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Safety assessment of street vended juices in Multan-Pakistan: A study on prevalence levels of trace elements

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Abstract

Street vended juices are most commonly available, accessible and economical nutritional food sources of poor slums in developing economies like Pakistan. Study was undertaken to elucidate impact of industrialization, agro chemicals induction in agronomic practices and food processing hygiene measurements on food chain heavy metals intoxication. If overlooked, certain quality risks associated either with fresh produce or processed commodity might initiate food intoxication.In order to understand gravity of the issue, street vended freshly drawn juices extracted from the food crops (orange, sugarcane, carrot and mango) cultivated in Southern Punjab peri-urban areas and country sides were evaluated for microelements and heavy metals load in summer and winter 2012. The safety study of juices depicted higher concentration of lead (Pb) and cadmium (Cd) breaching international safety limits implemented in the country. However some microelements (Fe, Zn, Mn) were found below the prescribed maximum tolerant limits. The study concluded prevalence of higher concentration of some toxic heavy metals as a serious breach of threshold levels potentially compromising consumer's safety.

1. Introduction

Fruits are tremendous source of multiple vital nutrients including vitamins, minerals, sugar and worth mentioning are a wide range of antioxidants. Beside their normal consumption pattern, fresh fruit juices and drinks are offered for sale in all seasons as recreational, nutritional beverages and disease preventive drinks against chronic malignancies like coronary heart diseases (Oguntibeju, Truter, & Esterhuyse, 2013). Traditional drinks including fresh fruit juices are thirst quenching and nutritionally enriched food category of Asiatic region extracted at mobile and stationary carts and offered for sale in loose form.

Presence of tolerable amount of trace elements in fresh fruits and vegetables is enormously important to regulate normal body metabolism and avoid deficiency consequences. Maintenance of neurological system, avoiding deadly anemia, regulating hundreds of enzymatic reactions and protecting vital organs muscular system are a few of significant healthier properties of trace elements (Brown, 2004; Zahir, Naqvi, & Mohi-uddin, 2009).Mostly fresh fruit juices are extracted by diluting with water or ice and in some cases with milk that render their safety at risk of certain foodborne threats if overlooked. It has been identified that water might serve as carrier of higher levels of certain toxic trace metals beside microbiological threats. In addition, widespread concept of adulteration had turned the situation worse. Masking fruit juices and drinks natural properties with artificial flavors and non-food grade colors had risen the risks of acute and chronic illness among vast majority of the consumers especially the one with weaker immune system.

In addition to negligence in manufacturing, fruits and some commonly consumed vegetables are grown in heavily polluted regions rendering them more toxic than nutritional. Enormously changing pattern of cultivation deploying tonnes of pesticides and fertilizers had absolutely challenged consumer food safety in all parts of world and to greater extent in underdeveloped

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nations having higher population and growth rates. Certain food safety reports (Krejpcio, Sonkowsk, & Bartela, 2005; Roberts, & Orisakwe, 2011) had declared toxicological contamination of fruit juices with exceptionally higher levels of metals. Process of heavy metals bioaccumulation and biomagnifications in food system is well understood food safety concern throughout the World. Biological safety of succulent food crops in region with reported contamination of pesticides and heavy metals is another high profile risk to the health of consumers. Human induced contamination of soil ecosystem has emerged as a significant health hazard in Pakistan that has been extending though out the country parallel to urbanization, industrialization and mechanization (Bhuttoet al., 2009; Zahir, Naqvi, & Mohi-uddin, 2009). Incorporation of industrial waste in drinking water streams without recycling, injudicious pesticides and fertilizers application, lack of regulatory control on implementing waste monitoring and disposal strategies are heuristically extending throughout the country. Realistically, under such a miserable food safety situation, it is quite under stood that heavy metals toxicity of food crops and products derived thereof might initiate certain deadly acute and chronic disorders including neurological break down, liver necrosis, mutagenesis, carcinogenesis, renal and reproductive failure (Galal-Gorchev, 1991; Giaccio et al., 2012).

