EVALUATION OF CONCENTRATION OF HEAVY METALS IN SELECTED BABY FOOD IN BAYELSA STATE

***Ezomoh, O. Olubunmi; *Olumorin, O. Priscilla; *Ebizimor Wodu; Fredrick, A. Kelvin**

*Department of Biochemistry, Niger Delta University, Bayelsa State.
Corresponding address; bunmiezomoh@gmail.com

DOI: 10.31364/SCIRJ/v11.i9.2023.P0923963
http://dx.doi.org/10.31364/SCIRJ/v11.i9.2023.P0923963

Abstract: This study presents an analysis of the heavy metal concentrations in four distinct Baby foods samples. The samples were subjected to dry ashing as a method of digestion, and the heavy metal content was afterwards assessed using an atomic absorption spectrophotometer. Based on the findings, it was observed that Cerelac exhibited the greatest content of arsenic, measuring 0.0052 parts per million (ppm), while Kendamil displayed the lowest concentration at 0.0037 ppm. Cerelac had the highest lead concentration at 0.0072 parts per million (ppm), whereas Kendamil demonstrated the lowest lead concentration at 0.0056 ppm. The analysis of cadmium levels in the samples of Cerelac and Nutribom revealed that Cerelac exhibited the greatest concentration of 0.0036 parts per million (ppm), whereas Nutribom displayed the lowest concentration of 0.0021 ppm. The maximum recorded concentration of copper in Cerelac was 3.5057 parts per million (ppm), while the minimum concentration was 2.7463 ppm. The recorded values of mercury ranged from 0.0001 to 0.0003 parts per million. The concentrations of nickel (Ni) exhibited variation among the tested products, with Kendamil displaying the lowest concentration at 0.0049 parts per million (ppm), while Cerelac exhibited the highest concentration at 0.0078 ppm. The highest iron content was seen in Nutribom at a concentration of 1.4806 parts per million (ppm), while the lowest iron content was found in Peak Infant at a concentration of 0.5342 ppm. The readings collected were found to be below the permitted limit set by the World Health Organization (WHO).

KEY WORDS: Baby foods, spectrophotometer, Cerelac, Nutribom, WHO.

INTRODUCTION

The majority of food items consist of inherent or artificially derived chemical compounds that have the potential to pose a hazardous risk to anyone consuming them. Food toxicology encompasses two distinct categories of pollutants: natural contaminants, which are inadvertently present in food, and purposeful contaminants, including food additives, veterinary medications, and pesticides. According Wald and Pascal (2000), the concept of "risk" pertains to the likelihood of an unfavorable health outcome and the magnitude of that outcome, which arises from being exposed to a food-related hazard. The continuous discharge of hazardous pollutants into the environment leads to a permanent rise in metal concentrations, hence resulting in the contamination of the food chain. Metal contamination can occur throughout the many stages of food handling and processing, spanning from the agricultural production phase to the final consumption stage. In addition to the phenomenon of plants thriving in polluted soils and animals consuming feeds containing harmful metals, there are additional factors that can potentially contribute to the contamination of food.

The human body requires roughly 70 essential trace elements, including various heavy metals. However, certain heavy metals, such as lead, mercury, aluminium, arsenic, cadmium, nickel, chromium, among others, possess toxic properties that can disrupt the normal functioning of enzyme systems and metabolic processes inside the body. Regardless of the use of beneficial health supplements or utilization of various medical procedures, an excessive accumulation of heavy metals might impede the body's innate healing mechanisms (Kakulu et al., 1987; Elson and Haas, 2003). Heavy or hazardous metals refer to trace metals that possess a density at least five times greater than that of water. Therefore, these substances exhibit stability, indicating that they cannot undergo metabolism within the human body, and possess the ability to accumulate in biological systems. In certain instances, they may be transferred up the food chain and ultimately reach the human population (Fergosson, 1990). The metals encompassed in this group are mercury, nickel, lead, arsenic, cadmium, aluminium, platinum, and copper, both in their metallic and ionic forms. According to Fergosson (1990), the majority of heavy metals lack any advantageous physiological roles inside the human body and possess significant toxicity. The entry of these substances into the human body occurs by inhalation, ingestion, and skin absorption. If the rate at which they enter and accumulate in bodily tissues exceeds the capacity of the body's detoxification pathways to eliminate them, there will be a progressive accumulation of these toxins. It is not essential to have a high concentration exposure in order to induce toxicity in bodily tissues. Over time, the concentration levels can become toxic (Khalid et al., 1978; Proti, 1989; Prusty, 1994).

