Available online freely at www.isisn.org

Bioscience Research

Print ISSN: 1811-9506 Online ISSN: 2218-3973

Journal by Innovative Scientific Information & Services Network

RESEARCH ARTICLE BIOSCIENCE RESEARCH, 2020 17(2): 1299-1307. **OPEN ACCESS**

Elemental and nutritional values of plants in Markhor (C*apra falconeri cashmiriensis*) habitat Toshi Shasha conservancy, District Chitral, Khyber Pakhtunkhwa, Pakistan

Syed Fazal Baqi Kakakhel*

Conservator Wildlife Northern Circle Tindodag Barikot District Swat Khyber Pakhtunkhwa **Pakistan**

***Correspondence:** syedkakakhel1164@hotmail.com **Received 27-05-2020, Revised: 16-06-2020, Accepted: 17-06-2020 e-Published: 18-06-2020**

Elemental and nutritional potentials are essential in markhor (*Capra falconeri cashmiriensis*) diets aimed at healthiness and fitness. Scarcities in animal diet can reduce population. Therefore, elemental and nutritional values of six plant species were investigated in markhor (*Capra falconeri cashmiriensis*) habitat through elemental analysis in Centralized Resource Laboratory, University of Peshawar and nutritional analysis in Soil and Plant Nutrition Laboratory Agriculture Research Institute (ARI) Tarnab Farm Peshawar. Two methods of elemental analysis reported highest result in the same species that Carbon with 69.38 and 75.46 and Aluminum with 0.33 and 0.16 was highest in *Quercus ilex*. Oxygen (40.85 and 35.48) was highest in *Ephedra gerardiana;* Magnesium (0.55 and 0.31) in *Prunus amygdalus*; Silicon (0.55 and 0.27) in *Pistacia integerrima*; Sulphur (0.28 and 0.12) was *Ephedra gerardiana,*; Potassium (1.21and 0.42) in *Artemisia brevifolia,*; Calcium (2.89 and 0.99) *Prunus amygdalus*; Copper (2.89 and 0.18) in *Artemisia brevifolia,*; Zinc with 0.68 and 0.14 was found in *Pistacia integerrima* only. The % moisture was highest in *Quercus ilex* with 9.51%. The % ash and fats were highest in *Artemisia brevifolia* with 21.18 % and 20.0 % respectively. The finding reveals that the plants in the study area fulfill diet requirements of markhor. Highest variance was found in Carbon σ^2=24.55 and σ^2=29.45 and Oxygen σ^2=14.12 and σ^2=13.70 while % fats σ^2=4553.

Keywords: Elemental and nutritional value, Markhor habitat, Toshi Shasha Conservancy, District Chitral, Pakistan

INTRODUCTION

The wild ungulates including markhor (*Capra falconeri cashmiriensis* Wagner) health is dependent on the available plant species in its habitat. The dietary minerals of plants play a key role in providing energy to the animals. Various plant species have different elements but the concentration of element in one plant is varied than the other, depending on constraints of environment, genotype and species (Soetan et al., 2010). A balanced diet which contain various sources of plant food can provide a satisfactory dietary intake of those minerals elements which are essential for the health of a given species. Mineral elements have a great importance for plant nutrition, animal. To evaluate adequacy of minerals and the dietary intake, collection of information about mineral elements is needed (Simsek and Aykut, 2007). Generally, an animal which is well- nourished, can fights with diseases even at the time of exposing to infection than the animal which is malnutritional. The immune system of an animal stop fighting with infections when exposed to pathogens but due to proper nutrition the immune system develops and reduce the incidence of diseases (Klasing, 2007) but the animal requires protein and energy for improvement of immune system (Conroy, 2005). The present study is carried out to assess elemental and nutritional value of plants in markhor (*Capra falconeri cashmiriensis*) habitat Toshi Shasha conservancy Chitral Khyber Pakhtunkhwa Pakistan.

