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Comparative analysis of the level of lead and cadmium contamination of food during processing with atlas machine and a local grinding stone

[1]Wyasu G. , [1]Onoja E., and [2]Omeiza, F.S.

[1]Department of Science Laboratory Technology, Federal Polytechnic, Kaura-Namoda Zamfar A State- Nigeria
[2]Department of Chemistry, Ahmadu Bello University, Zaria Nigeria

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ABSTRACT

The following food samples; maize, Sorghum, Soya-beans, Beans and Millet were analyzed to determine the level of lead (Pb) and cadmium (Cd) after the food samples were processed with milling engine and the local grinding stone. The food samples were digested with concentrated solution of HNO_3, H_2SO_4 and $HCIO_4$. Atomic absorption spectrophometry (AAS) analysis of the digested food samples were carried out to determine the trace metal (lead and cadmium). On comparison of the results obtained from the samples processed by the milling engine, and that processed by the local grinding stone, it was found out that the food samples processed by the milling engine had 0.250ppm of Pb and 0.030ppm of Cd: 0.210ppm of Pb and 0.030ppm of Cd: 0.188ppm of Pb and 0.028ppm of Cd: 0.225ppm of Pb and 0.026ppm of Cd: 0.200ppm of Pb and .031ppm for maize, sorghum soybeans, beans and millet respectively; while the level of contamination from local grinding stone are 0.130ppm of Pb and 0.021ppm of Cd: 0.120ppm of Pb and 0.019ppm of Cd: 0.138ppm of Pb and 0.027ppm of Cd: 0.147ppm of Pb and 0.024ppm of Cd: 0.156ppm Pb and 0.026ppm of Cd for maize, sorghum soybeans, beans and millet respectively.

Key Words: Heavy metals, grinding stone, Atlas machine, Food samples.

INTRODUCTION

Food processing is vital and important as the food itself. Food processing involved the mechanic breaking down of food samples into finely powder before cooking and consumption(1).

During processing of food samples some toxic contaminants were introduced into the food stuff. The contaminants include lead, cadmium and e.t.c. The contaminant can be introduce into the

food sample as result of the type of plate (whether an alloy or not). The plate rubs each other and toxic metals were introduced into the food samples (2).

According to the world health organization(3), which was recorded in the journal of ministry of Agriculture, fisheries and food (MAFF LONDON), the daily intake of lead via food is 200-300µg, and the provision tolerable weekly intake of cadmium is 0.3-0.4mg.

Effect of lead and cadmium

It has been confirmed, that children are known to be especially susceptible to lead (Pb) poisoning, suffering from mental retardation, disturbed behaviour and serious damage to the brain.(4)

The ingestion of cadmium (Cd) in food or in drinks can cause symptoms such as nausea, vomiting, abdominal craps and headache within minutes of ingestion. In severe cases, diarrhea and shock can also develop(5)

According to (6) which was recorded in the 126th journal of the Association of official Analytical chemist; he reported that the average level of cadmium in shredded wheat obtained in the laboratory ranged between 0.18-1.69 ppm.

Similarly in the 125th journal edition of 2003, of the association of official analytical chemist, the AAS result of lead (pb) in flour and corn meal grounded by the wailey mill ranged from the average of 3.20-5.707µg/g and 2.24-3.60µg/g respectively (7).

MATERIALS AND METHODS

Samples used during the study

Sample used include the following;
Maize Sorghum, Soya beans, Beans and millet.

Sampling: The food sample were obtained from Ahmadu Bello University farm, Shika Zaria.

Grinding of sample

Before the food stuff were subjected to analysis, 100g of each sample was milled into fine powder. Milling was done in two ways:

i. Using the Atlas machine
ii. Using the local grinding stone.

Drying of samples

The samples were dried to maintain the moisture content and also to constant weight in an oven maintained at 70^{0}C. The sample were then kept in a dessicator.

Preparations of samples for analysis

Materials: weighing balance, 50ml kjeldahls flask, measuring cylinder, thermometer (0-300^{0}c) heating mantle, distilled water, fumed cupboard and concentrated solution of H_2SO_4, $HCIO_4$ and HNO_3. (8)

Destruction of organic matter

Procedure: Generally, however metals present in food stuff after processing cannot be estimated, unless the organic matrices of the food is first remove. This can be achieve by wet digestion using oxidizing acid. The wet digestion was carried out in a Kjeldahl flask, preferably with some reflux of the acid. Oxidizing acids used include HNO_3, H_2SO_4, and $HClO_4$. They are usually mixed in ratio of 3:1:1 respectively together with the samples solution. Heat was applied gently by the heating mantle at moderate temperature until foaming ceases. Heating is continued until the solution turned cleared and colourless. The solution is allowed to cool. After cooling, 5ml of distilled water was added to the digested solution and was heated for about ten (10) minute after which the solution was allowed to cool down.