Toxicity values for trace elements in fruits and their products in the form of Acceptable Daily Intake have been set by World Health Organization. US Food and Nutrition Board and Food and Drug Association has also played their role in identifying critical levels of fruits nutritional elements and setting nutritional and safety standards (Goldhaber, 2003). Current study was carried out to determine level of heavy metals and trace

Table 1. Zones of Experimental Design

Zone	Area	Types of sampled commodities	No. of Samples of each commodity	Total No. of Samples
Zone I	Pak Arab Fertilizer, Khanewal Road, Bosan Road, Gulgasht, MDA	04	03	12
Zone II	Doulat Gate, Clock Tower, Civil Hospital, Nishtar Hospital, Cantt, Sher Shah	04	03	12
Zone-III	Old Shujaabad, Grain Market, Bahawalpur Road, Vehari Road	04	03	12
Zone IV	General Bus Stand, Shah Rukn-e-Alam, Masoom Shah Road, ChowkKumharan	04	03	12

Table 2. Instrumental parameters for determination of micro elements with atomic absorption spectroscopy

Element	Wave Length (nm)	Lamp Current (mA)	Fuel (Acetylene flow) L/min	Burner Height (mm)	Band Pass (nm)	Nebulizer Uptake Time (Sec)	Excess curvature Limit (%)	Detection Limit (ppm)
Fe	248.3	15	0.9	7	0.2	4	10-40%	0.05
Zn	213.9	12	1.2	7	0.2	4	10-40%	0.01
Mn	279.5	15	1	7	0.2	4	10-40%	0.02
Cd	228.8	10	1.2	7	0.5	4	10-40%	0.01
Cu	324.8	6	1.1	7	0.5	4	10-40%	0.03
Co	240.7	8	1	7	0.2	4	10-40%	0.06
Ni	232	15	0.9	7	0.2	4	10-40%	0.05

elements in ready to drink fresh fruit juices and conventional drinks openly vended in streets of Pakistan's highly populated city i.e. Multan. The study was executed to assess the maximum levels of heavy metals prevalence in order to establish critical ranges of trace elements in street vended fresh fruit juices.

2. Materials and methods

2.1. Zone distribution

The entire city of Multan was geographically divided into four zones and hot spots for fruit juices consumption were selected for sampling purpose.

Twelve samples of each orange, carrot, mango and sugarcane juices were procured in clean polyethylene bottles by conducting three visits of sampling sites. Micro-elemental and heavy metals load were determined in each sampled commodity as shown in Table 1.

2.2. Procurement of juices samples

Forty eight fresh samples of *Orange Juice, Carrot Juice, Mango Juice and Sugarcane Juice* were procured from the four zones of entire city. All samples were procured from the mobile and stationary carts. Samples for minerals and metal analysis were collected in polyethylene bottles prewashed with de-ionized water. Samples were brought to food analysis laboratory Institute of Food Science & Nutrtition, Bahauddin Zakariya University Multan for trace elements analysis.

2.3. Standards

Standard solutions for Iron, Zinc, Manganese, Lead, Cadmium, Copper, Cobalt and Nickel were provided by BDH. Series of working solutions were prepared from 1000mg/L standard (BDH) stock solution.

2.4. Minerals and heavy metals detection

Mineral and heavy metals including Iron, Zinc, Manganese, Lead, Cadmium, Copper, Cobalt and Nickel were determined in all juices samples using atomic absorption spectrophotometer (AAS) Model no. iCE 3000.Samples were wet digested by the method as described in AOAC (2000). One gram sample was taken in 100ml conical flask along with 10ml of nitric acid. The contents were heated at 70°C for 20min and cooled followed by addition of 5ml perchloric acid. The contents were heated to 190 °C until less then 1ml residues were left with the flask. Contents of flask were cooled and diluted to final volume of 50ml with de-ionized water. Samples were run at multiple hollow cathode lamps equipped atomic absorption spectrometer after calibration using different strength standard solutions of elements under investigation.

Each experiment was repeated three times and the research findings were presented in the form of mean and standard deviation by using Microsoft Excel 2007.

3. Results and discussions

Changing cultivation patterns deploying tonnes of pesticides on agricultural crops, automobiles heavy smoke and industrial effluents incorporation in food supplies through wrong irrigation practices are the reasons necessitating assessment of trace element concentration in different food commodities. A similar situation prevails in the near vicinities of industrial slums of Pakistan big cities and the cotton belt of *southern Punjab*. Analytical findings on assessment of trace element residues in fresh fruit juices are presented in Table (2-5) was carried out in the four zones of Multan, most populated industrial city of Southern Punjab.

