Open Science Journal of Bioscience and Bioengineering
2020; 7(2): 26-29
http://www.openscienceonline.com/journal/bio
ISSN:2381-3806 (Print); ISSN:2381-3814 (Online)

Analysis of Heavy Metal Content in Selected Noodles Sold in Main Market, Onitsha, Anambra State, Nigeria

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To cite this article

Collins Chibuzor Odidika, Nkiruka Charity Eboagu, Chinwe Priscilla Okonkwo, Christian Chukwuemeka Oli, Tochukwu Blessing Okonkwo. Analysis of Heavy Metal Content in Selected Noodles Sold in Main Market, Onitsha, Anambra State, Nigeria. *Open Science Journal of Bioscience and Bioengineering*. Vol. 7, No. 2, 2020, pp. 26-29.

Received: June 12, 2020; **Accepted**: June 28, 2020; **Published**: July 15, 2020

Abstract

The concentrations of some selected heavy metals such as Cd, Cr, Pb, Mn, Fe and Zn were analysed in four instant noodles samples (Indomie noodles-A, Tummy tummy noodles-B, Minimie noodles-C, Supreme noodles-D) consumed in Onitsha, Anambra State, Nigeria, And was carried out using Atomic Absorption Spectrometery (AAS). Except for the Zn concentration in sample C (58.66ppm) which was observed to be greater than the permissible range of WHO, all beneficial heavy metals (Fe and Zn) analysed in the noodle samples occurred within the permissible range of WHO (10.00-50.00ppm and 5.00-22.00ppm). The heavy metals (Cd, Cr, and Pb) in all the samples occurred at elevated levels relatively above the WHO permissible limit, with the absence of Cr and Cd in sample B (Tummy tummy noodles) and sample C (Minimie noodles) respectively, while the WHO permissible limit for Mn is not yet established. Therefore, precautionary measures should be employed in the frequent dietary intake of these noodles, to prevent health problems and detrimental effects, associated with the bioaccumulation of these heavy metals in the human body over a long period of time, especially in samples where they appeared in high concentration. We therefore recommend that more stringent policies and routine regulatory activities be carried out by monitoring agencies/bodies (WHO, FAO, NAFDAC, SON), to ensure healthy noodles get to consumers.

Keywords

Heavy Metal, Instant Noodles, Atomic Absorption Spectrometer

1. Introduction

Instant noodles are ready fast food made from wheat or rice flour and eaten throughout the world; it is one of the convenience food in Nigeria. It's global consumption is second only to bread [1]. Historically, noodles originated from North China and were later introduced to other countries by traders, seafarers and migrants [2, 3]. Excessive consumption of instant noodles by Nigerians at large, has lead to concerns about it's industrial production processes and health implication as regard to heavy metal content.

Heavy metals are potential environmental contaminants with the capability of causing health problems if present in excess in the food we eat like noodles, they also find their way into this noodles through the use of contaminated soil, water, raw materials and during industrial processing [4-10]. Heavy metals are given special attention throughout the World due to their toxic effects even at very low concentration, several cases of human disease, disorder, malfunction and malformation of organs due to metal toxicity have been reported [11-14]. There are two types of heavy metals; toxic heavy metals and beneficial heavy metals. Toxic heavy metals are dangerous even in small amount (minute concentrations), while beneficial heavy metals are important to the health and function of the body, however, in

large amount even these beneficial heavy metals can be harmful in the body. Examples of toxic heavy metals are mercury, platinum, lead, cadmium, arsenic and chromium while beneficial heavy metals include; iron, cobalt and zinc [15-18].

Toxic Heavy metals may enter the human body through food, water, air, or absorption through the skin in agricultural, pharmaceutical, industrial, or residential settings. Industrial exposure is common in adults while ingestion is common in children, children may ingest heavy metals from normal hand to mouth activity through coming in contact with contaminated soil or eating objects that are not food such as dirt. Heavy metals become toxic when they are not metabolised by the body and tend to bioaccumulate. Bioaccumulation is an increase in the concentration of a chemical in a biological organism over time, compared to the chemical concentration in the environment. Chemical Compounds tend to accumulate in living things anytime they are taken up and stored faster than they are broken down (metabolized) or excreted. Bioaccumulation of toxic heavy metals causes serious health issues such as renal failure, reduction in neuropsychological function, liver damage, neurological impairment, cardiovascular disease, gastrointestinal disease and even death [2, 19-21]. The growth of the pastry industry in Nigeria due to the increasing consumption of instant noodles then lead to this present study which seeks to analyse the heavy metal content in selected noodles sold in Main market, Onitsha, Anambra State, Nigeria, so as to determine the potential health risk associated with their consumption.

2. Materials and Method

Sample Collection

The samples were bought from Main market, Onitsha, Anambra State, Nigeria, and were labelled as follows; Indomie instant noodles (A), tummy-tummy instant noodles (B), Minimie instant noodles (C) and Supreme instant noodles (D). All the samples were in 100g packets.

