Available online at www.scholarsresearchlibrary.com

Scholars Research Library

Scholars Research Library

Annals of Biological Research, 2015, 6 (10):15-19
(http://scholarsresearchlibrary.com/archive.html)

Annals of Biological Research
Scholars Research Library
ISSN 0976-1233
CODEN (USA): ABRNBW

Trace metals and contaminants in commercial fruit juices sold in south eastern states, Nigeria

Onyeneto T. C.[1], Nwachukwu I. N.[2]* and Nwogwugwu N. U.[2]

[1]Department of Microbiology, Anambra State University of Science and Technology, Uli, Nigeria
[2]Department of Microbiology, Federal University of Technology, Owerri, Nigeria

---

ABSTRACT

Fruit juices have numerous micronutrients, some of which are trace metals such as tin, zinc, copper, iron and they also contain other metals with no documented benefits to human health (arsenic and lead). These metals found in fruit juices are contaminants and their levels need to be controlled. Atomic absorption spectrophotometer (AAS) was used to determine the levels of some metals: Arsenic, Tin, Copper, Lead, Zinc and Iron in commercially sold fruit juices in South Eastern Nigeria. The results show that Arsenic and Tin contents in the juice samples were very low, less than 0.001mg/l (<0.001mg/l) while other trace metals ranged between 0.001 and 1.532mg/l; Lead ranged between 0.001 and 0.05mg/l; Copper ranged between 0.015 and 0.22mg/l; Zinc ranged between 0.605 and 1.360mg/l and Iron ranged between 0.755 and 1.532mg/l. This paper calls for tighter regulation and the discussion in the choice of materials for processing plants.

INTRODUCTION

Fruit juices are laden with numerous micronutrients some of which are trace metals such as Arsenic, Lead, Zinc, Tin, Copper and Iron. These metals found in fruit juices are contaminants and their levels need to be controlled [1]. The equipment used in the processing line is still very important in maintaining the quality of the fruit juices, since metals such as copper, aluminum, iron, galvanized steel (except stainless) are easily attacked by fruit acids and in turn impact metal ion to the juice, and these metal ions are normally called trace metals [1]. In consideration of metals as contaminant in fruit juices, their levels should not exceed the following maxima in Table 1.

Table 1: Maximum Limits of Contaminants in Fruit Juice

Contaminant	Maximum Limits (mg/kg)
Arsenic (AS)	0.2
Lead (Pb)	0.1
Tin (Sn)	200
Copper (Cu)	5.0
Zinc (Zn)	5.0
Iron (Fe)	15.0
Sum of Copper, Zinc, and Iron	20.0

[Source 1; 2].

These metal ions usually have peroxidant properties and adversely affect flavor, colour clarity, quality and nutritive value [3]. These metals found in fruit juices are contaminants and their levels need to be controlled, although they

are important parts of fruit juices and has both direct and indirect health significance [4]. These samples are supposed to be within the required standards for these metals, however there were variations from pack to pack [5]. When taken in amount over the recommended maximum allowable range, they can be toxic to health and their effects can be dangerous on nervous system [4; 6].

MATERIALS AND METHODS

A number of methods are available for their determination; the method of choice was the one that employs the use of Atomic Absorption Spectrophotometer (ASS) [4, 5].

In this method, a known weight of sample (250gm) is evaporated in a platinum dish, and subsequently ashed in a muffle furnace. The total ash obtained is dissolved with about 20mls of 1% Nitric acid or 1ml of concentrated Nitric acid to ensure complete dissolution. Resulting solution is transferred quantitatively into a 100ml volumetric flask and made up to mark with distilled water. Solution is then shaken to ensure homogeneity and filtered through a medium fast filter paper. The trace metals in the filtrate collected are determined by the atomic absorption spectrophotometer, using the appropriate hollow cathode ray lamps and standard solutions.

COLLECTION OF SAMPLES

A total of hundred and thirty (130) packaged fruit juice samples of thirteen different brands were purchased. They were purchased from Enugu, Awka, Owerri, Abakiliki and Umuahia Main Markets, all in South Eastern Nigeria. The samples were 'Five alive citrus burst', 'Dansa apple', 'Dansa orange', 'Dansa mango', 'Frutta mango', Chivita orange', 'Frutta mango', 'Chivita apple', 'Chivita pineapple', Chivita mango', Chivita orange', Five alive apple splash' and 'Fumman orange' juices. The juices had at least four (4) months to their expiry date from the period of analysis and were approved by National Agency for Food and Drug Administration and Control (NAFDAC). The samples were transported immediately to the laboratory for analysis.