3.1. Iron

Being 4th abundantly found element of earth crust, a great significance of Fe lies in the entire human biochemistry. Process of haemoglobin (blood pigment) generation entirely depends upon iron contents of body (Beliles, 1994). Amongst the natural food sources, fruits and vegetables are the second best reservoirs of Fe after meat.

Variable concentration of Fe was found in different street vended juices. Mean trace element comparison revealed mango juice with highest Fe concentration(0.885mg/L) followed by carrot (0.845mg/L), orange (0.554mg/L) and sugar cane juice (0.352mg/L). A wide variability in iron contents of orange juice was observed where the measured range was 0.356 – 0.703 mg/L. Maximum iron contents were detected in mango juice (1.112mg/L) while the least concentration of the element was found in sugarcane juice sample (0.213mg/L). Recommended daily dietary intake of iron has been reported as 10-15mg per day by Nordic Council of Ministers (Nordic Council of

Table 3. Mean concentration of microelements and heavy metal in fresh orange juices (mg/L)

Element	Spectrometry Method	Mean (mg/L)	Standard Deviation (±SD)	Range (Min-Max) (mg/L)	Number of Samples (*n*)
Fe	FAAS	0.554	0.125	0.356 - 0.703	12
Zn	FAAS	0.141	0.024	0.112 - 0.178	12
Mn	FAAS	0.471	0.139	0.299 - 0.600	12
Cu	FAAS	0.114	0.044	0.040 - 0.176	12
Pb	FAAS	0.202	0.042	0.134 - 0.253	12
Cd	FAAS	0.034	0.016	0.011 - 0.056	12
Ni	FAAS	0.161	0.046	0.106 - 0.256	12
Co	FAAS	0.376	0.051	0.287 - 0.431	12

Table 4. Mean concentration of microelements and heavy metal in sugarcane juices (mg/L)

Element	Spectrometry Method	Mean (mg/L)	Standard Deviation (±SD)	Range (Min-Max) (mg/L)	Number of Samples (*n*)
Fe	FAAS	0.352	0.096	0.213 - 0.460	12
Zn	FAAS	0.129	0.019	0.102 - 0.157	12
Mn	FAAS	0.265	0.066	0.176 - 0.359	12
Cu	FAAS	0.150	0.046	0.089 - 0.209	12
Pb	FAAS	0.167	0.037	0.110- 0.207	12
Cd	FAAS	0.052	0.017	0.032 - 0.081	12
Ni	FAAS	0.085	0.029	0.047 - 0.126	12
Co	FAAS	0.400	0.015	0.380 - 0.419	12

Data are presented as mean ± SD
FAAS = Furnace atomic absorption spectroscopy

Ministers, 1995). Under maximum tolerable guidelines, detected concentration of Fe in all juices could be referred to cause no toxicological effects but potentially contribute in alleviating iron deficiency. Commercially available mango and orange juices has been surveyed from city of Karachi in 2009 presenting mean concentration of Fe as 0.908 and 0.595mg/L, respectively (Jalbaniet al., 2010). Present study represents relatively lower values of iron contents in fruit juices that could be associated with region, fruit type and variety in addition to practices like dilution with water or ice. Higher concentration of Fe (2.75mg/L) in fruit juices has also been reported from Brazil (Tormen et al., 2011). However, sugarcane juice has been reported with lower Fe contents i.e. 0.266mg/L by Adekola & Akinpelu (2002) than observed in present study.

3.2. Zinc

Zinc is an essential trace element constituting around 33µg/g of body mass however, toxicity can't be avoided from intake of higher concentration of Zn (Bhowmik, Chiranjib, & Kuma, 2010; Onianwa et al., 1999). Safety assessment of juices reflected fresh fruit juices possess lower levels of Zn that can't meet body requirements independently. The study in question focused mango juice as a carrier of maximum Zn contents (0.372mg/L) among analysed juices. A slight variability in mean Zn contents of orange (0.141 mg/L) and sugarcane juice (0.129mg/L) was observed however, carrot juice (0.121mg/L) was at the bottom line on mean concentration graph of trace element under discussion. Minimum and maximum ranges of the element in all available types of juices identified carrot juice samples to hold least Zn contents (0.092mg/L) while maximum concentration was observed in mango juice sample i.e. 0.461mg/L.

