Pak. J. Bot., 45(6): 2071-2074, 2013.

QUALITATIVE CHARACTERISTICS OF THE COMMONLY USED VEGETABLES IN USTERZAI OF KOHAT REGION

JAVID HUSSAIN[1,2*], NAJEEB UR REHMAN[2], ZABTA KHAN SHINWARI[3], LIAQAT ALI[2], AHMED AL-HARRASI[2], ABDUL LATIF KHAN[1,2], AND FAZAL MABOOD[2]

[1]*Department of Chemistry, Kohat University of Science & Technology, Kohat, 26000, Pakistan*
[2]*Department of Biological Sciences and Chemistry, College of Arts and Sciences, University of Nizwa, Birkat Al-Mouz, Nizwa 616, Sultanate of Oman*
[3]*Department of Biotechnology, Quaid-i-Azam University, Islamabad, Pakistan*
[*]*Corresponding authors: javidhej@yahoo.com*

Abstract

The present study was conducted with the aim to investigate the proximate composition and elemental analysis of important leafy (*Malva sylvestris, Eruca sativa,* and *Mentha sylvestris*) and fleshy (*Brassica rapa*, *Brassica oleracea var. botyris,* and *Raphanus sativus*) vegetables, which are commonly used in the rural areas of Usterzai (Khyber Pakhtunkhwa – Pakistan). The proximate parameters (moisture, fat, protein, carbohydrate, ash and crude fiber) were evaluated by using AOAC methods whereas elemental analyses were carried-out by Atomic Absorption Spectrophotometer. The results showed that *R. sativus* had highest moisture contents (15.46 ± 0.16%). The ash and protein contents were highest in *M. sylvestris* (18.48 ± 0.01% and 16.16 ± 0.32% respectively). *E. sativa* has highest fiber (14.64 ± 0.24%) contents while *B. oleracaea* had highest carbohydrate (86.22 ± 0.54%) and energy values (354.17±0.54 Kcal/100g). In case of micro and macro nutrient concentrations, the *R. sativus* had highest iron *(*13.03 ± 0.14*),* copper (9.96 ± 0.16), manganese (0.79 ± 0.01), cadmium (0.21 ± 0.01) and lead (0.44 ± 0.02) while *E. sativa* had highest magnesium (25.65 ± 0.21) and *M. sylvestris* had highest sodium (81.04 ± 0.17) concentrations. In conclusion, the present support the results that *B. oleracaea* and *R. sativus* are active in nutritional qualities. Thus, toxic elements such as cadmium and lead are negligible in concentrations making these vegetables more healthful to the local people.

Introduction

Vegetables are important protective food and highly beneficial for the maintenance of health and prevention of diseases. These contain valuable food ingredients, which can be utilized in the synthesis of essential build blocks of body. The human food should be nutritious and attractive in flavor and appearance. The fleshy roots are high in energy and good source of vitamin B, while the green leafy vegetables contain significant amount of iron (Shinwari *et al*., 2013; Naz *et al*., 2013; Perveen *et al*., 2012). The leaf concentrate made from fractionating fresh green vegetables is one of the richest sources of this element. Besides, it also contains a large amount of β-carotene, folic acid and proteins as well as a considerable amount of pyridoxine, riboflavin and copper. Leaf concentrates can be an excellent dietary factor for the prevention of anemia (Mathur, 1989; Rehman *et al*., 2013).

Vegetables are considered as rich sources of essential bio-chemicals and nutrients such as carbohydrates, proteins, vitamins, calcium, iron and palpable concentration of trace minerals (Prakash & Pal, 1991; Jimoh & Oladiji, 2005). Certain vegetables contain various medicinal and therapeutic agents and thus are highly beneficial in the treatment of various diseases. The highly soluble minerals like calcium, phosphorus, iron, magnesium, copper, and potassium contained in vegetables maintain the acid/base balance of hydrogen concentration of body tissues. These help to completely absorb the vitamins, proteins, fats and carbohydrates of the food (Kalita, 2007; Hussain *et al*., 2010a; Hussain *et al*., 2011b).

