Assesement of Some Heavy contaminants (Cu, Fe and Ni) present in Long term Exposure and Daily Consumption of Ready-to-eat foods sold at Petrol station's Atmospheric conditions (AF) in Calabar Metropolis.

Abstract

Aim: In this study, the concentrations of Cu, Fe and Ni, long term exposure and daily consumption of ready-to-eat food foods sold at Petrol station's Atmospheric conditions (AF) in Calabar Metropolis was evaluated.

Methods: Foods samples, including such prepared ready-to-eat foods as garri, meat pie, stew, rice, beans, afang and melon soups were collected at the point of sale at the fuel stations, about 7:00am in the morning before they were opened for sale (and exposed to the environment of the filling stations). These were labelled "Before". At about 2:00pm to 3:00pm same day, the same ready-to-eat food samples were collected again at the same spots (after they have been exposed to the filling stations atmospheric environment). These were labelled "After". The food samples were collected in such a way that all the Garri purchased before, across the different filling stations were mashed together as a single sample, while the ones purchased after were equally collected to form a single sample. The other food samples were handled in like manner.

Results: The levels of Cu, Fe and Ni recorded for garri, afang soup, melon soup, white rice, beans, stew and meat pie (ready-to-eat meals) are presented in Figures 1-3. The results showed that the level of Ni was significantly high in garri, afang soup, melon soup, white rice, beans and stew, while the level of Fe was significantly ($p<0.05$) increased in garri, melon soup, white rice, beans, stew and meat pie after 6 hours of exposure to petrol station's atmospheric conditions. It was also observed that the level of Cu was significantly high in garri and white rice after 6 hours of exposure to petrol station's atmospheric conditions. This also gave an indication exposure of most ready-to-eat foods to the petrol stations atmospheric conditions for 6 hours, during sales, are likely to results in the contamination of the foods with Ni.

Conclusion: In this study, such ready-to-eat foods as garri, afang soup, melon soup, white rice, beans, stew and meat pie displayed for sale at the petrol refueling stations in Calabar were observed to be contaminated with Cu, Fe and level of Ni. The results of this study therefore suggest that most ready-to-eat foods that exposed to prevailing environmental conditions at filling stations are likely to be contaminated with some heavy metals (such as Cu, Fe and Ni).

Key words: Copper, Iron, Nickel, environmental and contaminants.

Introduction

Ready-to-Eat foods are important because they are readily available to both high and low income workers in most Nigerian cities. They are very economical and are sold on the streets of the major urban cities around the country. The fact they are sold in the open on street sides, exposes these foods to certain contaminants in the course of preparation, processing and sales of these foods. It has been reported that hundreds of chemical pollutants, including heavy metals, are discharged into the environment in the course of various human activities [1].The presence of heavy metals in ready-to-eat foods could make these foods to become environmental hazards to human health. Consumption of these foods over time usually leads to build-up of heavy metals which may therefore lead to retention of the metals in the body, thereby producing some kind of hypertoxicity effects. Various human activities are known to release heavy metals to the different environments, including the atmosphere. Heavy metals are therefore chemical substances that occur naturally, or are released into the environments by several human and industrial activities. Such metals as arsenic, cadmium, lead and mercury can be present at various levels in environments, e.g. soil, water and atmosphere. It has been reported that there exists a relationship between metal content in plants and soil in wheat.The metallic load of food crops depends mainly on their uptake by the plant, ability to induce toxicity, and bio-accumulate in the food chain[2]. Food has been reported to constitute the principal source of cadmium in non-smokers. Different mean daily cadmium intake from food have been reported in such places like Croatia, Czech Republic, France, Poland, Germany and Spain[3,4].

Some of the ready-to-eat foods are commonly sold along petrol stations, motor parks, mechanic workshops and roadsides of most cities in Nigeria include roasted plantain, stick meat, rice, beans, porridge yams and soups. Various occupational activities at the petrol stations, motor parks, mechanic workshops and traffic congested roadsides release some chemical pollutants, including heavy metals and hydrocarbons into the environment. Exposure of these ready-to-eat foods to the atmosphere at the petrol stations, motor parks, mechanic workshops and traffic congested roadsides is likely to introduce atmospheric chemical contaminants, such hydrocarbons and heavy metals pollutants, into these foods. The deposition of heavy metals are potentially poisonous and toxic with its accumulation in human system.

