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Elemental Analysis of Some Selected Fruits and Vegetables Samples in Bangladesh

Md. Redwanur Rahman

Institute of Environmental Science, University of Rajshahi, Rajshahi, Bangladesh

Email address:
redwan_rahman_iesru@yahoo.com

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Abstract: Some selected essential elements in some fruit and vegetables which are commonly consumed by all income groups of rural and urban people of Bangladesh. PIXE technique has been employed to perform essential and trace elemental analysis of Zn, Ca, Fe, K, Cl, Cu, Mn and Br in some fruits and vegetables of Rajshahi region of Bangladesh. The concentration of the elements in each fruits and vegetables are investigated that in fruits *Psidium guajava* contains the highest amount of Ca (66800mg/kg) and *Averrhoa carambola* contain highest of K (28950mg/kg). In vegetables highest amount of Ca and K are exhibited by Brassica rapa (30541mg/kg) and *Solanum tuberosum* (31098mg/kg) respectively. The Fe content fairly good in all fruit samples varying from 250.30mg/kg in *Emblica officinalis* to 545mg/kg in *Carica papaya* and all vegetables samples varying from 319mg/kg in Lagenaria siceraria to 9230mg/kg in *Daucus carota*. Zn content in the studied samples is highest in *Artocarpus heterophyllus* (65mg/kg) in fruit and *Daucus carota* 110.05mg/kg in vegetables. Mn is found in all fruits and vegetables samples. Among them in vegetables *Daucus carota* contains highest amount (10mg/kg) of Mn and in fruits *Olea europea* contain highest amount (9mg/kg) of Mn. Copper content in the studied samples is found only in *Cucurbita moschata* (26.87mg/kg) in vegetables and *Averrhoa carambola* (20.56mg/kg) in fruit which probably plays a role in prevention of inflammation, given that Cu is a useful anti-inflammatory agent. Highest CI content is found in vegetables in *Solanum tuberosum* (7890mg/kg) and *Averrhoa carambola* (4567mg/kg) in fruit. The minimum chloride requirement for a healthy adult is 700mg/day. Bromine only found in Lycopersicon esculentum (118mg/kg) in vegetables. In all over the world such analysis is running routinely to ensure the good health and quality of life of human being.

Keywords: Elemental Analysis, Fruits, Vegetables, PIXE, Bangladesh

1. Introduction

PIXE analysis was investigated of some vegetable species by [1]. Characterization of fruit and vegetable wastes as a single substrate for the anaerobic digestion was observed by [2]. The concentrations of chlorine (Cl), potassium (K), calcium (Ca), titanium (Ti), manganese (Mn), iron (Fe), cobalt (Co), copper (Cu), zinc (Zn) and bromine (Br) in fruits and vegetables measured by [3]. Mineral elements play a crucial role for the nutrition of human being. Fruits and vegetables are one of the main sources of mineral elements. Excess or lack of mineral elements in fruits and vegetables may cause various disorders in human health and the people may suffer from various diseases. Increased fruits and vegetables consumption can improve the mineral regulation and reduce cardiovascular diseases and certain cancer risks. Therefore evaluation of micronutrients and essential trace elements levels of fruits and vegetables is a growing trend in nutritional studies throughout the world. Trace elements do not provide any calorie but they maintain the body pH, osmotic regularity and used as coenzyme which regularize the metabolic reactions. Trace elements are required in a diet in amounts less than 100 mg/day which is vital for health [4]. The deficiency of Zn in the soil and the excess of As in water have already become two established problems in Bangladesh. Therefore such studies will help us to understand the environmental pollution and its effects on human health. In the developed countries such analysis are done routinely to ensure the good health and quality of life of their citizens.

The main objective of the present research to find out the toxicity or the deficiency of some major, minor and trace elements in some selected vegetables and fruits samples which are commonly consumed by both rural and urban population of Bangladesh. So the main objectives are analysis of major, minor and trace elements concentration in some fruits and vegetables.