Malva sylvestris, Eruca sativa, Mentha sylvestris, Brassica rapa, *Brassica oleracea* var. *botyris,* and *Raphanus sativus* are the selected vegetables in this study which are used commonly by the local communities of Ustarzai in the Northwestern part of Pakistan. These vegetables are being cooked in various combinations and are used extensively as a part of food by the local communities. The taxonomy and pattern of local use of these vegetable species are summarized in Table 1. In addition to the local uses of these vegetable species, the local communities through their indigenous knowledge also utilize them against various diseases.

Table 1. Vegetables collected for the study and pattern of local use.

Vegetable name	Family name	Parts used	Common name
M. sylvestris	Malvaceae	Leaves	Sonchal
E. sativa	Brassicaceae	Leaves	Salaad
M. sylvestris	Lamiaceae	Leaves	Poodina
B. rapa	Brassicaceae	Root/Fruit	Shalgham
B. oleracaea	Brassicaceae	Fruit	Phool Gobhi
R. sativus	Brassicaceae	Root/Fruit	Mooley

The frequent use of these vegetables by the local community (Table 1) inspired us to analyze these vegetable species for the proximate composition and available nutrients composition. In proximate analysis; ash, carbohydrate, proteins, fats, fibers, energy valuation and moisture contents were analyzed, while in elemental analysis, the concentrations of magnesium (Mg), sodium (Na), iron (Fe), copper (Cu), manganese (Mn), chromium (Cr), cadmium (Cd), and lead (Pb) were estimated quantitatively.

Materials and Methods

Sample collection: The selected vegetable species (*M. sylvestris, E. sativa, M. sylvestris, B. rapa*, *B. oleracea var. botyris,* and *R. sativus*) were collected from Usterzai in the Kohat region, packed in the kraft papers and herbarium sheets were prepared. These vegetable samples were identified by the plant taxonomist, Mr. Shoaib Khan, Department of Botany, Kohat University of Science and Technology, Kohat, Pakistan.

Sample preparation: The selected vegetables were washed thoroughly under running water and blotted dry. The moisture content of the vegetable species (dry) was determined at 105°C. The dried matter was ground to a fine powder and was stored at 5°C in the air-tight containers prior to further analyses, which was then performed according to the standard procedures reported in literature (Hussain *et al*., 2010b).

Nutritional analysis: The moisture content was determined using oven dry method. The ash was calculated by drying the samples in a furnace for 3 hrs at 550°C. Protein content was calculated from the available nitrogen being determined by micro Kjeldahl method (Pearson, 1976), which involved the digestion of the samples to extract nitrogen in the form of ammonia or ammonium sulfate, followed by distillation and trapping of this nitrogen. The titration of this trapped nitrogen against the known standard was then carried out to determine quantitatively the amount of nitrogen. The protein content was then calculated by multiplying this nitrogen value with a converting factor of 6.25. Carbohydrate content was determined by difference method. All the experiments were recorded in triplicates and the proximate values are reported in percentages (Anon., 2003; Hussain *et al*., 2010a; Hussain *et al*., 2011a).

Analysis of micro- and macro- elements: The macro and microelements (Mg, Na, Fe, Cu, Mn, Cr, Cd, and Pb) of the selected vegetables were analyzed using the Atomic Absorption Spectrophotometer (Perkin Elmer AA Analyst 700). The results were obtained using a working standard of 1000 ppm for each of the species (Hussain *et al*., 2011a).

Statistical analysis: Each experiment was run in triplicate. The results were calculated for three independent determinations with their means, standard deviations and correlation matrix. Statistical analysis was performed using ANOVA Statistical Analysis System (SAS 9.1) by using the reported procedure (Steel & Torrie, 1980).

Results and Discussions

Analysis of nutritional composition: Six vegetable species including three leafy (*M. sylvestris, E. sativa,* and *M. sylvestris*) and three fleshy vegetables (*B. rapa*, *B. oleracea var. botyris,* and *R. sativus*) were selected. The quality characteristics i.e. moisture content, crude fats and fiber, ashes, carbohydrates and protein values of these six selected vegetables were analyzed. The energy values of these selected vegetables were calculated based on nutritional parameters. The nutritional analysis of these vegetables revealed very convincing and comparable results, which are summarized in Table 2.