MATERIALS AND METHODS

Study area

Toshi Shasha conservancy is located in district Chitral (figure-1). Toshi Shasha is a remarkable habitat of markhor (*Capra falconeri cashmiriensis*). Markhor is a trophy hunting animal. Toshi Shasha is positioned between 35˚ 57' 13" N and 31˚ 48' 51.70" E. It has borders on the north with Shoghor ridge, in the west with Chitral Gol National Park, in the east with watershed line between Mastuj River and Lotkoh River and in the south is boundary between Lotkoh and Chitral. The area was declared as game reserve in 1979 with an area of 1045 hectares but due to floral and faunal diversity the area was extended to core zone and redesigned as community game reserve with an area of 20000 hectares in December 16, 1998 (Ali et al., 2015).

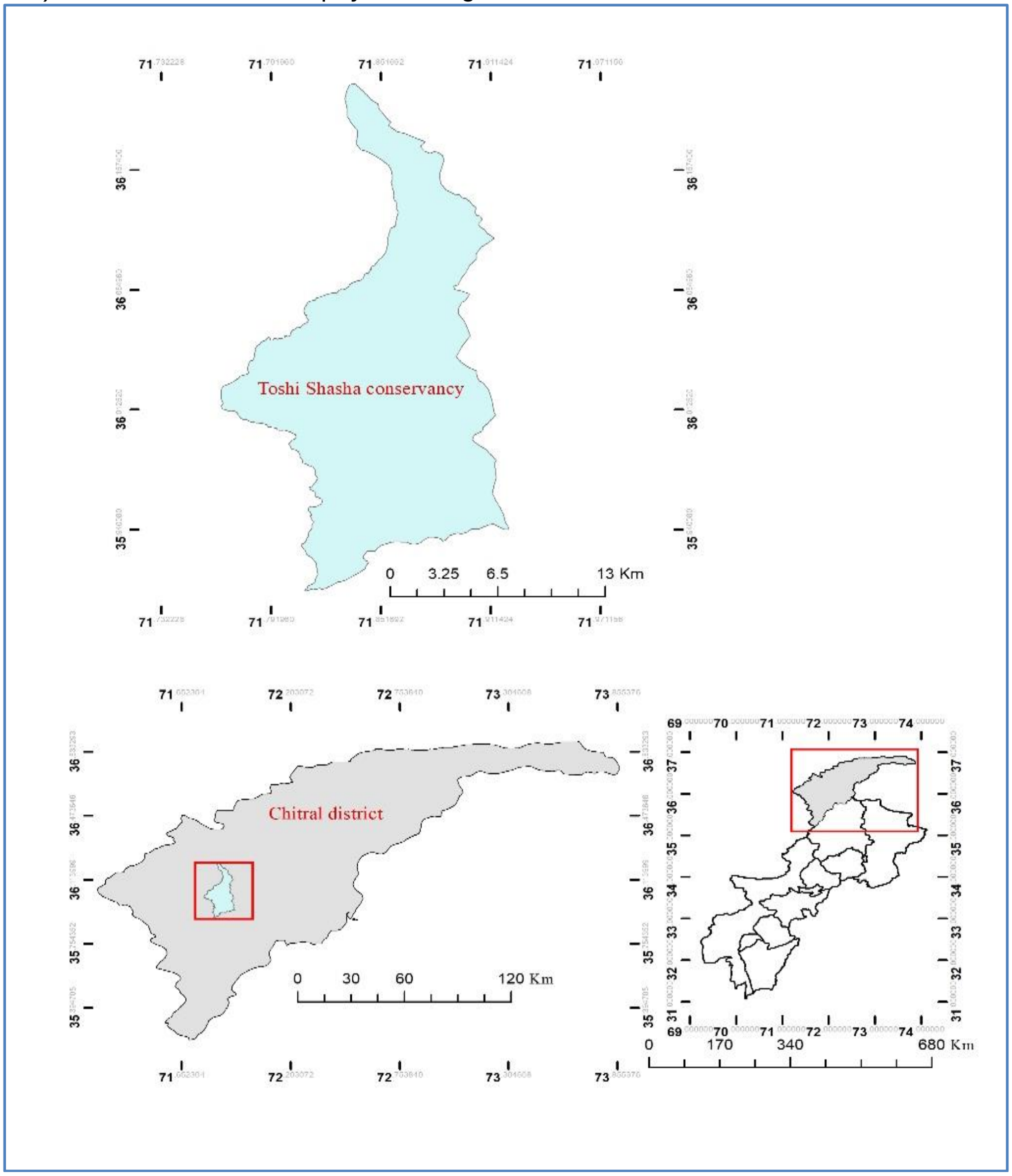

Figure-1: Location of Toshi Shasha conservancy Chitral

The area is dry temperate. The *Quercus ilex* grows on slopes and other species include *Artimisia brevifolia, Prunus amygdalus, Ephedra gerardiana, Pisticia integerrima*, *Indigofera* species, *Picea smithiana, Abies pindrow* and *Cedrus deodara* also found in the study area., (Ali and Qaiser, 2009; Khan et al., 2012 and Ashraf et al., 2014).

Methods

The study was conducted during April to June 2015. Plants were identified with the help of authentic literature *i.e.,* Ali and Nasir, 1989-1991; Nasir and Ali, 1970-1989 and 1980-2005; Ali and Qaiser, 1993-2018.

The plant specimens were dried in shade for 20 days till it dried out completely. The specimens were cleaned from dust and were grinded into powder with the help of a grinding machine. The powder specimens were kept in air tight glass jars and plastic bottles to keep them away from any type of contamination and moisture.

For elemental analysis powdered specimens were transferred to a metallic stub using a double-sided cello tape and coated with silver by using (JEE-420) Model Vacuum Evaporator (JEOL). Six specimens were inserted at a time for elemental analysis. The elemental analysis was carried out for leaves of all the six specimens.

The elemental analysis was carried out at Centralized Resource Laboratory, University of Peshawar by using Energy Depressive X-rays Spectrometer (EDX), Model Inca-200, Oxford Instruments Company (Made in U.K.). The Scanning Electron Microscope was connected to the computer and operated with the help of computer software. Automated software EDX (INCA analyzer) was used and the results were noted both in digits and graphical form. This method was also used by AOAC, 1984; Hussain et al., 2009a, b and 2010a, b.

