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DETERMINATION OF LEAD AND IRON CONTENT IN GROUND PEPPER (*Capsicum annum)* IN OTA OGUN STATE

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ABSTRACT

The concentration of heavy metals (Lead and Iron) released into pepper (*Capsicum annum)* that is used as a spice in food preparation, ground using a machine was determined using an Atomic Absorption Spectrophotometer (AAS). The wet and dry samples were ground using grinding plates, while the control samples were milled with a blender. The maximum and minimum concentrations of lead (Pb)in mg/kg in the wet samples were (2.40 mg/kg and 0.40 mg/kg) and (13.0 mg/kg and 2.0 mg/kg) in the dry samples respectively. The concentration of Iron (Fe) obtained in this study was between 45.98 mg/kg and 0.60mg/kg for the wet samples and (58.15mg/kg and 16.4mg/kg) for the dry samples. The iron content in the control was 0.62 mg/kg and 3.71 mg/kg in the wet and dry samples respectively.
The result of this research shows that the concentration of Lead and Iron is above and within the permissible limit recommended by the World Health Organization (WHO) respectively. The level of lead in the samples poses a high risk of health danger to consumers.

Keywords: Heavy metal, Atomic Absorption Spectroscopy, contaminants, grinder, toxicity

1.0 INTRODUCTION

Pepper is one of the most important spices in making most Nigerian food. There is hardly a complete meal without using at least one variety of pepper. A food grinding machine is a unit operation designed to break solid materials into smaller pieces, usually pulverized into fine powder. It is a machine used to process cereals, legumes, nuts and spices into flour. It is an indispensable tool in the flour industry. It can be found in cities, towns and villages across Nigeria due to the dependence on spices for the preparation of many dishes. It has a pair of circular grinding plates which is made of cast iron (Kwofie *et al.*, 2006). Pepper belongs to the Family *Solanaceae*, which is an important group of vegetables. The use of food grinding machines is a common practice in food preparation and processing in Nigeria and many other developing nations. Wearing of this grinding plate introduces heavy metals such as Lead, Iron, Nickel, Zinc, Arsenic, Copper, Cadmium and Mercury into the food during the milling process is inevitable. This research aims to determine the concentrations of lead (Pb) and iron (Fe) in-ground wet and dried pepper from three local markets in Ota, Ogun State.

Materials and Methods

Sampling and Sample Pre-Treatment

A basket of pepper *Capsicum annum* was bought from Ota market in Sango Ota, Ogun State. It was washed with de-ionized water and divided into two parts. One part was dried. Three markets were selected for this research work and this includes Ota market, Sango market and Oju Ore market in which ten different milling points were selected in each market. Both the dried and wet samples were ground at these points in each market and transferred into a small air-tight plastic container for further analysis.

Apparatus, Reagents and Solvent

The glassware was washed with detergent and rinsed with distilled-deionized water. They were then soaked for hours in a 10% nitric acid solution and dried before use. Analytical-grade reagents were used.

Digestion of Samples

The samples were digested in duplicate according to (Bamgbose *et al*, 2000), 5g of pepper sample was weighed into a 250ml conical flask and 10ml of Conc. HNO_3 was added and heated to dryness on a hot plate in a fume cupboard. After which 5ml of aqua-regia (HNO_3 3: 1 HCl) was added and heated to dryness. The digested sample was allowed to cool at room temperature, 10ml of 1M HNO_3 was used to dissolve and filtered with Whatman filter paper and made up to 50ml in a 50ml volumetric flask with de-ionized water and stored for elemental analysis.

Conversion of Result from AAS Analysis

The final concentration of metals was calculated from the AAS reading by using the formula.

$$C_T = \frac{C_m \times V}{M}$$

Where

C_T denotes the final concentration of total metal

C_m denotes the concentration of analysis generated by AAS

V (Nominal Volume) denotes the final volume of 50ml solution prepared

M denotes the mass of the weighed sample for digestion

Result

Table 1.0 shows the concentrations of Lead (Pb) in (mg/kg) in wet and dry samples from the different locations.

