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Determination of Heavy Metals in Some Selected Flavour Drinks in Nigeria

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Abstract:- The level of heavy metals contamination in flavor drinks has not been investigated in Nigeria. This research was aimed at arsenic at the level of heavy metals contamination in five (5) different powdered flavor drinks commonly sold in Nigerian local markets using atomic absorption spectroscopy (AAS) after acid digestion (HNO_3, H2SO4 &$HCLO_4$) in the ratio 1:1:1. The results showed the presence of heavy metals that are considered toxic such cadmium, lead, mercury, nickel, and arsenic at concentrations range between 0.040-0.199, 0.075-0.260, 0.132-0.487, 0.091-0.1324 and 0.221-1.185 mg/L respectively and were found to be above the maximum contaminant level sets by USEPA (2011). Other heavy metals such as chromium, cobalt, copper, selenium, manganese, and iron that are considered essential and less toxic were also determined using this method.

Keywords:- *Flavor Drinks & Heavy Metals.*

I. INTRODUCTION

In Nigeria, several research have been conducted to investigate the level of contaminations of heavy metals in soft drinks (Magomya et al., 2015), (Ogunlana et al., 2015), (Godswill et al., 2015) and (Adepoju-Bello et al., 2012). However, the level of these heavy metals in powdered flavor drinks available at Nigerian markets has not been investigated. These flavor drinks are commonly consumed day-in da-out by both young and older members of the Nigerian society as substitutes to soft drinks due to their low cost. These flavor drinks are in powdered form with high flavor contents and coloring agents. Water is needed for dissolving the powder into the desired liquid content. The negative trends of consuming of soft drinks in Nigeria make it necessary to investigate the level of contaminants in these flavor drinks due to the exposure to trace elements and heavy metals via foods and drinking water (Woyessa et al., 2015) and (Ogunlana et al., 2015a).

The composition of heavy metals in foods is of concern (Azeh et al., 2015) due to their essential or toxic nature. For example, iron, zinc, copper, chromium, cobalt, and manganese are essential, while lead, cadmium, nickel, arsenic, and mercury are toxic at certain levels (Bingöl et al., 2010). Long term accumulation of cadmium may lead to cancer, its intake over a long period may accumulate in the kidney and liver because of its long biological half-life causing kidney damage (Azeh et al., 2015). Lead is known to affect humans and animals of all ages, but the effects of lead are most serious in young children (Godwill et al., 2015). Chromium (Cr) can exist in several oxidation states. Hexavalent chromium (VI) is highly soluble and mobile and is harmful to the skin, liver, kidney, and respiratory organ causing various diseases (Zhong et al., 2016).

II. MATERIALS AND METHODS

- *Sample Collections.*

Five different flavor drinks samples of different manufacturing company with different flavoring agents (coconuts, pineapple, orange, cola, and mango). Baby mix, Euro, Foster clerk, Jolly Juice and Tiara flavour drinks were purchased from Gumel central market, and the samples were labelled as BF, EF, FF, JF and TF respectively for identifications.

- *Sample Digestion/Preparation.*

Wet digestion techniques were employed to destroy the organic matrix and brought element in solutions using a mixture of 5ml each of Nitric acid (HNO_3), Hydrochloric acid (HCl) and Perchloric acid ($HCL0_4$) in 1:1:1 ratio.

1 gram each of the five samples was dissolved in 25ml distilled water and then mixed with 15ml (acid mixture). The mixture was evaporated on a hot plate in a fume cupboard at a temperature of about 100^oc for 1 hour until a clear solution was obtained. This was allowed to cool, filtered, and then make up to 50ml using distilled water and stored at room temperature until required.

The solutions were then taken to Department of Science Laboratory Technology, Abubakar Atta Polytechnic, Bauchi for Flame Atomic Absorption Spectroscopy (AA320N) Shanghai General Analytical Instrument Factory, where the concentrations and standard deviations of Pb, Cd, Cu, Fe, Mn, Ni, Hg, Co, Se, As and Cr were determined and reported as mean concentration$\pm$standard deviation were reported in table 2.0.

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As defined by the United States Environmental Protection Agency, the standard for the determination of heavy metal contamination in soft drink is based on two units of measurements; the Maximum Contaminant Level Goal (MCLG) and Maximum Contaminant Level (MCL). MCLG is the level of a contaminant in drinking water below which there is no known or expected risk to health and hence allow for a margin of safety and are non-enforceable public health goals. On the other hand, MCL is the highest level of a contaminant that is allowed in drinking water. The MCLG and MCL are measured in milligrams per liter (mg/L) which is equivalent to parts per million (USEPA, 2011).

