder.

Plants offer nutritional requirements as they comprise a protein, carbohydrates, fats and other nutrients, mandatory for growth and development of humans (Aruma, 1996). The subsequent parameters were estimated in the proposed plants.

Nutritional analysis

Plant samples were examined in tri-plicate for their moisture, ash, dry matters, crude proteins, crude fats, crude fibers, carbohydrates and gross energy value using standard methods as outlined by Association of Official Analytical Chemists (AOAC, 1999, 2000, 1990)and Association of American Oil Chemists (AOCS, 2005). Elemental analysis of powder from the selected parts were carried out with atomic absorption spectrophotometry for Nitrogen (N), Phosphorus (Ph), Potassium (K), Magnesium (Mg), Calcium (Ca), Sulphur (S), Manganese (Mn), Silicon (Si), Iron (Fe), Copper (Cu), Zinc (Zn), Cobalt (Co), Lead (Pb), Nickel (Ni), Chromium (Cr) and Cadmium (Cd). All the samples were prepared by wet digestion process (Hseu, 2004). For elemental analysis, we followed the method of Eslami *et al.*,(2007) in triplicate. Calibration standard of each metal was arranged by suitable of stock solutions (Elekes *et al.,* 2010; Isildak *et al.,* 2004; Saeed *et al.,* 2010; Soylak *et al.,* 2005; Svoboda *et al.*,2006)

Results and discussion

During the current study, 5 wild plants species of Poaceae were selected for nutritional and elemental analysis due to extensively use in different areas of District Bannu for livestock fodder.

The following eleven elements (K, Ca, Zn, Cu, Fe, Mn, Cr, Ni, Br, Rb and Zr) were determined with Energy Dispersive X-ray Fluorescence (EDXRF) in selected Sudanese medicinal plants. The human body requires a number of minerals in order to retain good health (Srivastava *et al.,* 2004).

Macro and microelements control biochemical processes in the human organism (Kolasani *et al.,* 2011). Medicinal plants have their active constituent's metabolic product of plant cells and a number of Mineral elements which play an important role in metabolism (Choudhury and Garg, 2007). Some minerals act as a chelate with the organic ligands and make them bioavailable to the body system. Some of the plants have their medicinal value and usually used in the homeopathic system due to the presence of Ca, Cr, Fe, Mg, K, and Zn (Rai *et al.,* 2001).

Table 1. Optimal analytical conditions for the elemental analysis using air-acetylene flame on atomic absorption spectrophotometer.

Elements	Wavelength (nm)	HC Lamp Current (mA)	Slit width (nm)	Fuel-gas flow rate (L/min)	Detection limit (µg/L)
Ca	422.7	6.0	0.5	2.0	4
Cd	228.8	4.0	0.3	1.8	4
Co	240.7	6.0	0.2	2.2	5
Cr	357.9	5.0	0.5	2.6	6
Cu	324.8	3.0	0.5	1.6	4
Fe	248.3	8.0	0.2	2.0	6
K	766.5	5.0	0.5	1.9	4
Mg	285.2	4.0	0.5	1.6	1
Mn	279.5	5.0	0.4	1.9	3
Pb	217.0	7.0	0.3	1.8	10
Zn	213.9	4.0	0.5	2.0	2

Aristida adscensionis L. is a grass that occurs naturally in this area and used as food for cattle. This specieshas 5.5% moisture contents, 10% Ash, 28% Fiber, 8% Fats, 3.15% Proteins, 45.37% Carbohydrates and 396.50% Gross energy respectively (Table 2). The results were compared with the similar studies like Devi and Rehman (V.K. and Rehman, 2002) that the substances with well-known nutritional purposes, such as carbohydrate, proteins, vitamins, minerals, amino acids and fatty acids come under this category. The most frequently known nutrients are antioxidants, vitamins and vital minerals. The macro and micro elemental value of this plant was total nitrogen 0.50%, phosphorus 0.18µg/gm, Potassium 6.895%, Calcium 3.892µg/gm, Mg 1.124µg/gm, Fe 2.209µg/gm, Zn 0.434µg/gm, Pb 0.244µg/gm, Cr 0.027µg/gm, Cd 0.010µg/gm and Ni 0.026µg/gm respectively (Table 3). Similar results were displayed that macro and microelements are essential for growth and development which were present in wild edible fruits and vegetable (PANDEY-RAI).

Dichanthium annulantum

Forssk belongs to family Poaceae that occurs naturally in this area and is used as food for cattle. The Moisture contents of this plant are 6%, Ash 11%, Fiber 34%, Fats 5 %, Proteins 4.44%, Carbohydrates 38.56% and the Gross energy is 380.20% respectively (Table 2). The Phyto-nutrients are ingredients that occur apparently in plants, have been proved to hold specific and powerful disease-preventing potential (Frasher, 2006).

The macro and micro elemental status of this plant include total nitrogen 0.71%, phosphorus 0.11µg/gm, Potassium 6.802 %, Calcium 2.337µg/gm, Mg 1.183µg/gm, Fe 2.510µg/gm, Zn 0.570µg/gm, Pb 0.281µg/gm, Cr 0.024µg/gm, Cd 0.002µg/gm and Ni 0.025µg/gm respectively (Table 3). Similarly,(Tucker, 2003) reported that together essential and nonessential nutrients should be measured as bioactive food components centered on the specific physiological purpose they communicate, including characterization of their metabolic and physiological utilities and related target, and biomarker.

Table 2. Nutritional analysis of the aerial parts of fodder species.

