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HEAVY METALS IN FRUIT JUICES IN DIFFERENT PACKING MATERIAL

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Abstract

A comprehensive study carried out for determination of heavy metals including trace (Cr, Fe, Zn, Ni, Mn, Co, Cu) and toxic (Pb, Cd) metals in variety of fruit juices and also studies the impact of these on human health. These heavy metals were determined by atomic absorption technique. Statistical analysis (ANOVA) was also done for heavy metals of a variety of juices of different packing material. The results of heavy metal were compared with permissible limit in drinking water imposed by the United State Environmental Protection Agency (US-EPA), World Health Organization (WHO) and recommended dietary allowances (RDA). Statistical analysis (ANOVA) Result showed that null hypothesis for Zn and Ni was rejected. Synthetic chemicals used in the packaging, storage, and processing of food stuffs, Most of these substances are not inert and can leach into the foods, harmful to human health over the long period.

Introduction

Fruit juices are becoming an essential part of the modern diet in many communities. Fruit juices contain nutrients as minerals, trace elements, vitamins and phytochemicals antioxidant. Fruit juices are nourishing beverages, in a healthy diet can play a major part because a variety of nutrients found naturally in fruits, also offer good taste Juices exist in natural concentrations or processed forms. ([a]Tasnim *et al*., 2010) Fruit juices are available in any place in the world are available in bottles, cans, laminated paper packs, pouches, cups and almost every other form of packaging in the diet of most people, irrespective of age included significantly thus, it contribute to good health ([b]Tasnim *et al.,* 2010). In most countries, the hot climate means that the intake of liquids must be high to compensate for the expected losses from respiration (Al Jedah and Robinson, 2002; Victor *et al*., 2012). All over the country Liquid consumption increases in hot weather. Directly available drinks become better-looking and important for Metro cities and towns and for seasonal consumers (especially in Northern areas) because fruit juice is measured to be particularly agro based industry, when fresh crop is coming into the bazaar and pulp is easily offered at low prices, manufacture must be started this will also be extremely dependable on what fruit is being chosen for juice manufacture. Fruit produce, fruit juice which can be mainly consumed by infants, children and adults to meet their nutrient requirement mainly that of micro nutrients (Nnam and Njoku, 2005)Against diseases Juices are most effective associated to chronic inflammation, cancer, heart and bone diseases, problems related to cognition and aging, and possibly

Vitamins take considerable role, since are vital for life; however the majorities are not formed by the body. The body needs vitamin C (ascorbic acid) to form collagen, cartilage, muscle, and blood vessels, and to help absorb iron. Orange juice is rich in vitamin C, an excellent source of bioavailable antioxidant phytochemicals (Frank *et al*., 2005), and significantly improves blood lipid profiles in people affected by hyper-cholesterolemia (Kurowska *et al*., 2000). Fruit juices support detoxification inside the human body (Deanna and Jeffrey, 2007). Fruit juices are really recognized for their capability to raise serum antioxidant power and even equalize the thing cannot be attributed to fruit juices. On the opposing oxidative pressure and inflammation normally caused by high fat and high sugar meals. (Ghanim *et al*., 2010), juice consumption overall in Europe, Australia, New Zealand and the US has increased possibly due to public awareness of juices as a healthy natural source of nutrients and increased public interest in health issues(TOC, 2008). In fact intake of fruit juice has been constantly related with reduced risk of many cancer types (Brock *et al*., 1988; Kwan *et al*., 2004) might be protective beside stroke (Feldman,. 2001) and holdup the beginning of Alzheimer's disease (Dai *et al*., 2006). A set of elements through mass density larger than 4.5 g /$cm^3$are called heavy metals.(Szyczewski *et al*., 2009) Traces Metals consist of that metals which are required by the body in biological system of the human body. In the past century due a significant increase in economic activities and industrialization. Primary sources of atmospheric metallic burden such as burning of fossil fuels and petroleum industry activities have been identified as leading to environmental pollution. Several studies have shown that heavy metals such as lead, cadmium, nickel, manganese and chromium amongst others are responsible for certain diseases (Hughes, 1996).Heavy metals gain into the surroundings through water, soil, air and land activities like powerful agriculture, power generation, industrial discharges, leakage of municipal landfills, infected tank effluent (Hughes, 1996).

Systems in which toxic metal elements can induce impairment and dysfunction include the blood and cardiovascular, eliminative pathways (colon, liver, kidneys, skin), endocrine (hormonal), energy production pathways, enzymatic, gastrointestinal, immune, nervous (central and peripheral), reproductive and urinary that have lethal effects on man and animals. These diseases include abdominal pain, chronic bronchitis, kidney disease, pulmonary edema (accumulation of fluid in the lungs), cancer of the lung and nasal sinus ulcers, convulsions, liver damage and even death (Hughes, 1996).

Food packaging can wait product drop, remain the valuable effect of processing, increase shelf life, and keep or raise the value and safety of food. Packaging provides resistance from three main classes of outside influences like chemical, natural, and physical (IFT, 2007). Synthetic chemicals used in the packaging, storage, and processing of food stuffs. Most of these substances are not inert and can leach into the foods, harmful to human health over the long period.

Taking into description these and other matter and factors affecting human life, we are motivated to identify the hazardous impacts of fruit juices on human health with diverse analysis of their use, their packing, their contamination due to unhealthy ingredients and other numerous reasons.

Materials and Methods

Analytical grade HNO_3 Merck 65% and deionized water were used throughtout this research work. Standard stock solutions (1000 ppm) of respective metal ions, which were obtain from Merck. The Laboratory glass wares including beaker, pipettes, volumetric flasks, Petri dish, Funnels wash with detergent and rinsed with distilled water dried in oven and stored in a place which was free from dust and fumes. Watman filter paper 40 was used to filter digested juice samples.

