Scholars Journal of Applied Medical Sciences (SJAMS) **ISSN 2320-6691 (Online)**
Sch. J. App. Med. Sci., 2016; 4(1C):273-277 **ISSN 2347-954X (Print)**

(An International Publisher for Academic and Scientific Resources)
www.saspublishers.com DOI: 10.36347/sjams.2016.v04i01.049

Original Research Article

Attribution of Metals Concentration of Fruits and Vegetables of Hail Markets on Anemia Prevalence

Walid Abu Rayyan[1], Ahmed Abu-Rayyan[2]
[1]College of Medicine, University of Hail, Hail, KSA.
[2]College of Public Health and Health Informatics, University of Hail, Hail, KSA.

***Corresponding author**
Dr. Walid Abu Rayyan
Email: walrayyan1@yahoo.com, w.aburayyan@uoh.edu.sa.

Abstract: World health organization has announced almost 48% of the worldwide population issuffering from anemia in its report 2008.There is a relatively high incidence of anemia in the Saudi society, despite the high prevalence for obesity in the Saudi population 63.6%. The Kingdome of Saudi Arabia imports fruits and vegetables among different types of food stuff from all over the world. In this study, we have addressed the question of what are the levels of metals in fruits and vegetables imported to the Saudi market in Hail province and is there a correlation between the incidence of anemia and metals levels in fruits and vegetables sold in the local market of Hail. 240 Samples of fruits and vegetables were collected from 10 markets in the city of Hail, KSA and analyzed for copper, magnesium and iron using Inductively coupled plasma atomic emission spectroscopy (ICP-AES).Copper levels ranged between 1.2 µg/g and 4.1 µg/g, whereas, magnesium levels ranged between 1 µg/g and 9 µg/gand iron levels ranged between 0.5 µg/g and 4.1µg/g. There was an exponential decrease of 25% in the levels of Iron and magnesium of this study compared to the Australian guidelines, whereas, there was an increase of 20% in the levels of copper. As a consequence of these results, iron and magnesium did not meet the Provisional Tolerance Weekly Intake (PTWI) recommended by Food and Agriculture Organization of the United Nations (FAO/WHO). In conclusion, we propose another cause for anemia prevalence in Hail province, as well as, we highly recommend having a nutritional monitoring on the food and vegetables imported to Saudi Arabia beside to the physical and chemical inspection for fruits and vegetables.
Keywords: Anemia, Metals, Fruits and Vegetables, Hail, KSA

INTRODUCTION

World health organization has announced almost 48% of the worldwide population suffering from anemia in its report 2008 [1]. The highest prevalence was in Africa; around83.5 million people were affected, whereas, the lowest incidence was in Europe only 11.1 million. On other geographical points, Middle East, and Gulf region, there was a high incidence of 46.7 % [1]. Globally, Iron deficiency anemia (IDA)(the most common cause of anemia in the world) is the first nutritional deficiency problem worldwide, especially in developing countries. In children causes of IDA include inadequate intake together with rapid growth, low birth weight and gastrointestinal losses due to excessive consumption of cow's milk [2]. Other causes of anemia include inflammation, malabsorption of important micronutrients such as iron, H. pylori infection and celiac disease (CD)[3]. Anemia causes shortness of breath, dizziness, headache, coldness in hands and feet, pale skin, chest pain, weakness, and fatigue [4]. In Africa, causes of anemia can be attributed to inadequate intake of nutrients due to several causes among them food famines, wars and socioeconomic factors. on the contrary, in The Kingdome of Saudi Arabia(KSA)(which considered as the first petrol exporter country),there is a relatively high incidence of anemia in the Saudi society, despite the high prevalence for obesity in the Saudi population 63.6%[5]. Trace metals, one of the food nutritional components, are required for organogenesis during different life stages. Iron is one of the most abundant elements in the nature [6]. It is required for the hematopoiesis process; around 70% of the total iron in human body is present in a form of hemoglobin. The daily intake needs for iron is estimated around 10-50 mg/day according to the physiological requirements of the body[2]. Several factors as age sex and iron bioavailability play a vital role for the daily allowance intake for iron. The iron daily intake is obtained through food ingestion and water intake; one liter of water contains 2 mg of iron[7]. Copper is an essential trace element playing several functions in organ and biochemical reactions in the human body. The daily intake allowance is estimated around 0.5 mg/kg; higher intake can cause acute gastric

irritation[8]. Copperaids in iron absorption and works to form the body red blood cells. It also helps to keep the blood vessels, nerves, immune system, and bones healthy[9]. Magnesium is required for many biochemical reactions in the body. It helps in maintaining normal nerve and muscle function, supports a healthy immune system, keeps the heart beat steady, and helps bones remain strong. It also helps regulate blood glucose levels and aid in the production of energy and protein[10].