Table 1.0: Concentration of Lead (Pb) (mg/kg) in Wet and Dry Samples from different locations

S/N	SW	SD	OW	OD	OO W	OOD
1	1.2	7.0	0.9	12.5	1.65	13
2	0.8	5.0	0.4	8.0	1.5	10.5
3	1.6	6.0	0.5	10.5	1.3	6.5
4	0.5	9.0	1.2	12.0	1.25	9.0
5	1.2	3.0	0.6	13.0	1.6	10.0
6	1.3	2.0	0.9	8.5	1.05	9.5
7	1.2	2.0	2.0	9.5	1.6	11.5
8	0.45	4.0	1.0	5.5	0.95	12.5
9	0.9	2.5	1.8	9.0	1.35	9.5
10	0.8	2.5	2.0	13	2.4	6.0

Key	Meaning (Sample)
SW	Sango Wet
SD	Sango Dry
OW	Ota Wet
OD	Ota Dry
OOW	Oju Ore Wet
OOD	Oju Ore Dry

Results for the concentration of Iron (Fe) in (mg/kg) in both wet and dry samples from the different locations are shown in Table 2 below

Table 2: Concentration of Iron (Fe) in (mg/kg) in both wet and dry samples from the different locations

S/N	S W	SD	OW	OD	OOW	OOD
1	2.55	8.35	1.56	8.85	0.59	43
2	5.0	2.75	1.03	5.4	0.97	9.4
3	17.9	3.7	0.86	4.3	0.5	7.95
4	5.64	16.4	1.72	48.7	0.6	58.1
5	30.0	3.0	4.08	20.7	6.49	56.35
6	45.98	2.9	1.12	43.6	0.9	8.15
7	6.91	4.55	0.72	15.7	3.0	6.35
8	6.23	4.45	1.09	13.15	6.39	58.15
9	0.65	0.45	1.76	8.4	1.11	52.0
10	1.2	7.95	1.47	47.9	2.18	58.15

The mean concentration of Lead (Pb) in (mg/kg) with their Standard deviation from the different locations are given in Table 3.0

Table 3.0: Mean Concentration of Pb (mg/kg)

Samples	N	Range	Minimum	Maximum	Std. Deviation
SW	10	1.15	0.45	1.6	0.36701
SD	10	7	2	9	2.39444
OW	10	1.6	0.4	2	0.60562
OD	10	7.5	5.5	13	2.49499
OOW	10	1.45	0.95	2.4	0.40418
OOD	10	7	6	13	2.28765

Table 4.0 below shows the mean concentration of Iron (Fe) in (mg/kg) and their Standard deviation.

Sample	N	Range	Minimum	Maximum	Std. Deviation
SW	10	45.33	0.65	45.98	14.89385
SD	10	15.95	0.45	16.4	4.52438
OW	10	3.36	0.72	4.08	0.96099
OD	10	44.4	4.3	48.7	17.99878
OOW	10	5.99	0.5	6.49	2.33287
OOD	10	51.8	6.35	58.15	24.3523

The result of the statistical analysis of T-test with 95% confidence Interval level, standard deviation, standard error and mean.

Table 5.0: The T-test analysis for significance difference

Samples Test

Paired Samples Test									
		Paired Differences					**T**	**df**	**Sig. (2-tailed)**
		Mean	**Std. Deviation**	**Std. Error Mean**	**95% Confidence Interval of the Difference**				
					Lower	Upper			
Pair 1	DPb–WPb	6.88667	3.53324	0.6451	5.56733	8.206	10.676	29	0
Pair 2	DFe–Wfe	15.620	25.46141	4.6486	6.11255	25.12745	3.36	29	0.002

The value of P is greater than 0.05 (P>0.05) indicating there is a significant difference between the results for the concentration of lead and iron in both dry and wet samples.

Key	**Meaning**
DPb	Lead in Dry Sample
WPb	Lead in Wet Sample
DFe	Iron in Dry Sample
WFe	Iron in Wet Sample

The bar chart below shows the mean concentration of Lead (Pb) in (mg/kg) for the different locations.

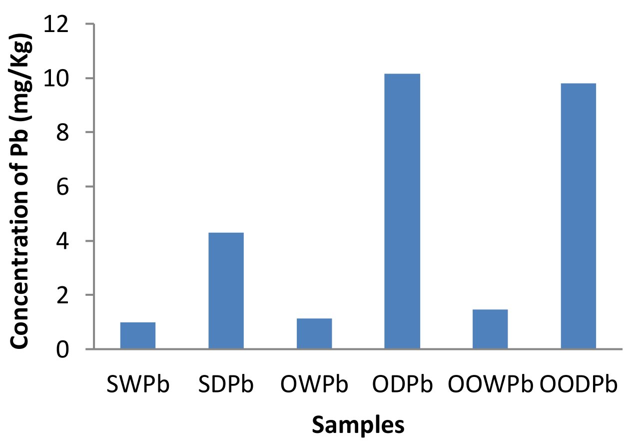

Figure 1.0: Mean Concentration of Pb (mg/kg)

