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Determination of Nutritional Status of Some Vegetables Grown with Different Water Resource Applications in Sargodha, Pakistan

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Abstract. Proximate and nutritional concentrations of some vegetables irrigated with different types of water were determined in present study. *Allium fistulosum* showed highest concentrations of N and P at site3 and site1, respectively. Highest ash concentration in *Trigonella foenum-graecum* demonstrated high mineral concentration of this vegetable. The crude protein contents ranged from 15.38% to 26.19% and crude fiber contents ranged from 12.81% to 16.73% in all vegetables. The tannins and saponins contents showed significant ($P<0.05$) result among all vegetables at all sites. Proximate and nutrient analysis of cultivated vegetables can help us to determine the health benefits achieved from their use in marginal communities.

Keywords: nitrogen, potassium, phosphorus, crude protein, crude fiber, vegetables

Introduction

Vegetables are important means of nutrients particularly in rural zones, where they contributes significantly to protein, minerals, vitamins, filaments and different supplements which are normally hard to come by diets (Mohammed and Sharif, 2011). Vegetables are consisting of crude material for setting up a variety of sustenance, in this way improving nutrition (Butnariu and Chimie, 2006).

Proximate and nutrient investigation of vegetables assumes a critical part in evaluating their nutritious status (Pandey *et al*., 2006). It provides information on ash content, crude protein and crude fibre etc. Ash is the inorganic residue left over after water and organic matter and can be removed by heating, which gives information about the total amount of minerals in food. In the presence of N, soil have better capacity to hold essential elements because positive ions holding ability of soil increased by N (Epstien *et al*., 1976). Certain crude substances which required at specific limits and are growth regulators are known as nutrients (Parveen *et al*., 2006).

Already, various studies found that water rich with significant sources, for example, natural matter, macro and microelements that needed by the vegetables for ripeness and fertility of soil (Kiziloglu *et al*., 2008). Different specialists discovered wastewater utilized for irrigation supply N, K and P to vegetables and soil, in this manner expanding yields and quality (Rusan *et al*., 2007). It has been accounted for that vegetables contain protein, vitamins and minerals required in food; and additionally roughage which advance assimilation and avert obstruction. 4-10% weight of young leaves consisting proteins, while in more old leaves the rate is just 1-2% (Aliyu, 2006). The potassium level of leafy vegetable is great in the control of diuretic and hypertensive muddling (George, 2003).

These vegetables however contain anti-nutritional components that can influence the accessibility of the nutrients. Anti-nutritional variable is known to hinder with metabolic procedures such that development and

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bioavailability of nutrients are negatively affected (Abara, 2003; Binta and Khetarpau, 1997). Proximate (ash, crude fibre, crude protein and ether extract), nutritional (N, P, K) and anti-nutritional (Tannins, saponins, alkaloids, terpenes) were determined in the present study in order to know the nutritional status of some vegetables.

Materials and Methods

Study area. Study area was Sargodha which occupies fifth position in the cities found in Punjab. In North East side of Pakistan Sargodha is situated. Its latitude is 32, 08369 (32.5′ to 0.960 N″)., its longitude is 72,6711(7240′ 15.960″ E) and its altitude is 193 m. On its western and northern sides the river Jhelum flows and river Chenab flows on its eastern side. Sargodha is known as city of Eagles, the largest airbase PAF Mushaf which is famous for air warriors is found here. In summer the average temperature in day time reach up to 35 °C and drops down to 27 °C, in night time. In the month of July the temperature reach to maximum till 43 °C (109 °F) and in December the lowest recorded temperature 14 °C. Six most common vegetables at three sites were chosen for investigation namely, *C. sativum* (*Coriandrum sativum* L.), spring *A. fistulosum* (*Allium fistulosum* L.), fenugreek leaves (*Trigonella foenum-graecum* L.), *D. carota* (*Daucus carota* L.), *R. sativus* (*Raphanus sativus* L.) and *B. rapa* (*Brassica rapa* L.). The collection of samples was done from December 2014 to March 2015.

Vegetable collection. Eighteen samples of each vegetable were taken from three sites; one was supplied with groundwater, second with canal water and third with wastewater. Wastewater is a combination of domestic Sewage water and non-sewage water. The domestic sewage includes all wastewater generated by home dwellings, public restrooms, hotels, hospitals. Non-sewage water includes water from floods (storm water), runoff water from car garages and cleaning centers.

Deionized water was used for washing samples in order to evacuate soil and stored for further examinations.