CHEMICAL ANALYSIS OF MINERIAL CONTENT OF FRUIT JUICES:

Atomic Absorption Spectrophotometer (ASS) was used. 1ml of each sample was digested with $5cm^3$ of concentrated hydrochloric acid (HCL) and $5cm^3$ of concentrated nitric acid (trioxonitrate acid) $HN0_3$. The digested sample was diluted with de-ionised water and made up to $50cm^3$ with de-ionised water in graduated flask. This was immediately transferred to a polythene bottle.

Solar unican 969 Atomic Absorption Spectrophotometer (manufacturer USA, Country) was used for this analysis. Acetylene was used as fuel and compressed air as oxidant according to manufacturer instruction. Standard solutions of each element under investigation were aspirated into the nebulizer-burner assembly via a capillary and absorbance readings were taken from the direct readout of the atomic absorption Spectrophotometer. This was immediately followed by the aspiration of the sample solutions into the nebulizer burner assembly via a capillary tube and the absorbance readings also obtained. This was repeated for each element in turn using its hollow cathode lamp and at the wave-length of the element. Standard curve of each element was produced by plotting the absorbance readings against the corresponding concentrations in mg/l (milligrams per liter). The concentrations of each sample in mg/kg (milligrams per kilogram) as obtained by converting the mg/l to the mg/kg using the weight of the juice sample made up to $50cm^3$.

RESULTS

The trace metals determined in the juice samples were Arsenic, Lead, Tin, Copper, Zinc and Iron. The values of Arsenic and Tin in the juice sample were very low, less than 0.001 (<0.001), while other trace metals ranged between 0.001 to 1.532 mg/l. The values for the metals are significantly different from each other. Lead range between 0.001 and 0.005mg/l; Chivita orange had the highest value of 0.005mg/l, while Dansa mango, Frutta apple, Frutta mango, and Chivita apple each had the lowest value of 0.001mg/l. The result is presented in Figure 1.