Table 2. Summary of the proximate analysis of the selected vegetables.

Vegetable species	Moisture (%)	Ash (%)	Fats (%)	Fiber (%)	Protein (%)	Carbohydrates (%)	Energy value (Kcal/100g)
M. sylvestris	14.97 ± 0.04	18.34 ± 0.07	1.92 ± 0.01	12.18 ± 0.32	13.63 ± 0.42	51.12 ± 0.45	276.36 ± 0.54
E. sativa	14.39 ± 0.03	17.13 ± 0.02	1.46 ± 0.08	14.64 ± 0.24	12.53 ± 0.21	54.46 ± 0.24	281.21 ± 0.34
M. sylvestris	11.68 ± 0.04	18.48 ± 0.01	1.09 ± 0.06	13.37 ± 0.02	16.16 ± 0.32	52.57 ± 0.32	284.84 ± 0.65
B. rapa	11.14 ± 0.18	0.61 ± 0.04	0.23 ± 0.04	0.77 ± 0.01	2.30 ± 0.02	85.71 ± 0.32	354.11 ± 0.71
B. oleracaea	10.93 ± 0.10	0.80 ± 0.02	0.22 ± 0.00	0.96 ± 0.03	1.81 ± 0.01	86.22 ± 0.54	354.17 ± 0.45
R. sativus	15.46 ± 0.16	0.76 ± 0.01	0.83 ± 0.00	0.67 ± 0.05	0.87 ± 0.00	82.05 ± 0.43	339.21 ± 0.64

± shows the standard error

The moisture analysis results of the leafy vegetables indicated that *M. sylvestris* contained the lowest moisture content (11.68% ± 0.04) among the three selected vegetables. Whereas other two vegetable species, *M. sylvestris* and *E. sativa* showed slightly higher moisture content (14.97% ± 0.043 and 14.39% ± 0.037 respectively) than *M. sylvestris*. These results were justified in comparison to smaller leaf size of *M. sylvestris*. The results of the moisture analysis of the fleshy vegetables indicated that *R. sativus* contain the highest moisture content among the selected three vegetables, and this observation was in agreement with previous findings of Hussain *et al.,* (2010b; 2011a). The overall moisture content was highest in *R. sativus* (15.46% ± 0.16) whereas *B. oleracea var. botyris* had the lowest (10.93% ± 0.10).

The other parameters showed very promising results and ashes, fats, crude fiber, and the protein contents of leafy vegetables were found significantly higher than fleshy vegetables. However, the carbohydrate contents of the leafy vegetables were found considerably lower than those of the fleshy vegetables (Table 2). Furthermore, all the above parameters have shown the comparatively similar values within the fleshy vegetables and leafy vegetables (Table 2).

The highest ash content (18.48% ± 0.01) and protein value (16.16% ± 0.02) were observed in *M. sylvestris*. *M. sylvestris* had highest crude fat content (1.92% ± 0.01). *E.*

sativa and *B. oleracea var. botyris* had higher fiber content (14.64 ± 0.24) and carbohydrate content (86.22% ± 0.54) respectively. The lowest level of crude fats, fiber, and carbohydrate were found in *B. oleracea var. botyris* (0.22% ± 0.00), *R. sativus* (0.67% ± 0.05), and *M. sylvestris* (51.12% ± 0.45) respectively.

Considering all these observations, results indicating that the fleshy vegetables are considerably different from the leafy vegetables. This indicate that fleshy vegetables can be a better source of carbohydrates whereas the leafy vegetables provided relatively better overall yield of proteins, fats and fibers (Table 2). In addition to these, the energy values were also calculated for these vegetable species based on available fats, proteins and carbohydrates by the reported procedure (Oaborn & Voogt, 1978) and the results are also summarized in Table 2. The calculated energy values indicated that the fleshy vegetables were relatively higher than the leafy vegetables (Table 2).