The digested sample was transferred into a 50ml volumetric flask and was made up to the mark and stored in sample bottles ready for the atomic absorption spectrophotometry (AAS)analysis. (8)

Analyses of lead and cadmium by AAS

Atomic absorption spectrophotometry is the current method of choice for determination of lead and cadmium metals present in food (8).

The AAS machine used is computerized and the wavelength of choice (a monochromator of each) was use. The hollow cathode lamp of each was allow to stabilizes before aspiration of the sample.

The wavelength for cadmium is 229nm and that of lead is 283.3nm.

RESULTS AND DISCUSSION

The following tables show the results obtained from AAS analysis of the food samples used.

Table 1: Standard solution readings

Concentration (ppm)	ABSORBANCE	
	Lead (Pb)	Cadmium (Cd)
0.1	0.0013	0.0066
0.2	0.0026	0.013.2
0.3	0.0039	0.0198
0.4	0.0052	0.0264
0.5	0.0065	0.0330

See appendix II foe standard calibration curves for the values shown on the table above.

Table 2: Concentration of lead contamination using machine

Sample	Pb (ppm) before milling	Pb (ppm) after milling	Level of Pb contamination (ppm)
Maize	0.120	0.370	0.250
Sorghum	0.110	0.320	0.210
Soya beans	0.092	0.280	0.188
Beans	0.115	0.340	0.225
millet	0.110	0.310	0.200

Table 3: Concentration of cadmium contamination using machine

Sample	Cd (ppm) before milling	Cd (ppm) after milling	Level of Cd contamination (ppm)
Maize	0.030	0.060	0.030
Sorghum	0.030	0.060	0.030
Soya beans	0.025	0.053	0.028
Beans	0.024	0.050	0.026
millet	0.031	0.062	0.031

Table 4: Concentration of lead contamination using grinding stone

Sample	Pb (ppm) before milling	Pb (ppm) after milling	Level of Pb contamination (ppm)
Maize	0.120	0.250	0.130
Sorghum	0.110	0.230	0.120
Soya beans	0.122	0.260	0.138
Beans	0.123	0.270	0.147
millet	0.124	0.280	0.156

Table 5: Concentration of cadmium contamination using grinding stone

Sample	Cd (ppm) before milling	Cd (ppm) after milling	Level of Cd contamination (ppm)
Maize	0.020	0.041	0.021
Sorghum	0.021	0.040	0.019
Soya beans	0.024	0.051	0.027
Beans	0.025	0.049	0.024
millet	0.026	0.052	0.026

DISCUSSION

With respect to the results obtained from tables 2 and 3, the concentration of lead and cadmium is higher in all the food samples milled with atlas machine compared to the results obtained from tables 4 and 5 when milled with a local grinding stone. These results showed that more metals were introduced into the food samples as a result of the plate rubbing each other frequently (plate are made up of metals).

The analysis or comparative results are as follows:

MAIZE: The concentrations of lead and cadmium in maize sample milled by atlas machine were found to be 0.250 ppm and 0.030 Ppm respectively. Milling using the local grinding stone, the concentration of lead and cadmium was found to be 0.130 ppm and 0.021ppm respectively.
SORGHUM; Milling using atlas machine gave the concentration of lead and cadmium to be 0.210ppm and 0.030ppm ,while milling using a local grinding stone gave 0.120ppm and 0.019 ppm respectively.

SOYA BEANS; The concentration of lead and cadmium was found to be 0.188ppm and 0.028ppm when milling with engine respectively. On the other hand, the concentration of lead and cadmium was found to be 0.138 ppm and 0.027 ppm when using a local grinding stone respectively.

BEANS: The level of lead and cadmium obtained was 0.225ppm and 0.026 ppm respectively, when milling with Atlas machine. Moreover, Milling with local grinding stone produce a concentration of 0.147 Ppm for lead and 0.024 Ppm of cadmium.

MILLET: The concentration of lead and cadmium was found to be 0.200 ppm and 0.031 ppm respectively when milling with engine. Milling using a local grinding stone gave the concentration of lead and cadmium to be 0.156ppm and 0.026 ppm respectively. It was noticed that the various samples contained lead and cadmium in trace quantities which are harmful when compared with world health organization (WHO) standard as in appendix 1.

CONCLUSION

From the analysis, we realized that during food processing, some toxic metals (cadmium and lead) were introduced into the food which is higher when the atlas machine was used compared to when using local grinding stone. Hence, the manufacturers of atlas grinding machine should look inward towards the type of plate produced, by ensuring that they are free from toxic metals.

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Appendix 1: Tolerance limits of some toxic metals according to world health organization (9)

METAL	UPPER LIMIT OF CONCENTRATION (mg/L)
Lead	0.05
Mercury	0.001
Cadmium	0.01
Arsenic	0.05
Chromium	0.05

Appendix II: Standard Calibration Curves