Copper is to play important role in maintenance of several metabolic activities in the body. However, excessive intake of copper may produce adverse effect in the body. Hence, the recommended dietary intake of copper had been documented by the various National and International Regulatory Bodies. According to[5], 0.2mg/kg/bw/day is recommended as the upper limit, a safe range of adults' standard consumption for copper. Therefore, the acceptable safe limit of copper recommended for adults by WHO is about 0.2mg/kg body weight/ day.

High level of nickel has been reported in foods such as oatmeal and some legumes such as soybean and cocoa[6]. A comparatively higher level of about 900 µg/day of nickel has been reported in Denmark probably due to high dietary intake from these foods. In Uk, Finland, US and Canada, "the mean total dietary intake of nickel has been reported to be between 0.12 - 0.21 mg, 0.13 mg, 0.17 mg, 0.207 - 0.406 mg respectively"[7,8,9,10]. These reports indicate that daily dietary intake of nickel varies on the basis of food type and quantity of food eaten. It can therefore be deduced the amount of nickel vary considerably with food type and from place to place.

Materials and Methods

Materials

The following equipment and glass wares were used in the course of this research: Laboratory mortar (model EW-63100-60, from Cole-parmer company Ltd, USA), Evaporating plate (model SER-No.62, from Gallenkamp company Ltd, UK), Atomic Absorption Spectrophotometer (model AA6800, Schemadzu company, Japan).

Reagents/chemicals

Standard reagents and chemicals were used and include: Lichens coded International Atomic Energy Agency (IAEA-336), from Sigma, USA, Nitric acid (Riedel-deHaën, Germany), Perchloric acid (Sigma-Aldrich, Germany), Hydrofluoric acid, Ethanol, Methanol, Ethyl-acetate, (British Drug House Chemicals Ltd, Poole, England), distilled deionized water (obtained from Cross River State water board, Calabar-Nigeria).

Methods

Collection of food samples

Foods samples, including such prepared ready-to-eat foods as garri, meat pie, stew, rice, beans, afang and melon soups were collected at the point of sale at the fuel stations, about 7:00am in the morning before they were opened for sale (and exposed to the environment of the filling stations). These were labelled "Before". At about 2:00pm to 3:00pm same day, the same ready-to-eat food samples were collected again at the same spots (after they have been exposed to the filling stations atmospheric environment). These were labelled “After”. The food samples were collected in such a way that all the Garri purchased before, across the different filling stations were mashed together as a single sample, while the ones purchased after were equally collected to form a single sample. The other food samples were handled in in like manner.

Preparation of food samples for heavy metal analysis

One gram (1.0g) each of the pulled samples was weighed into a beaker. 20ml of aqua-rega (a solution of Nitric acid and perchloric acid (3:1) was added and the beaker was covered with glass for the initial effervescence to subside. Thereafter, the beaker was placed on a hot plate and heated to near dryness at about 80-90^{0}C. The aqua-rega was added as required in the course of digestion, to avoid drying. After the sample was fully digested, giving light coloured solution, the beaker was transferred onto a work bench and allowed to cool. The cooled sample was filtered into a 50ml beaker and made up to the mark with distilled water. This was transferred into a sample container in preparation for heavy metal (elemental) determination using Atomic Absorption Spectrophotometer[11].

Analytical Quality Assurance

To make sure that the analytical methods used for heavy metal determination are reliability, standard reference materials, Lichens coded (International Atomic Energy Agency; IAEA-336) were also digested and then analyzed using same procedure. Comparison of determined values with certified elemental values was carried out to ensure reliability of the analytical method used [12].

