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TRACE METAL LEVELS IN VARIOUS *ORYZA SATIVA* BRANDS SOLD IN NIGERIA

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ABSTRACT

Levels of selected trace metals namely Cadmium, Lead, Nickel and Iron in local and imported brands of rice popularly consumed in Nigeria were investigated to ascertain their toxicity levels in the brands. Lead and Nickel were found to be well above safety levels of 1.5mg/kg and 0.2mg/kg respectively as specified by world health organization (WHO) while all the brands were safe from cadmium and iron toxicity. The results obtained for cadmium were comparable with the findings of other researchers, while our results for Lead, Nickel and Iron were higher than results obtained by other researchers. The local brands' mean concentration for lead showed 9.5toxicity above safety levels while imported brand showed 4.6 toxicity above safety levels. In the local and foreign rice brand, nickel was found to be 31.2 and 85.8 respectively more toxic relative to accepted safety levels. Regular consumers of rice (local and imported) must be cautious to avoid health challenges associated with Lead and Nickel toxicity. Conversely rice (local and imported) brands need to be fortified with other related food supplement to balance their cadmium and iron deficiency.

Key words; Trace Metals, Toxicity, Rice Brands, Chronic Diseases

INTRODUCTION

Rice (*Oryza sativa*) Cultivation is increasing greatly in Nigeria due to its ever high demand and popularity among all levels of the society. Apart from cassava food products, rice is the next staple and most consumed food commodity in Nigeria. As at 2016 estimation, Nigerians consume about Six million metric tons of rice annually and this estimate is above local production capacity of the country which is put at 3.8 million metric tons per year, hence the rise in the nation's imports to fill up the gap of local production deficiency (Oweye, 2016).

Environmentalists are raising concern about the quality of rice imported into the country as well as that produced locally. Trace metals are known to be nutritionally essential for healthy and normal physiological processes in biological tissues. These trace metals become harmful or toxic to life when their concentration in food exceed the required values and in these respect certain health and life threatening diseases becomes manifest in the host organism (Horsfall, 2011; Kakulu and Sibanjo, 1986; Odoemelam, 2005; FEPA, 1991; Okoye, 1994). Heavy metal toxicity is of global concern due to anthropogenic activities that releases them into the

environment. The mina Mata and itai itai health incidence in Japan and the lead poisoning of children in northern state of Nigeria are flashes of the seriousness which heavy metal toxicity could pose (Horsfall, 2011).

Through one mechanism or the other heavy metals becomes available for plant uptake. Our serious concern is drawn to Lead, Nickel, Cadmium and Iron content of rice available in the Nigerian market due to the possible implications to the human health. There are vast reports by scientist about the toxicity of Cadmium, Lead, Nickel and Iron in food (FAO/WHO, 1972; Pearson, 1976).

Toxicological symptoms of excessive heavy metal exposure include; Parkinson Disease, Cancer, abdominal pain, Renal failure, goiter, shortage of blood, irritation, Hemorrhage, ulcer, decreased sperm production, Eczema, Mucosa, Coma etc.(Horsfall, 2011; Odoemelam and Ibezim, 2010).

Bioaccumulation, Biomagnification and Biotransformation of these heavy metals persists in organism to wreak havoc to the health of host and are transported up the trophic level (Iwuoha and Onojake, 2016).

Our focus in this Research is to investigate and report the level of trace metals namely Lead, Nickel, Cadmium and Iron levels in some imported and local rice brand samples sold in Nigerian markets. Evaluate the safety levels of the heavy metal toxicity and compare the two brands to help us ascertain the toxicity and make appropriate recommendation for public awareness and necessary action.

MATERIALS AND METHODS

Study area;

The southern part of Nigeria i.e. Abakiliki to Port Harcourt axis are the focal points of sampling. Abakiliki in Ebonyi state and Uzoakoli in Abia state are sampling areas for locally produced rice labeled A and B while the imported brands labeled C and D which represents Caprice and Royal stallion rice brands obtained from notable shops in Port Harcourt, are the popular imported brands. The soil mineralogical composition, metal availability in soil, plant biological factors and rate of uptake of these trace metals by plants are the main determinant factors for their levels in the plants. The geographical coordinates (latitude and longitude) of Abakaliki, Uzuakoli and Port Harcourt are (6.32^{o} N, 8.11^{0} E), ($5^{0}\,38^{'}0^{''}$N, $7^{0}34^{'}0^{''}$E) and (4.82^{0}N, 7.05^{0}E) respectively. Random sampling from shops and markets of the two brands of imported rice from Port Harcourt axis of Rivers State was done.