The nutritional analysis of plant samples including leaves of plants, collected green from markhor habitat was provided to the laboratory after processing such as air drying under shade, and crushed into powder through 1 mm sieve and the nutritional value of each plant species to markhor was find out and analyzed at Soil and Plant Nutrition Laboratory Agriculture Research Institute (ARI) Tarnab Farm Peshawar. This method was also used by numerous researchers include; (Anonymous. 1990; Haro et al., 1968; Boussama et al., 1999 and Das et al., 1997).

Statistical analysis for variance

Variance was calculated using the following formula.

$$\sigma^2 = \frac{\sum (X-\mu)^2}{N}$$

1-μ is mean of all sample time
2-x is the sample time observation
3-N is number of samples

RESULTS

Elemental analysis by % weight

Parts of six plants were studies for 11 elements comprising Carbon, Oxygen, Magnesium, Aluminum, Silicon, Sulphur, Potassium, Calcium, Iron, Copper and Zinc. The parts include leaves. The % by weight of elements was different in all the species. It is evident from the table-1 that *Quercus ilex* was the dominant species with % weight Carbon of 69.38 and ranged gradually between 54.15-59.04 in theremaining five species. The Oxygen and Silicon varied slowly with 29.41-40.85 and 0.16-0.55 in all six species. The Calcium varied slowly from to 2.12 to 2.89 in *Ephedra gerardiana, Fraxinus hookeri, Pistacia integerrima, Prunus amygdalus* and *Prunus amygdalus* while it was comparatively low 0.34 and 1.09 in *Quercus ilex* and *Artemisia brevifolia.* The Magnesium ranged slowly 0.16 to 0.55, Aluminum (0.14-0.33), Sulphur (0.22-0.28), Potassium (0.52-1.21), Copper (0.59-0.84) and Zinc 0.68 merely in *Pistacia integerrima.* However, the Magnesium remained zero in *Quercus ilex*, Aluminum in *Artemisia brevifolia*, Sulphur in *Fraxinus hookeri, Pistacia integerrima, Prunus amygdalus, Quercus ilex*, Potassium in *Quercus ilex,* Copper in all the six species and Zinc in *Artemisia brevifolia, Ephedra gerardiana, Pistacia integerrima, Prunus amygdalus,* and *Quercus ilex.*