Table 1 Maximum Contaminant Level of Metal ions as given Environmental Protection (USEPA) 2011.

As	Cr	Cu	Fe	Pb	Mn	Ni	Co	Cd	Hg	Se
0.01	0.1	1.3	0.3	0.015	0.05	0.1	N	0.005	0.002	0.5

III. RESULT AND DISCUSSION

Table 2 Concentrations of Metal Ions in the Samples (ppm or mg/L)

ID	Cd	Cu	Cr	Fe	Pb	Mn	Ni	As	Se	Hg
BF	0.118	1.030	1.024	0.756	0.114	1.446	1.130	1.185	1.015	0.487
EF	0.075	0.098	0.727	1.210	0.199	0.239	0.091	0.221	0.342	0.374
FF	0.260	0.155	0.464	1.340	0.048	0.284	1.324	0.326	0.535	0.397
JF	0.233	0.170	0.404	1.108	0.184	0.875	0.165	0.246	0.404	0.132
TF	0.135	0.075	0.466	1.205	0.161	0.367	0.884	0.380	0.383	0.330

➢ *Discussions*

0f all the samples analyzed, there was no detectable metal ion in the distilled water used as blank control. The study showed 100% detection of metal being analyzed with significant concentrations.

The concentrations of Lead, cadmium, and arsenic ranges from 0.040-0.199, 0.075-0.260, and 0.221-1.185 mg/L respectively which were far above the maximum contaminant level sets by USEPA (2011). Although, our research is the first conducted to assess the level of heavy metals in flavor drinks in Nigeria, present studies on soft drinks had shown the presence of cadmium, Cd, arsenic, As and lead, Pb above the recommended values of WHO or the maximum contaminant level (MCL) sets by USEPA as reported by (Ogunlana et al., 2015b). The finding also agrees with that of (Godwill et al., 2015) where he reported that lead was detected in all the soft drinks analyzed and the concentrations were also found to be far above the accepted MCL of (0.015mg/L) as set by USEPA (2011).

Chromium is detected in all the five samples analyzed, while nickel is present in four, out the five samples and were found to be above MCL of (0.1mg/L) as reported by (Adepoju-Bello et al., 2012). Even though chromium intake is one of the essential elements, soft drinks may be a source of exposure to chromium at a high-level owing to its relative importance to diet by soft drink beverages. Accumulation of chromium in the body can cause damage to the liver, kidney, nose, lungs; and possible asthma attack (Adepoju-Bello et al., 2012). Food stuff naturally contains very small amounts of nickel, but its toxicity can lead to lung cancer, nose cancer and prostate cancer.

The concentration of mercury ranges from 0.132-0.487 mg/L; these values exceed the maximum contaminant level of 0.002 mg/L set by USEPA (2011). In humans, inorganic Hg affects the kidney, whereas methylmercury affects the central nervous system. The main source of Hg is food (May & Alzaid, 2016). Copper concentrations in all the samples analyzed were found to be within the acceptable level. Copper has an acute toxicity and serves as an essential element in mammalian nutrition as a component of metalloenzymes in which it acts as an electron donor or acceptor (Darkwah et al., 2020) whereas manganese has role to play in metabolic catalysis, Iron is critical for oxygen binding and transport in which its deficient leads to anemia (May & Alzaid, 2016). Selenium and cobalt are considered macronutrients, but their concentrations were far above the MCL of 0.05 mg/L in all the samples analyzed.

IV. CONCLUSION

In this study it was found that all the flavor drinks samples analyzed had significant number of heavy metals with concentrations above the maximum contaminant levels set by United State Environmental Protection Agency (2011), with great concerned on the toxic metals Cd, Hg, Pb and As with average concentrations of 0.075-0.260, 0.132-0.487, 0.040-0.199 and 0.221-0.185 mg/L respectively which are far beyond the MCL. The values are far above the ones found in the literature. With these, I therefore suggest more research to be carried out with a view to ascertain the level of contaminations in flavor drinks consumed in Nigeria. Government agencies such as NAFDAC should monitor the flavor drinks products sold in Nigeria to minimize the contamination level and assure the quality of the products to safeguard public health.

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