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Determining the magnesium concentration from some indigenous fruits and vegetables of Chittagong region, Bangladesh

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Abstract

Magnesium is an essential mineral for its crucial role in many physiological function and metabolism. While magnesium should be present in nutritionally important quantities in regular diets, average Bangladeshi diets frequently fail to contain an adequate supply of the element. Thus, the study aims to determine the amount of magnesium in four different dietary items, bananas, vegetables and pulses, locally available in Chittagong, Bangladesh, using Spectro-photometric method. As per the findings, the magnesium concentration for banana contrasts between 0.843 µg/g and 3.654µg/g. *Musa cavendishii* from Satkania Upazila contains the highest value while, the lowest amount is found in Musa paradisiaca from Lama Upazila. For arums, the amount varies between 0.476 and 21.3456µg/g. The highest amount was found in arums, *Colocasia esculenta* (Patiya upazila) i.e. 21.3456µg/g and the lowest amount appears from the same species at Boailkhali upazila. In vegetables, the quantity fluctuates between 1.62 and 5.93 µg/g with the maximum amount found in Anowara upazila. Magnesium in pulses was observed in the range 6.5333-28.3208 µg/g. The utmost value is found in *Lathyrus sativus* and lowest value is in *Phaseolus aureus* species of Hathazari upazila. Among the four kinds, the highest is found in pulse species, *Lathyrus sativus* and, the lowest is discovered in *Arums* species, *Colocasia esculenta* at Boailkhali upazila of Chittagong, Bangladesh. This analysis will serve as a fundamental research to study the amount of Mg enabling us to take preventive measures from magnesium deficiency diseases.

Introduction

The eighth most plentiful element in the earth's crust is Magnesium (Railsback, 2009). It's a common metal and the ninth most abundant ingredient in the world (Ash, 2009). In general, magnesium is a silvery-white metal, which burns with a dazzling radiance. The atomic number twelve i.e. Mg is an indispensable element for ordinary task of the nervous and cardiovascular systems of the cell life. It is the second richest mineral in cells after potassium (Sircus, 2006).

Mg plays a vital role for the trans-membrane and intracellular modulator of cellular electrical activity. The chemical analysis and the demonstration of biological samples show that certain elements such as Mg were played a significant role for growth of macro-organisms. This invention makes the importance of trace elements in nutrition from the early nineteenth (Sandstead and Clevay, 2000). The nature extensively dispersed all element especially trace elements in different proportion. The highest concentration of trace metal may become toxic (Bukhari *et al*., 1987).

Generally, plants may absorb heavy metals from soil, water or air. The absorbing capacity of plant depends on the species and the structure of soil (Bin *et al*., 2001). Typically, soil is contaminated through special deposition of heavy metals from different industrial activities and the other sources involved are fertilizers, pesticides, sewage sludge and organic manures (Singh *et al*., 1997). Plants generally take the element by the roots. Metallic ions get dissolved in water. In vegetable crops, the contamination regards as to be the foliar uptake of atmospheric heavy metals emission of the soil (Salim *et al.*, 1993). The toxic properties of heavy metals depend upon the chemical structure of elements, which are hazardous in the form of their cations and the highest toxicity depends on the structure of carbon atoms, which contain shorter chain of the structure (Hussain, 2006). The racial people use a wide range of wild plants and plant products as their food. India has one of the largest tribal populations in the world. The tribal people collect a wide variety of wild roots and tubers to supplement their small food available at home (Vidyarthi, 1987). Medicinal plants are used worldwide for treatment of several diseases, and are also an important source of raw material for pharmaceutical industries. Recently, the use of herbal medicines has risen dramatically in the world since

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the side effects of them are frequently lower than the synthetic drugs apart from the highest cost involved with their processing (Rates, 2000).

Magnesium plays an important role in the body to create their metabolic reaction. There is no doubt that the chemical brain imbalances in fibromyalgia show the connection of magnesium. The lower level of Mg may results to the disorder of metabolic functions. It causes further pressure on body, reducing the body's capability to absorb and retain magnesium. Mg protects the cell against oxyradical damage and helps to absorb and metabolic reactions of vitamin B, vitamin C and E, which are anti-oxidants key in cell protection. Recently, many evidence advices that vitamin E enhances glutathione levels and may play a preventive role in Mg deficiency-induced cardiac lesions (Barbagallo *et al.*, 1999). Mg significantly influences the digestive system and the kidneys. Our heart suffers without the sufficient levels of magnesium. Magnesium also coordinates the activity of the heart muscle as well as the nerve functions that initiate the heartbeat (Sircus, 2006).

