Research Article

Assessment of Proximate, Nutritional and Mineral Contents in Some Traditional Vegetables Consumed in Multan, Pakistan

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Abstract | Vegetables are considered as significant ingredients in daily dietaries as they have high nutritive values and impart valuable role in the deterrence of human diseases and improvement of health. People usually used to eat vegetable for developing taste without observing their nutritive significance. The present study was therefore, planned to assess the essential proximate nutritional and mineral contents in edible parts of some vegetables. All the analyses were carried out by following the standard analytical procedures during 2014. The highest values for ash contents were detected in *Abelmoschus esculentus* (1.34 g/100g), moisture contents in *Lycopericon esculentum* (93.7%), protein in *Spinacia oleracea* (2.23g/100g), fats and fiber in *Abelmoschus esculentus* (0.44g/100g and 3.27g/100g, respectively), ascorbic acid in *Spinacia oleracea* (84.5mg/100g) and carbohydrate and energy values in *Daucus carota* (11.25g/100g and 55.80 cal, respectively). While, higher mineral contents were recorded for phosphorous (P) in *Spinacia oleracea* (85.5mg/100g), sodium (Na) and iron (Fe) in *Lycopericon esculentum* (65.33mg/100g and11.67mg/100g, respectively), and potassium (K) and calcium (Ca) in *Abelmoschus esculentus (*277.33mg/100g and 81.17mg/100g, respectively). The present conclusions would be valuable for food experts to plan stable diet and estimate the energetic values of vegetables.

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Introduction

Vegetables are a significant source of nutritious rich elements valuable for the avoidance of diseases, improvement of human health and impart in building and repairing of body structure (Mohammed and Sharif, 2011). Vegetables have been classified into various groups like edible leaves, stems, roots, fruits, flowers and seed vegetables. Every group of vegetables adds essential nutrients in diet in different manner (Robinson, 1990). Pakistan produced vegetables (excluding potato) on an area of about 0.25 million hectares with the total production of about 3.1 million tonnes in fiscal year 2011-2012. Punjab province occupies on an area i.e. 0.14 million hectares and production of about 1.97 million tonnes (Anonymous, 2013). The environmental conditions of Pakistan are very friendly for growing all kinds of vegetables in various agro climatic regions of the country (Khalil and Rehman, 1977).

Vegetables contain vital elements contributing in improving health (Mohammed and Sharif, 2011). Vegetables provide nutrients that are engrossed and exploited as regulatory and defensive substances and used for building the body (Saidu and Jideobi, 2009; Kubmarawa et al., 2009). Vegetables contain considerable quantity of indispensable vitamins and mineral and adding low energy values to the body (Fasuyi, 2006; Adenipenkun and Oyetunji, 2010). Vitamins are desired for repairing of skin, skeleton, teeth and hair mucous membranes, apparition and replication. Vitamins play key role to take in minerals (calcium and phosphorous) required for escalation of bones and preservation (Chatterjea and Shinde, 1998).

Vegetable fats and oils reduce the blood lipids consequently lessen the fats and oils in vegetables have been reported to lower blood lipids, leading to lessen the prevalence of diseases caused with malfunction of coronary veins (Onunogbu, 2002; Adenipenkun and Oyetunji, 2010). Aliyu (2006) documented that the fiber contents provided by vegetables are recognized to prop up digestion and avert constipation.

Minerals are considered as an inorganic matter found naturally having specific chemical composition and prearranged atomically. Vegetables contain important minerals and add to the RDA of indispensable nutrients. Minerals are very significant and vital constituents of diet needed for metabolic actions of cells. Approximately 25 naturally occurring minerals were found in living organisms out of the total 92. They play essential part in the formation of bones, blood, teeth, hair, muscles and nerve cells. Alvarez (2002) depicted that vitamins cannot be appropriately digested without the accurate balance of minerals.

