

DETERMINATION OF LEAD CONCENTRATIONS IN SOME COMMON SPICES IN SOUTH-EASTERN NIGERIAN

¹VERONICA OBIAGELI EZIGBO AND ¹JULIANA CHINEZE OBI

¹Department of Pure and Industrial Chemistry, Chukwuemeka Odumegwu Ojukwu University, Uli, Anambra State, Nigeria.

ABSTRACT

The levels of Lead (Pb) were determined in fifty different samples of common spices purchased from three major markets in southeastern Nigeria using atomic absorption spectrometer. Two grams of the dried ground samples were digested using HNO₃/HClO₄ (2:1 equivalent) mixture and analyzed. Results show that range of detectable values µg/g of the common food spices and processed samples for Pb were 1.50 – 49.90 µg/g and 2.20 – 27.90 µg/g respectively. One way analysis of variance showed that the mean concentration of Pb in each selected common spice were all the same since $P > 0.05$. The mean concentrations of Pb in the various spices were also found to be the same with respect to location since $P > 0.05$. The mean concentration of Pb in each processed food spices are the same at $P > 0.05$ while the mean concentration of Pb in the various processed food spices are the same with respect to location at $P > 0.05$. The daily human intakes of lead was computed and it was observed that only 10% of the analyzed sample were below recommended values by FAO/WHO, while the rest exceeded the recommended limits for metals in common spices.

Key words:Lead, Atomic Absorption spectrophotometer, Processed food spices, common food spices.

1. INTRODUCTION

Food spices are used as diet components often to improve colour, aroma, palatability and acceptability of food. Most natural spices consists of rhizomes, barks, leaves, fruits, seeds and/or other parts of plants [Sharma, 2004]. The addition of spices that may be contaminated with trace heavy metals to food as a habit may result in accumulation of these metals in human organs and lead to different health hazards

Heavy metals are those with atomic weights from 63.546 to 200.590 [Kjennish, 1992], and specific gravity higher than 4 [Connell et al., 1992]. These metals may contaminate plants, vegetables, fruits and canned foods through air, water and soil during cultivation [Husain et al, 1995; Ozores et al, 1997; Geer et al., 1989] and also during industrial processing and packaging [Tsoumbari et al, 1994]. At present, there is virtually no information about the safety of these spices with respect to heavy metals contamination in Southeastern Nigeria, hence the present research was taken up to determine the dry matter levels of Lead in fifty selected commonly food spices sold in three major markets in Southeastern Nigeria

2. EXPERIMENTAL

Fresh vegetables and other spices of plant origin were purchased from Onitsha, Enugu and Nnewi markets in Southeastern Nigeria. They were identified and classified according to their common and botanical names by the Department of Crop Science, University of Nigeria Nsukka.

Analyses

Reasonable quantities of fresh leafy and non-leafy spices were washed with tap water and left to dry. The samples were placed in the watch glass and dried in an oven at 105°C for six hours.

Data Analysis

Daily intake of heavy metals from common spices

The daily intake of heavy metals through the consumption of common spices tested was calculated according to the following equation [Qui et al, 2004].

Vegetables-Containing Spices		Concentration of Lead
Botanical names	Common name	Pb
<i>Solanum anomalum</i>	Buba anara	16.39 ± 1.4
<i>Pisum sativum</i>	Akidi	1.24 ± 9.0
<i>Musa sapientum</i>	Banana	3.59 ± 2.0
<i>Doncas carota</i>	Carrot	12.10 ± 15.3
<i>Cucumis sativus</i>	Cucumber	1.68 ± 0.6
<i>Solonum mologena</i>	Garden egg	5.82 ± 2.0
<i>Phaseohus vulgari</i>	Green bearu (pas)	3.83 ± 1.33
<i>Amaranthus hybridus</i>	Green vegetable	6.84 ± 8.2
<i>Lpomea batata</i>	Irish potatoes	5.34 ± 2.5
<i>Abelmosihus macnzphylla</i>	Okro	2.86 ± 2.3
<i>Allium cepa</i>	Ordinary onion	12.08 ± 15.6
<i>Carica papaya</i>	Pawpaw	2.52 ± 0.97
<i>Aranos conosus</i>	Pineapple	1.79 ± 1.0
<i>Musa paradisaca</i>	Plantain	2.97 ± 1.85
<i>Citrus cinensis</i>	Sweet orange	2.34 ± 2.3
<i>Solanum tuberosum</i>	Sweet potatoes	3.37 ± 1.3
<i>Lycopersicon esculenton</i>	Tomatoes	3.81 ± 2.2
<i>Pentaclethra macrophyll</i>	Ukpaka	3.80 ± 1.8
<i>Gongronema letifolium</i>	Utazi	2.43 ± 1.1
<i>Citraillus valgaris</i>	Water melon	3.63 ± 1.6
<i>Allium cepa</i>	White onions	1.22 ± 0.97
<i>Ocilimum gratisimum</i>	Curry leaves	5.45 ± 3.7
<i>Monodova mycistica</i>	Efu	4.74 ± 3.0
<i>Mandora mynstica</i>	Ehulu	4.74 ± 3.0
<i>Allium sativum</i>	Garlic	3.52 ± 1.83
<i>Zingber officinule</i>	Ginger	4.21 ± 1.90
Vegetables-Containing Spices		Concentration of Lead
Botanical names	Common name	Pb
<i>Pipeguineense</i>	Mkpulu uziza	4.31 ± 1.6
<i>Myristica fraginace</i>	Nut meg	1.46 ± 0.7
<i>Piper nigium</i>	Red pepper	1.74 ± 0.6
<i>Ocimum americanus</i>	Scent leaves	6.95 ± 5.2
<i>Thymus vulgaria</i>	Thyme	4.58 ± 2.8
<i>Xylophia aethiopica</i>	Uda	5.19 ± 2.3