After burns, serious injuries, or surgery and in patients with diabetes Mg absorption is impeded which results in deficiency in Mg level in the body. The deficiency might also develop from liver disease, or intestinal mal-absorption problems and when magnesium elimination is increased. This is true for people who are used to alcohol, caffeine, or excess sugar, or who take diuretics or birth control pills. (Sircus, 2006).

Chittagong is the commercial capital city of Bangladesh. Many peoples are lived here. For that reason, it has become an important question of all peoples to find out the amount of Mg from various eating materials which will also helps to protect from various diseases. The environment of Bangladesh is fitting to grow up of different types of bananas, pulses, arums and vegetables. As a result, people can simply collect those vital foods from local market at a cheap rate or they can grow easily. Diverse bananas, pulses, arums and vegetables contain different amount of Mg. In this survey, the spectro-photometric method is used to find out the amount of Mg in different types of bananas, pulses, arums and vegetables of Chittagong region, Bangladesh. This analysis is concerned with the determining of the concentration of Magnesium metal content in some indigenous plant. The paper also studied the significance of magnesium for human body function.

Materials and Methods

Ammonium Chloride, Ammonium Hydroxide, Methanol, $MgSO_4.7H_2O$ (Use as Standard) and Ammonia solutions were purchased from Sigma Aldrich Chemicals (Steinheim, Germany) and Eriochrome Black-T and Hydrochloric acid from Merck (Germany). Twenty samples of all items i.e. arums, bananas, pulses and vegetables were collected from five upazila (The upazila constitutes by some villages) of Chittagong region, Bangladesh. Firstly, samples were washed with water followed with DDI (double de-ionized distil water) then were cut into small pieces and dried at 105^{o}C for 18 hrs (Wiermans and Ven, 1986) through gravity convention oven (DX 600, Yamato Scientific America). After drying, the samples were burned into the maffle furnace (L 3/11, Nabertherm, Germany) and then the ashes were weighed out and stored in the stopper bottles. After taking the weight of ash sample and then prepared by the conventional spectro-photometric method (Vogel, 1978). Finally, the amount of Mg in the present sample was determined using GBC UV-visible cintra spectro-photometer.

Results and Discussion

The present study reports on the Mg amount (µg/g) determined in selected fruit and vegetables collected from different sub-districts in Chittagong, Bangladesh. The range of Mg concentrations found in fruit and vegetables sampled from the different areas in Chittagong are summarized in Table 1, 2, 3, and 4. The results showed that the levels of Mg in all commodities ranged between 0.476µg/g and 21.3456µg/g in *Colocasia esculenta.*

In nearly all selected area of the Chittagong region in Bangladesh, the value of Magnesium was found to be similar (around 1-5 µg/g) in diverse arums (as shown in Table 1) without one exception value i.e. 21.3456 µg/g in Colocasia esculenta sample, which is comparatively about ten times lower than that of same species of Nigeria (28.02 mg/100 g) (Alinnor and Akalezi, 2010). But the *Colocasia esculenta* species of Patiya upazila, Chittagong contains the largest amount of Magnesium i.e. around 22 µg/g, whereas the value of Magnesium in other selected regions of Chittagong were around six times lower than that of Patiya and the second largest amount of Magnesium was found i.e. approximately 7 µg/g in the same upazila in *Typhonium trilobatum* species.