2. Methodology

2.1. Study Area

To measure of concentration of elements in the some fruits and vegetables were observed of population exposure. Under the limited scope of the research, we have selected Rajshahi district from the Northern part of Bangladesh. Samples are collected from different season during monsoon and winter season of different places of this district. The geographical location of sampling site is shown in figure 1.

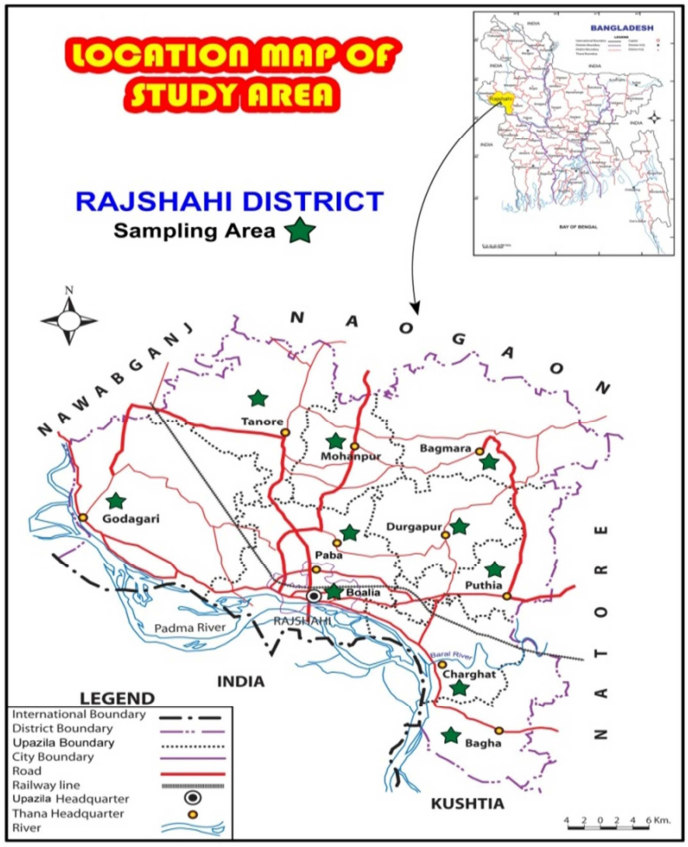

Figure 1. *Sampling sites of Rajshahi, Bangladesh.*

2.2. Sampling and Sample Preparation

Fruits and vegetables samples were collected from various areas of Rajshahi district *viz.,* Tanore, Mohanpur, Paba, Puthia, Godagari, Bagmara, Durgapur, Boalia, Chargat and Bagha in different season (Table 1).

2.3. Vegetables and Fruits Samples Preparation

Locally produced fruits and vegetables samples were taken for the analysis.

Table 1. *Fruits and vegetables sample collected from the study areas for elemental analysis.*

Fruits Samples

Sample no.	Local name in Bengali	English name	Scientific name
AF-1	Kamranga	Carambola	*Averrhoa carambola*
AF-2	Papay	Papaya	*Carica papaya*
AF-3	Peyara	Guava	*Psidium guajava*
AF-4	Kola	Banana	*Musa sapientum*
AF-5	Kalo Jam	Black Berry	*Syzygium cumini*
AF-6	Anaras	Pine-Apple	*Ananus comosus*
AF-7	Jalpi	Olive	*Olea europea*
AF-8	Aamalaki	Amla	*Emblica officinalis*
AF-9	Kathal	Jackfruit	*Artocarpus heterophyllus*
AF-10	Aam	Mango	*Mangifera indica*

Vegetables Samples

Sample no.	Local name in Bengali	English name	Scientific name
AV-1	Misti kumra	Pumkin/ Sweet gourd	*Cucurbita moschata*
AV-2	Begun	Bringal	*Solanum melongen*
AV-3	Dherosh	Lady's finger/Orka	*Abelmoschus esculentus*
AV-4	Alu	Patato	*Solanum tuberosum*
AV-5	Tomato	Tomato	*Lycopersicon esculentum*
AV-6	Lau	Bottle Gourd	*Lagenaria siceraria*
AV-7	Gajor	Carrot	*Daucus carota*
AV-8	Phul kopi	Coliflower	*Brassica oleracea var. botrytis*
AV-9	Bandhakapi	Cabbage	*Brassica oleracea*
AV-10	Shalgom	Turnip	*Brassica rapa*