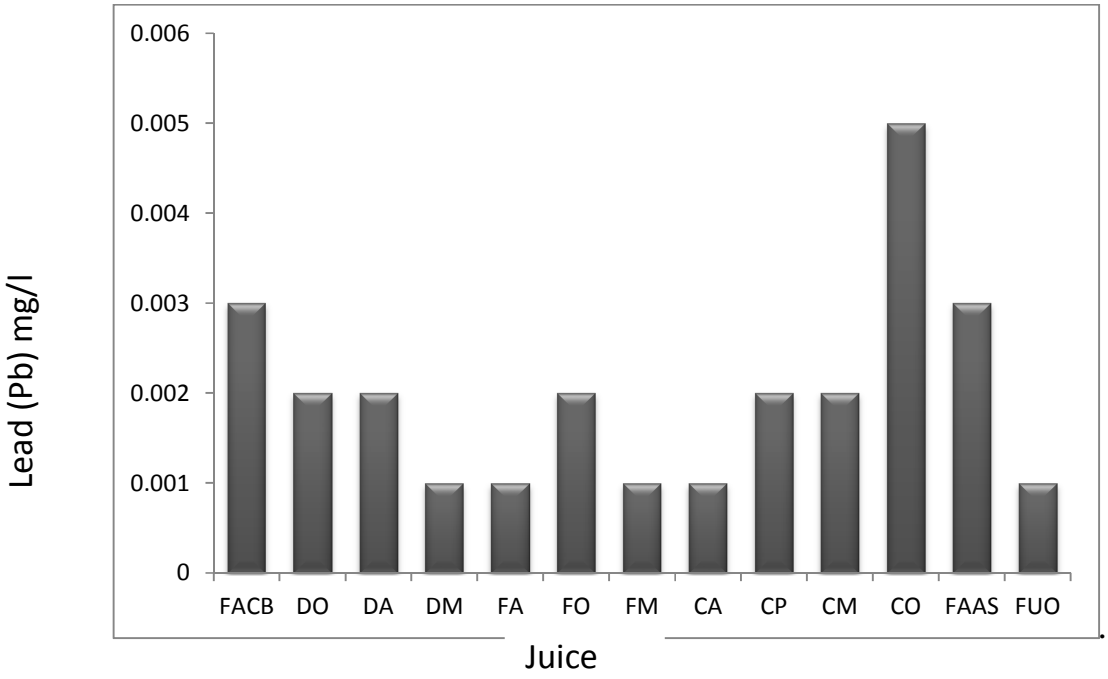

Figure 1: Lead traces in the juices. The juice drinks are: Five Alive Citrus Burst (FACB), Dansa Orange (DO), Dansa Apple (DA), Dansa Mango (DM), Frutta Apple (FrA), Frutta Orange (FrO), Frutta Mango (FrM), Chivita Apple (CA), Chivita Pineapple (CP), Chivita Pineapple (CP), Chivita Mango (CM), Chivita Orange (CO), Five Alive Apple Splash (FAAS), Fumman Orange (FuO)

All the juices contained Copper.Copper traces in the juices ranged between 0.005mg/l and 0.22mg/l. Chivita apple had the highest value of 0.22mg/l, while Fumman orange had the lowest value of 0.015mg/l. The result is presented in Figure 2.

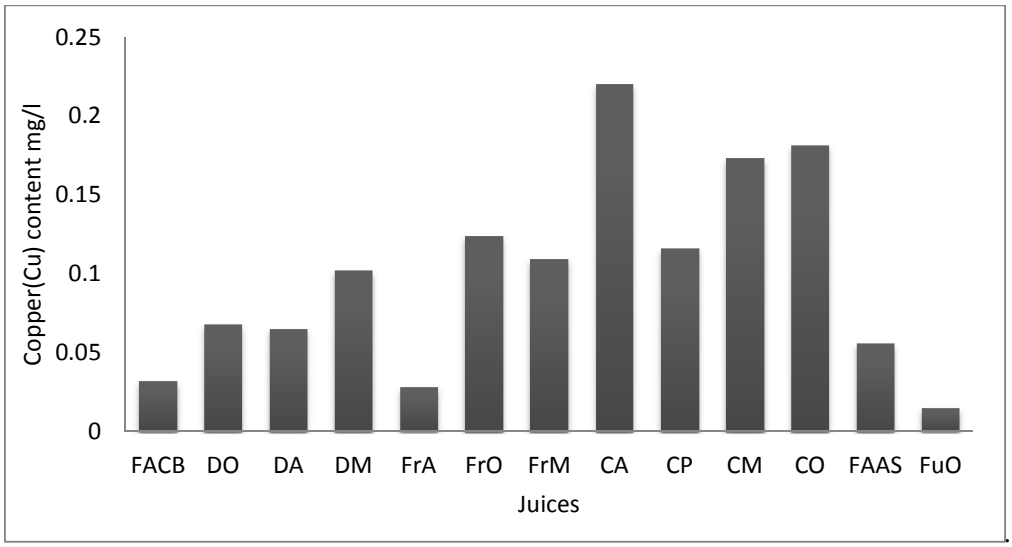

Figure 2: Copper traces in the juices. The juice drinks are: Five Alive Citrus Burst (FACB), Dansa Orange (DO), Dansa Apple (DA), Dansa Mango (DM), Frutta Apple (FrA), Frutta Orange (FrO), Frutta Mango (FrM), Chivita Apple (CA), Chivita Pineapple (CP), Chivita Pineapple (CP), Chivita Mango (CM), Chivita Orange (CO), Five Alive Apple Splash (FAAS), Fumman Orange (FuO).

Zinc traces in the fruit juices ranged between 0.605mg.L and 1.360mg/L. chivita orange recorded the highest value of 1.360mg/L; while Dansa apple had the lowest value of 0.605mg/L. The results are presented in Figure 3.