Toxicological limits of Zn as identified by Codex Alimentarius Commission is 15.0mg/L (Codex Alimentarius Commission, 2000) and is far higher than its concentration observed in current study. Concentration of zinc in fresh fruit juices differs greatly due to different soil conditions of the fruit growing regions. Acidic soils having pH lower than 4.5 have often been reported deficient in zinc (Alloway, 2009). Under such soil conditions replacement of zinc salts from external sources are recommended in order to fulfill edible crops zinc deficiency. A more vibrant range of zinc (0.05 – 0.23mg/L) in fresh juices from tropical climate of Brazil (Braganca, Melnikov, & Zanoni, 2012) and commercially available orange juice from Turkey (0.234 – 0.471 mg/L) has been reported in literature (Harmankaya, Gezgin, & Ozcan, 2012). A comprehensive study on copper, iron and zinc contents of commercially available fruit juices of Pakistan had reported mango and orange juices to carry 0.296 and 0.315 mg/L respectively (Jalbani et al., 2010) as shown in Table 4

3.3. Manganese

Excessive levels of manganese could truly be expected in the countries where manganese had replaced lead for petroleum products thereby increased risk of environmental and coherently fresh food commodities contamination. World Health Organization (WHO) and Scientific Committee for Food (SCF) have recommended upper limits of manganese 2 – 3mg/L and 1-10mg/L respectively as acceptable range for daily dietary intake (Scientific Committee for Food, 1996; World Health Organization, 1993). Maximum residual manganese contents in fresh fruit juices were found in orange juice (0.471mg/L) followed by carrot juice>sugarcane juice>mango juice as 0.375>0.265>0.095mg/L.High level of variability was observed among the observed values of manganese in orange and carrot juice i.e. 0.299 – 0.600 mg/L and 0.159 – 0.549 mg/L, respectively. Unlike other nutritional elements, least manganese concentration was observed in mango juice i.e. 0.077 mg/L.

Almost compatible results were found from the findings of (Harmankaya, Gezgin, & Ozcan, 2012) reporting Mn contents of orange juice in a range of 0.116 – 0.466mg/L. Enormously higher Mn contents (1.6mg/Kg) have been reported in carrot samples collected from local market of Karachi-Pakistan (Hashmi, Ismail, & Shaikh, 2007). Observed Mn levels in fruit juices were quite well in range of previous reports but significantly lower than reported for carrot juice. However, being lower than the maximum tolerable range, the observed findings suggest no toxicological effects on consumer health.

3.4. Copper

Presence of copper in food products might be correlated with its migration from food contact material. However there are chances of copper contamination from copper pipelines of potable water supplies use for food preparation and dilution in case of fresh fruit juices. Maximum tolerable limits of copper as contaminants in fresh vegetable juices have been defined by Codex Alimentarius Commission (Codex Alimentarius Commission, 2000) as 5.0mg/L.Study in question recorded mango juice to have maximum copper contents among fresh fruit juices sample i.e. 0.451mg/L while minor level of Cu was recorded in orange juice (0.040mg/L). Mean comparison of copper contents in different juices characterize reduction in the metal level (mg/L) 0.341<0.181<0.150<0.114 for mango juice < carrot juice < sugarcane juice < orange juice. If compared with Codex upper limits for Cu, present load of this particular metal in different fresh fruit juices seems not to bear any health risk.

Cu traces in orange juices as reported by Harmankaya, Gezgin, & Ozcan (2012) were quite higher (0.136 – 0.231mg/L) than observed in present study. A study on juices of similar food crops as reported by Farid & Enani (2010) conclude Cu level in a range of 0.318 – 0.500 mg/L. Copper assimilation in food crop is significantly correlated with soil metal status and cultivar. Sugarcane crop as reported from Becita sugar state, Nigeria (Adekola & Akinpelu, 2002) presents compatible findings suggesting variant Cu contents of two cultivars at lower (0.033 – 0.044mg/L)and higher residual soil Cu levels (0.130 – 0.540 mg/L). If compared with international findings in fresh juices, current study from Pakistan highlight higher but tolerable range of Cu as suggested by Codex (Codex Alimentarius Commission, 2000).