All the fruits and vegetables samples were dried in an electric oven at a temperature of 120°C for about four hours. After cooling the samples to room temperature, the dried sample was milled by milling machine uniformly and very carefully and made it into powder. After milling the sample was taken into aluminum fuel so that no moisture could into the sample. Then it was transferred to hydraulic pressure machine for making tablet.

2.4. Making Tablet by the Sample (Powder)

Some of the powder samples are presented in a photograph is shown in figure 2 and 3. Some portion (about 0.200gm) from powder samples was taken for making tablets by electrical balance during this time the electrical balance machine was calibrated by tearing. The sample was taken into weighting papers and specula were used for taking sample. The machine was totally error free and gave accurate results.

Figure 2. *Sample of Carrot (Daucus carota) powder.*

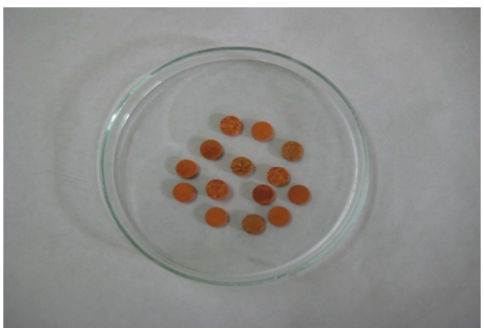

Figure 3. *Sample of Carrot (Daucus carota) tablets.*

The tablet was made by Hydraulic pressure machine that's diameter was 10mm. This work was done by giving 5 (five) tones pressure. After making tablet it was removed from the hydraulic pressure machine by just giving hand pressure and some of these prepared tablets are presented in a photograph is shown in figure 3.

2.5. Storage of Tablet

After being made tablets, it was storage at -200°C temperature into a refrigerator for analyzing essential contents. The proposed sample tablet was irradiated with proton beam 2.55 MeV using 3 M Tandem Acceleration of the Institute of Nuclear Science and Technology, Atomic Energy Research Establishment (AERE), Savar, Dhaka, Bangladesh.

Data Analysis: The X-ray spectrum was analyzed by using GUPIX software that can simply which automatically fit the spectra to obtain the elemental concentrations.

3. Results and Discussion

Locally produced fruits and vegetables samples were analyzed and the concentration of the elements is given in table 2 to 3 respectively. Concentration of different elements in fruits and vegetables are also shown in figure 3 and 4 respectively.

Table 1 and 2 summarizes the elemental concentrations of each fruits and vegetables in mg/kg under study. The elements determined in varying concentrations include Zn, Ca, Fe, K, CI, Cu, Mn and Br. From table 2 and 3, it is seen that the concentrations of the elements vary from one sample to another. The difference in the concentration of these elements within different fruits and vegetables is attributed to factors such as the preferential absorbability of a particular fruit and vegetable for the corresponding elements, the age of the plant, the mineral composition of the soil, in which the plant grows as well as its ambient climatologically conditions [5]. One research study suggests that a high intake of chloride ions, which tend to remain in the body, may trap positive sodium ions to balance the chemical charge. The minimum chloride requirement for a healthy adult is 700mg/day [4]. Highest CI content is found in vegetables in Potato 7890mg/kg (Table 3) and Carambola 4567mg/kg (Table 2) in fruit. It is clear that K and Ca are the most abundant detected elements in the samples (major elements). It is observed from table 2 and 3 that in fruits Guava contains the highest amount of Ca 66800mg/kg (Table 2) and

Carambola contain highest of K 28950mg/kg (Table 1). In vegetables highest amount of Ca and K are exhibited by Turnip 30541mg/kg and Potato 31098mg/kg (Table 2) respectively. The dietary recommended intakes (DRIs) of K and Ca for adults are 4500 and 1300mg/day respectively [6]. K has an important in regulation of the water balance of the body and crucial to heart function [7]. Ca is an essential element for maintaining healthy bones and teeth and also of neuromuscular systematic and cardiac functions.