Numerous heavy metals occur naturally inside the Earth's crust and are utilized for diverse industrial and economic endeavors. Within the category of heavy metals, certain elements possess the ability to exert either direct or indirect effects on the human body. Certain heavy metals, including copper, cobalt, iron, nickel, magnesium, molybdenum, chromium, selenium, manganese, and zinc, play vital functional roles in a wide range of physiological and biochemical functions within the human body. Nevertheless, it is important to note that certain heavy metals can pose a risk to human health when consumed in excessive amounts. For instance, cadmium, mercury, lead, chromium, silver, and arsenic, even in small quantities, can have detrimental effects on the body, leading to both acute and chronic toxicities.

MATERIALS AND METHOD

Method

Apparatus

Balance machine, hot air oven, hot plate, desiccator, muffle furnace, nitric acid and deionized water, Primary standards (crm)

Sample collection

The different brands of baby food were obtained from General Supermarket, Yenagoa, Bayelsa State

Washing

All glassware were washed first with detergent and then rinsed repeatedly with tap water. Afterwards, glassware were soaked in a solution of HNO_3 (5%) for about 24 h. Then rinsing was done using deionised water and dried at 80 °C for 48 h before use.

Preparation of Reagents

Diluent preparation (nitric acid solution)

Exactly 69.75ml of nitric acid (65%) was mixed with 800ml of deionized water. The mixture was well shaken and allowed to cool to room temperature after which deionized water was used o make it up to 1000ml in a volumetric flask.

Dry Ashing

Sample Incineration

Exactly 5g the samples were taken and placed in a crucible labelled accordingly. The crucibles containing the samples were heated at 150 degree until the smoke from the crucibles ceases. The crucibles were then moved to a muffle furnace to ash the samples at 550 degree for 12 hours to completely digest samples. After incineration samples were taken out of the muffle furnace and allowed to cool

http://dx.doi.org/10.31364/SCIRJ/v11.i9.2023.P0923963

Sample dilution

Nitric acid was used to wash all the volumetric flask, glass rods and funnels used for sample dilution. About 30ml nitric acid was added to the crucibles containing the samples and mixed thoroughly with glass rod and was filtered into the volumetric flask using filter papers.

Statistical Analysis

The samples of this study were analysed using the Statistical Programme for Social Sciences (SPSS). A t-test was used to determine the significant difference between the means of the various sample, using $P < 0.05$ level of significance.

RESULTS

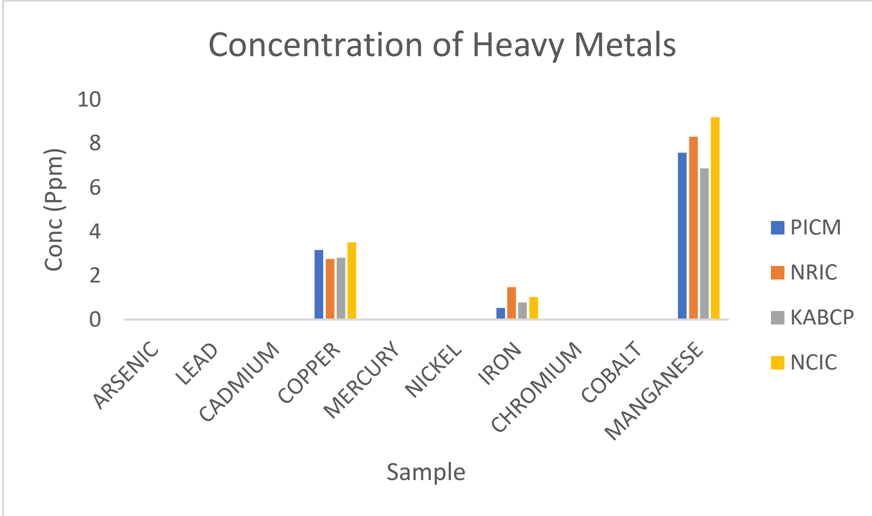
Table 1. Concentrations of Heavy Metals (ppm) in baby food. Mean ± SD.

