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Evaluation of some nutrients in selected vegetables of Solanaceae

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ABSTRACT

Aim of this study was to evaluate the selected essential nutrients sodium, potassium, iron and copper in vegetables of Solanaceae family i.e. *Solanum tuberosum (St), Capsicum annuum (Ca), Capsicum frutescence (Cf) and Solanum melongena (Sm)* using Flame Photometer and Atomic Absorption Spectrometer. Study shows that *St* has the highest sodium value (10.2mg/kg) which was significantly higher than that of *Sm* (5.5mg/kg), *Ca* (4.6mg/kg) and *Cf* (2.9mg/kg) having the lowest sodium value. *Sm* has the highest potassium content (340.15mg/kg) which was significantly higher than *Cf* (291.42mg/kg), *Ca* (276.02mg/kg) and *St* having the lowest potassium value (243.21mg/kg). Highest content of copper (0.158mg/kg) was observed for *Ca* followed by *Cf* (0.127mg/kg), *Sm* (0.081mg/kg) and *St* having the lowest copper value (0.016mg/kg). Iron content shows that *Capsicum annuum* (1.632mg/kg) has the highest iron followed by *Sm* (0.990mg/kg), *St* (0.433mg/kg) and *Cf* (0.133mg/kg). Potassium to sodium ratio is very important tool that can help in choosing healthy food ingredients for healthy dieting. The entire selected samples showed more sodium than potassium. The selected vegetables of the studied area have an excellent profile of studied macro and micro-nutrients and equally contribute to provide these nutrients to the local population.

INTRODUCTION

The Solanaceae family represents around 85 genera of flowering plants consisting of over 2800 species globally [1] and is widely cultivated all over the country for their edible fruits or modified stem. Several major crops of global agricultural importance and of economic and medicinal value such as potato (*Solanum tuberosum L.*), Chilli (*Capcicum frutescens*), Bell pepper (*Capsicum annum*) and egg plant (*Solanum melongena*) belong to the family Solanaceae.

Nutritionally, *Solanum tuberosum* are second only to soybean for amount of protein/ha, with the major storage protein being patatin, one of the most nutritionally balanced plant proteins known [2]. *Capsicum annum* has superfluous nutritional and medicinal value [3, 4], it is the only genus known to produce capsaicinoids and capsaicin is the major and the most active, pungent compound of chilli peppers [5]. *Capcicum frutescens* are great source of vitamin C and good amount of other antioxidants such as vitamin A, B-complex group of vitamins such as niacin, pyridoxine (vitamin B6), riboflavin and thiamin (vitamin B1) and flavonoids like β-carotene, α-carotene, lutein, zea-xanthin, and cryptoxanthin. Chili also carries different minerals like potassium, manganese, iron, and magnesium. *Solanum melongena* is 92% water, 6% carbohydrates, 1% protein, and has negligible fat. It provides low amounts of essential nutrients, with only manganese having a moderate percentage (11%) of the Daily Value. Minor changes in nutrient composition occur with season, environment of cultivation (open field or greenhouse), and genotype.

MATERIALS AND METHODS

All the standard solutions were prepared from analytical grade compounds of Merck Company. All the glassware's used were of Borosil. Prior to all chemical analyses, the reagent bottles, beakers, and volumetric flasks were cleaned by soaking overnight in 2N hydrochloric acid, rinsed with water and oven dried at 60^{o}C. Instruments used in the investigation are Atomic Absorption Spectrometer (Varian Model AA240), Flame photometer (ESICO Model-1382) industrial oven, fume hood, heating plate and weighing balance (A- KERN 572).

A. Sample collection and preparation: The samples were collected from vegetable sellers of local market. The sample was thoroughly washed in de-ionized water to remove dirt particles contained in them. The sample was then chopped into small pieces and air dried in shade at room temperature for three days. The plant material was further dried in the oven at 60°C for 04 hours in order to blend them into a powdery form in a food blender. The powder was then sieved using 2mm size and kept in an air tight sealed plastic/ glass container which were kept in desiccators in order to preserve it from humidity. To avoid sample contamination, all handling and preparation steps were carried out on clean benches. Wet digestion method was used for sample preparation. 1gm of sample was taken and transferred to 100ml beaker and 10 ml HNO3 was added and covered with watch glass, the mixture was heated to 95^{o}C on heating plate, and the digestion continued till no brown fumes evolved and solution becomes clear and colorless. The beaker was then cooled to room temperature. The solution was then filtered through whatman filter paper and transferred into a 100 ml volumetric flask and make up to the mark with de-ionized water, stopper the flask and mixed by inversion.

B. Determination of sodium and potassium: Potassium and sodium standards of 20, 40 and 60 ppm were prepared by 1000 ppm stock solutions of sodium and potassium. Deionised water was used as blank. The flame photometer was set up as outlined in its instruction manual. The blank was aspirated and the instrument was calibrated using standards. The prepared sample solution was aspirated and the result was noted by the display.

C. Determination of copper and iron: Stock standard solutions of Merck, 1000 ppm concentrations were used for copper and iron. A calibration series of standards were prepared by appropriate dilution from its stock solution with 0.5% HNO3. The instrument was calibrated using series of working standards for copper and iron. Then absorbance of the prepared sample solution was measured using Atomic Absorption Spectrometer.

