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CHROMIUM, NICKEL AND ZINC LEVELS FROM CANNED AND NON-CANNED BEVERAGES IN ZARIA, KADUNA STATE, NIGERIA

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ABSTRACT
Heavy metals (Chromium, Nickel and Zinc) were determined from both canned and non-canned beverages sold in Samaru, Zaria, Kaduna State, Nigeria. Concentration of Chromium was found to range from 0.528 - 1.509mg/L for canned and 0.176 - 1.358mg/L for non-canned beverages, Nickel concentration was found to range from 0.156 - 0.802mg/L for canned and 0.125 - 0.896mg/L for non-canned beverages while Zinc concentration was also found to range between 27.652 to 35.447mg/L for canned and 26.649 to 42.447mg/L for the non-canned beverages. All the samples studied have Chromium and Zinc concentrations exceeding the maximum concentration limit (MCL) as set by USEPA while 100% of the canned beverages exceeded the (MCL) for Nickel only 93.33% of the non-canned exceeded the Nickel MCL. Levels of the metals analysed exceeded the legislative safe limits set by both United States Environmental Protection Agency (USEPA) and Standard Organization of Nigeria (SON).
Keywords: Chromium, Zinc, Nickel, Canned, Non-canned beverages.

INTRODUCTION

Heavy or toxic metals are trace metals that are at least five times denser than water. As such, they are stable elements meaning they cannot be metabolized by the body and bio accumulative passed up the food chain to human (Ademoroti, 1979).
Heavy metals are often toxic to an organism having density greater than 5gcm^{-3}. There are many of such metals which may be discharged from industries, farmlands, municipal urban run offs etc. into surface waters to cause pollution (Ademoroti, 1979; Welch et a., 1988)

Living organisms require trace amounts of some heavy metals, e.g. Iron, Copper, and Zinc, as they are essential to maintain the metabolism of the human body, but at higher concentrations these metals can lead to poisoning and other hazards because they cannot be degraded or destroyed, and tend to bioaccumulation (Crini, 2006). Bioaccumulation means an increase in the concentration of a chemical in a biological organism over time, compared to the chemical's concentration in the environment.
Moreover, heavy metals are dangerous because they tend to accumulate in living systems thereby causing injurious effects like lung cancer, bone defects (*osteomalacia, osteoporosis*) in humans and animals, increase blood pressure, to the nervous system and accumulate in food chain (Alloway, 1990)
The levels of heavy metals in the commercially available beverages are unclear, therefore, this paper studied the concentration of Zn, Cr and Ni in beverages and fruit drinks commonly sold in Zaria, Nigeria using Atomic Absorption Spectrophotometry, the implications of chronic effects of Zn, Cr and Ni in humans was discussed.

MATERIALS AND METHODS

Sample Collection

Fifteen different samples of canned (8) and non – canned (7) beverages imported and locally manufactured purchased from three different places selected at random on June 2011 in Ahmadu Bello University (ABU) Zaria, Kaduna State Nigeria were used in the study. The samples were kept at room temperature for five (5) days before the digestion.
The glass wares were washed before and after the analysis using detergent solution, HCl and distilled water to minimize contamination. The samples were classified into canned and non-canned drinks.
The canned products were coded C1, C2, C3, C4, C5, C6 and C7 while the non-canned products were coded as N1, N2, N3, N4, N5, N6, N7 and N8.
The samples were digested and analysed for the Chromium, Nickel and Zinc concentration using Atomic Absorption Spectrometer (Model AA 6800) according to the standard analytical methods as reported by Oriasakwe et al., 2009.

RESULTS AND DISCUSSION

The figures (1-6) above revealed the concentrations of Chromium, Nickel and Zinc in some imported and locally manufactured beverage samples obtained in Zaria, Nigeria.
The Chromium concentration levels ranged from 0.528 - 1.509 mg/L for the canned and 0.176 - 1.358 mg/L for non-canned beverages. Figures 1and 2 of both canned and non canned show that 100% of the canned and non canned beverages had Chromium levels that exceeded the maximum contaminant level (MCL) of 0.10 mg/L as set by United States Environmental protection agency (US EPA, 2002).

The Nickel level ranged from 0.156 -0.802mg/L for the canned drinks and 0.125 – 0.896 mg/L for non-canned drinks. Figure 3 shows that 100% of the canned drinks had Nickel levels that exceeded the maximum contaminant level of 0.10 mg/L set by US EPA, while 93.33% of the non-canned drinks exceeded the MCL as shown in figure 4.