Proximate analysis. Crude protein (CP), ether extracts (EE), Crude fiber (CB) and ash content (AC) were analyzed using the method of AOAC (1996).

Ash. Take 1 g of sample, burn it at 600 °C for six hours. Burn all the organic contents. Ash contents were detected by using formulae (AOAC, 1996).

$$\text{Ash \%} = \frac{\text{weight of ash}}{\text{weight of sample}} \times 100$$

Crude protein. Percentage of crude protein was analyzed (AOAC, 1996).

$$\text{Crude protein} = \text{N (\%)} \times 6.25$$

Crude fibre. The first step was that samples were digested with 1.25% sulphuric acid and then with 1.25% sodium hydroxide solution and filtered. The filtrate was then weighed and heated at 55 °C in a muffle furnace till the remainder became white. Crude fibre percentage was calculated (AOAC, 1996).

$$\text{Crude fibre (\%)} = \frac{\text{weight loss in ignition (g)}}{\text{weight of sample (g)}} \times 100$$

Determination of macronutrients. ***Nitrogen.*** In order to determine the percentage of nitrogen, Kjeldahl's method was used (AOAC, 1990). Concentrated sulphuric acid and digestion tablets were mixed with the samples for approximately 2-3 h until the material became colorless. In order to dilute the sample, it was the mixed with 10 mL of 40% sodium hydroxide and 250 mL distilled water. In the end, ammonia released was then collected in 2% boric acid solution and titrated in 0.1 N sulphuric acid. The indicator used was methyl red resulting in golden brown colour at the end of process. Percentage of nitrogen was calculated by using the following formula:

$$\text{Nitrogen \%} = \frac{\text{Volume of 0.1 N } H_2SO_4 \times \text{Volume of dilution} \times 0.0014 \times 100}{\text{Weight of sample (g)} \times \text{Volume of dilution (mL)}}$$

Determination of phosphorus. Phosphorus was determined colorimetrically (Chapman and Pratt, 1961).

Determination of potassium. Potassium was determined according to Jackson (1959) using flame photometer (Jenway model PFP7).

Determination of anti-nutrients. Tannin, terpenes, alkaloids and saponins were determined.

Estimation of tannins. An aliquot of the sample extract containing not more than 0.5 mg of tannic acid was used and the percentage of tannin was determined.

Determination of terpenes. Terpenes were determined by using gas chromatograph-mass spectrometer (GC-MS) (Hewlett-Packard HP59822B, Palo Alto, California) (Kjeldsen *et al*., 2003).

Determination of saponin. 0.5 g of the sample was added to 20 mL of 1NHCl and was boiled for 4 h. After cooling it was filtered and 50 mL of petroleum ether was added to the filtrate for ether layer and evaporated to dryness. 5 mL of acetone ethanol was added to the residue and 0.4 mL of each was taken into 3 different test tubes. 6 mL of ferrous sulphate reagent was added into them followed by 2 mL of conc. H_2SO_4. It was thoroughly mixed after 10 min and the absorbance was taken at 490 nm (Cowan, 1999).

Determination of alkaloid. For alkaloid determination, a known weight of the plant material was extracted with 20% acetic acid in ethanol. The sample was filtered and then concentrated, using a water bath, to one-quarter of the original volume. Concentrated ammonium hydroxide was then added drop wise to the extract until precipitation was complete. The whole solution was allowed to settle and the precipitate was collected by filtration and weighed (Obadoni and Ochuko, 2001; Harbone, 1973).

Statistical analysis. All data were subjected to statistical analysis by using SPSS 20 for one way ANOVA. The differences between the mean concentrations were found at 0.001, 0.01 and 0.05 probability levels (Steel and Torrie, 1980).

Results and Discussion

Nitrogen. N concentration showed significant (P<0.05) variation in all vegetables (Table 1). Highest N concentration was found in *A. fistulosum* (1.97) at site3 and lowest in *D. carota* (1.53) at site2 (Table 2). The low N levels may be ascribed to their development on uncultivated land, since N in vegetable is because of nitrate treatment used to push development of the plant (Sarojini, 1998). Results of N content for *S. nigrum* and *S. biafrae* reported by Lola (2009) were lower than the present N concentrations. Highest value N was seen at site3 during present study. Macronutrients are thought to be essential in human nourishment (Ibang and Okon, 2009)

Phosphorus. P concentration showed significant (P<0.05) variation in all vegetables except in *A. fistulosum* (Table 1). Highest P concentration was found in *A. fistulosum* at site1 and lowest in *T. foenumgraecum* at site-I (Table 2). Useful and unwanted chemical contents in vegetables essentially influenced by agro-technical measure, chemical composition of water, soil fertility and in addition climate conditions (Takebe *et al*., 1995). Agbaire (2011) reported lower concentration of P in some local vegetables of Nigeria as compared to present study.

