Antioxidant Nutrient Density of Local Foods: Content of Vitamin C in Selected Fruits and Vegetables of Bangladesh

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Abstract

The study was carried out on 3 fruits and 6 vegetables. The samples were collected from the different locations covering the 30 agro-ecological zones of Bangladesh so that the study qualifies as a representative composite nutrient analysis. The proximate nutrients content was analyzed by AOAC method, while the antioxidant nutrient such as vitamin C (L-ascorbic acid) was measured by HPLC method. Ripe Mango (Langravarity) and green chili are rich source of antioxidant nutrient Vitamin C (L-ascorbic acid, about 103mg and 102mg/100g raw edible portion for mango and green chili, respectively); potato (Diamond variety), tomato and bean were found to contain medium amount of Vitamin C among the selected fruits and vegetables.

Key words: Antioxidant, Vitamin C, Fruits and vegetables

Introduction

An antioxidant has been described as a substance in foods that substantially reduces the unfavorable consequences of reactive oxygen and nitrogen species or each on a regular physiological feature of humans. Vitamin E, vitamin C, and carotenoids are generally considered to be major dietary antioxidants. Moreover copper, zinc, selenium and iron act as cofactor of different enzymes (Superoxide dismutases, Glutathione peroxidase, Fe-SOD and many other enzymes), some of which have antioxidant functions[1].

Currently, several empirical studies have shown clear scientific opinion that most diseases are triggered by oxidative stress due to activated oxygen, different free radicals, and lipid oxidation[1,2]. Reactive oxygen species (ROS) are produced continuously in vivo whether by aerobic cellular metabolism or by environmental factors when exposed to polluted air, radioactive substances, and drugs[3]. Oxidative stress has been shown to cause cancer and many lifestyles associated illnesses such as diabetes, hypertension, dementia, myocardial infarction, corneal ulceration, cerebral apoplexy, arterial sclerosis, and so on[2,4]. Significant attention has been given to dietary antioxidants concerning their beneficial effects toward oxidative damage[5,6]. Living organisms defend themselves toward oxidative injury by using internal antioxidant protection systems[7], or via consumption of dietary antioxidant broadly allotted in fresh food[6-8].Bioactive compounds may be phenolic compounds (phenolic acids, an active form of vitamin E, and flavonoids), nitrogen compounds (amino acids, chlorophyll derivatives, amines, and alkaloids) or carotenoids, as well as ascorbic acid[8,9]. In the human body, vitamin C mainly prevails in its reduced condition, ascorbic acid (AA); this even persists in tiny amounts in the oxidized state, dehydroascorbic acid (DHA). Ascorbic acids act as a coenzyme responsible for the biosynthesis of collagen[10], carnitine, norepinephrine[6] and in the amination of hormones. Ascorbic acid is a potent antioxidant, quenching ROS and reactive nitrogen species in plasma and cells. Intracellular vitamin C can reduce cell death and hinder DNA mutations caused by oxidative stress[3]. ROS plays a vital role in cellular responses as chemical second messenger molecules, while antioxidants can modulate specified signal responses[11].

Dietary Vitamin C is essential for humans, guinea pigs, primates, and some different animals and insects that absent of L-gulonolactone oxidase enzyme, the last enzyme in its biosynthetic pathway from glucose[12]. National nutrition surveys in 1995-96, have shown that cereal consumption represents the largest proportion (62%) of the diet, followed by using non-leafy vegetables, roots, and tubers, all of which make up more than four-fifths of the rural population's total diet[13]. However, according to HIES-2016, cereal (rice and wheat) contributed about 60% of calorie in the diet[14]. In Bangladesh, consumption of fruits is seasonal, with only a few fruits such as papaya,

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bananas, and some other fruits are grown throughout the year. However, consumption of Vitamin C rich foods in our population is assumed to be high but due to traditional cooking practices much of this Vitamin is lost. The food composition tables available in Bangladesh recorded the content of L-Ascorbic Acid estimated by decade-old colorimetric methods. The AOAC[15] has recommended estimation of vitamin C by HPLC method, which, to the best of our knowledge, has not been applied to local foods for the estimation of Vitamin C. The present study seeks to investigate the content of Vitamin C in local selected fruits and vegetables.

The present study has undertaken the analysis of highly consumed vegetables and fruits which supplying the Vitamin C as well as dietary fiber by recommended method of analysis and the macronutrients to assess the nutrient profile of analyzed foods and dietary contribution.

Materials and Methods

Sample collection and preparation

A stratified random sampling technique based on the National Population Census Model has been used for sampling fruit and vegetables. Taking into account the region and overlapping of the Agro-ecological zone from over the eight divisions of Bangladesh, 30 locations (two or three places of each section) both from bazaars (countryside markets) and wholesale markets for city areas were selected. Sampling was done randomly from the stock lots. Sample was collected in the middle of the seasons, and the sealed sample (about 0.5 kg) was transported to the laboratory for composite mixture by mixing equal amount of each sample and analysis. A single composite of a homogeneous mixture of units of the same form (from 10 to 12 locations) and a variety of food samples was followed. The composite mixed sample was then stored in -20ºC for further analysis.