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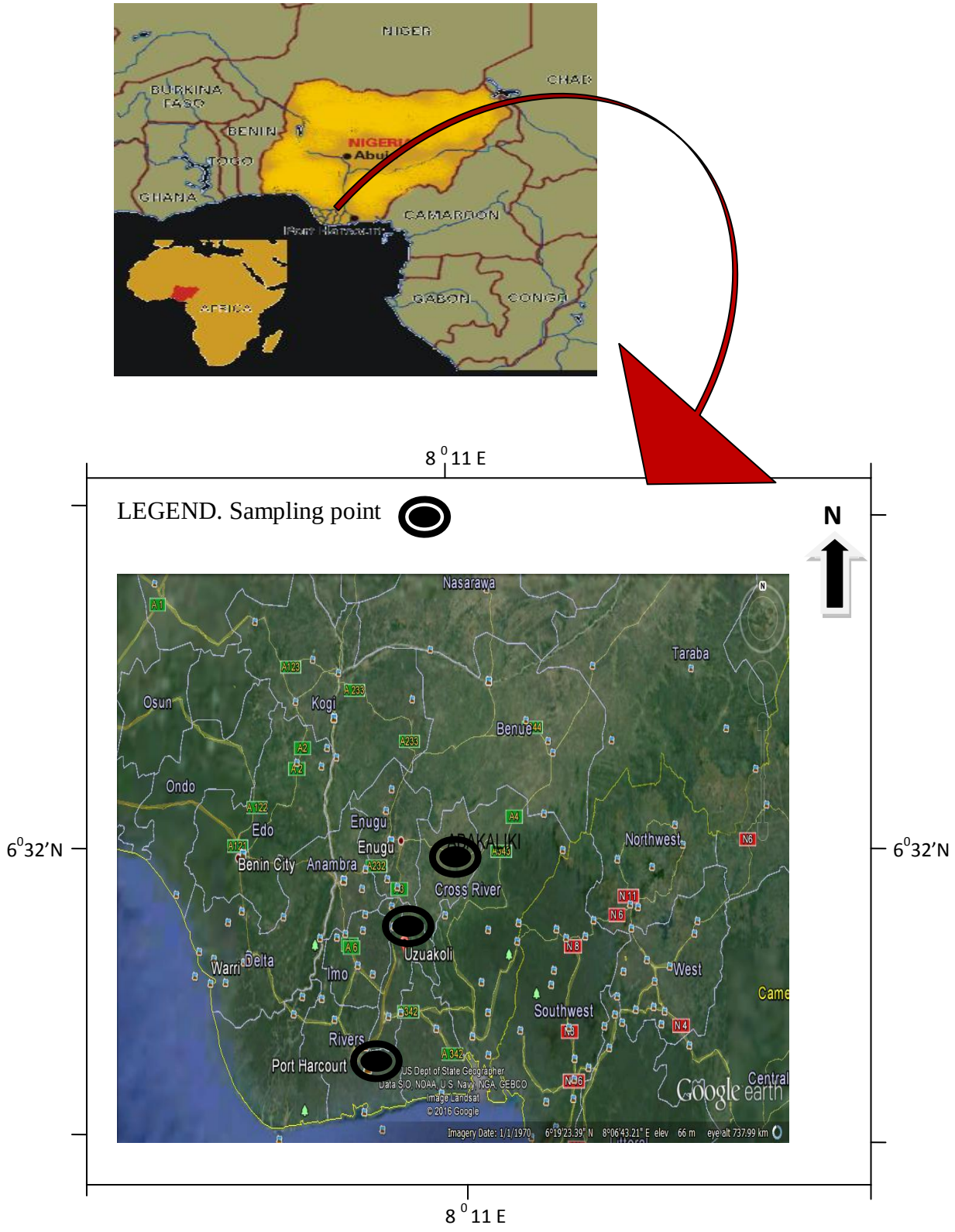