Plant Name	Part used	Moisture (%)	Ash (%)	Fiber (%)	Fats (%)	Protein (%)	Carbohydrates (%)	Gross Energy (%)
Rostraria cristata L.	Aerial parts	4.5	16	18.5	6	6.25	48.75	356.45
Polypogon mosnpeliensis (L.) Desf.	Aerial parts	5.0	12.5	4.5	8	4.88	65.12	373.94
Bromus pectinatus Thunb.	Aerial parts	5.5	10	23.5	5	4.18	51.81	387.52
*Dichanthium annulantum*Frossk.	Aerial parts	6.0	11	34	5	4.44	38.56	380.20
Aristida adscensionis L.	Aerial parts	5.5	10	28	8	3.15	45.37	396.50

Polypogon monspeliensis (L.) Desf

This plant also belongs to family Poaceae which occur naturally in this area and used as food for cattle. These species have Moisture contents of 5%, Ash 12.5%, Fiber 4.5%, Fats 8%, Proteins 4.88%, Carbohydrates 65.12% and Gross energy of 373.94% respectively (Table 2). Similarly, Ranfa *et al.*,(2014) analyzed four plant species and showed the presence of all the dietary active principles in different meditations. After water, carbohydrates made up the superior part with values that sort from 1.0% in *B. perennis* to 6.0% in *S. minor*; middle values were found in *C. juncea* and *B. erucago*, which limited to 2.0% and 3.0% respectively. Protein content extended from 1.4% in *B. perennis* to 3.8g/100g of the edible portion in *S. minor*, with *C. juncea* (1.9g/100g) and *B. erucago* (2.2g/100g) in an intermediary position. The total fat content was very little in all four species i.e. under 1.0%.

The macro and micro elemental status in *Polypogon monspeliensis* was that total nitrogen 0.78%, phosphorus 0.24µg/gm, Potassium 6.982 %, Calcium 4.029µg/gm, Mg 1.338µg/gm, Fe 10.30µg/gm, Zn 0.540µg/gm, Pb 0.206µg/gm, Cr 0.057µg/gm, Cd 0.004µg/gm and Ni 0.100µg/gm respectively (Table 3).

Bromus pectinatus Thunb.

This species also belongs to family Poaceae that occurs naturally in this area and is used as food for cattle. Our analysis revealed that the Moisture contents of 5.5%, Ash 10%, Fiber 23.5%, Fats 5%, Proteins 4.18%, Carbohydrates 51.81% and Gross energy of 387.52% was present respectively (Table 2). Similarly, Vanzani *et al.*,(2011) reported that the beneficial effect of the Mediterranean diet on human health are well recognized, such as high fiber content, vitamins with an antioxidant function, total polyphenols, vitamins and minerals. Following is the macro and micro elemental status of *Bromus pectinatus* i.e. total nitrogen 0.67%, phosphorus 0.23µg/gm, Potassium 8.896 %, Calcium 3.055µg/gm, Mg 1.044µg/gm, Fe 2.585µg/gm, Zn 0.500µg/gm, Pb 0.187µg/gm, Cr 0.027µg/gm, Cd 0.003µg/gm and Ni 0.024µg/gm respectively (Table 3). This is why that this study concentrating attention on these species and their significance for human nutrition, as knowledge and rediscovery of formulae in human and animal food could signify an economic potential (Guarrera *et al.,* 2006).

Rostraria cristata(L).

This species also belongs to family Poaceae which occur naturally in this area and used as food for cattle.

The results show that this species has Moisture contents of 4.5%, Ash 16%, Fiber 18.5%, Fats 6%, Proteins 6.25%, Carbohydrates 48.75% and Gross energy of 356.45% respectively (Table 2). Similarly, macro and micro elemental status of this plant was such that total nitrogen of 1.00%, phosphorus 0.36µg/gm, Potassium 9.892 %, Calcium 4.900µg/gm, Mg 1.295µg/gm, Fe 9.917µg/gm, Zn 0.822µg/gm, Pb 0.232µg/gm, Cr 0.090µg/gm, Cd 0.005µg/gm and Ni of 0.080µg/gm respectively (Table 3).

Table 3. Elemental analysis of Fodder plant species.

	Plants Name				
Elements Total (%)	*Rostraria cristata*	*Polypogon mosnpeliensis*	*Bromus pectinatus*	*Dichanthium annulantum*	*Aristida adscensionis*
Nitrogen	1.00	0.78	0.67	0.71	0.50
Phosphorus	0.36	0.24	0.23	0.11	0.18
K	9.892	6.982	8.896	6.802	6.895
Ca	4.900	4.029	3.055	2.337	3.892
Mg	1.295	1.338	1.044	1.183	1.124
Fe	9.917	10.30	2.585	2.510	2.209
Zn	0.822	0.540	0.500	0.570	0.434
Pb	0.232	0.206	0.187	0.281	0.244
Cr	0.090	0.057	0.027	0.024	0.027
Cd	0.005	0.004	0.003	0.002	0.010
Ni	0.080	0.100	0.024	0.025	0.026

Similar studied was conducted by Pardo-de-Santayana *et al.*,(2007)that wild plants have been objecting of several properties as many have new and unfamiliar nutritional properties.

Conclusion

This study was conducted to determine the nutritional and elemental values of selected grasses. Poaceae was the dominant family in this area and most of the species of this family were used as fodder for domestic animals.

These plants occur naturally due to this we have selected them that why not we explore their nutritional values and elemental analysis. Almost 11 elements were analyzed in these plants and also the gross energy of each plant was determined. It has been concluded from this study that these plants were beneficial to cattle's due to high gross energy. Control grazing and proper conservation of these plant species are not only necessary for future basis but also for soil erosion from natural calamities.

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