Short Communication

Evaluating The Levels of Cadmium, Lead and Nickel Present In *Solanum Tuberosum,* L. (Irish Potato) Marketed In Industrialized Areas of Ogun State, Nigeria.

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ABSTRACT

Solanum tuberosum, L. (Irish potato), the world's fourth largest food crop and a staple in many diets around the world is a source of highly digestible carbohydrate and nutritionally complete protein, as well as being an excellent source of other essential nutrients. The incidence of heavy metals contamination in humans through food, water, air or skin absorption, in varying levels of concentration has been reported. This study was carried out to determine the levels of three heavy metals (cadmium Cd, Nickel Ni, and lead Pb) in *Solanum tuberosum* around industrialized areas. Samples were purchased from markets at Sagamu, Ogijo and Sango- Ota industrialized areas of Ogun state. Tissue and peeled samples were pre-treated using acid digestion and the concentrations of Ni, Pb and Cd were determined using Atomic Absorption Spectrophotometer (AAS)(Perkin Elmer A. Analyst 200 Germany). The concentrations of the three heavy metals in all the tissue samples, except for Pb, in the Sango-Ota tissue samples, were within the standard permissible limit set by the WHO/FAO. However, the concentration of the heavy metals in all the peel samples exceeded the permissible limits, and the Sango-Ota peels have the highest concentrations while Sagamu peels were the lowest. The presence and concentration of industries have significant consequence on the levels of heavy metals presence in potato which may constitute great threat to safety and health of the consumers.

Keywords: Heavy metals, *Solanum tuberosum* L., tissue, peel, safety

INTRODUCTION

The potato (*Solanum tuberosum* L.) belongs to the Solanacea or night shade family whose other members include tomatoes, egg plants, peppers and tomatillos (Weatherford, 1998). They are the swollen portion of the underground stem which is called a tuber and is designed to provide food for the green leafy portion of the plant. Potato nourishes the spleen and benefits the stomach, stops pain, detoxifies and relieves swelling. It is good for general weakness of the body. A juice made from tubers, when taken moderately, can be helpful in the treatment of peptic ulcers, bringing relief from pain and acidity. The raw juice of potato contains no alkaloid, the chief ingredient being the potash salts which are present in large quantity. The tuber also contains a certain amount of citric acid, which like potash is ant scorbutic, and phosphoric acid, which yield phosphorus, in a quantity less only than that afforded by the apple and by wheat (Suttle, 2008).

The nutritional values in grains, milligrams and percentages of some food substances which are vital constituents of *Solanum tuberosum* (Irish Potato) are given as follows while the energy content is given as 321kg (77kcl), carbohydrates (19g), starch (15g), protein (2g), Dieafary fibre (2.2g), water (75g), vitamin A equivalent 0mg(0%) Thiamine (Vit. B) (0.08mg 7%), Niacin (Vit. B3) (1.05mg 7%) Vitamin B6 (0.295mg, 23%), Vitamin C (19.7mg, 24%), Iron (0.78mg.6%), Phosphorus (57mg, 8%), Potassium (421mg, 9%). The incidence of heavy metals, which are loosely-defined subset of elements, including the transition metals, occurring naturally in varying concentrations(Duffus,2002) and their contamination in humans, at varying level of concentration is supported by recent findings, particularly from a biomonitoring survey of heavy metal levels carried out in 2008, in children between age 2-6 years in Nigeria, ranging from chromium, Nickel, Manganese including traditional offenders like Lead, Cadmium to radioactive elements, were discovered(Nriagu,2008). Heavy metals gain entry into the human body through food, water, air or by absorption through the skin when contact is made with humans in agriculture, manufacturing, pharmaceutical, industrial or residential settings(Singh,2001). Industrial exposure account for a common route of exposure for adults while ingestion is the most common route of exposure for children (Andre, 2005).

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Qualitative and Quantitative studies have established the incidence of heavy metals contamination in potato genotypes. Recent studies evaluating heavy metals contamination of *Solanum tuberosum* have indicated 60-70% of Lead in the peels and 30-40% in the pulp while cadmium and mercury occur in the tuber in 70-80% and in the peels in 25-30% (Bulinski R,*et. al* 1991). Further studies revealed that the accumulation pattern for the general metals in the potato tubers was in the order: Fe>Zn>Mn>Cn>Ni>Pb>Cd (Lozak*et.al, 2002*). The present study is aimed at assessing the significance of heavy metals contamination on the peels of the Irish potato (*Solanum tuberosum*, L.)