Transition elements Mn, Fe, Cu and Zn are found in varying concentrations in the studied fruits and vegetables. These and other essential elements perform various complementary vital functions in the body to keep the organism healthy. The Fe content fairly good in all fruits samples (varying from 250.30mg/kg in Amla to 545mg/kg in Papaya in table 2). The Fe content fairly good in also all vegetables samples (varying from 319mg/kg in Bottle Gourd to 9230mg/kg in Carrot in table 3). The daily requirement of Fe is ranged 1.5 - 2.2 mg/day. Worldwide nearly 3.7 million people are iron deficient, the problem being serve enough to cause anemia in two billion people. 35% of the 0 - 5 year old children suffer from Zn or Fe deficiency [8]. Zn is an important element responsible for many enzymatic processes and is involved in working of genetic materials, proteins, immune reactions; wound healing, development of the fetus and sperm production. It has been suggested that normal levels of Zn can prevent diarrhea. According to the WHO recommendation fruits and vegetables are poor sources of Zn and ranged up to 1mg/kg and dietary intake for Zn is 10mg/day for an adult [6]. Zn content in the studied samples is highest in Jackfruit 65mg/kg in fruit (Table 2) and Carrot 110.05mg/kg in vegetables (Table 3). Manganese is an antioxidant nutrient and is important in the breakdown of fats and cholesterol and also helps in the nourishment of the nerves and the brain [9]. Mn safe limit for daily intake is 2.0mg/day for an adult [3] and its recommended range in fruits and vegetables are 0.42-6.64mg/kg [10]. Mn is found in all fruits and vegetables samples. Among them Carrot contains highest amount of Mn 10mg/kg (Table 3) and in fruit Olive contains highest amount of Mn 9mg/kg (Table 2). Cu is an essential trace element required for proper health in an appropriate limit. Its high uptake in fruits and vegetables can be harmful for human health and in the same way the lower uptake in human consumption can cause a number of symptoms *e.g*. growth retardation, skin ailments, gastrointestinal disorders *etc*. Copper only found in Carambola 20.56mg/kg (Table 2) in fruits and Pumkin 26.87mg/kg (Table 3) in vegetables respectively. Bromine only found in tomato 118mg/kg in vegetables (Table 3). Which probably plays a role in prevention of inflammation, given that Cu is a useful anti-inflammatory agent [11]. Cu is a factor necessary for the absorption and use of Fe in the formation of hemoglobin, part of many enzymes, and helps in the formation of protective covering around nerves. From table 1 and 2 it is find that no samples contain fluorine. So it can be concludes that vegetables and fruits are not a significance source of F uptake of the population of this region.

Table 2. *Elemental concentrations of the investigated fruits.*

Smaple No	Local name in Bengali	English name	Scientific name	Concentrations (mg/kg)								
				Zn	Ca	Fe	K	Cl	Cu	Mn	F	Br
AF-1	Kamranga	Carambola	*Averrhoa carambola*	64.00	5700	511.00	28950	4567	20.56	8	0	0
AF-2	Papay	Papaya	*Carica papaya*	45.00	20600	545.00	15374	2343	0	5	0	0
AF-3	Peyara	Guava	*Psidium guajava*	0	66800	404.70	12374	0	0	7	0	0
AF-4	Kola	Banana	*Musa sapientum*	50.67	3450	350.60	18705	0	0	6	0	0
AF-5	Kalo Jam	Black Berry	*Syzygium cumini*	0	22003	301.20	23643	0	0	7	0	0
AF-6	Anaras	Pine-Apple	*Ananus comosus*	0	20987	300.00	17890	0	0	8	0	0
AF-7	Jalpi	Olive	*Olea europea*	0	34211	290.50	20579	1324	0	9	0	0
AF-8	Aamalaki	Amla	*Emblica officinalis*	0	24532	250.30	19780	1098	0	4	0	0
AF-9	Kathal	Jackfruit	*Artocarpus heterophyllus*	65.00	32101	345.70	25673	0	0	8.5	0	0
AF-10	Aam	Mango	*Mangifera indica*	50.00	16431	377.90	24356	0	0	4	0	0

Error has been calculated using GUPIX.

