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Heavy Metals Content of Selected Loaves of Bread Sold in Ewekoro Local Government Area of Ogun State, Nigeria.

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A B S T R A C T

Five different bread samples produced in Ewekoro Local Government Area of Ogun state,Nigeria were analyzed for some heavy metals using Atomic Absorption Spectrophotometer (AAS). The heavy metals determined were Pb, Cd, Cu, Zn and Fe. Results obtained were assessed on the basis of the permissible limits for the respective metals in Foods. The concentrations of Pb and Cd in the samples were in the range of 0.57-0.96mg/kg and 0.02-0.08mg/kg respectively. The levels of these metals in some of the samples suggest a certain degree of contamination. The values for Cu, Zn and Fe in the samples ranged as follows; Cu (0.18-0.036mg/kg), Zn (0.62-0.97mg/kg) and Fe (1.05-1.45mg/kg). All metals analysed were within the permissible limits of foods.

Keywords: Heavy metals, Bread, Lead, Cadmium

1. Introduction

2. Heavy metals are potential environmental contaminants with the capability of finding their way into the food we eat and causing human health problems. They are given special attention throughout the world due to their ubiquitous nature and toxic effects even at very low concentrations (Das 2006).. Several cases of human disease, disorders, malfunction and malformation of organs due to metal toxicity have been reported (Jarup2003).The major route for humans' exposure to heavy metals is through the food pathway (Hubbard and Lindsay1979).Contamination of bread by heavy metals could arise from flour which may have been produced from contaminated raw materials. Water used for bread making could also be a source of heavy metal contamination. Studies by (Ahmed and Fadel, 2012).revealed that the kind of baking fuel used for bread production could also be responsible for heavy metal contamination.

3. Bread is a kind of food made from flour, water and other ingredients, usually combined with a leavening agent, kneaded, shaped into loaves, and baked. It is an important staple food of many countries of the world especially the African countries and South East part of Asia (Pomeranz2010). In Nigeria, bread is consumed extensively in homes, restaurants and hotels. It is one of the most consumed food type with predominant consumption among the poor (Maziya-Dixon et al., 2004) Bread usually contains several ingredients that would help improve its quality.

Bread is one of the oldest prepared foods. Evidence from 30,000 years ago in Europe revealed starch residue on rocks used for pounding plants. It is possible that during this time, starch extract from the roots of plants, such as cattails and ferns, was spread on a flat rock, placed over a fire and cooked into a primitive form of flatbread. Around 10,000 BC, with the dawn of the Neolithic age and the spread of agriculture, grains became the mainstay of making bread. Yeast spores are ubiquitous, including on the surface of cereal grains, so any dough left to rest leavens naturally (McGee, Harold 2004).. Bread are consumed with every meal of the day, not to mention for snacks, for breakfast we may think of bagels, croissants. Biscuits, muffins, or scones, lunches may contain sand wishes made with ciabatta, pita, Cuban, pumpernical or rye. For our supper we commonly see basket containing rolls, bread stick, focaccia or naan.

Some bread loaves are known to contain additives and contaminants that are deleterious to human health. Two of such contaminants are potassium bromate and metals (Kurokawa et al., 2008). The objective of this research is to determine quantitatively five (5) heavy metals such as Fe, Pb, Cu, Mn and Cd in locally bread sample in order to focus on the daily intake of these metals in public health.

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2. Materials and Methods

Five major retail outlets were visited in Ewekoro Local Government Area of Ogun State, Nigeria. The bread samples were chosen randomly from different areas in Ewekoro local government area of Ogun State, Nigeria which were:

- SAMPLE AOS was obtained from Iyana-Egbado
- SAMPLE BOS was obtained from Wasinmialafia
- SAMPLE COS was obtained from Itori
- SAMPLE DOS was obtained from Abalabi
- SAMPLE EOS was obtained from Papalanto

The samples were tied up tightly in polythene bags to prevent cross contamination and were stored. They were transported to the laboratory, all other materials were gotten from The Department of Food Technology, The Federal Polytechnic Ilaro, Ogun State, Nigeria. all reagents and chemical used for the analysis were of analytical grade. All the glass ware were through washed, rinsed with deionized water before use

3. Method

3.1 Digestion Protocol

The milestone digestion procedure was used where 1g of each bread samples were weighed. The bread samples were left to oven-dry at 60^{o} for 24hours.The dried samples were then powdered in a mixer grinder taking care not to over-heat the sample.0.5g of the dried bread samples was then digested with HNO_3 and HCL in a ratio of 5:1 ratio until a transparent solution was obtained. The digests were filtered and diluted to 25ml, with distilled water.

