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Evaluation of Zinc in various Arums, Bananas, Vegetables and Pulses from Five Upazila of Chittagong region in Bangladesh by Spectro-photometric Method

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Abstract: *Zinc is an essential element needed by the body in small amounts as it is the most abundant trace metals in human. It deficiency is occurring in different climate regions of the world. It has become an important risk factor for plant growth as well as human health throughout the world. In this study, we observed the amount of zinc in different arums, bananas, vegetables and pulses which are locally available in Chittagong region of Bangladesh. The amount of zinc in twenty samples of arums was found to vary from 0.3174-9.0755 µg/g. The highest and lowest value was found in arums of Typhonium trilobatum (Patiya) and Amorphophallus campanulatus (Satkaniya) respectively. In bananas vary from 0.1430 to 2.7360 µg/g. The highest and lowest value was found in banana of Musa acuminata in Satkania and Ramgarh upazila respectively. The amount of zinc in vegetables was found to vary from 0.92-7.59 µg/g. Zinc in pulses were found to vary from 1.2973-29.5008 µg/g. The highest and lowest values were found in Lathyrus sativus and Phaseolus aureus respectively. From four types of food, we see that the highest value of zinc in pulse species of Lathyrus sativus and the lowest value of zinc in banana species of Musa acuminata respectively of Chittagong region, Bangladesh.*
Key words: *Zinc, Arum, Banana, Vegetable and Pulse.*

I. Introduction

Zinc element commonly found in the Earth's crust. Because of its reactivity, zinc metal is not found as the free element in nature. There are approximately 55 mineralized forms of zinc. The most important zinc minerals in the world are sphalerite (ZnS), smithsonite ($ZnCO_3$), and hemimorphite ($Zn_4Si_2O_7(OH)2H_2O$). Zinc appears in Group IIB of the periodic table and has two common oxidation states, Zn(0) and Zn(+2). Zinc forms a variety of different compounds such as zinc chloride, zinc oxide, and zinc sulfate [1]. Zinc occurs in the environment mainly in the +2 oxidation state [2].

Zinc is an essential nutrient in humans and animals that is necessary for the function of a large number of metallo-enzymes. These enzymes include alcohol dehydrogenase, alkaline phosphatase, carbonic anhydrase, leucine aminopeptidase, superoxide dismutase, and deoxyribonucleic acid (DNA) and ribonucleic acid (RNA) polymerase. As such, zinc is required for normal nucleic acid, protein, and membrane metabolism, as well as cell growth and division. Zinc is also play an essential role in the maintenance of nucleic acid structure of genes (zinc finger phenomenon). Zinc deficiency has been associated with dermatitis, anorexia, growth retardation, poor wound healing, hypogonadism with impaired reproductive capacity, impaired immune function, and depressed mental function; increased incidence of congenital malformations in infants has also been associated with zinc deficiency in the mothers [3, 4]. Zinc deficiency may also have an impact on carcinogenesis, though the direction of the influence seems to vary with the agent [5, 6, 7]. Therefore, certain levels of zinc intake are recommended. The daily needs or the world's daily average uptake of 15 mg/day zinc is considered to be suitable for human adults by weighing of 70 kg [8]. It is necessary for proper growth and development of young children. Mothers who did not eat enough zinc during pregnancy had a higher frequency of birth defects and gave birth to smaller children (lower birth weight) than mothers whose zinc levels were sufficient. Very young children who did not receive enough zinc in the diet were smaller, both in length and in body weight, than children who ate enough zinc.

It enters the air, water, and soil as a result of both natural processes and human activities. Most zinc enters the environment as the result of mining, purifying of zinc, lead, and cadmium ores, steel production, coal burning, and burning of wastes. These activities can increase zinc levels in the atmosphere. Waste streams from

zinc and other metal manufacturing and zinc chemical industries, domestic waste water and run-off from soil containing zinc can discharge zinc into water ways. The level of zinc in soil increases mainly from disposal of zinc wastes from metal manufacturing industries and coal ash from electric utilities. Sludge and fertilizer also contribute to increased levels of zinc in the soil. [9] found concentrations of zinc were highest in grass samples.

Zinc compounds have dental, medical, and household applications. In pharmaceuticals, zinc salts are used as solublizing agents in many drugs, including insulin [10, 11]. Zinc compounds are utilized therapeutically in human medicine in the treatment of zinc deficiency [12].