metal	As	Pb	Cd	Cu	Hg	Ni	Fe	Cr	Co	MN
Peak Infant	0.0047 ±0.0001	0.0065 ±0.001	0.0028 ±0.001	3.1528 ±0.001	0.0002 ±0	0.0073 ±0.0001	0.5342 ±0.0001	0.0056 ±0.0001	0.0048 ±0.0001	7.5763 ±0
Nutribom	0.0044 ±0.0001	0.0062 ±0.0001	0.0024 ±0.0001	2.7463 ±0.0001	0.0001 ±0	0.0052 ±0.001	1.4806 ±0.001	0.0048 ±0.001	0.0041 ±0	8.3118 ±0.001
kendamil	0.0037 ±0.0001	0.0056 ±0.0001	0.0021 ±0.0001	2.8112 ±0.0001	0.0002 ±0.0001	0.0049 ±0	0.7752 ±0.0001	0.0043 ±0.0001	0.004 ±0	6.8644 ±0.0004
cerelac	0.0052 ±0	0.0072 ±0.0001	0.0036 ±0.0001	3.5057 ±0.0001	0.0003 ±0.0001	0.0078 ±0.0001	1.0234 ±0.001	0.0062 ±0.001	0.0052 ±0.001	9.1885 ±0.001

The table 1 show the concentrations in part per millions of various metals analyzed in the samples where Cerelac as the highest concentration of Arsenic; 0.0052ppm and Kendamil as the lowest concentration arsenic; 0.0037. For lead concentrations, Cerelac had the highest value (0.0072ppm) and Kendamil had the lowest value (0.0056ppm). The result of Cadmium indicate that sample Cerelac had the highest value (0.0036ppm) and Nutribom had the lowest value (0.0021ppm). For Copper Cerelac had the highest value 3.5057ppm and the lowest value 2.7463ppm. The concentration of Mercury ranged from 0.0001ppm to 0.0003ppm. The concentration levels of Ni ranged from with Cerelac having the highest value 0.0078ppm and Kendamil having the lowest level 0.0049ppm. For iron Nutribom had the highest values (1.4806ppm) with Peak Infant having the lowest value 0.5342ppm. Meanwhile Cerelac had the highest value for Chromium and the lowest values was found in Kendamil 0.0043ppm. Cerelac had the highest value 0.0052ppm for Cobalt with Kendamil having the lowest value 0.0040ppm. The concentration of Manganese ranged from 6.8644ppm to 9,1885ppm.

- An histogram showing the concentration of heavy metals in baby food

http://dx.doi.org/10.31364/SCIRJ/v11.i9.2023.P0923963



The concentration of manganese is high in all the samples, copper and iron value are significant. The concentration of the other analyzed metals are insignificant.

DISCUSSION AND CONCLUSION

Table 1 presents the findings on the influence of trace metal concentrations in various baby food samples that were chosen for analysis. Based on the obtained outcomes. The average concentration of arsenic was found to be 0.0044 mg/kg, with a range spanning from 0.0037 to 0.052 mg/kg. The Cerelac the highest recorded concentration of arsenic at 0.0052 parts per million (ppm), whereas the Kendamil product displayed the lowest recorded value at 0.0037 ppm. The levels of arsenic present in various brands of baby food are within the acceptable thresholds established by the European Food Safety Authority (EFSA) and the US Food and Drug Administration (USFDA) for infant nutrition products. The arsenic levels observed in this investigation exceeded those reported by Akpe et al. (2021), who documented an average concentration of 0.001 mg/kg for newborn formulae available in Cross River State, Nigeria.

Exposure of babies to lead has been found to have adverse effects on their brain, neurological system, and overall growth. The average concentration of all the infant food samples is 0.049 parts per million (ppm). Cerelac had the highest recorded lead concentration at 0.0072 parts per million (ppm), whereas Kendamil demonstrated the lowest recorded lead concentration at 0.0056 ppm. The study's findings regarding the elevated concentrations of lead raise significant concerns, mostly due to lead's propensity for bioaccumulation. However, it is worth noting that the potential adverse effects of lead exposure can be mitigated by increasing iron intake, as it aids in the chelation and subsequent excretion of lead from the body.