3.1.1 Atomic Absorption Spectrophotometer Determination

Analysis of heavy metals of interest was performed using Atomic Absorption Spectrophotometer (Perkin Elmer Model 460) with the recommended Instrument Parameters including detection limits for each metal determined.

3.2 Analysis

3.2.1 Determination of Cadmium

Digestion of sample was carried out by the method of (Akagi and Nishimura 2005). 1g of each sample was weighed into a 50ml digestion tube and 1ml of H_2O, followed by 2ml of HCL,5ml HNO_2,$HCLO_4$ (1:1) and 2ml H_2SO_4 was added. It was heated at 200^{o}C till the solution was cleared, the sample were cooled and filtered into standard 50ml volumetric flask and made to the volumetric mark. A blank digestion solution was made for comparism. A standard for element was prepared and used for calibration. Metal measurement was performed by using atomic absorption spectrophotometer .Hollow cathode lamp of Cd was used at the specific wave length of the metal.

3.2.2 Determination of Copper

Digestion of sample was carried out by the method of (Akagi and Nishimura 2005).1g of each sample was weighed into a 50ml digestion tube and 1ml of H_2O, followed by 2ml of HCL,5ml HNO_2,$HCLO_4$ (1:1) and 2ml H_2SO_4 was added. It was heated at 200^{o}C till the solution was cleared, the sample were cooled and filtered into standard 50ml volumetric flask and made to the volumetric mark. A blank digestion solution was made for comparism. A standard for element was prepared and used for calibration. Metal measurement was performed by using atomic absorption spectrophotometer .Hollow cathode lamp of Cu was used at the specific wave length of the metal.

3.2.3 Determination of Lead

Digestion of sample was carried out by the method of (Akagi and Nishimura 2005).1g of each sample was weighed into a 50ml digestion tube and 1ml of H_2O, followed by 2ml of HCL,5ml HNO_2,$HCLO_4$ (1:1) and 2ml H_2SO_4 was added. It was heated at 200^{o}C till the solution was cleared, the sample were cooled and filtered into standard 50ml volumetric flask and made to the volumetric mark. A blank digestion solution was made for comparism. A standard for element was prepared and used for calibration. Metal measurement was performed by using atomic absorption spectrophotometer .Hollow cathode lamp of Pb was used at the specific wave length of the metal.

3.2.4 Determination of Zinc

Digestion of sample was carried out by the method of (Akagi and Nishimura 2005)1g of each sample was weighed into a 50ml digestion tube and 1ml of H_2O, followed by 2ml of HCL,5ml HNO_2,$HCLO_4$ (1:1) and 2ml H_2SO_4 was added. It was heated at 200^{o}C till the solution was cleared, the sample were cooled and filtered into standard 50ml volumetric flask and made to the volumetric mark. A blank digestion solution was made for comparism. A standard for element was prepared and used for calibration. Metal measurement was performed by using atomic absorption spectrophotometer .Hollow cathode lamp of Zn was used at the specific wave length of the metal.

3.2.5 Determination of Iron

Digestion of sample was carried out by the method of (Akagi and Nishimura 2005).1g of each sample was weighed into a 50ml digestion tube and 1ml of H_2O, followed by 2ml of HCL,5ml HNO_2,$HCLO_4$ (1:1) and 2ml H_2SO_4 was added. It was heated at 200^{o}C till the solution was cleared, the sample were cooled and filtered into standard 50ml volumetric flask and made to the volumetric mark. A blank digestion solution was made for comparism. A standard for element was prepared and used for calibration. Metal measurement was performed by using atomic absorption spectrophotometer .Hollow cathode lamp of Fe was used at the specific wave length of the metal.

4. Results

Table 1: Results for Heavy Metals in Bread(mg/kg)

SAMPLES	LEAD (Pb)	CADMIUM (Cd)	COPPER (Cu)	ZINC (Zn)	IRON (Fe)
AOS	0.96 ± 0.01^{e}	0.02 ± 0.00^{a}	0.25 ± 0.0^{b}	0.85 ± 0.02^{c}	1.05 ± 0.02^{a}
BOS	0.66 ± 0.02^{c}	0.04 ± 0.00^{b}	$0.18 \pm 0\ 0.0^{a}$	$0.83 \pm 0\ .02^{c}$	$1.06 \pm 0\ .00^{a}$
COS	0.62 ± 0.02^{b}	0.07 ± 0.00^{c}	0.32 ± 0.01^{c}	0.62 ± 0.02^{a}	1.06 ± 0.00^{a}
DOS	0.57 ± 0.02^{a}	0.08 ± 0.00^{d}	0.23 ± 0.00^{b}	0.97 ± 0.03^{d}	1.45 ± 0.04^{c}
EOS	0.93 ± 0.03^{e}	0.08 ± 0.00^{e}	$0\ .36 \pm 0.02^{d}$	0.72 ± 0.03^{e}	1.23 ± 0.03^{b}

Means along the same column with different super-script are significantly different from each other p is less or equals to 0.05. Values are in triplicate for quantitative analysis. Values are means + SD of three (3) determination.