The Zinc levels ranged from 27.652 – 35.447 mg/L for canned and 29.649 – 42.442 mg/L for non- canned drinks. All beverages in figures 5 and 6 had Zinc levels that were above the MCL of 5.0 mg/L set by US EPA.

The concentration of Chromium determined in the Spanish study (Garcia *et al.,* 1996) was low compared to our findings in Nigeria. More so, the contributions of non- alcoholic drinks to dietary intake of this element have been estimated to be 0.41 mg/day in the Spanish diet. The range of value determined in the study, is obviously lower than the findings in this present study (Garcia *et al.,* 1996).

This call for serious public health concern on the part of both the Nigerian consumers and the regulatory agencies. Since as early as the 1950's, it has been known that Chromium is essential for normal glucose metabolism. Too little Chromium in the diet may lead to insulin resistance. However, there is still no standard against which Chromium deficiency can be established. Nevertheless, Chromium supplements are becoming increasingly popular. Generally it was that toxic effects of Chromium are seldom seen; recently, however, the safety of one of the dosage forms of Chromium (Chromium picolinate) has been questioned. One should be aware that individual patients with type-2 diabetes mellitus might have an increased risk of hypoglycemic episodes when taking chromium supplement as self medication. This speculation thus rases concern for people who may end up amassing toxic level of chromium from chromic low level intake. (Orisakwe *et al.,* 2009).

The concentration of Nickel found in this study are higher than mean values reported by for fruit drinks by Onianwa *et al.*, 1999, also the concentration of the Nickel found in Turkey were lower compared to our findings in Nigeria. (Mehmet *et al.,* 2010). Maduabuchi *et al.,* 2008, reported that 80.95% of the canned drinks had Nickel level that exceeded MCL of 0.10mg/L while 72. 41% of the non canned beverages had Nickel level exceeding the MCL. Nickel is a trace element, required in minute quantities by the human body. It is found widely in the environment and also all tissues in the human body. Though present in minute quantities, Nickel accumulates in the Kidneys, bones and thyroid gland and cause toxicity. Higher quantity of Nickel is known to be injurious for human health.

The bioavailability of Nickel and the present of constituencies that promote oxygen free radical reactions evidently influence the carcinogenicity of nickel oxides and related compound. Not all Nickel compounds are equally carcinogenic, because their carcinogenic potency is directly related to the ability to enter cells. Certain water insoluble nickel compound exhibit potent carcinogenic activity, whereas highly water soluble nickel compounds relates to their bioavailability and the ability of nickel ions to enter cells quiet efficiency via phagocytic processes. Subsequent intracellular dissolution yield very high cellular levels of Ni^{2+}. Water soluble nickel salts do not readily enter cell. Therefore, these compounds are generally not carcinogenic in animals and, to a large extent, have not been considered potent human carcinogens, although recent studies have suggested an increase in cancer in nickel refinery areas where exposure to water soluble nickel salts occurs.

Differences in the carcinogenic activities of nickel compounds may reflect variations in their capacities to provide Nickel ion (e.g Ni^{2+}) at critical sites within target cells. Ni^{2+} can initiate carcinogenesis, possibly by mutagenesis, chromosome damage, formation of Z-DNA, inhibit of DNA excision repair or epigenetic mechanisms.

The concentration of Zinc determined by Contreraslopez *et al.,* 1987 was reported as 50 mg/L in fruit juice while Paolo and Maurizio, 1978 reported 0.41 mg/L Zn in fruit in Italy. The level found in this study was lower than 50 ppm but also very much higher than mean level of 0.41 mg/L reported above..