Analysis of micro and macro elements: The trace element (micro and macro-element) concentrations of the vegetables species are mainly dependent on the type of species, collection site or type of soil where these are grown and environmental conditions. The microelements analyzed in the present study (Table 3) of the selected vegetables included iron (Fe), copper (Cu), manganese (Mn), chromium (Cr), cadmium (Cd), and lead (Pb) while magnesium (Mg) and sodium (Na) are analyzed as macro elements. The results of the elemental analysis revealed that Mn had highest concentration in *R. sativus* and lowest in *M. sylvestris*. The highest concentration of Cr was found in *M. sylvestris* whereas the lowest was in *M. sylvestris*. The other microelements (Fe, Cu, Cd, and Pb) were found greater in concentrations in fleshy vegetables as compared to the leafy vegetables (Table 3).

The macro elements, Na and Mg are essential, as these are required in larger amount by human body. The analysis of these macro-minerals indicated that all the selected vegetable species are rich in minerals, however, *R. sativus* and *M. sylvestris* showed the exceptionally high concentration of Na (70.79 ppm and 81.04 ppm respectively), while Mg was found in relatively higher concentration in all the leafy vegetables (Table 3) than in the fleshy vegetables.

The correlation analysis of the selected parameters showed that similar parameters have highly significant correlation while among other parameters the correlation is either significant, or non-significant, and in some cases moderate. Ash with fiber and proteins; fiber with proteins; and carbohydrate with energy value; showed significant correlation. However, ash with carbohydrates and energy value; fats with energy value; fiber with carbohydrates and energy value; and protein with carbohydrates and energy value showed non-significant correlation. Similarly, other parameters showed moderate correlation (Table 4).

Table 3. Analysis of the micro-elements (ppm; Fe, Cu, Mn, Cr, Cd, and Pb) and macro-elements (Mg and Na) in the selected vegetables.

Vegetable species	Fe	Cu	Mn	Cr	Cd	Pb	Mg	Na
M. sylvestris	7.88 ± 0.13	5.16 ± 0.13	0.54 ± 0.02	0.09 ± 0.00	0.19 ± 0.01	0.06 ± 0.00	24.93 ± 0.03	59.09 ± 0.43
E. sativa	7.96 ± 0.12	3.97 ± 0.17	0.75 ± 0.01	0.94 ± 0.03	0.09 ± 0.00	BD	25.65 ± 0.21	40.56 ± 0.24
M. sylvestris	2.71 ± 0.15	6.98 ± 0.18	0.62 ± 0.01	0.81 ± 0.01	0.13 ± 0.00	0.17 ± 0.01	22.14 ± 0.33	81.04 ± 0.17
B. rapa	8.73 ± 0.27	7.93 ± 0.15	0.56 ± 0.02	0.07 ± 0.00	0.18 ± 0.01	0.29 ± 0.01	13.31 ± 0.29	11.57 ± 0.24
B. oleracaea	11.82 ± 0.16	9.93 ± 0.16	0.67 ± 0.02	0.61 ± 0.01	0.18 ± 0.02	0.33 ± 0.02	14.28 ± 0.35	41.97 ± 0.31
R. sativus	13.03 ± 0.14	9.96 ± 0.16	0.79 ± 0.01	0.38 ± 0.02	0.21 ± 0.01	0.44 ± 0.02	15.91 ± 0.21	70.79 ± 0.29

BD = Below detection; ± shows the standard error

Table 4. Correlation matrix of the proximate parameters of the selected vegetables.

	Moisture	Ash	Fats	Fiber	Protein	CHO	E.V
Moisture	1						
Ash	0.299	1					
Fats	0.713	0.861	1				
Fiber	0.291	0.987	0.829	1			
Protein	0.175	0.988	0.785	0.971	1		
CHO	-0.375	-0.996	-0.895	-0.980	-0.977	1	
E.V	-0.453	-0.986	-0.925	-0.974	-0.954	0.995	1

CHO = Carbohydrates, E.V = Energy value

Conclusion

The present study revealed that leafy vegetables and fleshy vegetables, when used collectively, have a potential to utilize them as cheap and easily accessible sources of nutrition for human. The presence of high carbohydrate contents and reasonable protein values further support the nutritional importance of these vegetables. As all of the analyzed species contained varied concentrations of nutrients and minerals, a reasonable combination can be used for the maintenance of the required elements of human diet, and thus can well be incorporated in the daily diets of vulnerable sections of population.