Elemental analysis by % atomic absorption

The elements in leaves of six plants were also studied by % atomic absorption. The % atomic absorption of elements was dissimilar in all the six species. It is clear from the table-2 that *Quercus ilex* was the dominant species with Carbon 75.46 and changed gradually between 62.66 to 67.06 in the remaining five species. The Oxygen and Silicon varied slowly with 24.01-35.48 and 0.08-0.27 in all six species.

Table1: Elemental analysis of plants by % weight Toshi Shasha Conservancy Chitral

Plants	Parts of plants	Carbon (σ^2=24.55)	Oxygen (σ^2=14.12)	Silicon0.66)	Calcium (σ^2=0.76)	Magnesium (σ^2=0.036)	Aluminum (σ^2=0.43)	Sulphur (σ^2=0.014)	Potassium (σ^2=0.15)	Copper (σ^2=0.12)	Iron (σ^2=00)	Zinc (σ^2=0.064)
Artemisia brevifolia **Wall. ex DC.**	Leaves	59.04	37.07	0.36	1.09	0.16	00	0.22	1.21	0.84	00	00
Ephedra gerardiana **Wall. ex Stapf.**	Leaves	54.15	40.85	0.16	2.45	0.51	0.14	0.28	0.87	0.60	00	00
Fraxinus hookeri **Wenzig.**	Leaves	56.19	39.51	0.42	2.26	0.33	0.27	00	1.02	00	00	00
Pistacia integerrima **J. L. Stewart ex Brandis.**	Leaves	57.78	37.23	0.55	2.12	0.35	0.18	00	0.52	0.59	00	0.68
Prunus amygdalus **Var. amara (Ludwig ex. DC.)**	Leaves	56.39	39.01	0.34	2.89	0.55	0.13	00	0.69	00	00	00
Quercus ilex **auct. non Linn.**	Leaves	69.38	29.41	0.53	0.34	00	0.33	00	00	00	00	00

Table-2: Elemental analysis of Plants by % Atomic absorption Toshi Shasha Conservancy Chitral

Plants	Parts of plants	Carbon (σ^2=29.45)	Oxygen (σ^2=13.7)	Magnesium (σ^2=0.086)	Aluminum (σ^2=0.47)	Silicon (σ^2=0.0038)	Sulphur (σ^2=0.0025)	Potassium (σ^2=0.049)	Calcium (σ^2=0.091)	Iron (σ^2=0.00)	Copper (σ^2=.005)	Zinc (σ^2=0.0005)
Artemisia brevifolia **Wall. ex DC.**	Leaves	67.06	31.61	0.09	00	0.18	0.09	0.42	0.37	00	0.18	00
Ephedra gerardiana **Wall. ex Stapf.**	Leaves	62.66	35.48	0.29	0.07	0.08	0.12	0.31	0.85	00	0.13	00
Fraxinus hookeri **Wenzig.**	Leaves	64.36	33.98	0.19	0.14	0.21	00	0.36	0.78	00	00	00
Pistacia integerrima **J. L. Stewart ex Brandis.**	Leaves	66.22	32.03	0.20	0.09	0.27	00	0.18	0.73	00	0.13	0.14
Prunus amygdalus **Var. amara (Ludwig ex. DC.)**	Leaves	64.65	33.57	0.31	0.07	0.17	00	0.24	0.99	00	00	00
Quercus ilex **auct . non Linn.**	Leaves	75.46	24.01	00	0.16	0.25	00	00	0.11	00	00	00