Table 3. *Elemental concentrations of the investigated vegetables.*

Sample No	Local name in Bengali	English name	Scientific name	Concentrations (mg/kg)								
				Zn	Ca	Fe	K	Cl	Cu	Mn	F	Br
AV-1	Misti kumra	Pumkin/ Sweet gourd	*Cucurbita moschata*	0	16754	1021	18790	3789	26.87	7	0	0
AV-2	Begun	Bringal	*Solanum melongena*	45.00	12541	983	13211	2113	0	9	0	0
AV-3	Dherosh	Lady's finger/Orka	*Abelmoschus esculentus*	87.90	22314	879	15432	3123	0	5	0	0
AV-4	Alu	Patato	*Solanum tuberosum*	50.67	4321	511	31098	7890	0	6	0	0
AV-5	Tomato	Tomato	*Lycopersicon esculentum*	42.00	11856	6780	7560	4658	0	7	0	118
AV-6	Lau	Bottle Gourd	*Lagenaria siceraria*	0	10123	319	24288	0	0	8	0	0
AV-7	Gajor	Carrot	*Daucus carota*	110.05	20264	9230	30342	3706	0	10	0	0
AV-8	Phul kopi	Coliflower	*Brassica oleracea var botrytis.*	0	27621	8321	3421	0	0	9	0	0

Error has been calculated using GUPIX.

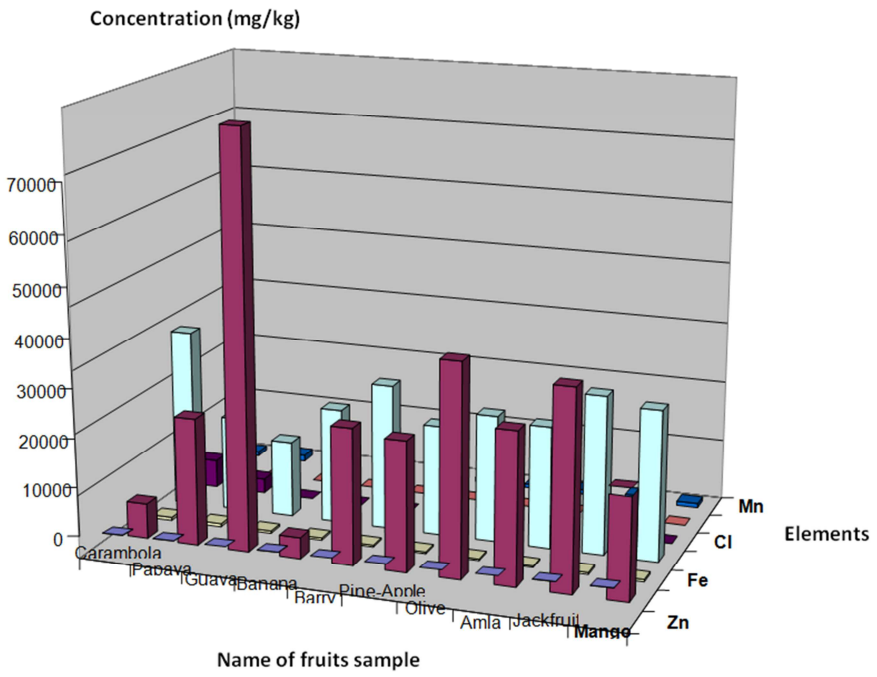

Figure 4. *Sample wise distribution of elemental concentration of the investigated of locally produced fruits.*