Vegetables are renowned as usual reservoirs of essential nutrients blessed us by Almighty Allah. Spinach and tomato are rich in vitamin C helpful in prevention of scurvy. Vitamin A is used for visualization provided by carrot, likewise, potato contains starches and carbohydrates. Bottle and sponge gourd provide fiber contents involved in removing constipation.

In current study, assessment of chemical composition and mineral elements of some selected edible vegetables (part of daily diet) of Multan, Punjab, Pakistan, was conducted. A lot of work was already conducted by various scientists to evaluate proximate and mineral composition of various vegetables (Faruq et al., 2002; Hanif et al., 2006; Hassan and Umar, 2006; Iqbal et al., 2006; Hussain et al., 2010). It is still required to do more work on the minerals, nutritional and proximate composition of root, fruit, flower and leafy vegetables.

Materials and Methods

Vegetable sampling

Five vegetables were selected on the basis of their edible parts such as root vegetable (*Daucus carota*), leaf (*Spinacia oleracea),* flower (*Brassica oleracea*) and fruit (*Lycopericon esculentum)* and (*Abelmoschus esculentus*). All these vegetable samples were procured from farmer's field located near University areas during 2014 and taken to the Laboratory of department of Horticulture, Faculty of Agricultural Sciences and Technology, Bahauddin Zakariya University, Multan. Each vegetable sample was replicated three times. Vegetables were washed with water and air dried.

Reagents

Chemicals used for analysis were of an analytical status and obtained from Merck. All the glass ware was immersed in nitric acid solution for a night and washed with distilled water before use.

Nutritional composition

Moisture content: The vegetable samples were placed in an oven (Memmert, 100-Germany), driedat 105±2 °C for 24 hours until stable weight following the procedure described by AOAC (1997).

Ash content: The ash contents of all the selected vegetable samples were estimated by incineration at 550°C for 6 hours using the method 942.05 (AOAC, 1990).

Protein: The nitrogen contents of all the vegetable samples were estimated by micro Kjeldahl (Glass Model Pyrex-1) using the method 984.13and protein was measured by multiplying nitrogen contents with factor 6.25 (AOAC, 1990).

Fat: Fat contents of the sample was find out by Soxhlet apparatus (J.P. Selecta–Spain) using method 920.39 illustrated in AOAC, 1990.

Crude Fiber: Crude fiber was estimated by following the standard method 962.09 ascribed by AOAC (1990).

Carbohydrate: Difference method was used to determine the carbohydrate content (Eyeson and Ankrah, 1975).

Energy value: Energy value was computed by the multiplication of protein and carbohydrate by 4.1 and crude fat by 9.3 as ascribed by Khalil and Saleemullah (2004).

Ascorbic acid (Vitamin C): For the determination of ascorbic acid, fresh samples of vegetables were taken, and ascorbic acid was formulated by reduction method using dichlorophenol indophenol dye (Smirnoff, 2000).

Mineral Assay: For mineral assays of potassium, phosphorus, calcium and sodium, $HClO_4$/ HNO_3 method was used for the digestion of samples (Steekel and Flannery, 1965). For the estimation of iron, dry ash method was used (Isaac and Johnson, 1975). The digested samples were analyzed on Atomic Absorption Spectrometer (Perkin Elmer-100) and flame photometer.

Statistical analysis: Each trial was repeated three times. Means, standard deviations and standard errors were used to present the data (Sakalauskas, 1998).