MATERIALS AND METHODS

Chemicals and Reagents

All chemicals and reagents were of analytical grade and were obtained from BDH Chemicals Ltd, UK. Concentrated Aqua Regia (mixture of Conc. HNO_3 and Conc. HCl in the ratio 1:3) was used for the digestion of the samples while corresponding metal salts (namely $CdCl_2.H_20$, $Pb(NO_3)_2$ and $NiCl_2.6H_20$) were used as standards.

INSTRUMENTATION

AAS Instrument (PERKIN ELMER A. Analyst 200; Germany) consisting of a hollow cathode lamp, slit width of 0.7nm and an air-acetylene (Sumontha, 2006). Flame was used for this work. The samples were analyzed for three heavy metals namely, cadmium at wavelength of 228.80nm, nickel at wavelength of 232.00nm and lead at wavelength of 283.31nm.

SAMPLING

Three popular markets in Ogun State metropolis were selected due to their peculiar industrial environment with industrial products such as cement, steel, plastics, paintse.t.c.

Ten (10) tubers of Irish potatoes (*Solanum tuberosum*) were bought at Sagamu, Ogijo and Sango-Otta markets in Ogun State Nigeria.

SAMPLE DIGESTION

To obtain the heavy metal of interest acid digestion using 2.5ml of nitric acid (HNO_3) was added to each tissue and peel sample in a beaker and placed on electric hot plate and adjusted heating was done to prevent evaporation. The digestion was completed with a colourless solution obtained.

Each solution was concentration to about 2ml solution, cooled and made up to 10ml with demonized water and filtered using what mains filter paper. The filtrates were made up to 100ml with distilled water and stored under room temperature for analysis.

SAMPLE ANALYSIS

Prepared stock standard was used to generate standard calibration curves. The absorbance for each sample was compared with those of the corresponding standards. The atomized blank (0PPM) standard was set to zero display and atomization of standard solutions carried out in order of increasing concentrations and the absorbance read off, with the sample solutions aspirated under the same conditions as the standards.

STATISTICAL ANALYSIS

To evaluate the extent of heavy metals accumulation in the samples obtained from the various markets, discriminate analysis was used.

RESULTS AND DISCUSSION

The results are as shown in Table 1. Cadmium is a non-essential element in foods and natural waters (WHO, 1992). It accumulates principally in the kidneys and liver. Various sources of environmental contamination have been implicated for the presence of cadmium in foods (Divrikliet.al, 2003). 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 vegetables. Lead poisoning is a global reality (WHO, 1995). Fortunately it is not a very common clinical diagnosis yet in Nigeria except for few occupational exposures (Afolami et. al, 2010).Humans may be exposed to Nickel by breathing air, drinking water, eating food or smoking cigarettes or skin contact with nickel-contaminated soil or water. This study which evaluated the levels of cadmium, lead and nickel present in the tissues and peel samples of Irish potato (*Solanum tuberosum* L.) marketed in industrialized areas of Ogun State discovered from the results in tables 1 and 2, that all the peels sample have concentrations of those heavy metals (cd, pb and Ni) beyond the standard permissible limits set by the WHO/FAO (2001). Lead (0.50mg/kg, 0.53mg/kg, 0.61mg/kg), Cadmium (0.22mg/kg, 0.25mg/kg, 0.30mg/kmg, 0.30/kg); Nickel (0.45mg/kg, 0.55mg/kg, 0.80mg/kg) respectively for Sagamu, Ogijo and Sango-Otta respectively as against WHO/FAO limits of (0.3,0.2, 0.4) for Lead, Cadmium and Nickel respectively, with lead showing greater variance in concentration in all the samples compared to other heavy metals.

Table 1: Results of concentration of heavy metals in samples (mg/l)

POTATO SAMPLES	LEAD (Pb)	NICKEL (Ni)	CADMIUM (Cd)
Sagamu potato tissues	0.005	0.002	ND
Ogijo potato tissues	0.003	0.003	0.0015
Sango Ota potato tissues	0.005	0.004	0.002
Sagamu potato tissues peels	0.005	0.0045	0.0022
Ogijo potato tissues peels	0.0053	0.0055	0.0025
Sango Ota potato tissues peels	0.0061	0.0080	0.003

Table 2: Concentration of heavy metals in samples and WHO/FAO (2001) permissible limits