Acknowledgment

The authors wish to thank the Higher Education Commission and Pakistan Academy of Sciences for providing financial support for the current study under the National Research Program for Universities (NRPU).

References

Adnan M., J. Hussain, M.T. Shah, F. Ullah, Z.K. Shinwari, A. Bahadar and A.L. Khan. 2010. Proximate and nutrient Composition of Medicinal Plants of Humid and Sub-humid regions in Northwest Pakistan. *Journal of Medicinal Plant Research,* 4(4): 339-345

Anonymous. 2003. *Official Methods of Analysis of AOAC International (17th ed.)*. Gaitherburg, MD, USA: Association of Official Analytical Chemists International.

Hussain, J., F. Khan, R. Ullah, Z. Muhammad, N. Rehman, Z.K. Shinwari, I.U. Khan, M. Zohaib, Imad-ud-din and S.M. Hussain. 2011b. Nutrient evaluation and elemental analysis of four selected medicinal plants of Khyber Pakhtoon Khwa, Pakistan. *Pak. J. Bot*., 43(1): 427-434.

Hussain, J., N. Rehman, A.L. Khan, H. Hussain, A. Al-Harrasi, L. Ali, F. Sami and Z.K. Shinwari. 2011a. Determination of macro and micronutrients and nutritional prospects of six vegetable species of Mardan, Pakistan. *Pak. J. Bot*., 43(6): 2829-2833.

Hussain, J., N. Rehman, A.L. Khan, M. Hamayun, S.M. Hussain and Z.K. Shinwari. 2010b. Proximate and nutrients evaluation of selected vegetables species from Kohat region, Pakistan. *Pak. J. Bot*., 42(4): 2747-2755.

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

Jimoh, F.O. and A.T. Oladiji. 2005. Preliminary studies on *Piliostigma thonningii* seeds: Proximate analysis, mineral composition and phytochemical screening. *Afri. J. Biotec.*, 4: 1439-1442.

Kalita, P., P.K. Mukhopadhyay and A.K. Mukherjee. 2007. Evaluation of the nutritional quality of four unexplored aquatic weeds from northeast India for the formulation of cost-effective fish feeds. *Food Chem*., 103: 204-209.

Mathur, B., R.M. Joshi and W.J. 1989. Bray. Impact of supplementing leaf protein concentrate on hemoglobin level of children. *Indi. J. Nutri. Diet*., 26: 267-271.

Naz, F., S. qamarunnisa, Z.K. Shinwari, A. Azhar and S.I Ali. 2013. Phytochemical investigations of *tamarix indica* willd. And *tamarix passernioides* del. Ex desv. Leaves from pakistan. *Pak. J. Bot*., 45(5): 1503-1507.

Oaborn D.R. and P. Voogt. 1978. The analysis of nutrients in foods. Acedemic Press London, 166-182.

Pearson, D. 1976. *Chemical Analysis of Foods (7th ed.).* Livingstone, London.

Perveen, S., A. Samad, W. Nazif and S. Shah. 2012. Impact of sewage water on vegetables quality with respect to heavy metals in Peshawar, Pakistan. *Pak. J. Bot*., 44: 1923-1931.

Prakash, D and M. Pal. 1991. Nutritional and anti-nutritional composition of vegetable and grain *Amaranthus* leaves. *Journal of the Science of Food and Agriculture,* 57: 573-585.

Rehman K., S. Ashraf, U. Rashid, M. Ibrahim, S. Hina, T. Iftikhar and S. Ramzan. 2013. Comparison of proximate and heavy metal contents of vegetables grown with fresh and waste water. *Pak. J. Bot*., 45(2): 391-400.

Shinwari, Z.K., N. Ahmed, J. Hussain and N.U. Rehman. 2013. Antimicrobial Evaluation and Proximate Profile of *Nepeta leavigata*, *Nepeta kurramensis* and *Rhynchosia reniformis. Pak. J. Bot*., 45(1): 253-259.

Steel R.G.D. and J.H. Torrie. 1980. *Principles and procedures of statistics*: *A biometrical approach*. New York: Mc Glaw-Hills.

(Received for publication 22 August 2012)