Results and Discussion

Nutritional composition

Five selected vegetables were evaluated for their nutritional composition and the results showed marked variations (Table 1 and 2). Among all the tested vegetables, the highest ash contents were recorded in *Abelmoschus esculentus* (1.34g/100g), whereas the lowest values found in *Daucus carota* (0.53g/100g). All the vegetables had higher moisture contents ranging from 85.6% to 93.67%. Tomato contained highest moisture contents (93.67%) and the lowest in *Daucus carota* (85. 6%).Spinacia *oleracea* contained higher protein content (2.23g/100g), followed by *Abelmoschus esculentus* (2.22g/100g), *Brassica oleracea* (1.86g/100g) and *Daucus carota* (1.53g/100g), while the lowest values for protein content was observed in *Lycopericon esculentum* (0.86g/100g). The mean values for fat analysis indicated that lower fat contents in all vegetables ranging 0.15-.44g/100g (Table1). The result shows that fiber contents were 0.65 to3.27g/100g, higher content found in *Abelmoschus esculentus* (Table 2). The higher ascorbic acid contents were detected in *Spinacia oleracea* (84.5mg/100g), followed by *Brassica oleracea* (45.67mg/100g), whereas *Daucus carota* showed the lowest ascorbic acid contents (7.70 mg/100g) (Table 2). From Table 2, it was observed that higher carbohydrates and energy values were recorded for root vegetable *Daucus carota* (11.25g/100g and 55.80 cal, respectively) and the minimum carbohydrates and energy values in fruit vegetable *Lycopericon esculentum* (2.68g/100g and 16.35 cal), respectively.

Mineral analysis

The mineral composition of selected vegetables showed significant variations (Table 3). It was noted that phosphorus (P) was high in *Spinacia oleracea* (85.5mg/100g), sodium (Na) and iron (Fe) in *Lycopericon esculentum* (65.33mg/100g and11.67mg/100g, respectively), potassium (K) and calcium (Ca) in *Abelmoschus esculentus* (277.33mg/100g and 81.17mg/100g),whereas the minimum mineral contents such as phosphorus (25.67mg/100g) and potassium (105mg/100g) foundin *Daucus carot,* calcium (23mg/100g) and iron (0.83mg/100g) in *Brassica oleracea* and sodium (10mg/100g) in *Abelmoschus esculentus*.

Edible vegetables are essential part of human daily diet containing compulsory biochemical components imperative for physical and chemical processes of human body (Aliyu, 2006). There has been marked variations recorded among different vegetables for proximate analysis such as ash, moisture, protein, fats, fiber, vitamin C, carbohydrate, energy values and mineral composition. Asibey-Berko and Tayie (1999) stated that higher ash content are good indicators of mineral elements in flora and fauna and recorded higher contents in *Trianthema portulacastrum* than other vegetables in ghana. *Abelmoschus esculentus* was found to be a valuable source of minerals, followed by *Spinacia oleracea*in the present study. Lockeett et al. (2000) found higher ash content in leafy vegetables like *Trianthema portulacastrum* (bitter leaves).

High moisture levels in vegetables aid in retaining the protoplasmic components and however put up vegetables vulnerable to spoilage and provides place for spoilage causing microorganisms in the vegetables (Gbadamosi et al., 2011; Emebu and Anyika, 2011) and ropes better action of enzymes and co enzymes (water soluble) required for metabolic regulation of vegetables (Ihenacho and Ubebani, 2009). It is observed from the present study that tomato had higher moisture contents, while tomato contained lower moisture contents. The vegetables with lower moisture contents are considered had a better shelf life because the low moisture content would restrain growth of microorganisms. The longest shelf life, as the relatively low moisture content would confine the growth of microbes.

Table 1: *Results of proximate nutritional analysis of vegetables (ash, moisture, protein, fats).*

Vegetables		Ash contents (g/100g)	Moisture contents(%)	Protein (g/100g)	Fats (g/100g)
Lycopericon esculentum	Mean± S.E* S. D*	0.93±0.033 0.0577	93.67±0.881 1.5275	0.86±0.029 0.0513	0.20±0.058 0.1
Abelmoschus esculentus	Mean± S.E S. D	1.34±0.050 0.0291	87.5±0.289 0.50	2.22±0.152 0.264	0.44±0.280 0.4854
Daucus carota	Mean± S.E S. D	0.53±0.218 0.3786	85.6± 0.152 0.2646	1.53± 0.145 0.2517	0.36± 0.031 0.0551
Brassica oleracea	Mean± S.E S. D	0.61±0.044 0.0764	89.73±0.218 0.3786	1.89±0.052 0.09	0.15±0.029 0.05
Spinacia oleracea	Mean± S.E S. D	1.03±0.088 0.1528	91±0.577 1.00	2.23±0.185 0.3215	0.39±0.017 0.03

