Quality Assessment of Commercial Fruit Juices and Health Hazards in Slemani City- Kurdistan Region/ Iraq

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Abstract

Fruit juices are especially valued in the human diet as these contain micronutrients, fiber, potassium, vitamin C, which work as antioxidants within the body as well as bio-functional components. The goal of this study is to determine the levels of Iron Fe, Zinc Zn, Magnesium Mg, Sodium Na, Potassium K, Calcium Ca and heavy metal manganese Mn, mercury Hg, Lead Pb as fruit juice consumed largely and will be in raise daily. Sixty-nine samples of different fruit juice were bought from retail markets in Sulaimani city, were analyzed using wet methods. The results obtained showed the ranges of the metals detected in all the of fruit juice were; Iron Fe (0-2), Zinc Zn (0), Manganese Mn (0), magnesium Mg (0-0.6), Sodium Na (0-22.9), Potassium K (0-19.2), Calcium Ca (0-29) and heavy metal mercury Hg (0-0.25), Lead Pb (0-4) mg/L. The mean value of Iron Fe, Magnesium Mg, Sodium Na, Potassium K, Calcium Ca and heavy metal mercury Hg, Lead Pb 0.421 , 0.16 , 4.188 , 3.348 , 7.362 ,0.029 , 0.578mg/L) respectively, Zinc and Manganese were not detected in any samples,some of the samples have nutrient value for sodium, potassium and calcium.

Keyword: *Heavy metals, fruit juice, public health, flame photometer, toxic metal.*

Introduction

Fruit juices are especially valued in the human diet as these contain micronutrients, fiber, potassium, vitamin C, which work as antioxidants within the body as well as bio-functional components (32) carotenoids, minerals (especially Mg, K) and various kinds of antioxidants and dietary fiber (pectin) is protective against degenerative and chronic diseases such as cancer and cardiovascular diseases 8 ,20. Fruit juice is commonly consumed by our youths not for their nutritional benefits, but to quench thirst during the hot summer, or maybe they think that these soft drinks will help them in digestion, while athletes use energy drinks to keep up their energy during intense physical activity and competitions. The market for these beverages has increased in the past years and although they might be harmless, overdoses or a combination of these with other drinks could be harmful to the health of some consumers in certain circumstances 19. Fruit juices are regularly utilized for culinary and dietary purposes 10. They are made up of chiefly cellulose, hemi-cellulose and pectin substances that give them their texture and firmness. Fresh fruits and vegetables are of great importance in the diet because of the presence of vitamins and mineral salts 10. In addition, they contain water, calcium, iron, sulphur and potash 21. They are very important protective foods and quite useful for the maintenance of health and the prevention and treatment of various diseases 7. At higher concentrations, they may be toxic to the biota and could disturb the biochemical process and cause hazards 1. Heavy metal composition of food is of interest because of their essential and toxic nature, for example Fe, Zn, Cu, Cr, Co & Mn are essential while Pb, Cd, Ni & Hg are toxic at certain levels 16. Iron fortification in foods has been increased to tackle the increased incidence of iron deficiency anemia, especially in the western countries 11. Iron deficiency anemia is the most common micronutrient deficiency affecting mostly lower socioeconomic populations of developing countries 23. The non-nutritive toxic metals which are known to have deleterious effects even in small quantities (below 100 ppm) are As, Sb, Cd, F, Pb, Hg, and Se 25,26.

Therefore the manufacture of juices requires special attention in terms of purity and the sources of water and its purification are crucial for maintaining quality and safety and quality control and market watching will be do more monitoring for food especially fruit juice. The aim of present study is to compare the result values with acceptable values were proposed by food administration of American and WHO and the corresponding values of different countries available in the literature.

Methods and Material

Sixty-nine samples of commonly consumed fruit juices were analysis to determinate the concentrations of Iron Fe, Zinc Zn, Magnesium Mg, Sodium Na, Potassium K, Calcium Ca and heavy metal manganese Mn, mercury Hg, Lead Pb by using Atomic Absorption Spectrophotometer (AAS) agricultural college, main laboratory research / university of Salahadin. Digestion of Fruit Juices Samples performed at Halabja technical agricultural college in Halabjah city. All glassware's washed with 1% nitric acid followed by demineralized water. 10 mL of concentration Sulphoric acid (H2SO4) was added to 2 mL of the fruit juice, then added 5 mL of hydrogen peroxide (H2O2), digestion of samples in a Kjeldahl digestion tube, the solution was heated on a Kjeldahl heater for 30 min or higher degree then turn into half and heated for 15 minutes. This was then allowed to cool in room temperature and transfer into a 100 mL volumetric flask and made up to mark with deionized water, which brought from the foundation of Kurdistan for strategic and research, then stored in a Pyrex glass bottle container transport into agriculture college, university of Erbil for analysis of Zn, Mn, Hg, Mg, Fe metal by atomic absorption spectroscopy model Alpha-4 and Na, Ca, K, flame photometer model Jenway PFP-7.