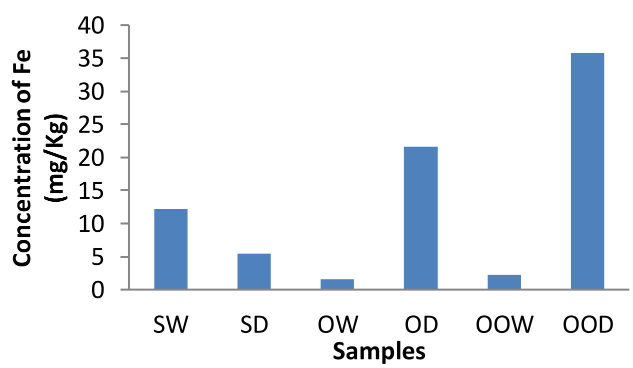

Figure 2.0: Mean Concentration of Fe (mg/kg)

Discussion

The mean result obtained for lead (Pb) showed that the Ota dry sample had the highest concentration of 10.15mg/kg while the Sango wet had the lowest value of 0.995mg/kg.

Generally, the concentrations of lead in all the samples are above the World Health Organization (WHO) standard and the EC regulation for lead (0.2 mg/kg). The concentration of lead in this study is relatively Lead was detected at a higher concentration, this concentration was relatively lower than the study (Oluwafemi O. *et al,* 2017) reported (34.85 – 150.22 mg/kg) in soup condiments. Lead was not detected in the sample ground using a blender which served as a control. Higher concentrations of lead may cause brain complications; coma and death may occur if not treated instantly (EPA, 2013).

The mean result obtained for Iron (Fe) revealed that the Oju Ore dry sample has the highest value of 35.76mg/kg while Ota wet has the lowest value of 1.54mg/kg. Control values were 3.71mg/kg and 0.62mg/kg for wet and dry samples respectively.

The difference in the concentration of Fe in the wet and dry samples is due to the lower concentration of wet samples than that of dry samples. That is the higher the concentration of the sample, the higher the concentration of the respective element. Also, the difference between the concentration of the control sample and the ground samples obtained using a metallic grinding plate can be attributed to the fact that Iron (Fe) has the highest percentage concentration of the alloy used for the grinding plate.

The concentration of Iron (Fe) metal in all the samples is within the limit of 425.5 mg/kg proposed by (FAO/WHO, 2001.) The concentration of Iron obtained in the present study is relatively higher compared to the concentration of 0.05 mg/kg reported by (Kwofie *et al,* 2011) for corn flour and lower than the concentration of (83.65-168.74 mg/kg) reported by(Oluwafemi O. *et al*, 2017) in soup condiments. Iron is an essential element in humans as it helps in oxygen transport and regulates cell growth and differentiation (Andrews, 1999). Deficiency of iron will, therefore, limit oxygen delivery to cells resulting in fatigue, poor work performance, and decreased immunity (Bhaskaram, 2001). Nevertheless, excess iron intake can result in iron overload and toxicity, arrhythmia, heart failure, increased atherosclerosis risk, and increases in the risk of liver, breast, gastrointestinal, and hematologic cancers (Araujo *et al*., 1995; Nelson *et al*, 1995; Sahinbegovie *et al*., 2010; Kallianpur*et al*., 2004; Dongiovanni *et al*., 2011; Kremastinos *et al*., 2011).

Conclusion

Grinding plates usually contaminate milled products with heavy metals such as arsenic, Cadmium, Copper, Iron, Lead and Zinc. Cadmium and lead are toxic metals and non-essential to the human body. They are not required by the body in any amount (ATSDR, 2011). Ingestion of these metals can have adverse health effects on human metabolism leading to serious health consequences (ATSDR, 2011). It is important to know their concentration introduced to milled products and the health implications by comparing with Standard references.

This study has been able to evaluate the concentration of Lead (Pb) and Iron (Fe) in *Capsicum annum*(pepper) in both wet and dry samples from three different locations (Sango, Ota and Oju Ore). The use of a metallic plate grinding machine in processing pepper to slurry form is efficient and faster. However, this advantage can lead to a problem as the grinder ages, leading to a rapid release of heavy metals into this spice, which might constitute health risks to the consumer. The result obtained from this study shows that lead (Pb) was not detected in the control samples when a portable blender was used to mill but detected in ground samples and the concentration of iron metal was within the permissive limit in both wet and dry samples according to the proposed value of 425.5 mg/kg by FAO/WHO (2001).

Recommendation

It is much safer to use a Blender for milling food products than a metallic grinding machine which introduces heavy metals into the food and poses a health risk to the end user or consumers.

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