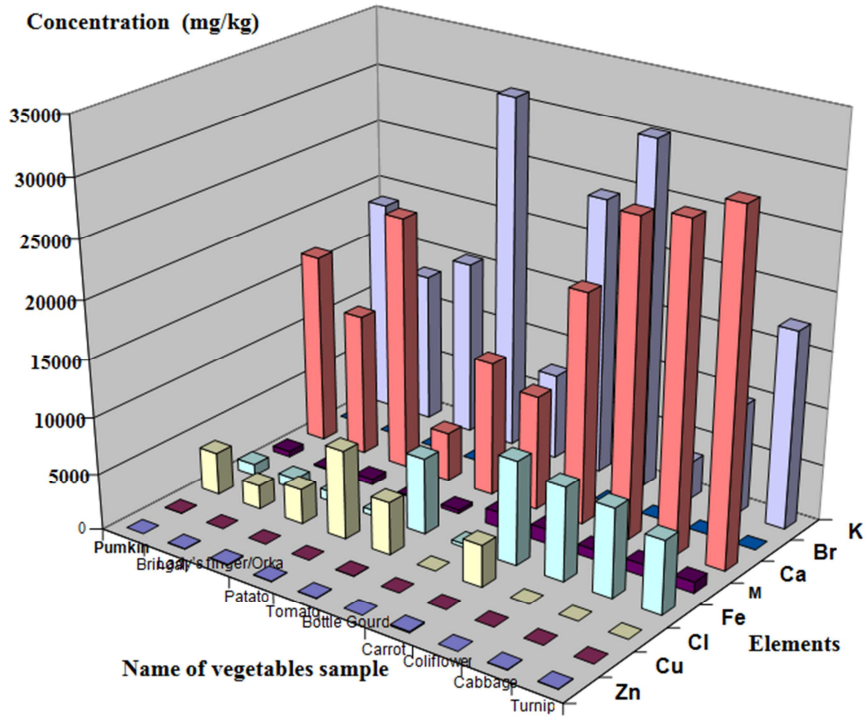

Figure 5. *Sample wise distribution of elemental concentration of the investigated of locally produced vegetables.*

4. Conclusions

Vegetables and fruits samples were analyzed but no samples contain fluorine. So it can be concludes that vegetables and fruits are not a significance source of F uptake of the population of this region. It is clear that K and Ca are the most abundant detected elements in the samples. It is observed that in fruits Guava contains the highest amount of Ca (66800mg/kg) and Carambola contain highest of K (28950mg/kg). The Fe content fairly good in all fruit samples (varying from 250.30mg/kg in Amla to 545mg/kg in Papaya) and all vegetables samples (varying from 319mg/kg in Bottle Gourd to 9230mg/kg in Carrot). Zn content in the studied samples is highest in Jackfruit (65mg/kg) in fruit and Carrot 110.05mg/kg in vegetables. Mn is found in all fruits and vegetables samples. Among them in vegetables Carrot contains highest amount (10mg/kg) of Mn and in fruits Olive contain highest amount (9mg/kg) of Mn. Copper content in

the studied samples is found only in Pumkin (26.87mg/kg) in vegetables and Carambola (20.56mg/kg) in fruit which probably plays a role in prevention of inflammation, given that Cu is a useful anti-inflammatory agent. Highest CI content is found in vegetables in Potato (7890mg/kg) and Carambola (4567mg/kg) in fruit. The minimum chloride requirement for a healthy adult is 700mg/day. The deficiency of chlorine causes anorexia, weakness, growth failure, severe convulsions. Bromine only found in tomato (118mg/kg) in vegetables. No toxic heavy metals were detected. Fruits and vegetables contain elements of vital importance in man's metabolism and that are needed for growth and developments, prevention and healing of diseases. It is hoped that the data from this study provide a preliminary assessment of the background levels of selected trace and essential elements of Rajshahi district. Therefore such studies will help us to understand the environmental pollution and its effects on human health. In the developed countries such analysis are done routinely to ensure the good health and quality of life of their citizens. I conclude that these data could provide as an important reference for future research.

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