3.5. Lead

Heavy metals including cadmium, mercury, tin and lead are thought to carry no health beneficial effects rather than extremely toxic if exposed beyond their safe limits that has been identified as 0.05mg/L for fresh fruits, vegetables and juices derived thereof (European Commission, 2006). Codex commission recommends

Table 5. Mean concentration of microelements and heavy metal in carrot juices (mg/L)

Element	Spectrometry Method	Mean (mg/L)	Standard Deviation	Range (Min-Max) (mg/L)	Number of Samples (*n*)
Fe	FAAS	0.845	0.066	0.735 - 0.966	12
Zn	FAAS	0.121	0.027	0.092 - 0.169	12
Mn	FAAS	0.375	0.118	0.159 - 0.549	12
Cu	FAAS	0.181	0.042	0.103 - 0.236	12
Pb	FAAS	0.248	0.025	0.200 –0.272	12
Cd	FAAS	0.045	0.010	0.031 - 0.060	12
Ni	FAAS	0.129	0.034	0.049 - 0.170	12
Co	FAAS	0.248	0.080	0.116 - 0.375	12

Data are presented as mean ± SD
FAAS = Furnace atomic absorption spectroscopy

maximum tolerable limit of Pbin fresh vegetable juices as 0.1mg/L(Codex Alimentarius Commission, 2000) however, Brazillian food safety codes permits 0.3mg/L as maximum tolerable limit of Pb (Braganca, Melnikov, & Zanoni, 2012).

As compared to the limits defined by codex Pb contents of all juices were approximately hundred times higher in study under discussion. Trace elements analysis revealed street vended fresh fruit juices of Multan with higher and potentially toxic levels of Pb where least magnitude of contaminant (0.110mg/L) was higher than tolerance limits. The study signified an increasing trend in mean concentration of Pb as 0.166> 0.167> 0.202> 0.248 (mg/L) in mango, sugarcane, orange and carrot juices, respectively. Elevated levels of Pb in food crops and derived products had strong correlation with atmospheric deposition of Pb on plants and fruits surfaces (Ali & Al-Qahtani, 2012), and from food contamination, tampering and adulteration (Goran et al., 2009). Relatively lower level of Pb i.e. up to 0.162mg/L and 0.200mg/L in different fruit juices has been reported by Goranet al. (2009) from Romania and Tasnim et al. (2010) from Bangladesh, respectively. Peri-urban soils of Pakistan under cultivation for vegetables have often been reported to be irrigated with sewage water supplies to boost the productivity. Hence there could be greater probability of soil contamination with Pb and other toxic trace metals. Being a root crop, prevalence of Pb at a higher extent in carrot juices might have an association with soil residues that could find their way in finished product from inadequate washing with potable water supplies. Lead had a lower probability of mobility in soil to plant that's why it did not look fair to connect lead contamination entirely on its translocation from waste water or sewage supplies. However as a malpractice in street vended juices, water being used as diluents or adulterant and sugar being added as sweetener might serve as major sources of lead contamination (Goranet al., 2009; Tudoreanu et al., 2007), as shown in Table 5

3.6. Cadmium

-Cadmium (Cd) is a toxic element of inert nature with no identified health benefits. Brazilian Surveillance Department Ministry of Health (Surveillance Department of Ministry of Health, 1998) had defined maximum acceptable level of cadmium in fresh fruit juices as 0.01mg/L. Cadmium levels in all fresh juices under study ranged from 0.009 – 0.081mg/L. Fruits and beverages derived thereof have been reported with lower level of cadmium as compared to vegetables, cereals and cereals products that readily contribute to cadmium intoxication (European Commission, 2006).