Table3: % moisture, Ash and Fats in plants of Toshi Shasha Conservancy Chitral

Plant	Parts of plants	% Moisture (σ^2=0.53)	% Ash (σ^2=528)	% Fats (σ^2=4553)
Artemisia brevifolia **Wall. ex DC.**	Leaves	8.344	21.18	20.0
Ephedra gerardiana **Wall. ex Stapf.**	Leaves	9.065	2.506	10.0
Fraxinus hookeri **Wenzig.**	Leaves	9.106	2.838	9.0
Pistacia integerrima **J. L. Stewart ex Brandis.**	Leaves	7.481	2.381	19.0
Prunus amygdalus **Var. amara (Ludwig ex. DC.)**	Leaves	7.824	2.032	12.0
Quercus ilex **auct. non Linn.**	Leaves	9.510	2.532	18.0

The Calcium slowly persisted different from to 0.11 to 0.85. The Magnesium ranged gradually 0.09 to 0.31, Aluminum (0.07-0.16), Sulphur (0.09-0.12), Potassium (0.18-0.42), Copper (0.13-0.18) and Zinc 0.14 only in *Pistacia integerrima.* However, the Magnesium remained zero in *Quercus ilex*, Aluminum in *Artemisia brevifolia*, Sulphur in *Fraxinus hookeri, Pistacia integerrima, Prunus amygdalus, Quercus ilex*, Potassium in *Quercus ilex,* Copper in *Prunus amygdalus, Quercus ilex* and Zinc in *Artemisia brevifolia, Ephedra gerardiana, Pistacia integerrima, Prunus amygdalus,* and *Quercus ilex*

Nutritional analysis

Nutritional value in 6 plants was studies and % moisture, % ash and % fats were finding out. A gradual change of % moisture was uncovered. Highest % moisture was recorded in *Quercus ilex* with 9.51 % and ranged between other species 7.481 %-9.106 %. The dominant species in % ash was *Artemisia brevifolia* with 21.18 % and the other species ranged gradually between 2.032%-2.838 %. *Artemisia brevifolia* was also the dominant species in % fats with 20.0 % followed by *Quercus ilex with* 18.0 %, *Pistacia integerrima* 19.0 % and retained from 9.0 % to 12.0 % in the remaining species (table-3.

Variance

Variance was calculated using statistical formula. Variance of elements was calculated from the data resulted by using % weight method and atomic absorption method. The data resulted from % weight method of elemental analysis, highest variance was found in Carbon (σ^2=24.55) and oxygen (σ^2=14.12) followed while in the remaining elements variance ranged between σ^2 =0 to ^{2}=0.76.

The data resulted from atomic absorption method variance was calculated and highest variance was found in Carbon (σ^2=29.45) and Oxygen (σ^2=13.7) while the variance ranged between σ^2= 0 to =0.47 in the remaining elements.

Variance was also calculated in % moisture, % ash and % fats. Highest variance was found in % fats (σ^2=4553) followed by % ash (σ^2=528) and % moisture (σ^2=0.53).

DISCUSSION

Observing 11 elements through % weight method highest concentration of 9 elements was found in two species comprising *Ephedra gerardiana and Pistacia integerrema.* By contrast using atomic absorption method the same concentration also remained maximum in the same two species but also expand to another species *Artemisia brevifolia.* The second concentration with 8 elements was found in *Artemisia brevifolia* only using % weight method. While adopting atomic absorption method this concentration reduced to 7 elements and expand to two other species such as *Fraxinus hookeri* and *Prunus amygdalus.* The 3rd concentration with 7 elements was recorded in two species comprise *Fraxinus hookeri* and *Prunus amygdalus* using % weight method while reduced to 6 in *Quercus ilex* by use of % weight method. By comparison, using atomic absorption method this concentration reduced to 5 elements in *Quercus ilex* only.

