Heavy Metal Levels in Common Spices From Selected Markets in Southeastern Nigeria.

Veronica O. Ezigbo,[a] Chukwuma O. Okoye [b]

a. Department of Pure and Industrial Chemistry Chukwuemeka Odumegwu Ojukwu University Uli

E-mail: Veroigbo@yahoo.com.

b. Department of Pure and Industrial Chemistry University of Nigeria, Nsukka.

ABSTRACT: Food spices sold in Nigerian markets are often exposed to diversity of conditions and environments before they reach the consumers. There is no doubt that along the route from the producers to the users, as well as during processing, these commodities, could become contaminated with sand and grits, dusts, smoke, particulates, pathogens and heavy toxic metals. In this research, the degree of contamination with chromium were determined in fifty common food spices bought from three major markets in Southeastern Nigeria. Two grams of ground dried spice samples were digested using 2:1 HNO_3 / $Hclo_4$ mixture and analysis of chromium metal were carried out using a GBC Avanta ver. 2.02 atomic absorption spectrophotometer. Results showed that the mean concentration of Cr range of detectable values (µg/g) in the fruits, vegetables, other natural spices and processed spices were (0.03-62.30) and (0.50-17.40) respectively. One way analysis of variance showed the mean concentrations of cr. in each selected common spice are not the same since the P-value is less than 0.05(i.e $P<0.05$). The mean concentration of cr. in the various spices are the same with respect to location since the P-value is greater than 0.05 (i.e $P>0.05$). The mean concentration of cr. in each processed food spices are the same at $P>0.05$ while the mean concentration of cr. in the various processed food spices are also the same with respect to location at $P>0.05$. The level of cr. was below the FAO/WHO recommended limits for metals in common spices. The daily human intakes of chromium have also been computed and was observed below recommended values by FAO/WHO.

Keywords: Atomic absorption spectrophotometer, Chromium, Contamination, Food spices, particulates and Southeastern Nigeria.

INTRODUCTION

The wide spread contamination of the environment by heavy metals in the past three decades has raised public and scientific interest due to their dangerous effects on human health. This had led researchers to study heavy metals contamination of the air, water, soil and foods including spices in order to mitigate their harmful effects and to determine food safety for human consumption.

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 other parts of plants (Shema 2000). 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. Contamination of plants and processed spices could occur through air, water and soil during cultivation and during industrial processing and packaging (Funtval *et al.*, 2008).

Trace heavy metals above the permissible level may result in illness in humans and animals. Some of the spices sold in southeastern Nigeria markets are purchased from the northern part of the country, there is no doubt that along the route, from the producer to the users, as well as during processing, the commodities could become contaminated with sand, and grits, dust, smoke, particulates, pathogens and heavy toxic metals, hence this study was taken up to determine the chromium levels in common food spices.

Food spices contribute protein, vitamins, iron, calcium and other nutrients to the human diet (Thompson 1990). Metal accumulation in common spices, may pose a threat to human health (Turkdoga *et al.,* 2003) and (Damac-Popramam and Sawicka – kapusta 2003). The consumption of heavy metal-contaminated food can seriously deplete essential nutrients in the body causing or contributing to a number of diseases (Arora *et al.,* 2008). At present, there is little 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 levels of Cd in fifty selected common food spices that are sold in three major markets in southeastern Nigeria.

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 dried at room temperature. The samples were placed in the watch glass and dried in an oven at 105^{o}C for six hours until constant weight was maintained. The dried samples were ground with wooden mortar and pestle and kept in acid leached nylon bags in a desiccators prio to digestion. The processed samples and dried spice samples were kept as purchased. The processed and dried samples were ground, packaged and left for analysis 2.00g of each ground sample were placed in 20ml $HNO_3/HCLO_4$ (2:1) mixture in a beaker covered with Petri dish, digested on electric hot plate. The digest was diluted to 50ml with deconised water.

Analyses for chromium were carried out using a GBC Avanta ver. 2.02 Atomic Absorption Spectro-photometer equipped with air-acetylene flame.

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 equation (Qui *et al.*, 2004).

Daily intake of metals (DIM) = DVC x VMC

DVC = 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)

RESULTS AND DISCUSSIONS

Table 1: Mean concentration (n-3) of trace metal in all the samples analyzed (fruits, vegetables and other natural spices (dry weight (µg/g).

