

METAL HAZARD ON THE HEALTH SAFETY OF THE PEOPLE OF TWO TOWNS IN THE OIL PRODUCING AREA OF AKWA-IBOM STATE

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ABSTRACT

Garri processed from cassava, one of the most common staple crop throughout tropical Africa, Asia and South America, were traditionally done. The effect of processing methods on the chemical pollutant loads were studied using twenty four matured, male wistar rats fed with blends of garri, while the control rats fed with rat ration only. The raw cassava and smoked fish used for the experiment were examined to assess the level of their contamination. Garri processed from the raw materials sourced from the two towns were compared by evaluating the effect the processing had in reducing the concentration of the pollutants. It was shown from the results that the feed had metal pollutants that would ultimately affect consumers of the food and, equally the effect of processing on the reduction of the metal pollutant load of the various feed ratios. The results also showed the prospect of processing on the safety of the foods and invariably, the health of consumers.

Keywords : Garri, Consumers health, metal – pollutants, food safety, processing methods.

INTRODUCTION

Food consumption is a vital aspect of life for any living being irrespective of location, colour, race, level or status. Food safety is basically the delivery of safe, nutritious and affordable food to people. People of oil producing community are bedeviled with low food production and toxic foods as a result of the heavy pollution resulting from oil spillage (Niger Delta Report, 2004).

The garri blended with other materials for the feed was made from Cassava (*Manihot esculentus*), which is grown in many parts of the world, most especially, tropical Africa, Asia, and South America. It is one of the major staple food crops in Africa. The roots are the main part consumed although the leaves are also edible though with poor storability (Aburto *et al.*, 2001) and its cyanogen contents (Asegbeloyin, and Onyimonyi, 2005; Cunibana, *et al.*, 2007; Ozohua *et al.*, 2007 and Oke, 1994) are its major problems. Processing into garri is the most popular food stable in Nigeria, most especially the people of the South South region (*fufu* also) of the country, because of its low cost, convenience, and acceptability by both the rich and the poor (Oluleye *et al.*, 2007). People from the South West region of Nigeria equally produce *lafun* from cassava, apart from garri and *fufu*. Industrially, cassava could be processed into starch, alcohol, pharmaceutical gums, confectionaries and livestock feeds. Onwyeme and Siriha, (1991) and Giami, (2002) reported that cassava root has water and starch (58 – 60%), carbohydrate (35%), protein (1 – 2%), fat (0.3%), fibre (1-2%), and mineral matter (about 1%).

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Pollution, as reported by Matthew and Ravelo, (2001), is the introduction by man, directly or indirectly, of substance or energy into the environment resulting in harmful effects on the mind and body. It occurs at every level in the biosphere with the presence of contaminating chemicals in the air, water, food, dust etc. However, industrialization plays a major role in the pollution of the environment through the manufacturing activities and disposal to toxic waste into air, water and land. Toxic components and accidental release of oil and chemicals usually impair the ability of individual organism to reproduce, grow, feed or perform other functions, and equally cause spillage or massive release of industrial chemicals and crude oil. The effect of crude oil could be due to the physical nature of the oil (i.e. physical contamination and smothering) or by its chemical components (toxic effects and accumulation) and this could cause temporary or permanent damage to the habitat in which plants and animals live (ITOPF, 2001) and could also lead to a large mortality in areas where these spills are common. These toxic constituents are categorized into chemical contaminants (such as residues from agricultural pesticides and insecticides, chemical leaching into food materials); metal contaminants (metals such as mercury, cadmium, lead and arsenic); hydrocarbon contaminants (e.g. hexane, chlorinated hydrocarbon which could cause various internal organs' malfunction and sometimes cancer); or natural contaminants which could induce toxicological risk such as cyanogen, saponin, heamagglutins, etc. These could cause acute liver damages or food poisoning (Santos and Gomet, 2001).