Cadmium (Cd) is introduced into the environment through both natural and artificial sources of varying origins. Nevertheless, the deposition of Cd in the soil-plant system primarily occurs as a result of human activities, including the use of phosphate fertilizers, discharge of wastewater, application of sewage sludge, and utilization of manures. The analysis of cadmium levels in the samples of Cerelac and Nutribom revealed that Cerelac exhibited the greatest concentration at 0.0036 ppm, whilst Nutribom displayed the lowest concentration at 0.0021 ppm. The administration of EDTA resulted in a substantial enhancement in the excretion of cadmium through urine.

http://dx.doi.org/10.31364/SCIRJ/v11.i9.2023.P0923963

The prevalence of chronic copper poisoning is low. Nevertheless, extended contact with copper can lead to significant health complications. Severe poisoning can lead to liver failure and mortality. The prognosis of poisonings resulting from a prolonged accumulation of copper within the body is contingent upon the extent of organ impairment. The maximum recorded copper concentration at Cerelac was 3.5057 parts per million (ppm), while the minimum concentration was 2.7463 ppm. The recorded mercury concentrations ranged from 0.0001 to 0.0003 parts per million. The concentrations of nickel (Ni) exhibited variability among the different infant formula brands. Kendamil displayed the lowest Ni concentration at 0.0049 parts per million (ppm), while Cerelac exhibited the highest concentration at 0.0078 ppm. On the other hand, Nutribom recorded the highest iron concentration at 1.4806 ppm, whereas Peak Infant had the lowest iron concentration at 0.5342 ppm.

The results of this study are comparatively less robust in comparison to the findings presented by Alkhalifa and Dlshad (2010), who investigated the levels of heavy metal contamination in infant food products inside Saudi Arabia. Given that heavy metals are eliminated throughout the production process of these feeds, it is unsurprising that the content of heavy metals in all the assessed samples was found to be below the permissible values set by the World Health Organization (WHO). The discrepancies in trace metal levels in cereal-based baby food items can be attributed to the diverse manufacturing techniques, quality of raw ingredients, and packaging materials employed by infant food makers.

CONCLUSION

The findings of this study indicate that the selected commercial baby food samples contain trace metals at concentrations that are considered sufficient. These results suggest that the presence of these trace metals does not have any adverse effects on the health of newborns. These findings align with previous reports on the composition of infant formula available in local stores, while also contradicting some of those earlier reports. Furthermore, the concentrations of the investigated trace metals in the baby food samples were found to be within the safe limits for food as recommended by the World Health Organization.

REFERENCES

Akpe, M. A., Ubua, P. U., & Ivara, S. E. (2021). Health risk evaluation of selected heavy metals in infant nutrition formula in Cross River State, Nigeria. *Journal of Applied Sciences and Environmental Management*, *25*(3), 419-423.

Al Khalifa, A. S., & Ahmad, D. (2010). Determination of key elements by ICP-OES in commercially available infant formulae and baby foods in Saudi Arabia. *African Journal of Food Science*, *4*(7), 464-468.

Elson, M., & Haas, M. D. (2003). Toxic Minerals and Heavy Metals (Excerpted from a Cookbook for all Season). *Edition, California*, *44*.

Fergosson, J. E. (1990). The Heavy Elements Chemistry. *Environmental Impact and Health*, *10*, 3-5.

Kakulu SE, Osibanjo O, Ajayi SO (1987). Trace Metal Content of Fishand Shellfishes of the River Niger Delta Areas of Nigeria. Environ Int.13: 247-251.

Khalid RA, Gambrell RA, Patrick WH (1978). Chemical Transformationof Heavy Metals.. Adriano DC, Bristbin IL Jr (Eds). US Department ofEnergy. Doe Symposium Series pp. 133-147.

Proti AJ (1998). Metals in Fish and Sediments from the RiverKolbacksan Water System pp. 26-27.

Prusty AW (1994). The Use of Fish in Monitoring Water Pollution. Tourof Biotech. pp 4-7.

Wal, J. M., & Pascal, G. (2000). Novel foods and novel hazards in the food chain.

http://dx.doi.org/10.31364/SCIRJ/v11.i9.2023.P0923963