In Table 2, the amounts of Magnesium are documented that were observed in various species of banana in different region of Chittagong. The value of Magnesium for the species of *Musa sapietum* and *Musa paradisiaca* in different upazila of Chittagong was observed nearly about the same value and the

Table 1. Amount of Mg (µg/g) in diverse arums in different upazilas of Chittagong area, Bangladesh

Biological name of the arums	English name of the arums	Bengali name of the arums	Name of the Upazilas	Amount of Mg (µg/g) in arums
Colocasia esculenta	Eddoe	Pani Kachu	Patiya	21.3456
			Chandanish	1.083
			Satkaniya	1.3918
			Lohagara	1.1673
			Boalkhali	0.476
Typhonium trilobatum	Taro	Mukhi Kachu	Patiya	7.2001
			Chandanish	2.0651
			Satkaniya	2.3379
			Lohagara	1.5613
			Boalkhali	1.493
Alocasia indica	Giant taro	Man kachu	Patiya	2.3816
			Chandanish	3.7412
			Satkaniya	1.2218
			Lohagara	4.4373
			Boalkhali	0.9591
Amorphophallus campanulatus	Elephant foot yam	Oal Kachu	Patiya	2.1003
			Chandanish	1.4925
			Satkaniya	2.7524
			Lohagara	2.934
			Boalkhali	1.4334

Table 2. Amount of Mg (µg/g) in diverse bananas in different upazilas of Chittagong area, Bangladesh

Biological name of the bananas	English name of the bananas	Bengali name of the bananas	Name of the Upazilas	Amount of Mg (µg/g) in bananas
Musa sapietum	Lady finger banana	Bangla kala	Hathazari	1.397
			Anowara	1.134
			Satkania	1.364
			Lama	1.776
			Ramgarh	1.675
Musa acuminata	Champa banana	Champa kala	Hathazari	1.745
			Anowara	1.904
			Satkania	2.198
			Lama	2.456
			Ramgarh	2.311
Musa cavendishii	Cavendish banana	Sagor kala	Hathazari	1.163
			Anowara	2.103
			Satkania	3.654
			Lama	1.126
			Ramgarh	1.638
Musa paradisiaca	Green banana	Kanch kala	Hathazari	1.858
			Anowara	1.015
			Satkania	1.452
			Lama	0.843
			Ramgarh	1.093

Table 3. Amount of Mg (µg/g) in diverse vegetables in different upazilas of Chittagong area, Bangladesh

Biological name of the vegetables	English name of the vegetables	Bengali name of the vegetables	Name of the Upazilas	Amount of Mg (µg/g) in vegetables
Enhydra fluctuans	Water cress	Helencha Shak	Hathazari	4.17
			Patia	1.94
			Anowara	2.39
			Pahartali	3.84
			Fatickchari	1.62
Alternanthera philoxeroides	Alligator weed	Moloncha Shak	Hathazari	3.06
			Patia	2.41
			Anowara	2.31
			Pahartali	5.84
			Fatickchari	3.01
Ipomoea aquatica	Swamp cabbage	Kolmi Shak	Hathazari	2.03
			Patia	1.86
			Anowara	3.46
			Pahartali	3.48
			Fatickchari	3.22
Centella asiatica	Indian pennywort	Thankuni Pata	Hathazari	4.35
			Patia	3.27
			Anowara	5.93
			Pahartali	5.71
			Fatickchari	4.49

Table 4. Amount of Mg (µg/g) in diverse pulses in different upazilas of Chittagong area, Bangladesh

Biological name of the pulses	English name of the pulses	Bengali name of the pulses	Name of the Upazilas	Amount of Mg (µg/g) in pulses
Vigna muungo	Black gram	Mash kalai	Hathazari	7.4696
			Anowara	32.2435
			Rawzan	6.7392
			Mirsharai	7.7021
			Chandanaish	12.7938
Phaseolus vulgaris	Southern pea	Felon kalai	Hathazari	7.4879
			Anowara	8.1475
			Rawzan	7.6244
			Mirsharai	13.7001
			Chandanaish	13.0346
Phaseolus aureus	Green gram	Mung kalai	Hathazari	6.5333
			Anowara	7.44436
			Rawzan	7.6119
			Mirsharai	11.6935
			Chandanaish	10.9313
Lathyrus sativus	Grass pea	Kheshari kalai	Hathazari	9.9241
			Anowara	28.3208
			Rawzan	7.9718
			Mirsharai	10.9313
			Chandanaish	18.3166