Chittagong is the commercial capital city of Bangladesh. Many types of Industry were built in this city. For that reason, we try to find out the amount of zinc from various substances. The climate of Bangladesh is proper for growing of various arums, bananas, vegetables and pulses. The people can easily collect arums, bananas, vegetables and pulses from local market by cheap rate or they can grow easy way to this arums, bananas, vegetables and pulses. Various arums, bananas, vegetables and pulses are contains various amount of zinc. In the present investigation, the amount of zinc in some arums, bananas, vegetables and pulses are determined by spectro-photometric method.

II. Methods

Twenty samples of each item i.e. arums, bananas, vegetables and pulses were collected from various upazila of Chittagong region, Bangladesh. All samples were washed with water followed with DDI (double de-ionized distil water). Samples were cut into small pieces and dried at 105^0C for 18 hrs [13]. After drying, the samples were burned into the maffle furnace and then the ashes were weighed and stored in the stopper bottle. Taking the weight of the ash sample, the amount of Zn present in the sample was determined by using conventional methods [14].

III. Results

The investigation on the collected sample of various Arums, Bananas, Vegetables and Pulses are presented by the value. The sample data in various Arums, Bananas, Vegetable and Pulses are presented in Table-1,5,7 and11 respectively and the reference table is 2,3,4,6,8,9,10,12 and 13 respectively. The amount of zinc in pulse is greater than Arums, Bananas and Vegetables. Specially, pulse species of *Lathyrus sativus* (Anowara) contain the highest value of zinc and the amount is 29.5008µg/g. On the other hand, banana species of *Musa acuminata* (Ramgarh) contain lowest value of zinc and the amount is 0.1430µg/g.

IV. Discussions

Food is the major source of zinc for the general population (EPA 1987c). Taking too much zinc into the body through food, water or dietary supplements can also affect health. The levels of zinc that produce adverse health effects are much higher than the Recommended Dietary Allowances (RDAs). If large doses of zinc (10–15 times higher than the RDA) are taken by mouth even for a short time, stomach cramps, nausea and vomiting may occur. Ingesting high levels of zinc for several months may cause anemia, damage the pancreas, and decrease levels of high-density lipoprotein (HDL) cholesterol. Just as zinc deficiency has been associated with adverse effects in humans and animals, overexposures to zinc also have been associated with toxic effects. In humans, death has resulted from acute exposure to zinc compounds. When a high concentration (estimated at 33,000 mg zinc/m3) of zinc chloride smoke resulted from the explosion of many generators in a tunnel following a bombing raid in World War II, 10 of the 70 exposed people in the tunnel died within 4 days [15].

The selected region of the Chittagong in Bangladesh, the value of zinc in various Arums of various upazila of Chittagong is differ from Tanzania and Uganda and different countries of world as shown in table- 1, 2 and 3. The highest value of arum species of *Typhonium trilobatum* is 9.0755µg/g and the second highest arum species of *Colocasia esculenta* is 4.5988µg/g. The mineral element list of any adult person as shown in table- 4.

In Nigeria, the value of zinc in Banana is very much greater than Bangladesh as shown in table- 5 and 6. Approximately, all substances contain lowest amount of zinc.

The value of various vegetables in Pakistan and India is greater than Bangladesh as shown in table- 7, 8, 9 and 10. Only *Ipomoea aquatica* contains the higher value than other species of vegetables and the value is 7.59µg/g.

The various pulses are the same as India and Pakistan is greater than Bangladesh as shown in table-11, 12 and 13. Only, the *Lathyrus sativus* pulse of Anowara upazila is the largest amount i.e. 29.5008µg/g.

Table 1: Amount of Zn^{2+} (µg/g) in various arums in various upazila of Chittagong region, Bangladesh.