In this study, we have addressed the question of what are the levels of metals in fruits and vegetables imported to the Saudi market in Hail province and is there a correlation between the incidence of anemia and metal levels in fruits and vegetables sold in the local market of Hail. In order to give an adequate answer for the study question, we have analyzed levels of iron, magnesium and copper in 8 different kinds of fruits and vegetables from local markets in Hail Provence.

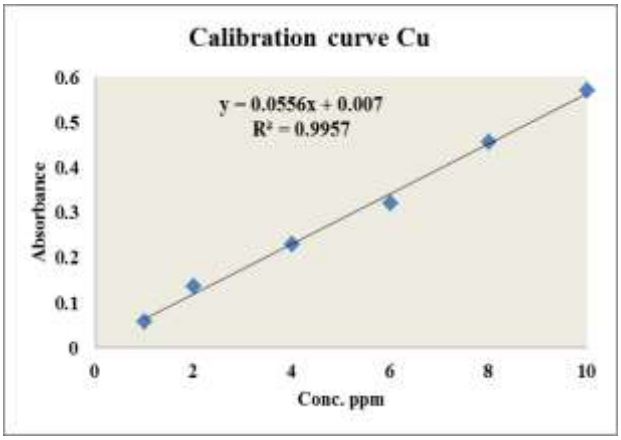
MATERIAL AND METHODS

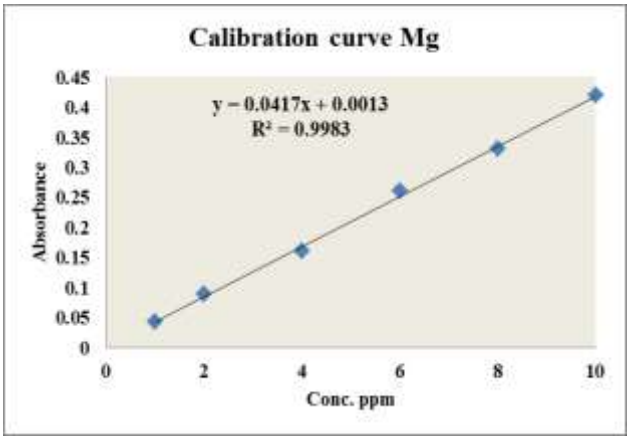
240 Samples were collected from 10 markets in the city of Hail, KSA. Before the chemical analysis, samples were cleaned and oven-dried at 130 C^{o} for ≈ 12 hrs. The dried samples were ground in a stainless steel. Samples were classified according to their English name.

To determinate the concentration of metals, the digestion of the dried samples was done according to the method described by [11] using conc. H_2SO_4 and 30% H_2O_2 mixture. To a 0.5 g of adry ground sample placed in a100-ml beaker, 3.5 mL of 30 % $H_2O_2$was added. The content of the beaker was heated to 100 °C, and the temperature was gradually increased to 250 °C and left at constant temperature for 30 min. The beaker was cooled and additional 1 ml of 30 % H_2O_2 was added to the digestion mixture and the contents were reheated again. The digestion process was repeated until aclear solution was obtained. The clear solution was filtered using 0.45 µm Whatman filter paper and transferred into the100-ml volumetric flask and completed to the mark with double distilled water. A blank digestion solution was made for comparison. A standard solution for each element under investigation was prepared and used for calibration. The metal measurement was performed with anInductively coupled plasma atomic emission spectroscopy (ICP-AES) (College of Public Health and Health Informatics, Hail).Measurements were done against metal standard solutions 1, 2,4,6, 8 and 10 ppm.

RESULTS

The concentrations of metals in the fruits and vegetables are presented in Table (1). Copper levels ranged between (1.2) µg/g and (4.1) µg/g. the highest value for copper was found in pears> tomatoes> bananas> eggplant> orange> cucumber> zucchini> apples. Magnesium levels ranged between (1)µg/g and (9) µg/g the highest value for magnesium was found in bananas> orange> cucumber> apples> zucchini> pears> eggplant> tomatoes. Iron levels ranged between (0.5) µg/g and (4.1) µg/g the highest value for iron in zucchini> tomatoes> pears> apples> eggplant> orange> cucumber> bananas. Recovery for the extraction ranged (90- 105%) with a mean of 96% (not shown).