5. Discussion

This shows the concentrations of the metals Pb, Cd, Cu, Zn and Fe in the bread samples analysed. Lead and cadmium are among the most abundant heavy metals and are particularly toxic. Excessive content of these metals in food is associated with a number of diseases, especially of the cardiovascular, renal, nervous and skeletal systems. These heavy metals are also implicated in carcinogenesis, mutagenesis and teratogenesis. The highest concentration of Pb was observed for sample AOS and EOS (0.96 and 0.93 mg kg-1) while the lowest was for samples DOS (0.57 mg/kg). Permissible level of Lead in food is in the range of 0.2-2.5 mg kg-1 (CAC 2003**)**.. All the bread samples analysed for Pb contents were within the acceptable limits, they may still have toxic potentials, with detrimental impact becoming apparent only after decades of exposure. The main sources of lead in the environment are: Industrial production processes and their emissions, road traffic with leaded petrol, smoke and dust emissions of coal and gas-fired power stations, the laying of lead sheets by roofers as well as the use of paints and anti-rust agents.

The level of Cd in the bread samples ranged from 0.02-0.08. Permissible limit for Cd in food is 0.05mg/kg (Walker 2003). Cd concentration was high in sample DOS (0.08mgkg-^{1}) while Cd concentration was low in sample AOS. These results are of concern as cadmium is highly toxic and is regarded as the most serious contaminant of modern age. High concentration of cadmium exerts detrimental effects on human health and causes severe diseases such as tubular growth, kidney damage, cancer, diarrhea and incurable vomiting (Sabine and Wendy2009)

Cu, Zn and Fe are nutritionally essential metals. They are referred to as trace elements and are commonly found naturally in foodstuffs. However, these metals are toxic when taken in excess of requirements. The concentration of Cu in the different bread brands ranged from 0.18-0.36 mg/kg. These concentrations are far below the permissible level of Cu in foods (10 mg/kg) (Salama, and Radwan2005). The samples can therefore be considered free from Cu contamination.

The average daily intake of zinc has been estimated to be maximally 20 mg/day for adults. In human, high levels of zinc has been associated with acute effects such as vomiting and gastrointestinal irritation (nausea, cramps, diarrhea). The highest Zn concentration in the bread samples analysed was observed for sample DOS (0.97 mg/kg) while the lowest was in sample COS (0.06mg/kg). These values are within the permissible level of Zn in foods (50mg/kg) (USDA 2003).

Iron is an essential trace element required by all forms of life. In man it is required for the synthesis of haem proteins and in many enzyme systems. Various groups (male, female, children, pregnant, lactating) differ in requirement for iron, iron deficiency is one of the most common nutritional deficiencies in children, women of child bearing age, and pregnant women. It rarely occurs in adult men, except in cases of chronic bleeding. The concentrations of Fe in the bread samples studied ranged from 1.05-1.45 mg kg-^{1}. The permissible limit for Fe in food is in the range of 2.5-5.0 mg/kg depending on the foodstuff (CAC 2003**).** However, in human, acute toxicity of iron ingested from normal dietary sources has not been reported.

Metal containers used for kneading of dough during bread making may be responsible for high levels of such metals. Atmospheric deposition from urban and industrial areas may result in contamination of agricultural produce with heavy metals which are in turn transferred to the finished products.

6. Conclusion

In conclusion, the present study provides useful guides for bread choices, bread preparation and marketing taking into consideration the heavy metal toxicity effects. In general, the possible source of heavy metals contamination are metal surface in contact with the material and those present in air and in the environment due to industrial processes. Results of the heavy metal analysis showed that the levels of Cu and Zn are generally within safe limits. However, the concentrations of Fe and Cd in some of the samples were above permissible levels. All the samples contained traces of lead; the content was notably high in one of the bread samples.

There is need for relevant regulatory bodies in Nigeria to establish stricter conditions regarding bread production and carry out regular monitoring of bakeries to ensure that the bakers do not flout the laws and that the environment and indeed the materials used by these bakeries are devoid of contamination of any kind so as to safeguard the health of the consumers.

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