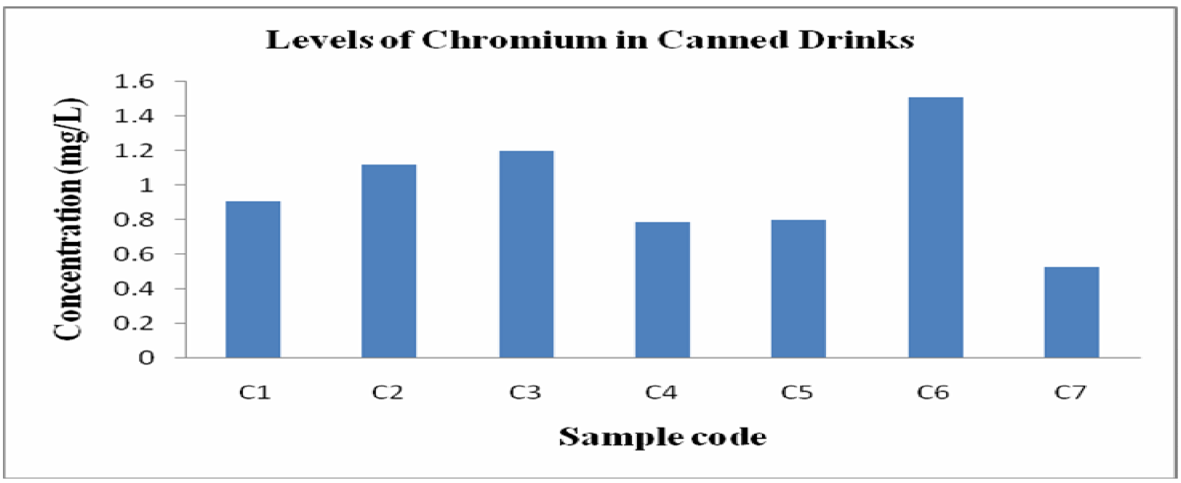

Figure 1: Showing the concentration of Chromium in the canned beverages

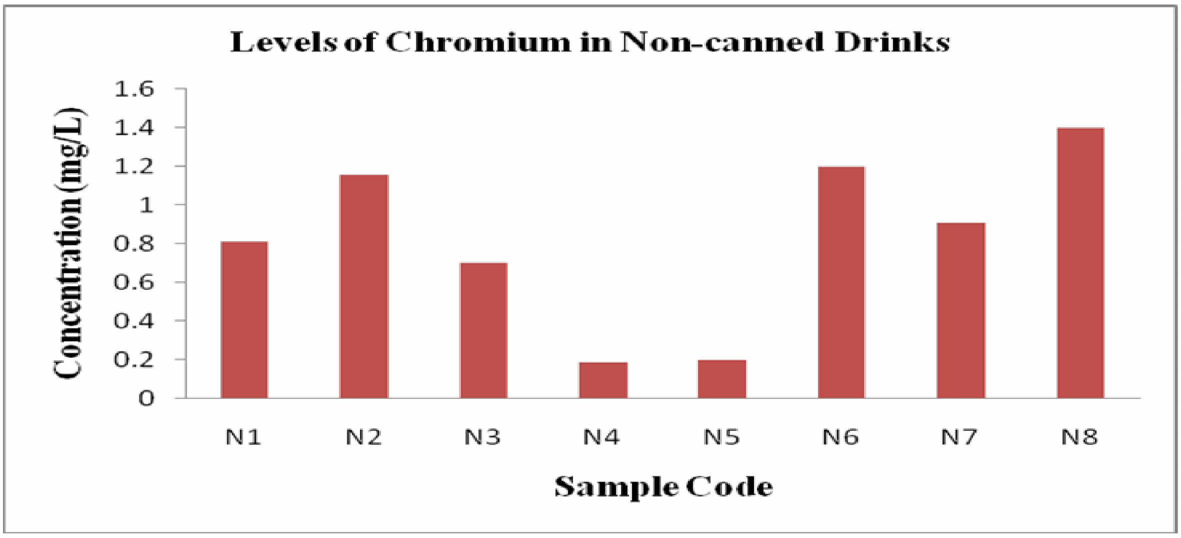

Figure 2: Showing the concentration of Chromium in the non-canned beverages