Nutrient analysis

The proximate nutrients such as moisture, protein, fat, carbohydrate, dietary fiber and ash were determined by AOAC[15] and other standard methods[16]. Total dietary fiber was estimated according to the AOAC method by using the total dietary fiber assay kit (enzymatic-gravimetric method). The amount of available carbohydrate for all foods was calculated "by difference". Available carbohydrate by difference: 100 - (Water + Protein + Fat + Ash + Fiber). Ash content was measured by heating the dried raw sample in a muffle furnace at 600^{o}C to burn all organic substances for 3-5 hours until it came to a constant weight. Vitamin C (L-ascorbic acid) was estimated by HPLC method. The calculation was carried out by comparing the peak area to the ascorbic acid standard[17].

Results and Discussion

Fresh vegetables and fruits are excellent sources of vitamin C, known for its antioxidant and immune-enhancing properties. Mango and green chili were found to be rich source of vitamin C (102.98 mg and 102.27 mg/100g for mango and green chili, respectively) (Table 1); potato, tomato and bean were found to have medium amount of vitamin C among selected fruits and vegetables included in present study. The moisture content of potato in present study was in the range as was reported in previous finding[18] but for brinjal the value is lower than a previous finding18. As depicted in table-2, some of the nutrient values were compared with the USDA nutrient database, and it was observed that some values in present study were in close proximity to USDA database, while the rest differed. For example, Vitamin C in green chili in the USDA database was found to be more than twice compared to our values, because in this study we measured the only L-ascorbic acid by HPLC method and may be some of L-ascorbic acid were converted to DehydroAcsorbic Acid during the sample preparation, but the values for potato, brinjal, tomato and beans were much closer. However, amount of L-ascorbic Acid/Vitamin C of the selected fruits and vegetables in the present study will be differ from other sources due to the regional varieties, location and cultivation methods[19]. Regular intake of antioxidant-rich fruit and vegetables (vitamin C and other antioxidants) is associated with decreased risks of cardiovascular disease, Alzheimer's disease, cancer, stroke, along some of the cognitive and physical declines related to aging.

Table 1: Proximate nutrients (g/100g EP) and L-ascorbic acid (mg/100 g EP) content of the selected fruits and vegetables on fresh weight basis

Name	Moisture (g)	Protein (g)	Fat (g)	Ash (g)	TDF (g)	CHO (g)*	L-ascorbic acid (mg)
Bean *(Dolichos lablab)*	90.02	2.41	0.11	0.65	4.65	2.16	9.63 ± 0.55
Brinjal/Eggplant (*Solanum melongena)*	91.35	1.90	0.06	0.66	4.07	1.96	1.29 ± 0.46
Green chili (*Capsicum frutescent*)	85.51	2.77	0.13	1.04	8.37	2.18	102.27 ± 3.30
Potato (*Solanum tuberosum*)	81.71	1.19	0.16	0.87	2.11	13.96	19.07 ± 5.70
Tomato (*Lycopersicon esculentum*)	95.01	1.11	0.25	0.54	1.65	1.44	12.29 ± 2.80
Carrot (*Daucus carota*)	89.71	0.92	0.26	0.60	2.55	5.96	1.44 ± 0.16
Banana (*Musa paradisiaca*)	75.22	1.26	0.84	0.84	4.37	17.47	1.03 ± 0.15
Jackfruit (*Artocarpusheterophyllus*)	76.99	1.19	0.20	1.08	2.27	18.27	3.43 ± 4.30
Mango (*Mangiferaindica*)	78.44	0.79	0.41	0.76	1.56	18.04	102.98 ± 3.96

Result are expressed as Mean ± SD; *NEF= Nitrogen free extract; [CHO = 100 - (protein+ fat+TDF+ash+moisture)]; TDF = Total Dietary Fiber

Table 2: Comparison of nutrient content of the fruits and vegetables with National Database

Name	Nutrient content in this study				USDA National Nutrient Database			
	Protein (g)*	Fat (g)*	CHO (g)*	Ascorbic Acid (mg)**	Protein (g)*	Fat (g)*	CHO (g)*	Vitamin C (mg)**
Vegetable								
Bean	2.41	0.11	2.16	9.63	1.83	0.22	6.97	12.2
Brinjal/Eggplant	1.90	0.06	1.96	1.29	0.98	0.18	5.88	2.2
Green chili	2.77	0.13	2.18	102.27	2.0	0.20	9.46	242.5
Potato	1.19	0.16	13.96	19.07	2.05	0.09	17.49	19.1
Tomato, ripe	1.11	0.25	1.44	12.29	1.16	0.19	3.18	16.0
Carrot	0.92	0.26	5.96	1.44	0.93	0.24	9.58	5.9
Fruit								
Banana	1.26	0.84	17.47	1.03	1.09	0.33	22.84	8.7
Jackfruit	1.19	0.20	18.27	3.433	1.72	0.64	23.25	13.7
Mango	0.79	0.41	18.04	102.98	0.82	0.38	14.98	36.4

Data are expressed as: * g/100 g edible portion; ** mg/100 g edible portion

The findings in present study will provide suitable guides to the general population in making their choices of vegetables with high content of Vitamin C. Adequate intake of the fruits and vegetables with high content of Vitamin C will improved the health status especially immune system; thereby reducing diabetes, cardiovascular diseases, eye diseases, infertility and cancers that may be prevalent in Bangladesh. In addition, stronger immune system can support the body resistance against infectious disease.

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