Results

Results showing the different concentrations of Cu, Fe and Ni in some ready-to-eat meals before and after 6 hrs of exposure to petrol station’s atmospheric conditions (AF)

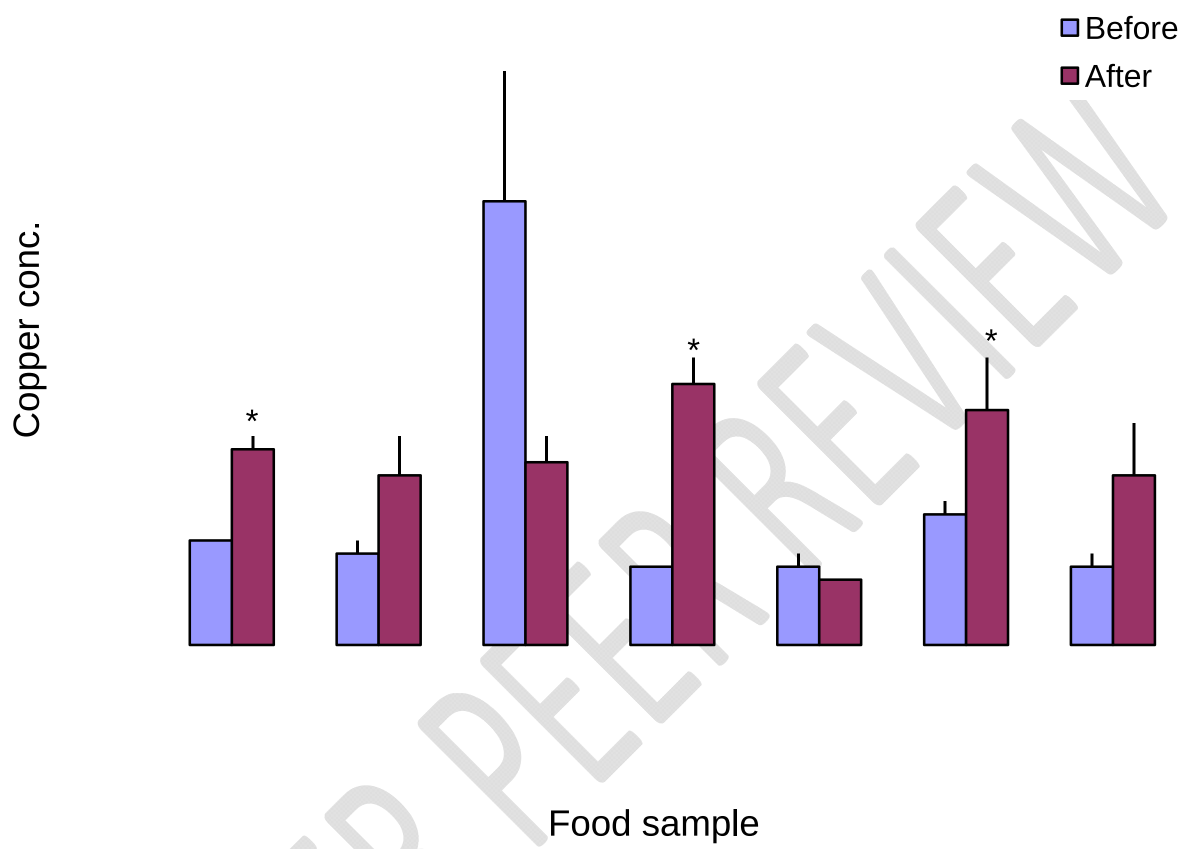

Figure 1: Comparison of concentration of copper before and after exposure in the different food samples.

Values are expressed as mean + SEM, n = 3.
* = significantly different from before exposure at $p<0.05$