The nutritional analysis was also investigated in leaves of 6 plants species and three parameters were studied include % moisture, % ash and % fats. *Artemisia brevifolia* was the dominant species in % ash and % fats while *Quercus ilex* was the dominant species in % moisture. The change in elemental and nutritional value of plants may be due to the soil condition and plant growth. Numerous researchers have also contributed in determining nutritional value of plants include (Dike, 2010; Akubugwo et al., 2000; Hussain et al., 2010; Afolayan and Jimoh, 2009; Maisuthisakul et al., 2008).

The occurrence and concentrations of several elements in various plant vary on the structure of the soil, fertilizers and water consumed as well as acceptability, choosiness and absorbability of plants for the acceptance of these elements. Hence, the detected differences in concentration of the elements are credited to the nature of the plant in addition to its habitats (Rajurkar and Damame, 1997). The maximum concentration of elements reveal that plants assimilate and accumulate numerous elements from the soil. it is clear that the majority of these plants accumulate essential, helpful and useful elements for animals and plant. The existence of these elements exposes their function as basic nutrient elements, frequently as activators in enzyme complexes of metal-ligand (Valkovic, 1975). The highest concentration of particular metals, Calcium, Magnesium, Potassium and Iron in the plants are important for usual functioning and good growth of the plant (Underwood, 1971). Copper and Zinc are crucial for hair development and for improving the rate of milk making by pregnant female animals (Valkovic, 1975).

Grazing and browsing of free-ranging ungulates including markhor (*Capra falconeri cashmiriensis*) depends upon several ecological factors such as nutritional resources, nutritional requirements and inter and intra specific interactions.

Nutritional interactions are established at three levels, the population, individual and the ecosystem. The wildlife populations and food of high quality are directly proportion to one another while by contrast high nutritional control over animals causes selection pressure, resulting small sizes of population (Simard et al., 2008). Whereas over densities of ungulates reduce the sources of food diversity resulting decrease of other associations or even affect population of other species such as carnivores (Berger et al, 2001; Allombert et al., 2005).

CONCLUSION

Leaves of six plant species were studied for finding elemental values. Two methods include % weight and atomic absorption methods were used. Observing order of elements on the basis of values in all species using % weight method, showed order Carbon > Oxygen > Calcium > Silicon > Potassium =Copper > Magnesium > Aluminum > Zinc > Sulphur > Iron. By contrast using atomic absorption method reveals order Carbon >Oxygen >Calcium >Potassium > Silicon >Aluminum >Magnesium >Copper >Sulphur >Zinc > Iron. The two methods differ order in Potassium, Silicon, Aluminum, Magnesium, Copper, Sulphur and Zinc. Elemental analysis carried out through % weight and atomic absorption methods. Findings of both methods reveal highest results in the same species that Carbon with 69.38 and 75.46 and Aluminum with 0.33 and 0.16 was highest in *Quercus ilex* using % weight and atomic absorption methods respectively. Oxygen (40.85 and 35.48) was highest in *Ephedra gerardiana;* Magnesium (0.55 and 0.31) in *Prunus amygdalus*; Silicon (0.55 and 0.27) in *Pistacia integerrima*; Sulphur (0.28 and 0.12) was *Ephedra gerardiana,*; Potassium (1.21and 0.42) in *Artemisia brevifolia,*; Calcium (2.89 and 0.99) *Prunus amygdalus*; Copper (2.89 and 0.18) in *Artemisia brevifolia,*; Zinc with 0.68 and 0.14 was found in *Pistacia integerrima* only and iron remained zero throughout all species. The % moisture was highest in *Quercus ilex* with 9.51%. % ash and % fats were highest in *Artemisia brevifolia* with 21.18 % and 20.0 % respectively. The finding reveals that the plants in the study area fulfill diet requirements of markhor. Highest variance was found in Carbon σ^2=24.55 and σ^2=29.45 and Oxygen σ^2=14.12 and σ^2=13.70 while % fats σ^2=4553.