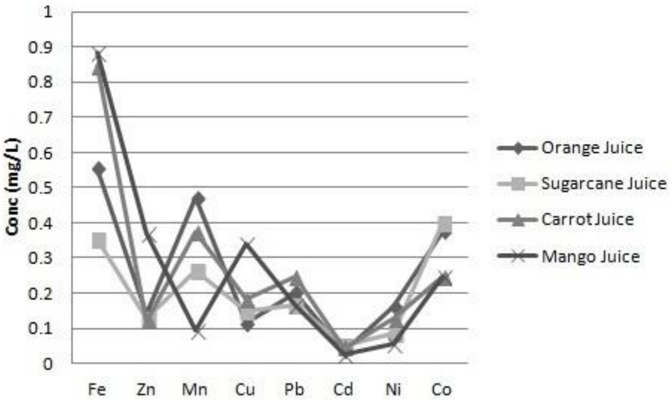

Figure 1. Comparative level of trace elements in different fresh juices

Figure 1. Comparative level of trace elements in different fresh juices

Maximum mean residual concentration of Cd was detected in carrot juice (0.052) followed by sugarcane juice (0.045) however least magnitude of element under study was observed in mango juice with a mean value of 0.025mg/L.As depicted from individual sample analysis, 33% of carrot and sugarcane juice samples were found to breach the maximum level of acceptability of this particular metal. However, orange and mango juice samples were having lower percentile of sample population above prescribed range i.e. 25 and 8% respectively. Utilization of phosphate fertilizers in carrot and sugarcane crop is a common practice in the region. Cd is often reported as a contaminant in phosphate fertilizer that might raise bio-assimilation of cadmium in root crops, particularly carrot. Such a situation encourage supporting organic production instead of intensive fertilizers application that might render food crops at a risk of heavy metal contamination (Domagala-Swiatkiewicz & Gastol, 2012; Rembialkowska, 2000). Higher concentration of Cd (0.080 – 0.101mg/Kg) at upper soil depth and food crops being cultivated in untreated effluent feed peri-urban soils o Pakistan have been reported by (Murtaza, Ghafoor, & Qadir, 2008).Earlier in a study from Islamabad – capital city of Pakistan (Ashraf, Jaffar, & Masud, 2000),orange and mixed fruit juices of local origin has been reported with higher Cd residues i.e. 0.170 and 0.205mg/L respectively however majority of the tested fruit juices were well in prescribed standard limits i.e. 0.004 – 0.020mg/L. The differences among the measured concentration of analyte absolutely signify the codes of food crop cultivation and processing being observed in both cities and their peripheries as shown in Table 6.

3.7. Nickle

Acute Ni toxicity is rear but accidental and appears in the form of neurological and gastrointestinal upsets due to exposure of higher multiple doses i.e. 0.01mg/Kg body weight (Jr Sunderman et al., 1988). Some similar studies had reported dermatitis in nickel sensitized persons at a single similar dose (Hindsen, Bruze, & Christensen, 2001; Jensen et al., 2003).

An overview of the data collected from current study revealed nickel prevalence in a range of 0.040 – 0.256 mg/L. Mean comparison of the Ni contents in fresh fruit juices categorized orange juice to bear maximum Ni contents i.e. 0.161mg/L followed by carrot (0.129mg/L), sugarcane (0.085) and mango juice (0.055mg/L). Apparently, observed level of Ni contents are lower than the acute toxicity limits. However, chronic exposure of higher levels of Ni to food and food sources particularly drinking water, fruits and vegetables could contribute its toxicological effects in consumers. Some studies from Turkey and Nigeria had reported quite lower levels of Ni in orange juices (0.034 – 0.066 mg/Kg) and other fruit juices (0.001-0.100mg/L) (Harmankaya, Gezgin, & Ozcan, 2012; Onianwaet al., 1999). Although the reported quantity of Ni is still lower than current findings from Pakistan however, the authors still refer appearance of toxicological symptoms on chronic exposures.