Figure 1. Map of southern Nigeria indicating sampling points (Google earth, 2016)

Procedure;

5g of the different rice brands were weighed in a crucible and further ashed at and temperature of 400^0 C for over three hours. Their ashed sample was pulverized and put into a beaker. Acid digesting mixture of Agua regia solution was used to digest the ashed rice samples for some minutes and the beakers' content was transferred separately to 25ml standard flasks. Deionized water was added to the standard flasks up to the 25ml mark. The digest was later analyzed for heavy metal using AAS Agilent 55B model for Lead, Nickel, Cadmium and Iron at the respective resonance lines. Three analytical determinations were done for each metal and the average noted.

RESULTS

Table 1: Mean concentration (mg/kg) of heavy metals in some local and foreign rice brands consumed in the Niger-delta, Nigeria.

S/N	Pb	Ni	Fe	Cd	Brands
1	18.10	2.05	2.74	0.03	local
2	10.61	10.43	11.31	N.D	local
3	5.85	15.24	9.68	N.D	foreign
4	8.01	19.08	21.04	0.05	foreign
Maximum limit(mg/kg)	1.5(WHO)[a]	0.2[b] (WHO,2007)	100[b] (WHO,2007)	0.2(WHO)[a]	

Note; N.D. = Below detection limit of the machine used. [a] =Agency for toxic substances (Mgbemena and Obodo, 2015).[b] = (Iwuoha et. al, 2013)

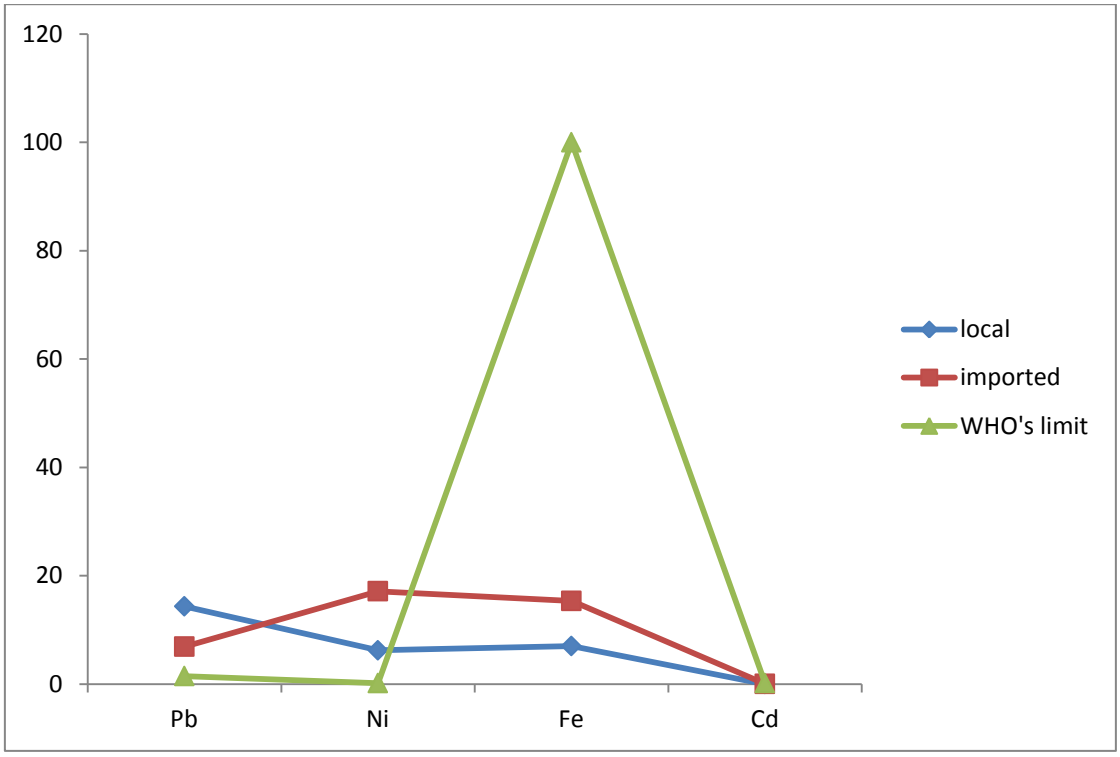

Figure 2.0: The relative levels of the means of heavy metals in local and foreign rice to WHO's maximum accepted limit.