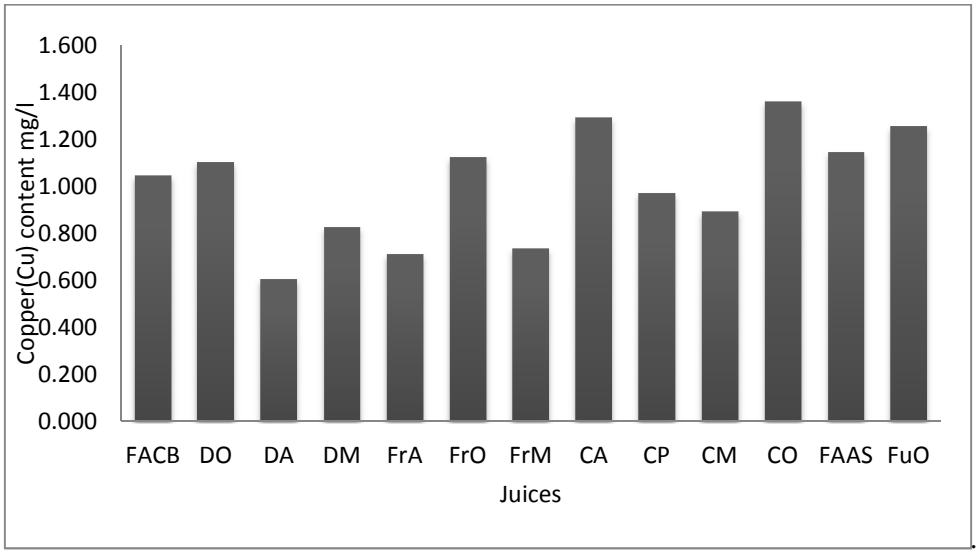

Figure 3: Zinc traces in the juices. The juice drinks are: Five Alive Citrus Burst (FACB), Dansa Orange (DO), Dansa Apple (DA), Dansa Mango (DM), Frutta Apple (FrA), Frutta Orange (FrO), Frutta Mango (FrM), Chivita Apple (CA), Chivita Pineapple (CP), Chivita Pineapple (CP), Chivita Mango (CM), Chivita Orange (CO), Five Alive Apple Splash (FAAS), Fumman Orange (FuO).

Iron traces in the fruit juices ranged between 0.755mg/l and 1.532mg/l. Dansa mango recorded the highest value of 1.532mg/l, while Chivita apple had the lowest value of 0.755mg/l. The results are presented in Figure 4.

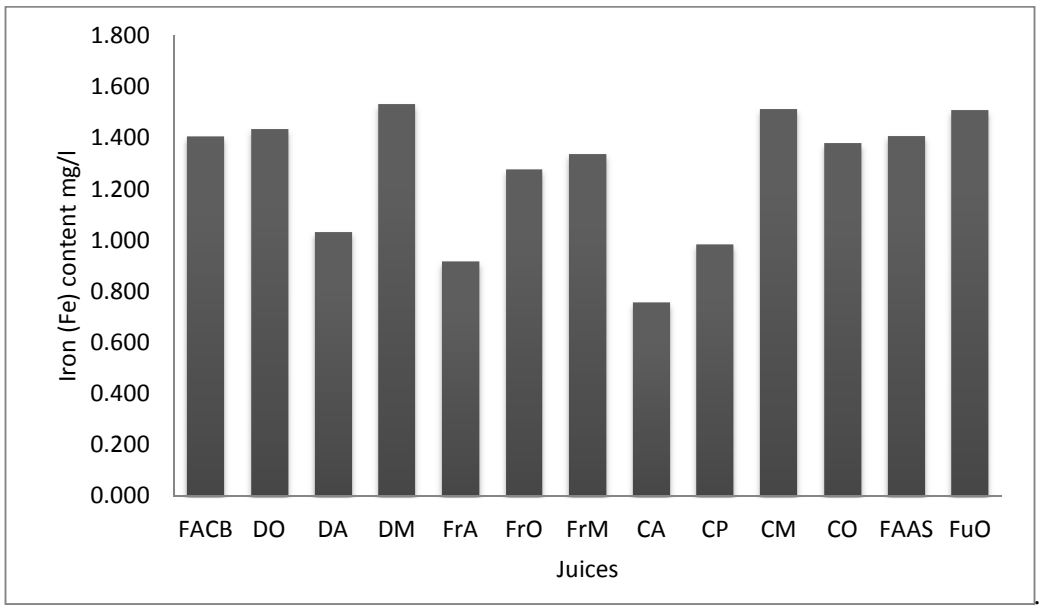

Figure 4: Iron traces in the juices. The juice drinks are: Five Alive Citrus Burst (FACB), Dansa Orange (DO), Dansa Apple (DA), Dansa Mango (DM), Frutta Apple (FrA), Frutta Orange (FrO), Frutta Mango (FrM), Chivita Apple (CA), Chivita Pineapple (CP), Chivita Pineapple (CP), Chivita Mango (CM), Chivita Orange (CO), Five Alive Apple Splash (FAAS), Fumman Orange (FuO).