Potassium. K concentration showed significant (P<0.05) variation in all vegetables except in *A. fistulosum* and *R. sativus* (Table 1). Highest K concentration was found in *D. carota* at site3 and lowest in *B. rapa* at site2 (Table 2). Concentrations of K were in the range 1.36-1.58. FNIC (2011) also suggested concentrations (mg/Kg) of K in some vegetables as; cabbage (147), broccoli (229), *D. carota* (183), Chinese cabbage (268) and spinach (167). Emmanuel *et al*. (2011) reported much higher concentrations of P and K in Iringa district, Tanzania. During present study lower concentrations of K were found as compared to the concentration of K recorded by Osman (2004) in *A. digitata* pulp. The concentrations of K in present study were varied from 1.36% to 1.58 and lower than prescribed 18.0 mg/g every day necessity.

Ash. Ash contents showed significant (P<0.05) variation in all vegetables (Table 1). At site2, maximum ash contents were observed in *T. foenum-graecum* and the minimum in *R. sativus* (Table 3). Ash values are an evidence of the mineral status, these high values demonstrated that the vegetables are high in mineral concentration. Proof from epidemiological studies suggested that expanded fiber use may add to a lessening in the frequency of specific maladies like diabetes, coronary illness, colon tumor, hypertension, corpulence, and different digestive issue (Eriyamremu and Adamson, 1994). The ash content of present study were in the range 15.79-23.66%, this was significantly higher than that of *C. aconitifolius*, *T. occidentalis and A. cruentus* (Kochhar, 1981). Present values of ash were above than the acceptable range for edible vegetables as suggested by Lucas (1988) and high to those obtained by Abidemi *et al*. (2009).

Crude protein (%). Analysis of variance showed significant (P<0.05) variation in all vegetables except *C. sativum* (Table 1). The crude protein contents ranged from 15.38% to 26.19% in all vegetables. These values were higher than the value 1.20 and 1.93% reported for *L. tetraxidicolie* and *B. rubra*, respectively (Isa *et al*., 2006). Present values of crude protein were much higher as compared to findings of Ajala (2009). The higher crude protein contents as contrasted and results by Abidemi *et al*. (2009) makes them a good supply of vegetable protein which can provide animal protein. Vegetables containing high crude protein contents may

Table 1. Analysis of variance of the parameters under different water resource applications in various vegetables

Parameters	*C. sativum*	*A. fistulosum*	*T. foenum-graecum*	*D. carota*	*R. sativus*	*B. rapa*
N	0.05***	0.017***	0.006***	0.07***	0.03***	0.05***
P	0.01***	0.01ns	0.007***	0.02***	0.009***	0.011**
K	0.03***	0.01ns	0.019***	0.04***	0.002ns	0.009***
Ash (%)	11.99***	6.33**	39.6***	26.37***	25.29***	5.89***
C.P (%)	71.99ns	26.05***	1.85***	11.14***	1.89***	3.08***
C.F (%)	9.97***	2.17***	2.73***	4.02***	3.37***	0.59*
E.E (%)	0.02***	0.02***	0.015***	0.006***	0.015ns	0.006**
Terpenes (mg/Kg)	75.44**	109.8**	1518***	616.8***	148**	800.8***
Tannins (%)	0.05***	0.032**	0.009**	0.008**	0.125***	0.048**
Alkaloids (%)	0.007**	0.001ns	0.003*	0.004ns	0.014**	0.009ns
Saponins (%)	0.959***	2.29***	0.79***	0.79***	1.71***	0.048*