Table 5. Mean concentration of microelements and heavy metal in mango juices (mg/L)

Element	Spectrometry Method	Mean (mg/L)	Standard Deviation	Range (Min-Max) (mg/L)	Number of Samples (*n*)
Fe	FAAS	0.885	0.117	0.728-1.112	12
Zn	FAAS	0.372	0.034	0.367 - 0.461	12
Mn	FAAS	0.095	0.019	0.077 - 0.132	12
Cu	FAAS	0.341	0.057	0.270 - 0.451	12
Pb	FAAS	0.166	0.027	0.110- 0.192	12
Cd	FAAS	0.025	0.014	0.009 - 0.052	12
Ni	FAAS	0.055	0.013	0.040 - 0.072	12
Co	FAAS	0.245	0.054	0.179 - 0.336	12

Data are presented as mean ± SD
FAAS = Furnace atomic absorption spectroscopy

Comparatively higher level of Ni contents has already been reported from Islamabad and Karachi where varying concentration of the metal were found in mango, orange and sugarcane juice i.e. 0.137, 0.276 and 0.606mg/L, respectively (Ashraf, Jaffar, & Masud, 2000) and 0.173 – 0.299 mg/Kg in 10 different fruits (Zahir, Naqvi, & Mohi-uddin, 2009).

3.8. Cobalt

A very few cases of cobalt toxicity have been reported in the form of cardiovascular and respiratory problems in persons with abnormally higher levels of Co intoxication (Elinder & Friberg, 1986). However, a more constructive role of Co is associated with human body normal metabolism that necessitates supply of its ample quantity from dietary intake.

Maximum concentration of Co from the analysed samples was found in orange juice (0.431mg/L) while least prevalence of analyte was observed in carrot juice. Mean comparison of Co concentration in different juices identified sugarcane juices with higher level of metal followed by orange, carrot and mango juice i.e. 0.400, 0.376, 0.248 and 0.245, respectively. Least variability of Co concentration was observed in sugarcane samples where the established range of the metal was 0.380 – 0.419mg/L.

Very little information is available on the higher level of cobalt in food materials and their integrated toxicity. Some major findings for assessment of levels of trace elements in water as well as fruits and vegetable from various parts of the country reveal quite higher contents of Co i.e. 0.07 – 0.32 mg/L in soda water (Wattoo, Kazi, & Jakhrani, 2003) and 0.1038 – 0.126 mg/100g in fruits and vegetables (Ismail et al., 2011) as compared to international reports from Brazil (Tormen et al., 2011) and Saudi Arabia (Farid & Enani, 2010) where the observed ranges were <LOD - 0.0069 and 0.0079 - 0.0081 in fruit juices. No WHO guidelines are available for Co upper limits in food however daily dietary requirement of this particular element has been reported as 0.3 – 4.0 mg/day (Wattoo, Kazi, & Jakhrani, 2003). Certainly it can be commented that evaluated concentration of cobalt in street vended fresh fruit juices is significantly higher than previously reported but the levels are still under the normal dietary requirements.

4. Conclusions

Distribution and concentration of microelements and heavy metals in the environment is more or less associated with human activities. Monitoring the levels of trace elements in agricultural commodities especially the food and food products is well acknowledged techniques to assess impact of human induced environmental changes on biological life. Intensive application of fertilizers, pesticides and industrial sludge to food crops as growth promotive and production enhancing techniques has heuristically destroyed our ecosystem. Prevalence of higher rate of chronic deadly diseases in the most impacted regions is the apparent features of this imbalance. Southern Punjab, an exclusive cotton growing region of the country has already been reported to bear higher rate of morbidity from chronic disorders that could significantly be associated with the higher heavy metal (lead, cadmium, and arsenic) load in agricultural commodities and potable water supplies. Findings from current study represent majority of the trace elements within the prescribed maximum tolerant limits but the study conferred some very toxic metal compounds i.e. Pb and Cd to breach the International safety limits for metal in fresh fruit juices and fruits and vegetables.

The pragmatic levels of heavy metal (Pb and Cd) in street vended juices elucidate the poor sanitary, phytosanitory and badly managed hygienic system of the major entities worth mentioning are the poor agronomic practices, inadequate treatment of industrial waste, contaminated water being used as diluents in juices, location of vendor’s cart/shop, processing equipments and utensils, handling practices and the raw material, recommending some positive and immediate measures to ensure food safety. Study further suggests law enforcement authorities to make arrangements for educating the low profile street food vendors regarding food safety concerns and their responsibilities towards safe food handling. Certain fruits and vegetables like oranges and carrots are brought to the market from different regions that further necessitate complete survey of entire province to assess actual impact of agricultural practices on the trace elements profile of fruits and vegetables and juices derived thereof.

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