Values are mean ± Standard error; standard deviation of three replications; **S.E:** *Standard error.*

Table 2: *Results of nutritional assays of vegetables (fiber. ascorbic acid, carbohydrates, energy value).*

Vegetables		Fiber (g/100g)	Ascorbic Acid (mg/100g)	Carbohy-drate(g/100g)	Energy value (Cal)
Lycopericon esculentum	Mean± S.E S. D	1.67±0.18 0.32	33.50±0.76 1.32	2.68±1.11 1.93	16.35±4.10 7.12
Abelmoschus esculentus	Mean± S.E S. D	3.27±0.09 0.15	40.77±0.62 1.080	5.24±0.42 0.73	34.66±0.51 0.89
Daucus carota	Mean± S.E S. D	0.75± 0.02 0.05	7.70± 0.53 0.92	11.25± 0.48 0.83	55.80 ±1.37 2.38
Brassica oleracea	Mean± S.E S. D	0.83±0.03 0.05	45.7±1.45 2.52	6.77±0.29 0.49	36.93±1.25 2.17
Spinacia oleracea	Mean± S.E S. D	0.65±0.02 0.05	84.5±0.29 0.50	4.67±0.82 1.42	31.96±2.58 4.47

Values are mean ± Standard error; Standard deviation of three replications; **S.E:** *Standard error;* **S.D:** *Standard deviation.*

Table 3: *Results mineral assays of vegetables (Ca, P, Na, K and Fe).*

Vegetables		Ca (mg/100g)	P (mg/100g)	Na (mg/100g)	K (mg/100g)	Fe (mg/100g)
Lycopericon esculentum	Mean± S.E S. D	74.33±1.45 2.51	26.67±0.88 1.52	65.33±3.75 6.50	112.33±3.84 6.65	11.67±0.498 0.86
Abelmoschus esculentus	Mean± S.E S. D	81.17±0.60 1.04	62.67±1.45 2.51	10±0.57 1.0	277.33±15.3 26.53	7.4±0.265 0.45
Daucus carota	Mean± S.E S. D	35.67±0.88 1.52	25.67± 0.88 1.52	32.67± 1.45 2.51	105± 1.73 3.0	1.30± 0.058 0.10
Brassica oleracea	Mean± S.E S. D	23±1.15 2.0	43.33±0.88 1.52	53.33±1.76 3.05	135.33±1.45 2.51	0.83±0.020 0.03
Spinacia oleracea	Mean± S.E S. D	77.33±1.20 2.08	85.5±0.288 0.50	59±0.45 0.78	205.67±1.76 3.05	6.5±0.287 0.50

Values are mean ± Standard error and standard deviation of three replications; **S.E:** *Standard error;* **S.D:** *Standard deviation.*

In the present study, higher protein contents were observed in *Spinacia oleracea,* followed by *Abelmoschus esculentus* and these results were near with the conclusions of Roger et al., 2005; Hanif et al., 2006; Hussain et al., 2010. Roger et al. (2005) further described that low protein caloric foods primarily cause the nutritional deficiencies which lead to various diseases. Plants that contain above 12% caloric protein are believed to be admirable source of protein (Pearson, 1976). Antia (2006) revealed that fat is a chief influencing lusciousness of foodstuff. Onunogbu (2002) described that fats and oils achieved from vegetables play important part in decreasing the blood lipids, consequently lessen the incidence of diseases due to injuries in coronary veins. Lower fat contents were obtained in the current study as compared to values

reported by Asaolu et al. (2012) and Fagbohun et al. (2012).