Sample Preparation

The samples were removed from sachet and ground to fine power on a porcelain crucible. Digestion of the samples was done by weighing out 15g each of the ground samples and inserting it into conical flasks. 50ml of aqua regia was poured into the flasks containing the samples. The mixture obtained was heated at a low temperature in a fume cupboard using a heating mantle until a solution was formed and the brown fumes stopped evolving. The fume cupboard was used to trap the gases given out during heating. The solutions were brought out and allowed to cool, after which they were filtered with a whatman filter paper and the volume of the filtrate made up to 100ml using distilled water for AAS analysis. The solutions were poured into the sample bottles and were labelled A, B, C and D prior to their use for the analysis.

Quality Assurance

Proper quality assurance procedures and precautions were carried out to guarantee the accuracy and reliability of the results. Samples were properly handled to avoid contamination, the reagents used were of analytical grade and distilled water was used in the preparation of all solutions used. A 1000 ppm stock solution of Cd, Cr, Pb, Mn, Fe and Zn were used for the preparation of calibration curve solution. Reagent blank determinations were used to correct the instrument readings. Then, to ensure the method validation and the quality of results, spiking method was followed which involved spiking and homogenizing of several already analyzed samples with varied amounts of standard solutions of the metals. The spiked samples were processed for the analysis by the digestion method.

Heavy Metal Analysis of Samples

The analysis of the heavy metals in the noodles samples was carried out using the Varian AA 280 Atomic Absorption Spectrometer according to the method of APHA (American Public Health Association) working principle.

3. Results and Discussion

Heavy Metals Analysis

Table 1. *Results of Heavy Metal Analysis of the selected noodle Samples sold in the study area.*

SampleCode	SampleName	Fe (ppm)	Cd (ppm)	Mn (ppm)	Pb (ppm)	Zn (ppm)	Cr (ppm)
A	Indomie	12.40	1.06	5.66	0.53	5.73	11.00
B	Tummy-Tummy	16.53	13.33	6.20	1.06	7.46	ND
C	Minimie	21.86	ND	6.67	1.33	58.66	4.13
D	Supreme	14.33	0.26	7.13	2.40	21.33	0.40
	WHO Standard	10.00-50.00	0.003	NA	0.025	5.00-22.00	0.05

ND = not detected, NA = not available.

Table 1 showed the level of heavy metal concentrations in the four brands of noodles sold in the study area. The concentration of Fe in the noodle samples ranged from 12.40 to 21.86 ppm. The Fe concentrations were within the range of the WHO standard (10-50 ppm) [22]. Therefore, someone who depends solely on these noodles will be found efficient of this vital essential metal.

The concentration of Cd in the noodle samples ranged from 0.26 to 13.33 ppm. Except for sample C which had no Cd concentration in it, the Cd concentrations of the other samples were above the permissible limits of WHO (0.003 ppm) [22]. Hence such noodles could be considered as being harmful to humans if taken over a long period of time due to bioaccumulation.

The concentration of Mn in the noodle samples ranged from 5.66 to 7.13 ppm. For Mn, the WHO/FAO permissible

limit is not yet established.

The concentration of Pb in the noodle samples ranged from 0.53 to 2.40 ppm. A high concentration of Pb was observed in sample D (2.40 ppm) followed by sample B (1.60 ppm), sample C (1.33 ppm) and sample A (0.53ppm) respectively. According to WHO standard [22], the permissive level of lead metal in food should be 0.025ppm, and none of the samples conformed to this standard. Hence caution should be taken in the constant consumption of these noodles and measures taken to curtail the presence of Pb in these noodles.

The concentration of Zn in the noodle samples ranged from 5.73 to 58.66 ppm. Except for the Zn concentration in sample C (58.66ppm) which was observed to be greater than the permissible range of WHO (5-22 ppm) [22], the Zn concentrations of the other samples were within the range, hence potential consumers of sample A, B and D will be rich in the essential Zn metal without any detrimental health effect.

The concentration of Cr in the noodle samples ranged from 0.40 to 11.00 ppm. Except for sample B which does not contain Cr, the Cr concentrations of the other samples were above the WHO tolerable limit (0.05 ppm) [22], therefore caution should be taken in the regular daily consumption of these noodles to prevent health problems associated with Cr contamination and bioaccumulation.

4. Conclusion

Except for the Zn concentration in sample C (58.66ppm) which was observed to be greater than the permissible range of WHO, all beneficial heavy metals (Fe and Zn) investigated in the noodle samples occurred within the threshold limit of WHO, (2003) standard, hence the consumption of these noodles could be regarded safe for users when Fe and Zn are only considered. The concentrations of Cd, Cr, and Pb in most of the noodle samples were above the tolerable limit of WHO, hence caution should be taken in the frequent intake of these noodles due to health issues that could be triggered as a result of bioaccumulation of these toxic heavy metals in the human body system. This knowledge should therefore guide consumers on their choice and consumption of these noodles. We therefore strongly recommend that manufacturers of these noodles be constantly regulated by government monitoring agencies such as NAFDAC and SON, to conform to various health standards so that wholesome noodles get to final consumers, and also manufacturers of these noodles should also look into their production process so as to ascertain the sources of these heavy metals and reduce them to acceptable limits.

Abbreviations

WHO = World Health Organization, FAO = Food and Agriculture Organization, NAFDAC = National Agency for Food and Drug Administration and Control, SON = Standard Organization of Nigeria, APHA = American Public Health Association.

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