The results reveal that the elemental and nutritional values of plants fulfill diet requirements of markhor (*Capra falconeri cashmiriensis)* in the study area. The study area supports viable population of markhor. Markhor is offered for trophy hunting in the area. Trophy hunting encourage conservation efforts and improve community development and livelihood in the study area. This study may enable conservationists and policy makers on managing diet of markhor in related habitats.

CONFLICT OF INTEREST

The authors declared that present study was performed in absence of any conflict of interest.

ACKNOWLEGEMENT

The author is thankful to Mr. Altaf Ali Shah Range Officer Wildlife and his staff for their assistance during collection of data. The author is also thankful to the Khyber Pakhtunkhwa Wildlife department for providing field gears and mobility during the period of the study. The author also extends his gratitude to Mr. Asad Ullah Director Biodiversity Center University of Peshawar for his cooperation in developing coordination with administration of the Centralized Resource Laboratory, University of Peshawar and Soil and Plant Nutrition Laboratory Agriculture Research

Institute (ARI) Tarnab Farm Peshawar, gratitude is also extended to administration of both laborites for their intime response.

AUTHOR CONTRIBUTIONS

The author SFBK fully contributed to the study at all stage from data collection to developing final manuscript. The author read and approved the final version.

REFERENCES

A.O.A.C, 1984. Official methods of Analvsis (14th ed). Williams, S. (ed) Association of Official Analytical chemists. Washington, D.C, pp: 152-164.

Afolayan A. J. and F. O. Jimoh. 2009. Nutritional quality of some wild leafy vegetables In South Africa. *International Journal of Food Sciences and Nutrition,* 60 (5): 424-43.

Akubugwo, I. E., A. N Obasi and S.C Ginika. 2007. Nutritional Potential of the Leaves And Seeds of Black Nightshade Solanum nigrum L. Var virginicum from Afikpo Nigeria. Pakistan Journal of Nutrition 6 (4): 323-326.

Ali H.; M. M Shafi, H. Khan, M. Shah and M. Khan. 2015. Socio-economic benefits ofcommunity based trophy hunting programs. Environmental Economics 6 (1): 1-16

Ali S. I and M. Qaiser. 1993-2018. Flora of Pakistan. University of Karachi, Missouri Botanical Garden Press. USA. 194-221.

Ali S. I and M. Qaiser. 1993-2018. Flora of Pakistan. University of Karachi, MissouriBotanical Garden Press, USA. Pp 194-221.

Ali S. I and Y. J. Nasir (Eds). 1989-1991. Flora of Pakistan. No.191-193, Department of Botany, University of Karachi and National Herbarium PARC, Islamabad Pakistan.

Allombert S, A. J. Gaston and J.L Martin. 2005. A natural experiment on the impact ofoverabundant deer on songbird populations. Journal of Biological Conservation 126(1): 1 13.

Anonymous, 1990. Official Methods of Analysis. 15th Edn. Association of Official Analytical Chemists Washington, DC, USA.

Ashraf, N, M. Anwar and I. Hussain. 2014. Competition for food between markhor anddomestic goat in Chitral, Pakistan. Turkish Journal of Zoology 38: 191-198.

Berger J, P.B Stacey, L. Bellis and M. P. Johnson. 2001. A mammalian predator prey imbalance: grizzly bear and wolf extinction affect avian neo-tropical migrants.Ecological Applications 11: 947–960.

Boussama, N, O. Ouariti, A. Suzuki and M.H. Ghorbal. 1999. Cd-stress on nitrogen assimilation, J. Plant Physiol 155: 310-317.

Conroy C. 2005. Participatory livestock research: a guide, published by ITDG Publishing, London UK, 1-16 and 304.

Das P, S. Samantaray and G.R. Rout. 1997. Studies on cadmium toxicity in plants: a Review, Environ. Pollut 98: 29-36.