*,**,*** = Significant at 0.05, 0.01 and 0.001 levels; ns= non-significant

Table 2. Mineral composition of different vegetables

Minerals	Study sites	*C. sativum*	*A. fistulosum*	*T. foenum-graecum*	*D. carota*	*R. sativus*	*B. rapa*
	Site1	1.68±0.01	1.83±0.13	1.85±0.19	1.83±0.14	1.89±0.11	1.76±0.22
N (%)	Site2	1.54±0.02	1.87±0.17	1.75±0.11	1.53±0.11	1.73±0.21	1.57±0.12
	Site3	1.78±0.03	1.97±0.21	1.81±0.15	1.77±0.12	1.91±0.14	1.81±0.14
	Site1	0.89±0.02	0.81±0.04	0.65±0.03	0.76±0.21	0.81±0.22	0.85±0.02
P (%)	Site2	0.83±0.01	0.87±0.17	0.78±0.02	0.69±0.18	0.89±0.26	0.84±0.03
	Site3	0.79±0.07	0.91±0.02	0.75±0.06	0.84±0.22	0.78±0.15	0.74±0.09
	Site1	1.52±1.3	1.48±0.08	1.53±0.14	1.36±0.2	1.52±0.17	1.48±0.04
K (%)	Site2	1.47±1.8	1.51±0.13	1.47±0.11	1.56±0.1	1.53±0.21	1.36±0.08
	Site3	1.45±1.5	1.56±0.11	1.37±0.17	1.58±0.5	1.57±0.19	1.43±0.14

be used as high protein sources in some sustenance definitions. It has been accounted for that protein-calories hunger lacks is a central point dependable in nourishing pathology (Roger *et al*., 2005). Mean concentration of crude protein was recorded maximum at canal-water-irrigated-site. Plant sustenance that give more than 12.0% of its calorific quality from protein are considered great source of protein (Pearson, 1976). The consequences of this work demonstrated that sufficient protein is present in these vegetables and are great eating regimen for human being.

Crude fibre (%). Crude fibre contents showed significant (P<0.05) variation in all vegetables (Table 1). The Crude fiber contents ranged from 12.81% to 16.73% in all vegetables (Table 3). These values are high as compared to crude fiber reported for *L. tetraxidicolie* and *B. rubra* (Isa *et al*., 2006). The American Dietetic Association (ADA) prescribed an intake of 20-35 g of fiber for every day (Duyff, 2002). Highest value (16.73 %) of crude fiber was found at site3. Right now estimation of sustenance, crude fiber in the eating regimen is vital for absorption and for effective removal of wastes (Vadivel and Janardhanan, 2005).

Ether extract (%). Analysis of variance showed significant effect of sites in all vegetables except *R. sativus* (Table 1). Highest concentrations of ether extract were found in T. foenum-graecum at site1 and lowest in *R. sativus* at site 2. Ether extract is a big source of energy which is utilized by individuals for protection and construction (Babayemi *et al*., 2009).

Terpenes (mg/Kg). The terpenes content showed significant (P<0.05) result among all vegetables (Table 1). The terpenes contents among different vegetables ranged from 128 mg/Kg to 211 mg/Kg in (Table 4). Utilization of vegetables with moderate concentration of anti-nutrients is useful for human health (Mensah *et al*., 2008; Lewis and Elvin-Lewis, 1998).

Tannins (%). The tannins contents showed significant (P<0.05) result among all vegetables (Table 1). The tannins contents among different vegetables ranged from 1.33% to 1.91%. The tannin content in *S. nigrum*

Table 3. Proximate composition of different vegetables

Proximate	Study sites	*C. sativum*	*A. fistulosum*	*T. foenum-graecum*	*D. carota*	*R. sativus*	*B. rapa*
	Site1	19.55±0.04	20.56±0.08	20.41±0.08	18.24±0.2	21.42±0.02	21.38±0.21
Ash (%)	Site2	22.46±0.04	18.53±0.11	23.66±.02	16.63±0.1	15.79±0.05	18.61±0.11
	Site3	18.63±0.05	17.75±0.57	16.41±0.07	22.38±0.3	17.35±0.04	19.66±0.04
	Site1	19.38±0.01	20.41±0.3	20.51±0.02	19.53±0.18	21.31±0.03	20.47±0.06
C.P (%)	Site2	15.38±0.06	26.19±0.7	18.95±0.07	23.38±0.26	17.52±0.04	22.16±0.03
	Site3	25.12±0.01	22.33±0.4	19.54±0.04	21.65±0.13	18.33±0.06	20.34±0.08
	Site1	13.63±0.04	13.42±0.09	16.14±0.05	15.32±0.2	15.53±0.14	16.33±0.09
C.F (%)	Site2	16.29±0.01	14.24±0.08	14.33±0.04	14.44±0.1	13.41±0.13	15.64±0.14
	Site3	12.81±0.02	15.12±0.09	14.71±0.05	16.73±0.7	14.32±0.17	15.53±0.28
	Site1	0.68±0.01	0.85±0.02	0.95±0.02	0.75±0.14	0.79±0.4	0.71±0.18
E.E (%)	Site2	0.75±0.08	0.69±0.08	0.81±0.04	0.84±0.17	0.65±0.3	0.76±0.17
	Site3	0.85±0.02	0.73±0.09	0.84±0.08	0.81±0.14	0.77±0.13	0.67±0.07