Daily intake of metals (DIM) = DSC x VMC

DSC = daily spice consumption; VMC = mean vegetable metal concentrations (mg/day, dry weight). Where daily vegetable consumption was taken as 98g of vegetables per person per day as set by the FAO/WHO [1999], for heavy metal intake based on body weight for an average adult (60 kg body weight).

3. RESULTS AND DISCUSSION

The permissible concentrations of lead in the food spices for the various vegetables are presented in Table 1.

Table 1: Mean concentration (n-3) of Lead in the food spices (fruits, vegetables and other natural spices (dry weight $\mu\text{g/g}$)

Range: 1.50 – 49 – 94; WHO FAO 2001 $\mu\text{g/g}$: 10.00; P-value: $P>0.05$.

Lead was detected in 99.32% of the fruits, vegetables and other natural spices with a range from 0.08 $\mu\text{g/g}$ in red pepper from Onitsha samples to 125.77 $\mu\text{g/g}$ in Onyesibelu from the same Onitsha samples. The concentration of Pb in fruits, vegetables and other national spices were below the permissible limits of 35 – 30 $\mu\text{g/g}$ set by WHO/FAO [2001] but 2.5% exceeded this limit. Pb is a toxic element that can be harmful to plants, although plants usually show ability to accumulate large amounts of lead without visible changes in their appearance or yield. In many plants, lead can exceed several hundred times the threshold of maximum level permissible for human consumption. The high levels of Pb in some plants may probably be attributed to pollutants in irrigation water, farm soil or due to pollutants from the highways traffic [Qui et al, 2000].

The mean lead concentration are the same in each selected food spices and in the various spices with respect to location at $P>0.05$. The mean lead concentration of this study for fruits and vegetables and other natural spices is higher than 0.3 – 0.7 mg/kg reported by Ladipo et al [2011]. Lead is a serious cumulative body poison which enters into the body system through air, water and food and cannot be removed by washing fruits and vegetable spices [Divrikli et al, 2003]. The high level of lead may be due to the way these food spices were packaged in sacks, in such a way that they were exposed to atmospheric lead. In addition, these food spices were transported from the northern states and were probably contaminated with lead. Lead pollution has been shown to be commensurate with population / vehicular density [Afolami et al, 2010].

The concentrations of lead in fruits, vegetables and other natural spices from different locations in the South-Eastern Nigeria are presentable in Table 2.

Table 2: Mean Concentration of Lead ($\mu\text{g/g}$ dry weight) in fruits, vegetable and other natural spices from each market.

	Enugu		Nnewi		Onitsha	
Metal	Fruits and vegetables	Other natural spices	Fruits and vegetables	Other natural spices	Fruits and vegetables	Other natural spices
Pb	6.35 ± 4.4	5.79 ± 2.85	7.78 ± 3.1	3.04 ± 2.5	1.94 ± 0.63	3.03 ± 0.20

One way analyses of variance showed the mean concentration of lead in each selected common spices were all the same at $P > 0.05$. The mean concentrations of lead in the various spices were also the same with respect to location at $P > 0.05$.

Table 3: Mean concentration of Lead ($\mu\text{g/g}$) (dry weight) in processed spices.