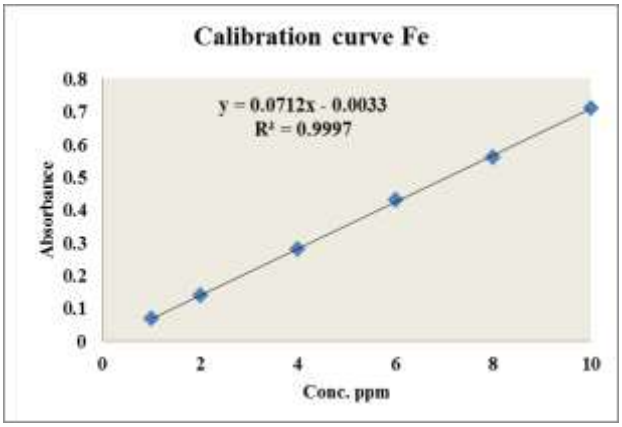


Fig -1: Calibration curves for the determination of Cu, Mg and Fe in the fruits and vegetables

Table -1: Concentrations of metals in fruits and vegetablestaken from Hail city markets, KSA.

Plants		Cu (µg/g) Mean ± SD	Mg (µg/g) Mean ± SD	Fe (µg/g) Mean ± SD
Fruit	Bananas	3.2 ± 0.65	9 ± 1.2	1.8 ± 0.1
	Cucumber	1.9 ± 0.41	2.1 ± 0.58	0.93 ± 0.3
	Apples	1.2 ± 0.15	2 ± 0.33	0.5 ± 0.14
	Tomatoes	3.5 ± .71	1 ± 0.12	1.5 ± 0. 4
	Orange	2.3 ± 0.38	5 ± 0.66	1.1 ± 0.12
	Pears	4.1 ± 0.91	1.3 ± 0.14	1.3 ± 0.12
Vegetables	Zucchini	1.6 ± 0.22	1.6 ± 0.32	4.1 ± 0.56
	Eggplant	3.1 ± 0.27	1.1 ± 0.14	2.4 ± 0.09

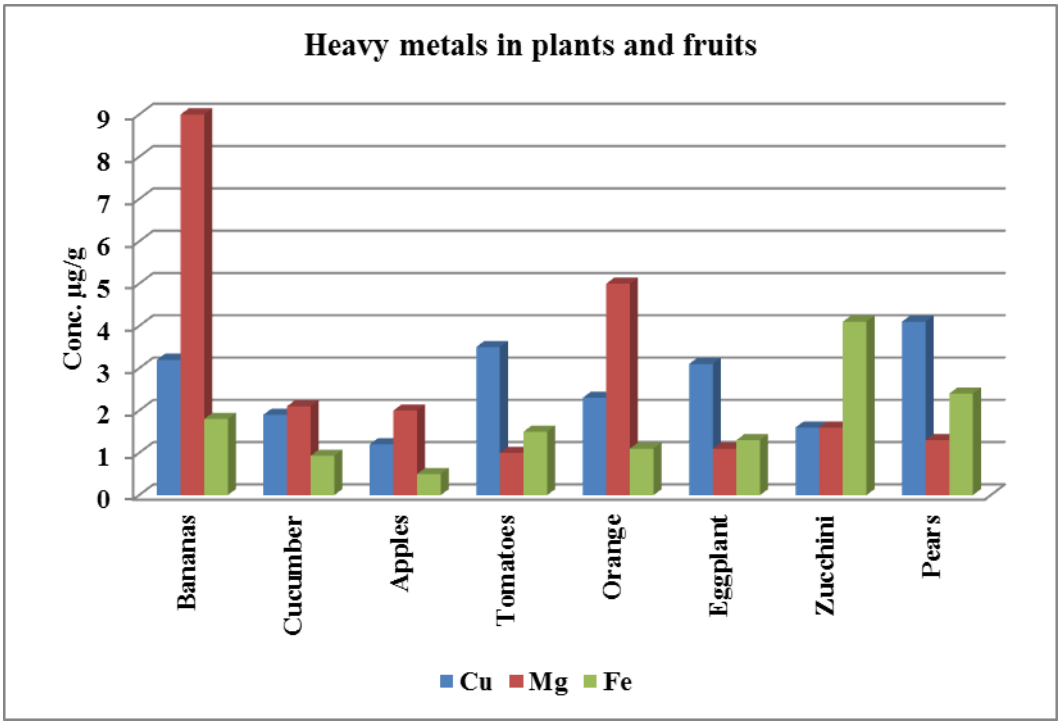


Fig-2: Mean Concentrations of Metals in fruits and vegetables from Markets of Hail city, KSA.