Botanical names	Common name	Cr
Solanum anomalum	Buba anara	5.36 ± 3.10
Pisum sativum	Akidi	3.43 ± 4.53
Musa sapientum	Banana	0.56 ± 0.20
Doncas carrota	Carrot	0.14 ± 0.10

Cucumis sativus	Cucumber	0.03 ± 0.02
Solonum mologena	Garden egg	0.46 ± 2.12
Phaseohus vulgari	Green bearu (pas)	0.72 ± 0.32
Amaranthus hybridus	Green vegetable	7.79 ± 3.50
Lpomea batata	Irish potatoes	0.33 ± 0.10
Abelmosihus macnzphylla	Okro	1.15 ± 0.70
Allium cepa	Ordinary onious	1.95 ± 0.55
Carica papaya	Pawpaw	0.78 ± 043
Aranos conosus	Pineapple	3.07 ± 3.56
Musa paradisaca	Plantain	0.54 ± 0.34
Citrus cinensis	Sweet orange	0.82 ± 0.29
Solanum tuberosum	Sweet potatoes	0.65 ± 0.36
Lycopersicon esculenton	Tomatoes	0.07 ± 0.05
Pentaclethra macrophyll	Ukpaka	0.44 ± 0.33
Gongronema letifolium	Utazi	3.63 ± 1.60
Citraillus valgaris	Water melon	3.61 ± 1.25
Allium cepa	White onions	0.77 ± 0.67
Ocilimum gratisimum	Curry leaves	0.69 ± 0.00
Monodova mycistica	Efu	4.09 ± 4.02
Mandora mynstica	Ehulu	2.57 ± 1.53
Allium sativum	Garlic	1.75 ± 0.00
Zingber officinule	Ginger	0.30 ± 0.10
	Janser	17.81 ± 7.96
	Kamanpari	3.39 ± 0.00
	Kpafura	62.27 ± 6.43
	Millo	2.00 ± 0.00
Pipeguineense	Mkpulu uziza	2.26 ± 0.00
Myristica fraginace	Nut meg	0.86 ± 0.00
	Onyesibelu	2.43 ± 0.00
	Orima	1.66 ± 1.38
Piper nigium	Red pepper	0.16 ± 0.00
	Rosemary	5.14 ± 0.00
Ocimium americanus	Scent leaves	2.83 ± 1.14
Thymus vulgaria	Thyme	1.73 ± 0.00
Xylopia aethiopica	Uda	1.97 ± 0.00
Range		0.03 - 62.30
WHO FAO 2001 µg/g		≤100
P-value		P<0.05

Chromium was detected in 43.5% of the fruits, vegetables, and other natural spices with a range from 0.14µg/g in carrot samples from Onitsha to 23.43 µg/g in Jansa from Enugu sample. The mean concentration ranges from 0.03 – 62.30 µg/g. The mean concentration of Cr in all the studied samples were lower than FAO/WHO limits of ≤100 µg/g. In air, chromium compounds are present mostly as fine dust particles. Low level exposure can irritate the skin and cause keratin. Long term exposure can cause kidney and liver damages.

Table 2: Mean concentration of chromium (µg/g dry weight) in fruits, vegetables and other natural spices from each market.

Metal	Enugu		Nnewi		Onitsha	
	Fruits and vegetables	Other natural spices	Fruits and vegetables	Other natural spices	Fruits and vegetables	Other natural spices
Cr	4.02 ± 2.33	4.40 ± 2.42	6.69 ± 2.20	0.00 ± 0.00	1.02 ± 1.13	3.48 ± 1.06

One way analysis of variance showed the mean concentration of chromium in all selected common, spice are not the same since the P-value is less than 0.05 (P<0.05). The mean concentration of chromium in the various spices are the same with respect to location since the P-value is greater than 0.05 (i.e. P>0.05).

Table 3: Mean concentration of Chromium (µg/g) (dry weight) in processed spices.

Common Name	Conc of Cr
Benny	6.19 ± 1.33
Fried rice seasoning	4.11 ± 2.46
Maggi star	17.43 ± 9.02
Mixed spices	2.18 ± 1.10
Nut meg	0.47 ± 0.10
Onga	7.53 ± 8.85
Pepper	11.71
Eshallot	0.63 ± 0.12
Steak seasoning	0.35 ± 0.10
White maggi	5.94 ± 9.01
Range	0.50 ± 17.40
WHO 1996.FAO 2001µg/g	≤100
P-value 0.157	P>0.05

Cr was detected in 66.7% of the processed samples with a range of 1.27µg/g in onga from Enugu samples to 27.64 µg/g in maggi star from Nnewi samples. The concentration of Cr in the processed spices were within the permissible limits of ≤100 µg/g set by WHO 1996, FAO 2001. None of the concentration of Cr in the processed spices exceeded this limit. In air, chromium compounds are present mostly as fine dust particles. Low level exposure can irritate the skin and cause keratin. Long term exposure can cause kidney and liver damages.