value varied between 0.843 µg/g to1.776 µg/g. For the species of Musa cavendishii, the value of Magnesium was found in Hathazari, Lama and Ramgarh 1.163 µg/g, 1.126 µg/g and 1.638 µg/g respectively. But in Anowara and Satkania upazila the value of copper contained was (2.103 µg/g and 3.654 µg/g, respectively) comparatively higher than those of other Upazila. The Champa banana (species of *Musa acuminata*) of Hathazari and Anwara contained comparatively same amount of Magnesium (1.745 µg/g and 1.904 µg/g, respectively). Whereas in Satkania, Lama and Ramgarh Upazila these values were 2.198 µg/g, 2.456 µg/g and 2.311 µg/g, respectively and those were about two times higher than of Hathazari and Anowara Upazila. It is observed from another investigation (Mohapatra *et al*., 2010) in India, the value of Magnesium of Banana is comparatively much higher than those of Bangladesh. The average value of Magnesium contained more than six times higher amount of Magnesium than those of Chittagong area of Bangladesh.

According to this investigation, the amount of Magnesium was presented in table 3 for the different species of vegetables e.g., *Enhydra fluctuans*, *Centella asiatica*, *Ipomoea aquatica* and *Alternanthera philoxeroides* in different upazila of Chittagong area were varied from1.62 µg/g to 5.93µg/g. The species of the *Centella asiatica* in Anowara Upozila contains the highest amount (5.93 µg/g) and the species *Enhydra fluctans* in Fatickchari Upozila contains the lowest amount (1.62 µg/g). An investigation contained the concentration of Magnesium in *Enhydra fluctuans* species of India (Bhowmik and Datta, 2012) around the same amount (2.85 µg/g) of others species in Chittagong region of Bangladesh.

The research has been showed (in table 4) the amount of Magnesium of different species of pulses e.g. *Vigna mungo*, *Phaseolus vulgaris*, *Phaseolus aureus* and *Lathyrus sativus* in various upazila of Chittagong were found around 6.5-32.3 µg/g. But the species of *Vigna mungo* in Anwara upozila and *Lathyrus sativus* in same upazila contained much higher value of Magnesium e.g. around 32.25 µg/g and 28.4 µg/g, respectively than those of other regions. The result has also been indicated the amount of Magnesium in diverse arums of different Upazila of Chittagong area in Bangladesh is six times lower than that of India (Tresina Soris *et al*., 2010).

Overall, the amount of Magnesium in pulses (6.5333-32.2435 µg/g) is comparatively higher than that of arums (0.476-21.3456 µg/g), Banana 0.843-3.654 µg/g) and Vegetables (1.62-5.93 µg/g). Specially, *Vigna mungo*, one species of pulses contained the highest value of Magnesium and the amount was 32.2435 µg/g. The varied concentrations of Mg found in these fruit and vegetable items may be explained by several factors such as the metal content of the soil, variation in element uptake by different plants, and fertilization (Alam *et al*., 2003). The mobility of micro and macro molecules from soil to plants is a function of the physical and chemical properties of the soil and of vegetable species, and is altered by innumerable environmental and human factors (Zurera *et al.*, 1987). This can explain why Magnesium concentration varies from one fruits to another and one vegetable to another. Mg is found to have higher mobility to Colocasia esculenta than to other fruit and vegetable plants. Hydrologic and geochemical influences also account for the varied concentration of Mg in different fruit and vegetable samples (Asano *et al*., 2003). These findings corroborate with the findings of Islam *et al*. (2012), who showed that concentration of Zinc varied in various Arums, Bananas, Vegetables and Pulses from Five Upazila of Chittagong region due to similar reasons.

Conclusions

Magnesium is a mandatory element for all living cells. It is used as catalyst for numerous biological reactions involving the release of energy. The present study revealed that the metal content of the selected indigenous plants of Chittagong area in Bangladesh were within the limits. Bangladesh is the world most densely populated country. About 31.5% people live below in the poverty line (Economy of Bangladesh-Wikipedia). So, many people cannot able to buy Mg sufficient food. People, who suffer from Mg deficiency, can alleviate deficiency of their diseases by selecting the Mg rich bananas, pulses, arums and vegetables which can easily grow in the field or easily collect from the local market. This survey provides a base line data to maintain a healthy life style as an effort towards awareness rising among the poor village inhabitants.

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