Bengali name of arums	**English name of arums**	**Biological name of arums**	**Name of the Upazilas**	**Amount of Zn2+ (µg/g) in arums**
Pani Kachu	Eddoe	*Colocasia esculenta*	Patiya	4.5988
			Chandanish	0.4773
			Satkaniya	3.0799
			Lohagara	0.4663
			Boalkhali	0.5959
Mukhi Kachu	Taro	*Typhonium trilobatum*	Patiya	9.0755
			Chandanish	3.1424
			Satkaniya	0.8783
			Lohagara	0.5869
			Boalkhali	0.9832
Man kachu	Giant taro	*Alocasia indica*	Patiya	2.6394
			Chandanish	0.621
			Satkaniya	2.0713
			Lohagara	3.2671
			Boalkhali	3.2566
Oal Kachu	Elephant foot yam	*Amorphophallus campanulatus*	Patiya	4.4961
			Chandanish	4.4314
			Satkaniya	0.3174
			Lohagara	4.2048
			Boalkhali	1.7196

Table 2: Amount of Zn^{2+} (mg/100g) in various Arums determined from Tanzania and Uganda [16]

Biological name of Arums	Amount of Zn^{2+}(mg/100g) in Arums	
	Tanzania	Uganda
Colocasia esculenta	5.63±0.04	3.01±0.34
Xanthosoma sagittifolium	1.35±0.13	4.08±0.55

Table 3: Amount of Zn (mg/100g) in various varieties of edible aroids from different countries [17]

Biological name of Edible aroids	Amount of Zn^{2+}(mg/100g) in Edible aroids
Colocasia esculenta	3.8
Xanthosoma spp	0.52
Alocasia spp	1.57
Cyrtosperma chamissonis	2.3
Amorphophallus campanulatus	1.05

Table 4: The daily needs or the worlds daily average up-take of elements by a person weighing 70 kg [8]

Element	**Average Daily Dietary Intake (mg/day) Range**
Fe	15 (10-28)
Mn	2.8(2-5)
Zn	15
Cu	2.5(2-3)
Ni	0.025
Cr	0.05-0.02
Co	0.04
Pb	0.415
Cd	0.057

Table 5: Amount of Zn^{2+} (µg/g) in various bananas in various upazila of Chittagong region, Bangladesh.

Bengali name of bananas	English name of bananas	Biological name of bananas	Name of the Upazilas	Amount of Zn^{2+} (µg/g) in bananas
Bangla kala	Lady finger banana	*Musa sapietum*	Hathazari	0.9610
			Anowara	0.3010
			Satkania	0.3490
			Lama	2.05
			Ramgarh	1.187
Champa kala	Champa banana	*Musa acuminata*	Hathazari	0.678
			Anowara	1.934
			Satkania	2.736
			Lama	1.552
			Ramgarh	0.1430
Sagor kala	Cavendish banana	*Musa cavendishii*	Hathazari	0.6070
			Anowara	1.0980
			Satkania	1.5950
			Lama	0.5860
			Ramgarh	0.5750
Kanch kala	Green banana	*Musa paradisiaca*	Hathazari	0.6450
			Anowara	0.2980
			Satkania	0.4040
			Lama	1.5050
			Ramgarh	0.3570

Table 6: Amount of Zn^{2+} (mg/Kg) in various bananas of Nigeria [18]

Nigerian name of bananas	Amount of Zn^{2+}(mg/Kg) in bananas
Musa Gross Michel (lgbo banana)	2.90
Musa Sapientum(paranta)	20.90
Musa paradisiacal(plantain)	31.10
Musa 'Wild banana'(Omini)	10.10
Musa 'Red'(Sweet banana)	21.10
Musa 'Fugamo'(Somupeke)	12.10

Table 7: Amount of Zn^{2+} (µg/g) in various vegetables in various upazila of Chittagong region, Bangladesh.

Bengali name of vegetables	English name of vegetables	Biological name of vegetables	Name of the Upazilas	Amount of Zn^{2+} (µg/g) in vegetables
Helencha Shak	Water cress	*Enhydra fluctuans*	Hathazari	7.19
			Patia	3.34
			Anowara	1.98
			Pahartali	6.59
			Fatickchari	0.92
Moloncha Shak	Alligator weed	*Alternanthera philoxeroides*	Hathazari	1.45
			Patia	1.37
			Anowara	1.47
			Pahartali	6.53
			Fatickchari	1.24
Kolmi Shak	Swamp cabbage	*Ipomoea aquatica*	Hathazari	7.59
			Patia	2.31
			Anowara	1.62
			Pahartali	1.79
			Fatickchari	3.69
Thankuni Pata	Indian pennywort	*Centella asiatica*	Hathazari	2.07
			Patia	1.34
			Anowara	5.12
			Pahartali	3.73
			Fatickchari	3.12