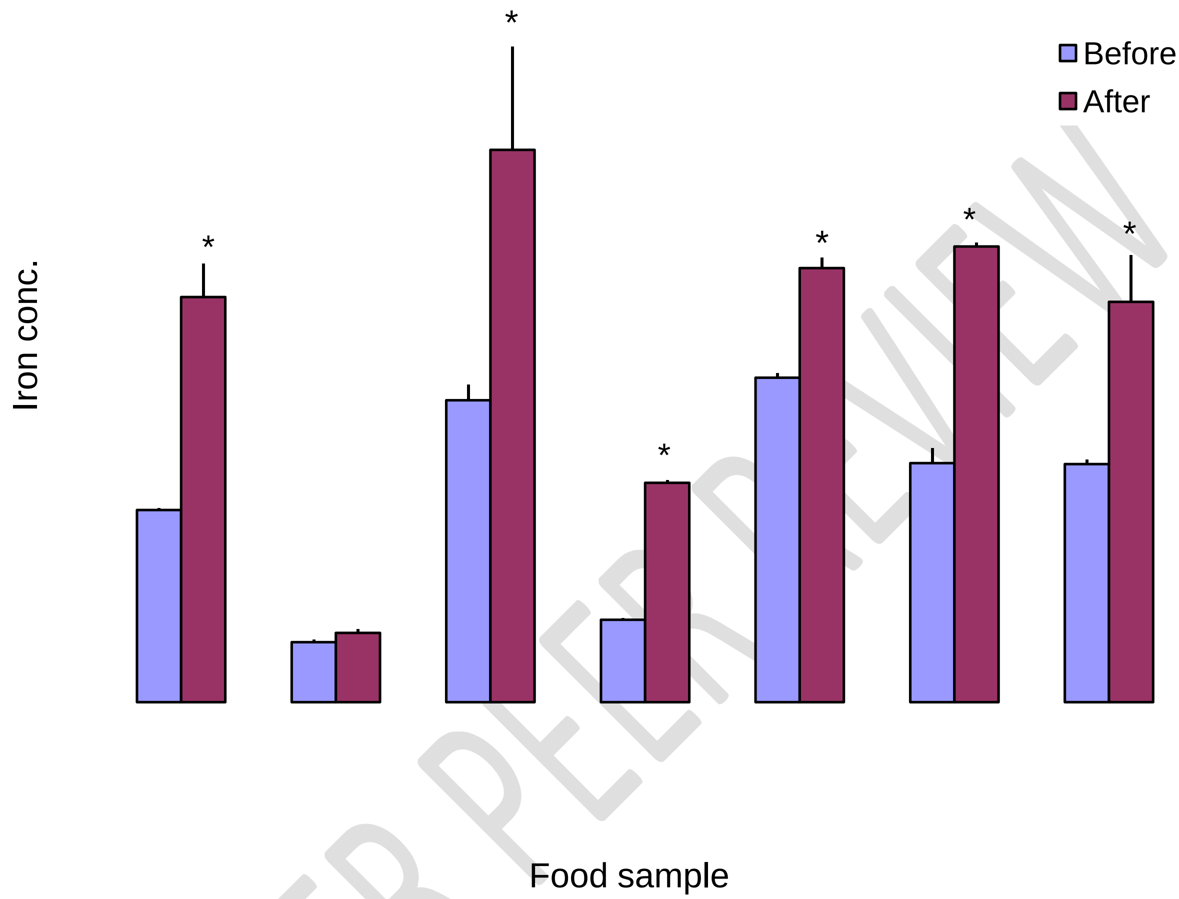

Figure 2: Comparison of concentration of iron before and after exposure in the different food samples.

Values are expressed as mean + SEM, n = 3.
* = significantly different from before exposure at $p<0.05$