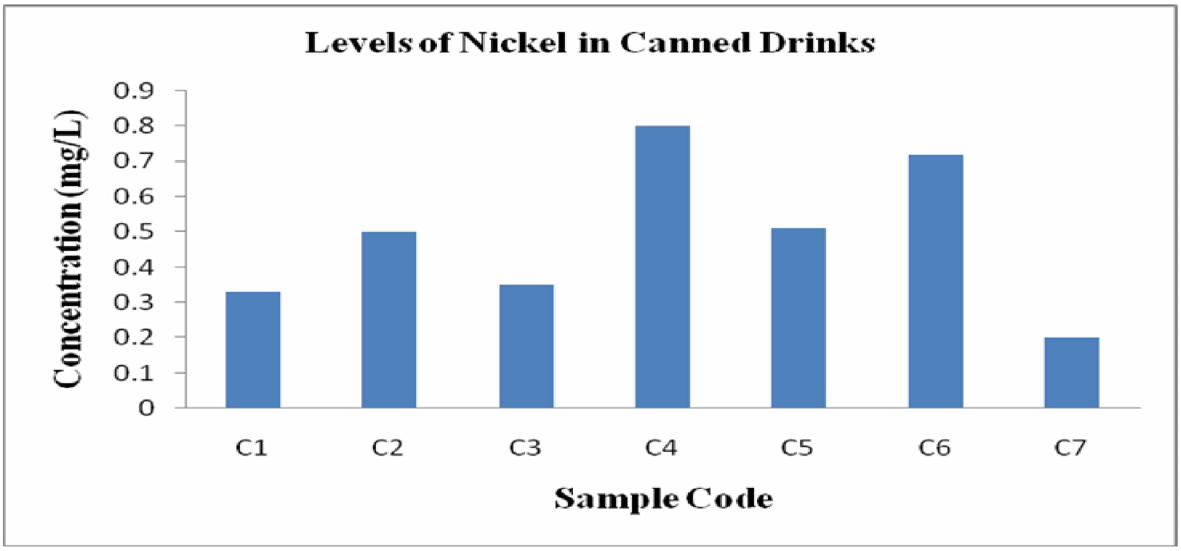

Fig. 3: Showing the concentration of Nickel in the canned beverages

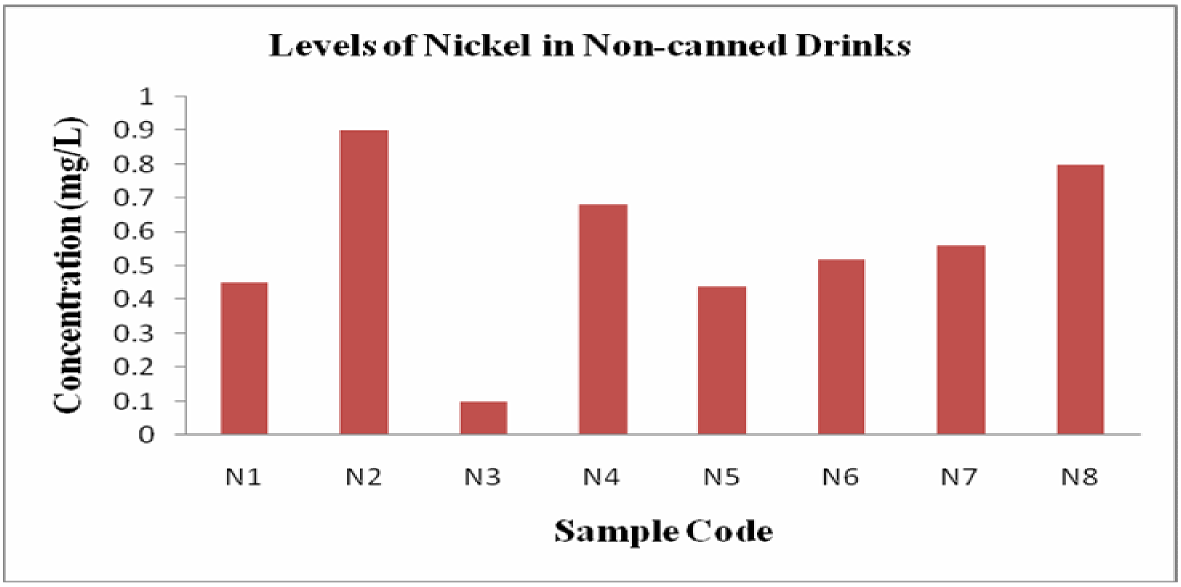

Figure 4: Showing the concentration of Nickel in the non-canned beverages.