Common Name	Concentrations of Pb
Benny	11.21 ± 9.20
Fried rice seasoning	8.36 ± 7.20
Maggi star	27.89 ± 28.90
Mixed spices	3.47 ± 3.80
Nut meg	3.10 ± 1.04
Onga	12.06 ± 2.27
Pepper	10.91 ± 4.22
Eshallot	2.23 ± 2.30
Steak seasoning	3.62 ± 1.39
White maggi	5.90 ± 6.60
Range	$2.20 - 27.90$
WHO 1996.FAO 2001 $\mu\text{g/g}$	$5 \mu\text{g/g} - 30 \mu\text{g/g}$
P-value	$P > 0.05$

Lead was detected in all the processed spice samples with a range from $0.12 \mu\text{g/g}$ in eshallot from Onitsha samples to $60.24 \mu\text{g/g}$ in Maggi star from Enugu samples. The concentration of lead in processed samples were below the permissible limit of $5 - 30 \mu\text{g/g}$ set by WHO [1996] and FAO [2001] but 3.3% of the processed samples exceeded this limits as illustrated in Table 4.

Table 4: Mean Concentration of Lead $\mu\text{g/g}$ in processed spices from each market.

Metal	Enugu	Onitsha	Nnewi
Pb	13.15 ± 16.70	3.49 ± 2.37	10.92 ± 8.45

One way analysis of variance showed that the mean concentration of lead in each selected common spices are the same at $P > 0.05$, there is no significance difference. The mean concentrations of lead in the various spices are the same with respect to location at $P > 0.05$.

Also, 75% of our estimated daily intakes of lead in the fruits, vegetables and other natural spices studied were above WHO/FAO PTDI limit while just 10% is below the limit as shown in Table 5

Table 5: Estimation of Lead intake through consumption of vegetables in South-Eastern Nigeria.

Heavy metal	Mean conc $\mu\text{g/g}$	Daily intake $\mu\text{g/dry}$	WHO/FAO limit $\mu\text{g/b}$
Pb	2.32	227.36	214

Source: b = Shuaibu *et al.*, in (2012)

Validation of Method Used

This method has been used and published by Prof P. Okoye my supervisor.

4. CONCLUSION

The results reported here confirmed that the food spices obtained from the three major markets in South-Eastern Nigeria contained reduced or trace amount of lead. The levels of lead obtained did not appear to pose any serious health hazard of concern.

5. RECOMMENDATIONS

We recommend that people living in contaminated areas should not eat large quantities of vegetables to avoid excess accumulation of heavy metals in the body. Regular monitoring of these toxic heavy metals from fruits and vegetables and other natural spices is essential to prevent their excessive build up in the food chain and as the spice samples are transported from different locations.

REFERENCES

- Afolami, F., Anyakaola, C., Ebuehi, O. and Bolawa, O. (2010): Lead levels in some edible vegetables in Lagos, Nigerian. *Sci. Research and Essays*, **5**, 813-818.
- Divrikli, U., Saracoglu, S., Soylu, M. and Eki, L. (2003): Determination of trace heavy metal contents of green vegetables samples from Keyseri, Turkey by flame atomic absorption spectrometry. *Frasenium Environ. Bull.*, **12**, 1123-1125.
- Geart, E.W., Van, L.J. and Kars, T. (1989): Heavy metals in vegetables grown in Netherlands and in Domestic and imported fruits, *Zlebensm Unters Forsch*, **190**, 34-39.
- Husain, A. Z. Baroon, S. Al-Khalafaw, T. Al-Ati and W. Sawaya (1995): Heavy metals in fruits and vegetables grown in kuwart during the oil well fines. *Arab Gulf J. Sci. Research*, **13** (3) 535 – 542.
- Kennish, M. J. (1992): Ecology of Estuaries. Anthropogenic effects. CRC. Press, Inc. Boca Raton, F. I. Nitrates and N-nitrosone compounds. Geneva, World Health Organization, 1978. (Environmental Health Criteria 5).
- Ladipo, M.K., Doherty, V.F. and Oyejadejo, S.A. (2011): Acute toxicity, behavioural changes and histopathological effect of paraquat dichloride on tissue of catfish (*Claarias gariepinus*). *International Journal of Biology*, **3**(2), 67-74.
- Ozores-Hampton M. E. Hanlon, H. Bryan and B. Schaffer. (1997): Cadmium, Copper, Lead, Nickel and Zinc concentrations in tomato and squash grown in MSW compost-amended calcareous soil. *Compost Sci. and Utilization*, **5** (4) 40 – 45.
- Qui Huang, D.F., Cai, S.X., Chen, F.R. and Cai, Y.C. (2000): Investigation on vegetables pollution and pollution source and its control in Fuzhou, Fujian province. *Fujian J. Agric. Sci.*, **15**, 16-21
- Sharma, R. K. Agrawal, M. and Marshal F. I. (2004): Heavy metal contamination of soil and vegetable in suburban area of varansi, India, *Ecotoxicity and environmental safety*, **66**, 258 – 266.
- Tsoumbaris, P. and H. Tsoukali Papado Poulou. (1994): Heavy Metals in common foodstuff: Quantitative analysis. *Bulletin of environmental contamination and toxicology*. **53**, 61 – 66.