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DISCUSSION

For the table 1.0 above, the concentration (mg/kg) of Lead varies in samples A, B, C and D as follows 18.10, 10.61, 05.85 and 08.01 respectively. The mean concentration (mg/kg) in the local rice brands is higher than the mean concentration (mg/kg) in the imported ones, i.e., 14.36 > 6.93 respectively. Interestingly lead concentrations in both local and imported brands are quite higher than lead maximum limit as stipulated by world health organization (WHO). It implies that rice irrespective of local or imported brands could be significant source of lead toxicity to people who eat rice food frequently.

The symptoms of lead toxicity include high blood pressure, kidney damage decreased sperm count, learning difficulties, aggressiveness etc. Above symptoms are frequent complaint of Nigerians and they persistence of these symptoms could be attributed to the rice we consume especially the local rice brands from Abakiliki axis.

For Nickel, its concentration (mg/kg) in rice brands A, B, C and D are 2.05, 10.43, 15.25 and 19.08 respectively, this implies that the mean nickel's levels (mg/kg) in imported rice is higher than local brand i.e., 17.16 > 6. 24. The concentrations in (mg/kg) of rice in both local and imported brands are at much higher level of 0.2mg/kg as stipulated by WHO. It implies that the vast populaces that consume rice are at high risk of nickel toxicity. The symptoms of nickel toxicity include reduced sperm count, headache, acute long injury, Eczema etc. These symptoms are prevalent in our society. The levels of cadmium in local and imported rice brands were below 0.2 mg/kg maximum levels as recommended by WHO for safe consumption levels. It implies that both local and imported rice brands popularly consumed in Nigeria are free from cadmium toxicity. It implies that consumers are free from symptom of cadmium toxicity like kidding damage and all forms of cancers in humans associated with cadmium toxicity.

The values obtained from this research for Lead and Nickel are higher than the mean concentration (mg/kg) Orish et al (2015) obtained for these metals in rice, i.e. < 0.05 and 0.84 respectively while Tilahun belayneh et al (2015) obtained lower concentrations (mg/kg) as well for Lead and Nickel i.e. 0.65 and 0.40 approximately for Lead and Nickel in Pakistan and Indian rice samples respectively. The values of cadmium (mg/kg) obtained in this research is comparable to the findings by other scientists, while Tilahun belayneh et al (2015) did not detect any Cadmium in their rice samples, Orish et al (2015) got 0.13 mg/kg which is higher than our values. Tilahun belayneh et al (2015) results in mg/kg (2.44 and 2.66) for iron in both Pakistan and Indian rice samples respectively were slightly below our results for the selected local and foreign brands.

The various results obtained for iron concentration (mg/kg) in the rice brands A, B, C and D which corresponds to 2.74, 11.31, 9.68 and 21.04 respectively indicates that in all brands iron concentrations are below the stipulated 100 mg/kg far iron by WHO. Comparing the imported brands to that of local shows that the local brands have on the average has lower concentration of iron relative to that of the imported ones i.e., 7.24mg/kg < 15.360mg/kg. The relative mean concentration (mg/kg) of heavy metals in local and imported rice to the WHO maximum permissible limit is

indicated in figure 2 above. Iron and cadmium levels in both brands are below accepted WHO's maximum limit, hence food supplements rich in iron and cadmium should added to rice meals to make it nutritionally balanced. The graph also indicated that lead and nickel are remarkably above maximum limit, hence regular rice consumers must guard against toxicity due to lead and nickel in the both local and imported brands.

In conclusion the mean concentration of lead is higher in the local rice brands relative to its mean concentration in those imported while both the local and imported rice brands have lead concentration above WHO maximum limit of 1.5mg/kg, hence popularly consumed rice could pose serious lead toxicity risk to regular rice consumer. The same argument goes of high risk of Nickel toxicity for those who depend on rice as the staple food.

Both local and imported rice does not pose any cadmium and iron toxicity health risk because the data gotten from both are well below maximum limit as stipulated by WHO. Competing forces of price and other nutritional values ought to determine or justify preference of choice for the local and foreign brands.

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