DISCUSSION

Minerals or trace metals are important parts of fruit juices and are of both direct and indirect health significance [4; 7]. Minerals such as zinc are just as critical to maintaining optimal health, but when taken in excess, they can be toxic. Iron is essential for formation of blood cells, while zinc is necessary for enhanced immunity and for reproductive function [4; 8]. However, when taken in amount over the recommended maximum allowable range,

they can be toxic to health and their effects on the nervous system have been reported. The values of lead and zinc in all the samples are very low and within the acceptable limits of 0.1mg/l and 5.0mg/l respectively [8]. Lead is highly toxic to humans especially to young children who love to drink fruit juices, it also has no known physiological value to humans [4; 7].

In children, even very low level of exposure to lead can result to reduced IQ (Intelligence quotient), learning difficulties, attention deficit disorders, behavioural problems, impaired learning and kidney damage. In adults, it can increase blood pressure (BP) and can cause fertility problems, nervous disorders, muscle and joint problems, irritability and memory and concentration problems[4,6,8,and 9].

Other trace metals found in fruit juices by other researchers include Aluminum, Magnesium, Lithium, Potassium, Sodium and Manganese, and if taken is excess, can also be toxic, but normal doses are critical to maintaining optimal health. For instance potassium is needed for a healthy nervous system, lithium is needed for controlling emotions and anger, magnesium for effective muscle function, manganese is necessary for protein and fat metabolism. Aluminum as a metal when present in our food, water supply and soil can induce individuals to suffer from aluminum toxicity[4, 6 and 10]. After years of accumulated exposure and storage in our body, it can result to brain degeneration and skeletal deformities. It is believed that Alzheimer's disease is related to aluminum toxicity [4, 10].

CONCLUSION

The equipment used in the processing lines is still very important in maintaining the quality and contamination of the fruit juices, since metals such as copper, tin, aluminum, iron, galvanized steel (except stainless) are easily attacked by fruit acids and in turn impact metal ion to the juice, and these metal ions are normally called trace metals. It is therefore better to monitor the proper management of the raw materials and production plant to prevent or minimize contaminants.

Further and regular analysis of commercially sold fruit juices should be done. Regulation in the insurance of permit to produce and sell these products should be under strict quality control and assurance to reduce and mitigate exposure to harmful microbes and toxic chemicals deleterious to consumers' health.

REFERENCES

[1] IPAN, (**1993**). Institute of Public Analysts of Nigeria, Lagos.
[2] US-FDA (**2006**). US Food and Drug Administration Annex 3-Hazard Analysis Managing Food Safety. *Center for Food Safety and applied Nutrition.*
[3] Singh, H.R (**2005**). Environmental Biology. 2nd Edition S. Chad and company, New Delhi. Pp 28-33.
[4] Suaad, S.A and Rman, A.H (**2008**). *Res.J. of Microbiology*, **3(5)**: 319-325.
[5] Willey, J.M; Sherwood, L.M and Woowerton, L.T (**2005**). Disinfection of Heavy Metal Microbiology, 7th Ed. McGraw, New York. Pp: 214-216.
[6] Basar, M.A and Rahman, S.R (**2007**). *Bangladesh J. Microbiol*, 4 (2): 166-1687)
[7] Prescott, L.M; Harley, J and Klien, D.A (**2005**), Microbiology. 4th Edition McGraw Hill, New York. Pp 678-697.
[8] Nahar, Z; Rahman, S.R and Gomes, D.J (**2006**). *Bangladesh Journal Microbiol*. **23 (1)**: 71-74.
[9] Oladipo, I.C, Adeleke, D.T and Adebiyi, A.O (**2010**). *Pakistan Journal of Biological Sciences*. **13(1)**: 16-21.
[10] Deronesne, C (**2004**). *Psycho. Neuropsychiatry Vicil*, **2 (1)**: 76.