DISCUSSION

The Kingdome of Saudi Arabia imports fruits and vegetables among different types of food stuff from all over the world. The rational increase in the resident's numbers in KSA due to the growth of economy in the gulf region combined with the dearth of water resources and low proportion of agricultural lands to desert area and the rough climate conditions has revealed a high demand for sustainable food supply chain [12-14]. The nutritional value of food can be affected by several factors, for instance, fruits and vegetables are subjected to a random variation in mineral deposition influenced by the product item, time of harvest, ripeness, climate, soil conditions including fertilizer application, storage and marketing conditions [15, 16].

The aim of this study is to assess the levels of copper, magnesium, and iron in fruits and vegetables sold in local markets of Hail district on the daily recommended intake levels of metals. Samples of bananas, cucumber, apples, tomatoes, orange, eggplant, zucchini and pears have been analyzed. Samples of fruits and vegetables were analyzed and compared with those of natural limits and the safe limits of various agencies. Levels of iron were 20 % higher in vegetables than fruits, whereas, copper and magnesium levels were found to be higher in fruits. The levels of metals in the fruits and vegetables of this study were heterogeneous and confounder from the results published by Cunningham *et al*. for the limits of metals in the Australian food agency, levels of copper for the fruits and vegetables in Australia were extremely lower than copper levels of fruits and vegetables in this study[17]. Whereas, there was an exponential decrease of 25% in the levels of Iron and magnesium of this study compared to the Australian guidelines. As a consequence of these results, some metals did not meet the Provisional Tolerance Weekly Intake (PTWI) recommended by Food and Agriculture Organization of the United Nations (FAO/WHO) and the others have exceeded it. Oteef *et al*. demonstrated higher levels in copper levels in tomatoes in KSA with a proportion of 50% than FAO/WHO recommendations[18]. In the current study, levels of copper obtained are confounder and more than the range of copper in agricultural crops of 0.4–1.5 µg/g dry weight [19]. In addition, levels of iron and magnesium are consistent with levels of metals found in fruits and vegetables analyzed from other parts of Saudi Arabia [20]. Literally, Iron and magnesium levels were less than the levels found in fruits and vegetables from different parts of the world including Sri Lanka [21], Egypt [6], and the USA [22]

The consumption of such fruits and vegetables by the community can develop health risks in near future [23]. Ashraf *et al* showed variations in metal concentrations among different tea kinds consumed by Saudi population [24]. Al-Jasser demonstrated higher levels of toxic metals in vegetables sold on the side of traffic road in Riyadh city in local markets [20]. Al-Saleh *et al* demonstrated higher levels of lead and cadmium in breast milk of mothers of Al-Ihssa region than Riyadh of KSA [25]. Al-Shayeb demonstrated higher levels of lead and zinc superficial contaminants on the surface of unwashed date palm (Phoenix dactylifera L.) [26]. Because the bulk of literature warns against the cumulative effects of prolonged heavy metal exposure, regular consumption of low nutritional fruits and vegetables by local populations might pose potential health problems. [27].

While literature reviewing, we were shocked from reports of different research groups about Hail , for instance, Enrera *et al*. showed a high prevalence of 58% of anemia among pregnant women in Hail province[28]. Additionally, the levels of Hb were below 11 mg/dl in 30% of healthy female students of Hail university [29]. All of these results of low metals in fruits and vegetables along with the high prevalence of anemia in the Hail province can strongly propose an additional cause for the incidence of anemia in the Saudi population of Hail.

In conclusion, we highly recommend having a nutritional monitoring on the food and vegetables imported to Saudi Arabia beside to the physical and chemical inspection for fruits and vegetables. Something else, there should be fortified food in the market especially the bread which could be fortified with iron.

REFERENCES

1. De Benoist B; *et al*., WHO global database on anaemia. Geneva: WHO, 2008: p. 1993-2005.
2. Özdemir N; Iron deficiency anemia from diagnosis to treatment in children. 2015.
3. Rostami-Nejad M; *et al*., H. pylori associated with iron deficiency anemia even in celiac disease patients; strongly evidence based but weakly reflected in practice. Gastroenterology and hepatology from bed to bench, 2015; 8(3):178.
4. Sankaran VG, Weiss MJ; Anemia: progress in molecular mechanisms and therapies. Nature medicine, 2015; 21(3):221-230.
5. Ahmed HG *et al*; Prevalence of obesity in Hail region, KSA: in a comprehensive survey. Journal of obesity, 2014. 2014.
6. Radwan MA, Salama AK; Market basket survey for some heavy metals in Egyptian fruits and vegetables. Food and Chemical Toxicology, 2006; 44(8):1273-1278.
7. Péneau S, *et al*.; Relationship between iron status and dietary fruit and vegetables based on their vitamin C and fiber content. The