Table 4. Anti-nutrients composition of different vegetables

Anti-nutrients	Study sites	*C. sativum*	*A. fistulosum*	*Trigonella foenum-graecum*	*D. carota*	*R. sativus*	*B. rapa*
Terpenes)	Site1	138.33±1.4	141.33±1.4	146±1.2	203±1.1	215±1.15	210±0.6
(mg/kg	Site2	134±1.5	148.67±0.9	173±1.4	174.67±1.8	211±1.11	193±0.6
	Site3	128.33±1.7	136.67±0.8	191±1.5	185±2.1	201±2.01	177±0.9
	Site1	1.65±0.1	1.64±0.11	1.54±0.14	1.51±0.11	1.72±0.17	1.39±0.2
Tannins (%)	Site2	1.91±0.1	1.79±0.14	1.61±0.17	1.45±0.12	1.64±0.14	1.64±0.4
	Site3	1.74±0.2	1.84±0.43	1.50±0.17	1.55±0.11	1.33±0.23	1.53±0.5
	Site1	1.85±0.12	1.79±0.1	1.85±0.11	1.81±0.05	1.78±0.21	1.84±0.13
Alkaloids (%)	Site2	1.89±0.15	1.77±0.8	1.89±0.14	1.87±0.01	1.69±0.19	1.76±0.17
	Site3	1.94±0.17	1.78±0.2	1.91±0.11	1.87±0.08	1.66±0.18	1.73±0.19
	Site1	3.44±0.11	4.28±0.14	5.87±0.08	5.15±0.01	6.28±0.11	4.77±0.5
Saponins (%)	Site2	4.21±0.14	5.69±0.11	5.83±0.04	6.13±0.08	4.86±0.18	4.87±0.3
	Site3	4.55±0.15	5.88±0.20	4.97±0.01	5.36±0.01	5.13±0.14	5.02±0.7

and *S. biafrae* reported by Ajala (2009) was lower and that of *C. aconitifolius* reported by Aletor and Adeogun (1995) was higher as compared to present study (Table 4). Present contents of tannins were lower as compared to tannin values reported by Kayode *et al*. (2012). Ajiboye *et al*. (2013) reported lower concentrations of tannins than present findings. Except for tea, long and unnecessary utilization of vegetables containing high amount of tannins is not prescribed (Fasuyi, 2006). Tannins are water dissolvable phenolic mixes with an atomic weight >500 and exist in every single vascular plant. Tannin ties to proteins making them bio-unavailable (Sotelo *et al*., 1995).

Alkaloids. The alkaloids contents showed non-significant (P>0.05) result among all vegetables except *C. sativum*, *T. foenum-graecum* and *R. sativus* (Table 1). Kayode *et al*. (2012) recorded high contents of alkaloids as compared to the present contents of alkaloids. By and large, alkaloids have particular impacts on the focal sensory system (for instance, caffeine), particularly on the neural connections (the crevices between nerve cells) in the conductors of the sensory system. The general solvency of alkaloids in lipids is correlated in this sort of exploits (Lewis and Elvin-Lewis, 1998). Alkaloids are critical in pharmaceutical and constitute the majority of the profitable medications. They have checked physiological impact on human (Edeoga *et al*., 2005).

Saponins (%). Saponins contents varied from 3.44% to 6.28% among vegetables (Table 3). These values were higher when compared with the results from other works (Nkafamiya *et al*., 2010). The difference between saponins contents of different vegetables was significant ($P < 0.05$) at all sites (Table 1). Chibueze and Akubugwo (2011) reported high contents of saponins as compared to present study. These anti-nutrients are of interest in light of the fact that they are critical both for the protection of plant and for human, as a class of cancer prevention agents. For example, saponins have been accounted for to have hypo-cholesterolic impact (Price *et al*., 1987) and this may help in the decrease of metabolic weight that would have been put on the liver while other anti-nutrients have anti-oxidation impact in animals (Enwere, 1998).

Conclusion

Highest concentration of N and P was found at site 3 suggested that wastewater is a good source of fertilizer. It is known that N and P are considered as the important macro nutrients that are required by crops for ample growth. Low ash content was found at site 3 in *T. foenum-graecum* which is usually an indicator of high nutrient quality of the selected vegetable. Proximate analysis revealed that the vegetable samples studied have great potentials as rich sources of essential nutrients like protein and fat when consumed.

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