Result and Discussion

The results of the determination of the concentrations of metal in the fruit juice are shown in tables 1 , maximum, minimum, mean, and detected percentage of contents represent in table 2 .The mean value of Iron Fe, Zinc Zn, Manganese Mn, Manganese Mn, Magnesium Mg, Sodium Na, Potassium K, Calcium Ca and heavy metal mercury Hg, Lead Pb 0.421 , 0 ,0, 0.16 , 4.188 , 3.348 , 7.362 ,0.029 , 0.578mg/L) respectively. The ranges of the metals detected in all samples of fruit juice were; Iron Fe (0-2), Zinc Zn (0), Manganese Mn (0), magnesium Mg (0-0.6), Sodium Na (0-22.9), Potassium K (0-19.2) , Calcium Ca (0-29) and heavy metal mercury Hg(0-0.25) , Lead Pb (0-4) mg/L.

Table 1: Maximum, minimum, average in mg/L and percentage content in each metals

Metals	**Pb**	**Fe**	**Zn**	**Mn**	**Mg**	**Na**	**K**	**Ca**	Hg
Mean	0.578	0.421	0	0	0.160	4.188	3.348	7.362	0.029
Min	0	0	0	0	0	0	0	0	0
Max	4	2	0	0	0.6	22.9	19.2	29	0.25
Percentage % detected	30.43%	69.57%	0%	0%	84.06%	72.46%	72.46%	57.97%	21.74

Mercury (Hg)

Mercury was detectable in (21.74 %) of samples as shown in table 1 and 2 above and has concentration (0 – 0.25 ppm), The maximum value for Hg was found in sample FJ1, FJ13 and 21 was 0.25 ppm, the mean value detected 0.029 ppm. All detectable value was high compared to the maximum permissible limit for mercury is 0.01 ppm according to the national standard of China on Maximum Levels of Contaminants in Foods, a maximum level for mercury in fruits is 0.01 mg/kg (NSCMLCF, 2005). The average daily intake of mercury is reported to be between 0.002-0.02 mg (GMACE, 2001). Mercury is one of the most toxic elements among the studied heavy metals and exposure to high level of this element could permanently damage

the brain, kidneys and developing fetus.

Sodium (Na)

It detected in 72.69% of samples and the mean of detected was 4.188 mg/dl, the range was (0-22.9 mg/dl).

Lead (Pb)

Lead was detectable in (30.43 %) of samples as shown in table 1 and 2 above and has concentration (0–4 ppm), The maximum value for pb was found in sample FJ7 was 4 ppm, the mean value detected 0.578 ppm. All detectable value was high compared to the maximum permissible limit for lead is 0.01 ppm set by WHO. The mean value was LESS than that reported in Accra Ghana fruit juice 1.59 mg/L.

Iron (Fe)

Iron was detectable in (69.57%) as show in table 1 above and has concentration (0 – 2 mg/L), The maximum value for Fe was found in sample FJ5, 6,27, 31 was 2 mg/L, the mean value detected 1.34mg/L. The values of iron were lower compared to 0.020 –2.090 mg/L for non-canned and 0.020 – 2.460 mg/L for canned beverages 12, and lower than (3.13-5.48 mg/L) 3 but higher than values (0.11 – 0.28 mg/L reported) 14. All the fruit juice samples had iron concentration higher than the maximum limit permitted by WHO 23 except undetected samples. Iron is important in many biological processes because it is an ideal oxygen carrier and because it can function as a protein-bound redox element. Iron deficiency is common worldwide and in infants can cause severe neurological deficit 17. Minerals play an important role in maintaining proper function and good health in the human body.

Calcium (Ca)

The values of Calcium were higher than 2.763 – 13.143mg/L 5 while lower compared to 0.28 – 262 mg/L [14], Calcium is needed for the formation and maintenance of bones, the development of teeth and healthy gums. It is necessary for blood clotting, stabilizes many body functions and is thought to assist in preventing bowel cancer 2. It has a natural calming and tranquilizing effect and is necessary for maintaining a regular heartbeat and the transmission of nerve impulses. The required amount includes: 1,000 mg/day for people aged 19-50 years and 1,200 mg per day for people over the age of 51 years. The maximum level of calcium is 2.5 g/day 18.