American journal of clinical nutrition, 2008;87(5):1298-1305.
8. Alturiqi AS, Albedair LA; Evaluation of some heavy metals in certain fish, meat and meat products in Saudi Arabian markets. The Egyptian Journal of Aquatic Research, 2012; 38(1):45-49.
9. Al-Jameil N, *et al.*; Analysis of serum trace elements-copper, manganese and zinc in preeclamptic pregnant women by inductively coupled plasma optical emission spectrometry: a prospective case controlled study in Riyadh, Saudi Arabia. International journal of clinical and experimental pathology, 2014;7(5): 1900.
10. Oumeisha S, *et al.*; Serum concentrations of magnesium among Jordanians: Effect of cardiovascular disease on magnesium levels Journal of Chemical and Pharmaceutical Research, 2015; 7(11): 499-503.
11. Jones Jr JB, Case VW, Westerman R; Sampling, handling and analyzing plant tissue samples. Soil testing and plant analysis., 1990(Ed. 3):389-427.
12. Al-Khateeb S, Leilah A; Heavy metals accumulation in the natural vegetation of Eastern Province of Saudi Arabia. Journal of Biological Sciences, 2005;5(6):707-712.
13. Seddigi ZS, *et al.*; Assessment of metal contents in spices and herbs from Saudi Arabia. Toxicol Ind Health, 2013.
14. Al Hawsawi ZM, *et al.*;High prevalence of iron deficiency anemia in infants attending a well-baby clinic in northwestern Saudi Arabia. Saudi Med J, 2015; 36(9):1067-70.
15. Southgate D, Greenfield H; Principles for the preparation of nutritional data bases and food composition tables. World review of nutrition and dietetics, 1992.
16. Torelm I, Danielsson R; Variations in major nutrients and minerals in Swedish foods: a multivariate, multifactorial approach to the effects of season, region, and chain. Journal of Food Composition and Analysis, 1998; 11(1): 11-31.
17. Cunningham J, Milligan G, Trevisan L; Minerals in Australian fruits and vegetables. Food Standards Australia. New Zealand, 2001.
18. Oteef MD, *et al.*; Levels of zinc, copper, cadmium, and lead in fruits and vegetables grown and consumed in Aseer Region, Saudi Arabia. Environmental monitoring and assessment, 2015;187(11):1-11.
19. Nagajyoti P, Lee K, Sreekanth T; Heavy metals, occurrence and toxicity for plants: a review. Environmental Chemistry Letters, 2010; 8(3):199-216.
20. Al Jassir M, Shaker A, Khaliq M; Deposition of Heavy Metals on Green Leafy Vegerables Sold on Roadsides of Riyadh City, Saudi Arabia. Bulletin of environmental contamination and toxicology, 2005; 75(5):1020-1027.
21. Kananke T, Wansapala J, Gunaratne A; Heavy Metal Contamination in Green Leafy Vegetables Collected from Selected Market Sites of Piliyandala Area, Colombo District, Sri Lanka. American Journal of Food Science and Technology, 2014; 2(5):139-144.
22. Mehari TF, *et al.*; Trace and macro elements concentrations in selected fresh fruits, vegetables, herbs, and processed foods in North Carolina, USA. Journal of Environmental Protection, 2015; 6(06):573.
23. Asdeo A, Loonker S; A comparative analysis of trace metals in vegetables. Research Journal of Environmental Toxicology, 2011; 5(2):125-132.
24. Ashraf W, Mian AA; Levels of selected heavy metals in black tea varieties consumed in Saudi Arabia. Bulletin of environmental contamination and toxicology, 2008; 81(1):101-104.
25. Al-Saleh I, Shinwari N, Mashhour A; Heavy metal concentrations in the breast milk of Saudi women. Biological trace element research, 2003; 96(1-3):21-37.
26. Al-Shayeb S, Al-Rajhi M, Seaward M; The date palm (Phoenix dactylifera L.) as a biomonitor of lead and other elements in arid environments. Science of the Total Environment, 1995; 168(1):1-10.
27. Al-Saleh I, Shinwari N; Report on the levels of cadmium, lead, and mercury in imported rice grain samples. Biological Trace Element Research, 2001; 83(1):91-96.
28. Enrera JA, AlHassan AE, Al-Shammary AR; Iron Deficiency Anemia among Pregnant Women in Hail Kingdom of Saudi Arabia. 2012.
29. Mohamed S, Sweilem S; Prevalence of anemia levels in a sample of university female students. International Journal of Science and Research, 2014; 3(6):805-809.