POTATO SAMPLES	LEAD (Pb)	NICKEL (Ni)	CADMIUM (Cd)
Sagamu potato tissues	0.05	0.20	ND
Ogijo potato tissues	0.30	0.30	0.15
Sango Ota potato tissues	0.05	0.04	0.20
Sagamu potato peels	0.50	0.45	0.22
Ogijo potato peels	0.53	0.55	0.25
Sango Ota potato peels	0.61	0.80	0.30
WHO/FAO (2001) PERMISSIBLE LIMITS	0.3	0.4	0.2

However, with the exception of lead still all the tissue samples for all the areas were within the permissible limits of the WHO/FAO (2001).This study results is comparable to the findings of Janette Musilova*et.al*(2017) which also confirms the high content of lead in twelve potato cultivars with different lengths. Many other researchers have established the high presence of lead & Chromium in some sampled vegetables(Fernando Guerra *et.al,*2012), lead & Cadmium in 3,785 vegetable samples analysed (Xian-Dong Pan *et.al,*2016) as well as high concentrations of Cadmium, Chromium and Lead ions in vegetables cultivated by wastewater(Adeel and Iffat, 2014).

It is not impossible for the concentration of industries around the markets sampled to have significant contributions to the high levels of the heavy metals in the tested samples, as the result gave prominent increased levels in the peels than the tissues, probably by reason of air pollution in the form of industrial fames, however, the main concern in this study is the implication of the peels contamination to the consuming human populace.

CONCLUSION

The detrimental impact of heavy metals contamination becomes apparent only after decades of exposure. Consequently, the high level of heavy metals presence in potato peels, which may constitute great health to safety and health of the consumers if not peeled before consumption, calls for urgency in sensitizing the general populace, moreso when potato is a consumable that is commonly prepared by cooking the whole tuber without peeling.

REFERENCES

Afolami I, Anyakora C, Ebuehi O. Bolawa O, (2010). Lead levels in some edible vegetables in Lagos, Nigeria Scientific Research and Essays. 5(8): 813-818.

Andre, L.O. (2005). Toxic metals in plants (dietary intake and health effects of selected toxic elements), *Brazilian Journal of plant physiology* 17(1), 79-93

Bulinski, R, Bloniarz, J, Libelt B (1993): Presence of some Trace Elements in Polish Food Products. XV. Contents of Lead, Copper, Cadmium, Nickel, Chromium, Zinc, Cobalt, Manganese, Copper and Iron in some Milk Products. *Bromatologia i. ChemiaToks*, 26, 23-27

Divrikci, U, Horzum N, Soylak M, Elci L. (2006). Trace heavy metal contents of some spices and herbal plants from Western Anatolia Turkey. *Int. J. Food Science Technology* 41: 712-716.

Divrikci U.S., Sara Coglu M. Soylak M, and Elci L (2003). Determination of trace heavy metal contents of green vegetables samples from Kayseri-Turkey by flame atomic absorption spectrometry, *Fresenius Environmental Bullentin (FEB)* 12:1123-1125.

Duffus J.H. (2002). Heavy Metals: a meaningless term? (IUPAC Technical Report)". *Pure and Applied Chemistry* 74:793-80?.

Joint WHO/FAO (2001). Expert Committee on Food Additives. Summary and conclusions, 53rd meeting.

Lozak A, Soltyk K. Ostapczuk P, Fijale K.Z (2002) Determination of selected trace elements in herbs and their in fusions. *Sci. Total Environ.* 289:33-40

Nriagu, J. (2008).Lead poisoning associated with malaria in children of urban areas in Nigeria. *International Journal of Hygiene and Environment* 211:591-605.

Singh B. (2001). Heavy metal in soil, sources, chemical reactions and forms in Smith D. Fityus and Allmon (eds). Geotechnics proceedings of the 2nd Australia and New Zealand conferences on Environment Geotechnics. New castle, NSW, Australia. Pp 77-93

Sumontha ,N.R.(2006).defereminotion of tracement in herbal tea products and their infusion consumed in thaiford. *J.Agric Food chem*.54:6439-6944.

Suttle,J.(2008). Symposium Introduction: Enforcing the Nutritional value of potato tubers. *Am.J.potato res* :85:266.

WHO (1992). Cadmium Environmental heath criteria General.vol134.

WHO (1995).Lead Environmental Health criteria, Geneva. Vol165.

Weather Ford, J.M (1988). Indian givers: how the Indians of the Americas transformed the world. New York: Fawcett Columbine. 69.ISBN 0-449-90496-2