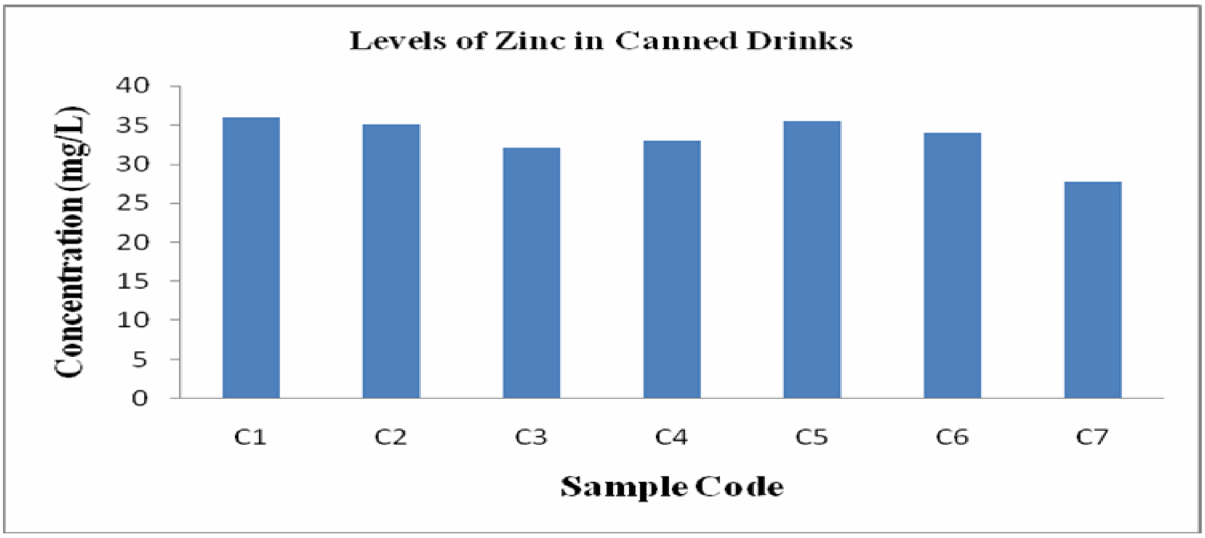

Figure 5: Showing the concentration of Zinc in the canned beverages

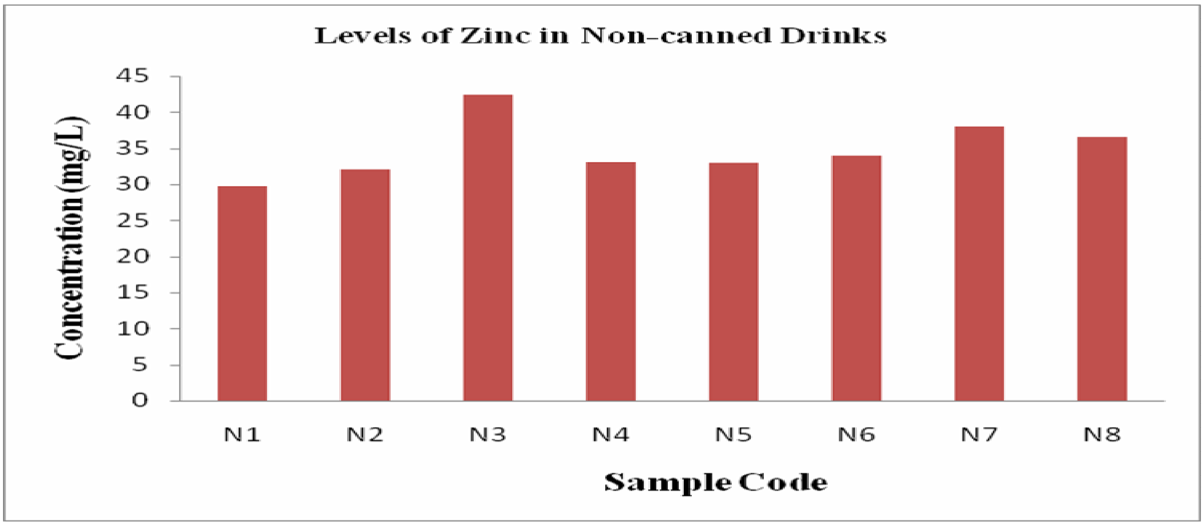

Figure 6: Showing the concentration of Zinc in the non-canned beverages

CONCLUSION

The maximum contaminant levels for the metals analysed from both canned and non-canned beverages were higher than the maximum contaminant levels set by United States Environmental Protection Agencies (US EPA) and agreed by Standard Organization of Nigeria (SON).

Though the source of these contaminants in beverages were not known or investigated in this research, it is advisable that consumers of beverages should reduce the amount of their daily consumption since this high concentration of heavy metals could lead to complication and even death. In view of this, all the steps involved in the production of beverages should be closely monitored to avert contamination by heavy metals.

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