RESULTS AND DISCUSSION

Minerals are important for vital body functions such as acid base and water balance. Na and K are used as an electron carrier in the body. Fe is an important constituent of Hemoglobin. Copper is a coenzyme and crucial cofactor in Fe utilization, collagen amalgamation, and concealment of free radicals etc. [6, 7]. Vegetables contribute these minerals and enhance their availability in daily life. The vegetables were found to be good sources of Na, K, Cu and Fe. These vegetables considered as sole source of macro and micro elements and can be used as one of the potential sources of the elements in the diet.

Table 1: The concentration of the sodium, potassium, iron and copper (mg/kg) in selected vegetables

S.N.	Botanical name	Sample Codes	Concentration of elements (mg/kg)			
			Sodium	Potassium	Copper	Iron
1.	*Solanum tuberosum*	*St*	10.2	243.21	0.016	0.433
2.	*Capcicum frutescens*	*Cf*	02.9	291.42	0.127	0.133
3.	*Capsicum annuum*	*Ca*	04.6	276.02	0.158	1.632
4.	*Solanum melongena*	*Sm*	05.5	340.15	0.081	0.990

Table 2: Potassium to sodium ratio of selected vegetable samples

Samples	*S. tuberosum*	*C. frutescens*	*C. annuum*	*S. melongena*
K/Na Ratio	23.84	100.48	60.00	61.84

St has the highest sodium value (10.2mg/kg) which was significantly higher than that of *Sm* (5.5mg/kg), *Ca* (4.6mg/kg) and *Cf* (2.9mg/kg) having the lowest sodium value. A.R. Freena et al (2018) [8] detected Na ranged from 3.22- 15.6 mg/kg in different vegetables, and these values are very much similar to the present values of sodium. Agnieszka et al (2021) [9] reported sodium concentration in green *Ca* ranged from 5.0- 6.5 mg/kg.

Sm has the highest potassium content (340.15mg/kg) which was significantly higher than *Cf* (291.42mg/kg), *Ca* (276.02mg/kg) and *St* having the lowest potassium value (243.21mg/kg). A.R. Freena et al (2018) detected K ranged from 4.11- 39.7mg/kg in different vegetables, and these values are lower than the present values of potassium. Agnieszka et al (2021) reported potassium concentration in green *Ca* ranged from 401- 481 mg/kg. Naiz et al (2022) [10] observed levels of K in the studied vegetables in the range of 38.40- 57.30mg/kg, quite lower in comparison to the present values.

Highest content of copper (0.158mg/kg) was observed for *Ca* followed by *Cf* (0.127mg/kg), *Sm* (0.081mg/kg) and *St* having the lowest copper value (0.016mg/kg). It has observed that the contents of Cu in all studied vegetables were within the WHO maximum permissible limit (50μgkg^{-1}). The finding of A.R. Freena et al (2018) (Cu 0.01- 0.25 mg/kg) was in accordance to the present result. According to Naiz et al (2022) the range of Cu in studied vegetables was 1.72-9.30 μg.kg^{-1}. *Ca* (1.632mg/kg), has the highest iron followed by content *Sm* (0.990mg/kg), *St* (0.433mg/kg) and lowest iron content was found in *Cf* (0.133mg/kg). The contents of Fe were found in all the vegetables within the WHO permissible limit (300μgkg^{-1}). Similar observations (Fe- 0.032- 0.63mg/kg) were reported by Samoo et al (2018). According to the investigation of Naiz et al (2022) the range of Fe in studied vegetables was between 2.70 and 11.30 μg.kg^{-1}.

Potassium to sodium ratio (table 2) is very important tool that can help in choosing healthy food ingredients for healthy dieting. The entire selected samples showed more sodium than potassium. N. Saupi et al., (2009) [11] stated that the high ratio of K/Na in any food is an important factor in prevention of hypertension arteriosclerosis, with potassium depresses and Na enhances blood pressure (N. Saupi et al., 2009). Highest ratio of K/Na (100.48) was observed for *C. frutescens*, though *Cf* is normally used in small quantities in cooking. The ideal ratio of sodium to potassium intake is roughly 1:3 that is; potassium intake would ideally be around three times our sodium intake. High intake of salt is associated with hypertension [12].

The more or less similar studies on different vegetables have been done by many researchers [9, 13, 14, 15, 16, 17, and 18] but there are differences in the analyzed vegetables for the element contents. These differences could easily be explained by the fact that the vegetables do not come from the same soil. They come from different geological horizons and growing conditions are not necessarily the same.

CONCLUSION

Vegetables have the potential to provide sufficient amount of the analyzed nutrients needed for normal body function, maintenance and reproduction. Vegetable intake in different combination is essential for the maintenance of healthy life and normal body functioning. The selected vegetables are good sources of sodium, potassium, iron & copper and can make some contribution to these micronutrient intakes, though *Cf* is normally used in small quantities in cooking. Moreover, the macro and micro minerals in studied vegetables were comparable with the literature reported on the same vegetables in different areas of India and other countries. Result describes that the presence of the sodium is seen higher in *St*, Potassium in *Sm* and it is also seen that *Ca* contains iron and copper in highest amount. The study indicates that the vegetables of the studied area have an excellent profile of studied macro and micro-nutrients and equally contribute to providing these nutrients to the local population.

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