Table 8: Amount of Zn^{2+} (µg/g) in various vegetables of Pakistan [19, 20]

Biological name of vegetables	Amount of Zn^{2+} (µg/g) in vegetables
Mentha sapicata	43
Brassica rapa	32.64 ±6.381
Luffa acutangula	59
Murraya koenigii	12.77 ±0.994
Brassica oleracea	11.54 ±0.397

Table 9: Amount of Zn^{2+} (µg/g) in various vegetables of India [19, 21]

Biological name of vegetables	Amount of Zn^{2+} (µg/g) in vegetables
Mentha sapicata	41.4–47.4
Brassica rapa	28.8–30.3
Luffa acutangula	5.79
Ipomoea hederacea	45

Table 10: Amount of Zn^{2+} (ig/Kg) in various Leafy vegetables in Assam of India [22]

Biological name of vegetables	Amount of Zn^{2+} (ig/Kg) in vegetables
Brassica capitala	46.45 (±7.15)
Colocasia esculanta	32.27 (±10.86)
Brassica esculanta	72.23 (±1.24)
Brassica oleraceae	33.79 (±1.06)
Spinacea oleracea	54.15 (±0.19)
Coriendrum sativum	34.41 (±7.60)
Cucurbita maxima	66.74 (±10.50)
Amaranthus viridis	27.66 (±7.49)

Table 11: Amount of Zn^{2+} (µg/g) in various pulses in various upazila of Chittagong region, Bangladesh.

Bengali name of pulses	English name of pulses	Biological name of pulses	Name of the Upazilas	Amount of Zn^{2+} (µg/g) in pulses
Mash kalai	Black gram	*Vigna muungo*	Hathazari	1.9782
			Anowara	16.4310
			Rawzan	5.7112
			Mirsharai	1.8604
			Chandanaish	3.4766
Felon kalai	Southern pea	*Phaseolus vulgaris*	Hathazari	4.9263
			Anowara	4.7369
			Rawzan	1.9232
			Mirsharai	1.3559
			Chandanaish	5.9140
Mung kalai	Green gram	*Phaseolus aureus*	Hathazari	1.2973
			Anowara	5.1217
			Rawzan	3.9165
			Mirsharai	3.2554
			Chandanaish	5.0324
Kheshari kalai	Grass pea	*Lathyrus sativus*	Hathazari	4.8318
			Anowara	29.5008
			Rawzan	5.4740
			Mirsharai	2.1903
			Chandanaish	8.3378

Table 12: Amount of Zn^{2+} (ig/Kg) in various Pulses of India [22]

Biological name of Pulses	Amount of Zn^{2+} (ig/Kg) in Pulses
Lens culinaris	58.05(±13.37)
Phaseolus mungo	58.32(±8.68)
Cayaners cajan	50.63(±8.74)

Table 13: Amount of Zn^{2+} (mg/100g) in various Pulses of Pakistan (Hamid U. S. et al. 2011; M. Z. Haq et al.)

Biological name of Pulses	Amount of Zn^{2+} ((mg/100g)in Pulses
Phaseolus aureus	3.25
Lens culinaris	4.2-4.4

V. Conclusion

Bangladesh is a densely populated and an agricultural country. Currently, the population is 16 crore and the area is 1,47,570 square kilometer. Most of the peoples of our country are poor and they live in village. So, they cannot buy zinc sufficient food. Zinc deficiency has been associated with dermatitis, anorexia, growth retardation, poor wound healing, hypogonadism with impaired reproductive capacity, impaired immune function and depressed mental function etc. It may also have an impact on carcinogenesis. The persons, who suffer from zinc deficiency, can get relieve of their diseases by selecting the zinc rich arums, bananas, vegetables and pulses. The study shows the amount of zinc is very higher in *Lathyrus sativus* pulse of Anowara Upazila and lower in *Musa acuminata* banana of Ramgarh Upazila. The reason for this trend is because of high translocation and transpiration rate of pulses in which transfer of metals from root to stem and ultimately to fruit. If they are unable to buy arums, bananas, vegetables and pulses from the market then they can grow such arums, bananas, vegetables and pulses in their garden or field. This analysis provides a base line data for our efforts directed towards maintaining a healthy life style.

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