Potassium (K)

The potassium detected in 72.46% of samples and the rang were (0-19.2 mg/dL). The values of potassium were lower compared to 2.0 to 110 mg/L 5, Potassium concentrations of the fruit juices were relatively low compared to the recommended daily intake (RDI) of potassium. The RDI of potassium ranged between 1600 - 5000 mg/day. Potassium is the major intracellular ion, intimately related to sodium movement out of the cell via Na/K ATPase.

Manganese (Mn)

Manganese was not detectable in any samples as shown in table 1 above,deficiency in manganese leads to various health problems, which may include bone malformation, eye and hearing problems, high cholesterol levels, hypertension, infertility, weakness, heart disorders, memory loss, muscle contraction, tremors, seizures. It could also result in decreased learning ability in school-aged children and increase the propensity for violence in adult.

Zinc (Zn)

Zn is one of the important trace elements that play a vital role in the physiological and metabolic process of many organisms. Nevertheless, higher concentrations of Zn can be toxic to the organism. Zinc was not detectable in any samples as shown in table 1 above also the Zn concentration below the limits imposed by USEPA (2008) and WHO. The maximum contaminant limit for zinc is 5.0 ppm . The result was less than that reported 0.301ppm 38 and reported in Accra Ghana fruit juice 3.33 ppm. Zinc is involved in numerous aspects of cellular metabolism. It is required for the catalytic activity of approximately 100 enzymes and it plays a role in immune function, protein synthesis, wound healing, DNA synthesis, and cell division.

Magnesium (Mg)

Manganese is known as trace elements. According to the USDA the daily recommended intake of manganese is 2.3 mg/day for adult males and 1.8 mg/day for female. The consumption of dietary trace-elements will help to prevent free radical damage. According to Olajire and Azeez 15, trace-elements have the ability to scavenge free radicals by inhibiting the initiation step or interrupting the propagation step of oxidation of lipid and as preventive antioxidants which slow the rate of

oxidation by several actions.

Conclusion

Iron, calcium, zinc and potassium are essential elements needed for the general health. Although their values were low compared to the acceptable total intakes, their presence contributes to the daily iron, calcium, zinc and potassium sources needed in the body. The lead detected in 15 samples (44.11%) were above the MCL of 0.01 mg/L while manganese of fruit juice were not detected in any samples and MCL of manganese is 0.05 mg/L.

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Conflict of Interest: None to declare.

Ethical Clearance: All experimental protocols were approved under the Sulaimania Polytechnic University (SPU), Kurdistan, Iraq and all experiments were carried out in accordance with approved guidelines.

References

1. A Dhiman, S. Ahmad and A. Nanda, "Metal analysis in Citrus Sinensis fruit peel and Psidium Guajava leaf", Toxicology International, 2011; 18: 163.
2. Z Attieh, C Mukhopadhyay. Ceruloplasmin Ferroxidase Activity Stimulates Cellular Iron Uptake by a Trivalent Cation-specific Transport Mechanism", Journal of Biological Chemistry. 1999; 274: 1116-1123.
3. M Bakare-Odunola, K Mustapha. Identification and quantification of heavy metals in local drinks in Northern Zone of Nigeria", Journal of Toxicology and Environmental Health Sciences. 2014; 6: 126-131.
4. R Beaty, J Kerber. Concepts, instrumentation and techniques in atomic absorption spectrophotometry. Norwalk, CT: Perkin-Elmer Corporation, 1988.
5. C Gimba, S Abechi, N Abbas. "Studies on Physicochemical Properties, Trace Mineral and Heavy Metal Contents of Common Energy Drinks", International Journal Of Advanced Research. 2014; 2: 131-138.
6. U Chaturvedi, R Shrivastava, R. Upreti, "Viral infections and trace elements: a complex interaction", Current Science Association. 2004; 87: 1536-1554.
7. J. D'Mello, Food safety: contaminants and toxins. Wallingford, Oxon: CABI Publishing, 2003, pp. 480-482.
8. L Dragsted, M Strube, J Larsen. Cancer-Protective Factors in Fruits and Vegetables: Biochemical and Biological Background." Pharmacology & Toxicology. 1993; 72: 116-135.
9. Jarup L, M Berglund, C Elinder, G Nordberg, M Vahter. 'Health effects of cadmium exposure-a review of the literature and a risk estimate ', Scandinavian journal of work, environment & health. 1998; 24:1-51.
10. Kalagbor I, Diri E. Evaluation of heavy metals in orange, pineapple, avocado pear and pawpaw from a farm in Kaani, Bori, Rivers State Nigeria. International Research Journal of Public and Environmental Health. 2014; (4): 87-94.
11. E Kusumi, M Shoji. Prevalence of Anemia among Healthy Women in 2 Metropolitan Areas of Japan", International Journal of Hematology. 2006; 84: 217-219.
12. J Maduabuchi, C Nzegwu, E Adigba. Lead and cadmium exposures from canned and non-canned beverages in Nigeria: A public health concern", Science of The Total Environment. 2006; 366: 621-626.
13. Ng X. N., Chye F. Y., and Ismail M. A, "Nutritional profile and antioxidative properties of of selected tropical wild vegetables, 2012", International Food Research Journal (Malaysia), 19 (4), p. 1487-1496
14. G. Obuzor and N. Ajaezi, "Nutritional content of popular malt drinks produced in Nigeria". The African Journal of Food Science, vol. 4, no. 9, pp. 585–590, Sep. 2010.
15. A Olajire, L Azeez. Total antioxidant activity, phenolic, flavonoid and ascorbic acid contents of Nigerian vegetables. African Journal of Food Science and Technology 2011; 2(2): 022-029.
16. P Onianwa, I Adetola. Trace heavy metals composition of some Nigerian beverages and food drinks", Food Chemistry. 1999; 66: 275-279.
17. A.S. Prasad "Zinc: an overview". Nutrition (Burbank, Los Angeles County, Calif.) 1995; 11.1 Suppl: 93-99.
18. R Milly, W Aldoori. "Health benefits of selected minerals." Canadian family physician. 2005; 51.5: 673.