Dike M. C. 2010. Proximate, phytochemical and nutrient compositions of some fruits,seeds and leaves of some plant species at Umudike, Nigeria. Journal of Agricultural and Biological Science 5 (1): 7-16.

Haro R.T, A. Furst and H.L. Falk. 1968. Studies on the acute toxicity of nickelocene. Proc West Pharmocol Soc 11: 39-42.

Hussain J, A.L. Khan, N. Rehman, M. Hamayun, T. Shah, M. Nisar, T. Bano, Z.K. Shinwari and I.J. Lee. 2009b. Proximate and nutrient analysis of selected vegetable species: A case study of Karak Region Pakistan. African J. Biotechnol 8(12): 2725-2729.

Hussain J, A.L. Khan, N. Rehman, Zainullah, S.T. Hussain, F. Khan and Z.K. Shinwari. 2009a. Proximate and nutrient analysis of selected medicinal plant species of Pakistan. Pakistan J. Nut 8 (1): 620 -624.

Hussain J, N. Rehman, A. L. Khan, M Hamayun, S. M. Hussain, Z. K. Shinwari. 2010b.Proximate and Nutrients Evaluation of Selected Vegetables Species from Kohat Region Pakistan” Pakistan. Pak. J. Bot 42(4): 2847-2855.

Hussain J, R. Ullah, N. Rehman, A. L. Khan, Z. Muhammad, F. U Khan, S. T Hussain and S Anwar. 2010. Endogenous transitional metal and proximate analysis of selected Medicinal plants from Pakistan. Journal of Medicinal Plants Research 4 (3): 267-270.

Hussain J, Riazullah, N. Rehman, A.L. Khan, Z.

Muhammad, Farmanullah and S.T. Hussain. 2010a. Endogenous Transitional Metal and Proximate Analysis of Selected Medicinal Plants from Pakistan. J. Med. Plant Res 4(3): 267-270.

Khan N, M. Ahmad, M. F. Siddiqut, S. bibi and I. Ahmad. 2012. A phystociological study of forest and non-forest vegetation of district Chitral., Hindukusk range of Pakistan. Fuuast J Biol 2(1): 91-101.

Klasing K. C. 2007. Nutrition and the immune system. Journal of British Poultry Science 48 (5): 525-537.Kuo, M. 2005. Morels. University of Michigan Regional, Ann Arbor. Pp 205.

Maisuthiasakul P, S. Pasuk and P. Rittuiouangde. 2008. Relationship between antioxidant properties and chemical composition of some Thai plants. Journal of Food Composition and Analysis 21: 229-240.

Nasir E and S. I. Ali. 1970-1989. Flora of West Pakistan. No. 1-190. Department of Botany University of Karachi.

Nasir, E and S. I. Ali. 1980-2005. Flora of Pakistan. No. 132-193. Department of Botany University of Karachi.

Rajurkar NS, Damame MM (1997). Elemental analysis of some herbal plants used in the treatment of cardiovascular diseases by NAA and AAS. J. Radioanalytical. Nuclear. Chem 219(1): 77-80.

Simard M.A, S. D Côté, R.B. Weladji and J. Huot. 2008. Feedback effects of chronic browsing on life-history traits of a large herbivore. Journal of Animal Ecology 77 (4): 678-686.

Simsek A and O. Aykut. 2007. Evaluation of the microelement profile of Turkish Hazelnut (*Corylus avellana* L.) varieties for human nutrition and health. Int. J. Food Sci. Nutr, 58: 677-688.

Soetan K. O, C. O. Olaiya and O. E. Oyewole. 2010.The importance of mineral elements for humans, domestic animals and plants - A review, African Journal of FoodScience 4(5). 200-222.

Underwood EJ (1971). Trace Elements in Human and Mineral Nutrition. New York, Academic Press, pp. 6-120.

Valkovic VV (1975). Trace Element Analysis. London: Taylor and Francis. pp. 5-83.