Ascorbic acid (vitamin C) is easily dissolved in water needed in high quantity, as body is losing this vitamin continuously (Fain, 2004; Iqbal et al., 2013; Hanif et al., 2006). It contributes in reestablishing the oxidation-reduction process. It helps in removing the diseases like scurvy and take part in the construction of derivatives of folic acid, which play a major role in the synthesis of DNA (Chatterjea and Shinde, 1998; Hanif et al., 2006). The present results are closely related with the findings of Hanif et al. (2006), who also found higher vitamin C in *Spinacia oleracea.*

Fiber obtained from vegetables play significant role in reducing the cholesterol level from body, lessen the hazard of cardiovascular diseases, lowers blood sugar, remove constipation, lowers hypertension, cure breast and colorectal cancer (Ishida et al., 2000; Hanif et al., 2006; Emebu and Anyika, 2011). Vegetables should be a regular part of our daily diet as they are essential for health and contain vital elements compulsory for usual working of body when utilized in suitable combination (Aletor and Adeogun, 1995; Hanif et al., 2006). The higher fiber contents were recorded in *Abelmoschus esculentus* in the current study. Carbohydrates provide power and fuel to the body which is necessary for keeping fit and to continue activities on daily basis. Regular provision of energy is essential for normal functioning of human body. Short supply of carbohydrates in daily food causes the drowsiness or weakness, poor patience and strength, and improper brain performance or working (Udousoro and Ekanem, 2013). Proteins, fats and carbohydrates are the main tools of the daily diet as they supply energy needed for the development, repairing and building up of body structure. Calbet and MacLean (1997) stated that the speed of vacating stomach is a role of caloric value in a health and fit the humans. The current results showed higher carbohydrate and energy values in root crop *Daucus carota* and lower in fruit vegetable *Lycopericon esculentum* like those reported by Hanif et al. (2006).

Abelmoschus esculentus provided higher potassium (K) contents (277.33mg/100g). Second copious mineral present in the majority vegetables was phosphorus. Sodium was present in noticeable quantity; higher amount was observed in the *Lycopericon esculentum* (65.33 mg/100gm). These results are in close agreement with the findings of Haward et al. (1962); Bors and Jasper, (1992); Hanif et al. (2006). Habtamu et al. (2014) reported that edible parts of okra (*Abelmoschus esculentus*) is considered aa powerhouse of significant nutrients and cheaper source of carbohydrates, protein, minerals, dietary fiber and vitamins. Increasing the use of okra (*Abelmoschus esculentus*) fruits in diet is a cheaper source of nutrients that could possibly not only improve the nutritional status but also reduce the incidence of malnutrition and also consumed as a source of food diversification (Gemede et al., 2015).

Minerals play very vital role in the human body functioning such as the balance of water and acid base. Phosphorus is found in the huge amount in the bones and body structure. Sodium and potassium play a role as an electron delivery service in the body. Iron is a significant component of hemoglobin formation, helps in regular functioning of the nervous system and important in the oxidation of proteins, fats and carbohydrates (Adeyeye and Otokiti, 1999). Vegetables provide all these elements and improve their ease of use in daily life.

Conclusions and Recommendations

It was concluded from the present research that all the tested vegetables had different nutrient and mineral levels. Higher vitamin contents were found in one vegetable while lower in others. Some vegetables contain higher fiber contents while other provides the maximum protein content. Some vegetables were rich in carbohydrate and calorific values while these contents were poor in others. All the tested vegetables contained higher moisture and low-fat contents. As far as mineral contents are concerned, some vegetables contained significantly higher levels of Ca, P, K, Na and Fe and their poor concentrations were noticed in others. It is suggested that vegetables are more profitable for the improvement of health and normal body working when ingested in different combinations. This research was carried out with the intention to alert the peoples about the significance of nutrients they intake while eating vegetables.

Author's Contribution

Safina Naz and Muhammad Akbar Anjum, Conceived the idea while Safina Naz wrote article. Syed Atif Hasan Naqvi and Bushra Siddique performed SPSS analysis. Muhammad Asif Zulfiqar performed references compilation and management of the arti-

cle.

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