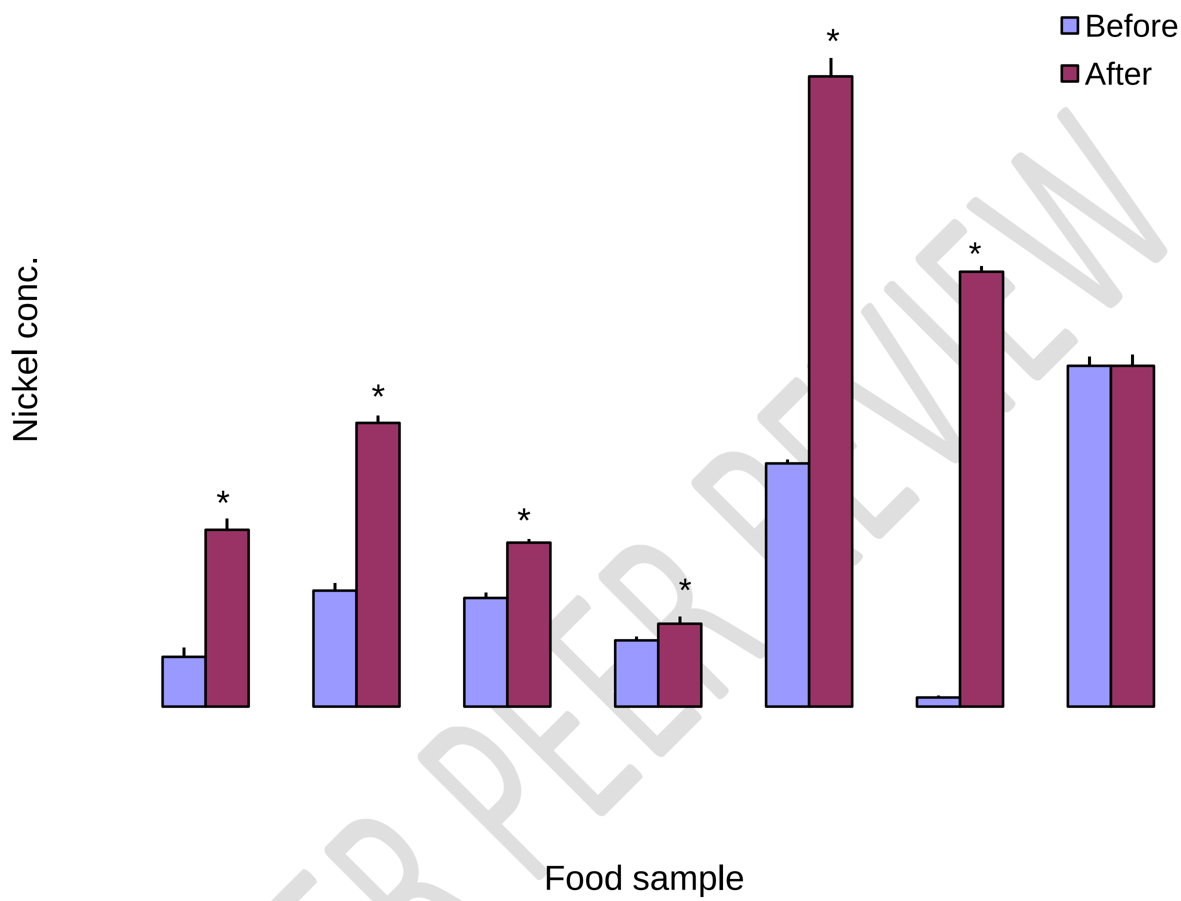

Figure 3: Comparison of concentration of nickel before and after exposure in the different food samples.

Values are expressed as mean + SEM, n = 3.
* = significantly different from before exposure at $p<0.05$

Discussion

The presence of heavy metals in the air, water and food forms a major health threat globally [13]. Such human activities as use of agricultural pesticides, increase in industrialization and mining are known to release high amount of heavy metals into the environment, thereby increasing the levels of heavy metal pollution in the ecosystem[14]. Consumption of food items displayed at these environments is therefore likely to expose the consumers to the risk of these heavy metals toxicity. Some heavy metals are known to cause various health hazards to individuals that consume those foods that are enormously contaminated with the metals. Generally, heavy metals get into human systems following consumption of foods and drinking of water that are contaminated with heavy metals. This study is therefore important in determining the possibility of dietary consumption of heavy metals from food sources. This may also play a key role in evaluating food safety and the consequent effects of heavy metals on the consumers.

This study assessed the level of some heavy metals in ready-to-eat foods such as prepared garri, meat pie, stew, rice, beans, afang and melon soups that are sold at the petrol refueling stations in Calabar. It was observed from the results of this study showed that petrol refueling stations atmosphere, introduced high levels of Pb and Cd into garri, afang soup, melon soup, white rice, beans, stew and meat pie sold within premises of the refueling stations. Also, high level of Cr was recorded in garri, afang soup, melon soup, white rice, beans, stew and meat pie at the petrol stations in Calabar, compared to the level recorded for the freshly prepared foods. According to the "Joint FAO/ World Health Organization Expert Committee on Food Additives (JEFCA) the established provisional tolerable weekly intake for lead is 0.025 mg/kg body weight". Also, the report of "WHO provisional guideline records 0.01 mg/L as the adopted standard for drinking water" [15]. According to the FAO/WHO standard, "the permissible level of cadmium and lead is 0.05 and 0.2mg/kg, respectively".

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Conclusion

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