19. A Santa-María. In Vitro Toxicity of Stimulant Soft Drinks", Ecotoxicology and Environmental Safety. 2002; 53: 70-72.
20. P Senesse, S Meance, V Cottet. High Dietary Iron and Copper and Risk of Colorectal Cancer: A Case-Control Study in Burgundy, France", Nutrition and Cancer. 2004; 49: 66-71.
21. O. Sobukola, O. Dairo, L. Sanni, A. Odunewu and B. Fafiolu, "Thin Layer Drying Process of Some Leafy Vegetables under Open Sun", Food Science and Technology International, vol. 13, no. 1, pp. 35-40, 2007.
22. H Wang, G Cao, R Prior. Total Antioxidant Capacity of Fruits", Journal of Agricultural and Food Chemistry. 1996; 44: 701-705.
23. World Health Organization. "Micronutrient deficiency. Battling iron deficiency anemia.2003
24. Faisal A. Heavy Metal Contents of Common Fruit Juice Drinks bought in Sulaimani market, Kurdistan region, Iraq, Raparin University journal. 2015; 3(6) 35-42.
25. Abdel- Rahman, T and A. M. Abdellseid., 2013. Evaluation of Heavy Metals Contamination Levels in Fruit Juices Samples Collected from El -Beida City, Libya. World Academy of Science, Engineering and Technology 77, International Conference on Agriculture, Food and Urbanizing Society in Amsterdam, The Netherlands. 2011; 15 -16.
26. AOAC. Official methods of analysis of AOAC International, 18thEdition. AOAC International, Gaithersburg, Maryland, USA. 2005.
27. Satarug S, Moore M. Adverse health effects of chronic exposure to low-level cadmium in foodstuffs and cigarette smoke. Environ. Health Prespect. 2004; 112 (10), 1099.
28. Finley JW. Does environmental exposure to manganese pose a health risk to healthy adult?,NutrReV. 2008; 62: 148-155.
29. Finley J. Does environmental exposure to manganese pose a health risk to healthy adult?,NutrReV. 2008; 62: 148-155.
30. Attieh ZK, Mukhopadhyay CK, Seshadri V. FoxCeruloplasmin Ferroxidase Activity Stimulates Cellular Iron Uptake by a Trivalent Cation-specific Transport Mechanism, J. Biol Chem. 1999; 274: 1119.
31. Cabrera C, Lorenzo ML, Lopez MC. Lead and cadmium contamination in dairy products and its repercussion on total dietary intake. Journal of Agricultural and Food Chemistry, 1995; 43: 1605–1609.
32. Ministry of Health and Family Welfare , Manual of Methods of Analysis of Metals. Lab. Manual 9, Government of India, New Delhi, India, 2005; (1)
33. Gunter E, Miller LM. Determination of oxidation state of manganese in brain, liver, heart mitochondria. J. neurochem.2000; 88: 266-280.
34. Ma J, Betts, NM: Zinc and copper intakes and their major food sources for older adults in the 1994- 96 continuing survey of food intakes by individuals (CSF II). J Nutrition. 2000; 130: 2838-2843.
35. Ryan-Harshman M, Aldoori, W. Health benefits of selected minerals, Can. Fam Physician. 2005; 51(5): 673– 675.