Table 4: Mean concentration of chromium µg/g in processed spices from each market

Metal	Enugu	Onitsha	Nnewi
Cr	4.20 ± 4.25	5.28 ± 3.31	7.13 ± 5.55

One way analysis of variance showed that the mean concentration of chromium in each selected processed spices are the same at P>0.05. The mean concentration of chromium in the various spices are the same with respect to location at P>0.05.

Table 5: Estimation of heavy metal intake through consumption of vegetables in southeastern Nigeria.

Heavy metal	Mean conc. (µg/g	Daily intake (µg/dry)	WHO/FAO limit (µg/g
Cr	0.03 – 62.30	2.94 – 6105.4	1000

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

The exposure of consumers and the related health risks are usually expressed in terms of the provisional tolerable daily intake. The FAO/WHO (1999) have set a limit for the heavy metal

intake based on the body weight for an average adult namely, 60kg body weight. The average diet per person per day of common fruits and vegetable spices is 98g. If the mean level of Cr (0.06mg/g) found here is consumed daily, the contribution of heavy metal intake for an average human being from the spice diets were calculated and presented as shown in Table 5. It can therefore be concluded that our estimated daily intakes for chromium studied here is below those reported by FAO/WHO, which had set a provisional tolerable daily intake (PTDI) limit for heavy metal intake based on body weight for an average adult (60kg body weight) for Cr. (Table 5) with exception of kpafura and Jansa whose PTDI the PTDI limit.

Validation of Method Used

This method has been used and published by Poof COB Okoye my supervisor

CONCLUSION

The results reported here confirmed that the food spices obtained from three major markets in Southeastern Nigeria contained reduced or trace amounts of Chromium. Furthermore the level of Cr obtained does not appear to pose any serious health hazard problem of concern yet.

RECOMMENDATIONS

We recommended 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 vegetables and other natural spices is essential to prevent excessive build up in the food chain and as the spice samples are transported from different sources.

ACKNOWLEDGEMENT

We wish to acknowledge the Laboratory technologist of Spring Board Research Centre for aiding and providing us with all the necessary equipments needed.

REFERENCES

Albagermi MA, Edwards HGM, Ala, Tal Al (2012): Monitoring of heavy metal content in fruits and vegetables collected from population and market sites in the misurata area of Libya. Intl. Scholarly Res. Net work 10: 1 – 5.

Arova M. Kiran B. Rani S. Rani A. Kaur B. *et al.,* (2008). Heavy metal accumulation in vegetables irrigated with water from different sources. Food chem.. 111: 811 – 815.

Damek Poorawa M. Sawicka –kapusta K. (2003). Damage to liver, kidney and testis with reference to burden of heavy metals in yellow-necked mice from areas around steel works and Zink smelters in Poland. Toxicology 186: 1 – 10.

FAO/WHO (1999). Joint Expart committee on Food Additives "Summary and conclusions" in Proceedings of the 53rd Meeting of Joint FAO/WHO Expart committee on Food Additives. Rome Italy.

Funtua M. A., Agbaji F. B., Ajibola V. O. (2008). Assessment of the heavy metal contents of spinach and lettuce grown along the bank of river Getsi, Kano. J. Chemistry Society Niger 5(1): 11 – 14.

Sharma O. P. (2004): Hills Economy A textbook of Botany, 2nd edition. Arish Press Dhaka, Bang ladesh, Pp. 18 – 21.

Shuaibu I. K. Yahaya M. and Abdulloti U. K. (2013). Heavy metal levels in selected green leafy vegetables obtained from Katsina central market, katsina, northwestern Nigeria African Journal of Pure and Applied Chemistry.

Thompson H. C. Kelly W. C. (1990). Vegetable Crops, 5th edition. MacGraw Hill Publishing Company Ltd. New Delhi.

Turkdogan M. K., Kilicel F., Kara K. Tuncer I. Uygan I. (2003): Heavy metals in soil, vegetables and fruit in the endemic upper gastrointestinal cancer region of Turkey: Environ Toxicol Phamacol 13: 175 – 179.

BIOGRAPHY

Veronica O. Ezigbo is a Senior Lecturer at the Chukwuemeka Odumegwu Ojukwu University. She received her B.Sc. and MSc. degrees in Chemistry from University of Nigeria, Nsukka in 1993 and 2005 respectively and her Ph.D degree in Industrial Chemistry is in view. She is the author of more than 30 Journal papers and has written three book chapters. Her current research interests include chemistry of wood and potential toxicity of heavy metals. She is a member of chemical society of Nigeria (CSN).

Chukwuma O. Okoye biography not available