Sample Collection: Total 50 Commercial Samples of Fruit juices including (Apple, Mango, Orange, Guava, Punch, Grape, Pineapple, Peach, Lemon) of different packing materials (Cardboard paper, Plastic bottle, Laminated paper) were collected from different market locations and retail stores in Karachi city Pakistan.

Digestion of Sample: In the present study Wet digestion methods has been used for this purposes single acid or mixture of acids with or without oxidizing agent were required (Niazi *et al.*, 1997). 50 ml of each liquid juice and 5g powder juice (sachet pack) sample was taken in a Acid washed 250ml of beaker and add 25ml of nitric acid, then heated on the hot plate for 60 minute at 105^{o}c The beaker were shaken during heating after heating mixture was cool and then filter, filtrated and washing were collected in a 100ml volumetric flask and then diluted up to the mark with deionized water.

Instrumentation: The Atomic Absorption Spectrophotometer instrument PE-AAnalyst 700, USA model was used in this study. Instrumental condition such as pressure of fuel, oxidant and others were adjusted according to the Atomic Absorption Spectrophotometer. Instrument was calibrated by blank solution and finally analyzed metals content in the fruit juice.

Statistical Analyses: Data analyses were performed using Statistical Package for the Social Sciences (SPSS version 21Values were expressed as mean. appropriate test statistics (ANOVA) was done to determine heavy metals content in fruit juices which were pack in different packing.

Result and Discussion

Concentration range of heavy metals in a variety of fruit juices of different packing material have been shown in (Table 1). Present study shows that concentration for Cr , Ni and Mn in (Table 1) above within the standards sets by the organization and also dietary intake (Table 3&4). It was found that concentration of Fe was not safe as in (WHO, 1985; Ofori *et al*., 2013) but lies below within dietary intake in (Table 4).

It was found that concentration of Zn was below the US-EPA also dietary intake of trace element (table 3&4). In the present study concentration of Cu and Co in all packaging was within in all standards (table 3&4). Concentration of Pb and Cd was not safe within Standard but Pb was found within US-EPA in (Table 3).
In (table 2) mean concentration of Zn and Ni in tetra pack, plastic bottle and sachet pack was not equal hence study rejected null hypothesis. It means that concentration of Zn and Ni in all packing was different. However means of Cr, Fe, Mn, Co, Cu, Pb and Cd were equal hence accepted null hypothesis. Study shows that concentration of above metals was not dissimilar in all packing materials.

Table 1.Concentration range of heavy metals (mg/L) in different packing materials of a variety of fruit juices.

Heavy metal	Tetra pack	Plastic bottle	Sachet pack	Order
Cr	0.119 - 2.595	0.41 - 0.608	0.124 - 0.609	T> S>B
Fe	0-9.286	0-5.782	3.136-4.012	T> B>S
Zn	0.11-0.222	0.026-0.298	0.046-0.264	B> S>T
Ni	055--.84-5.275	1.648-4.944	1.15-3.789	T> B>S
Mn	0.03-3.433	0.002-0.219	0.049 - 13.492	S> T>B
Co	0-0.101	0.048-0.081	0-0.00369	T> B>S
Cu	0.025-0.161	0.14-0.144	0.044-0.154	T> S>B
Pb	0.098 - 1.061	0-0.116	0.363-0.754	T> S>B
Cd	0-0.032	0-.016	0.0091 -0.249	S> T>B

T = Tetra pack
B = plastic bottle
S = Sachet pack

Table 2.Univariate analysis of variance of Heavy metals in a variety of fruit juices of different Packing material.

Heavy metals	Null hypothesis Ho	Alternative hypothesis Ha	Level of significance L.O.S	F-Statistic	P-Value	Remarks
Cr	All means are equal	All means are not equal	0.05	1.618	20.5	Accept Ho
Fe	do	do	0.05	2.764	0.069	Accept Ho
Zn	do	do	0.05	3.577	0.032	Reject Ho
Ni	do	do	0.05	6.677	0.002	Reject Ho
Mn	do	do	0.05	2.077	0.132	Accept Ho
Co	do	do	0.05	.819	0.444	Accept Ho
Cu	do	do	0.05	.615	0.543	Accept Ho
Pb	do	do	0.05	.166	0.848	Accept Ho
Cd	do	do	0.05	1.283	0.283	Accept Ho

P-value was considered by means of one way ANOVA F-test between varieties of juices.

Table 3. Drinking water contaminant and maximum admissible limits by different organization.

Heavy metal Contaminates	US-EPA Limits (mg/L)	WHO Limits (mg/L)
Cr	0.1	0.05
Fe	-	-
Zn	5	NGL[a]
Ni	0.1	0.07
Mn	0.05	0.4
Co	0.1	NM[b]
Cu	1.3	2
Pb	1.5	0.01
Cd	0.005	0.003

NGL[a]: no guide line, because it occur in drinking water at concentrations well below those at which toxic effects may occur.
WHO, 2008; US-EPA, 2008; Dehelean and Magdas, 2013.

Table 4. Dietary intake of trace elements in the human body.

S.No.	Essential trace elements	Diet mg/day
1	Chromium	0.05 - 0.1
2	Iron	15.0
3	Zinc	8.0 - 15.0
4	Nickel	0.4
5	Manganese	2.2 - 8.8
6	Cobalt	0.3
7	Copper	3.2

Said *et al.*, (1987)

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