It should be reported that heavy metals in our local foods have been studied. Heavy metals such as lead, cadmium, nickel, copper, aluminum, etc and in some cases, their dietary intake estimated from the consumption of the food, which gives valuable assessment of the local exposure risks to these heavy metals (Onianwa *et al.*, 1997; Onianwa *et al.*, 1999a, 1999b; Ketiku *et al.*, 1999; Onianwa *et al.*, 2000a, 2000b).As a result of the high demand for food, and in this area, garri or other carbohydrate foods are the most prominent, due to their staple nature, it has been observed that people living in this area suffer seriously from acute toxicity due to oil spillage that has made their land unfarmable; spread of chemicals which could leach into food materials and metals which find their way into their agricultural produce, in this case, cassava meant for processing into garri, through air, water, soil or land. This study seeks to evaluate the effect of processing on the safety of the garri.

MATERIAL AND METHODS

Collection of Materials

Cassava roots (white local variety) and of the same maturity sourced from Eket and Ibno towns in the state were processed into garri using traditional method, while equal weight of cassava from the two towns were mixed together and processed into garri using improved method (SPDC developed method, 1988).

Sourced cassava roots were equally analysed for contaminants. Fish (*Clarias*) samples to be used as source of protein from the sites were sun-dried in the vicinities of flared gas and properly packaged in a polythene bag. The diet composition is as given in the table below.

Table 1: Processed Feed of Garri fortified with Other Nutritive Ingredients

Composed feed	Feed 1	Feed 2	Feed 3
Processed cassava ₁ (kg)	5.0kg		
Processed cassava ₂ (kg)		5.0	
Processed cassava ₃ (kg)			5.0
Fish (kg)	2.0	1.0	1.0
Groundnut Oil (kg)	0.8	0.8	0.8
Blend of Min. and vit. premix (g)	80	80	80

Processed cassava₁ – Cassava from Eket Town; Processed cassava₂ – Cassava from Ibno Town

Processed cassava₃ – Blend of cassava from the two towns; Groundnut oil obtained from a local market in Uyo town; Minerals and vitamins obtained from the laboratory

After blending garri and other nutritional ingredients thoroughly in a mixer for homogeneity, each feed was packaged, sealed, labeled and kept properly to prevent insect or mould infestation or any form of external contamination.

Feeding regime

Twenty-four (two months old and healthy) wistar rats were purchased for the experiment. The weight range of the rats at the point of purchase was between 90 and 105g and was divided into four groups of six rats each. The rats were kept in cages and fed with normal rat meals for two weeks to stabilize to the condition of the new environment. The weight range of the rats after two weeks of acclimatization was 140 – 150g. The rats were fed on experimental feed [processed feeds 1 to 3], while group 4 fed on rat ration. All the animals had access to water and feed *ad libitum* and were placed on the experimental feeds for six (6) weeks. The body weight and food intakes were measured weekly and clinical observation made daily.

Analytical procedure

After six weeks of treatment, the animals were sacrificed by decapitation after chloroform treatment in desiccators. A 2cm³ blood was let into a centrifuge tube place in ice for 1hour. It was centrifuged to obtain Serum and analysed using assay kits obtained from Quinica Clinica Aplicada S.A.

Metal analysis

A Varian Techron AA-5 Atomic Absorption Spectrometer was used. The absorption signal was recorded on a Yokogawa 3046 strip-chart recorders and on Hewlett-Packard Model 5050-B printer with single element cathode lamp. The instrument settings for each element were as recommended by the manufacturers and the gas mixture was adjusted in each case to give maximum signal response. High purity certified reagents were used. Concentrated nitric acid was obtained from British Drug Houses (BDH), chemical stock solutions (1000ppm) of the elements were used to standardize the work, while properly distilled deionized water was utilized for the samples and standards.

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Sample digestion for atomic absorption determination

About 2.5g of oven dried, ground sample was placed in a 50cm³ long neck digestion flask, 10cm³ concentrated acid mixture was added with occasional string to obtain a homogenous mixture and digested slowly at 70⁰C using a hot plate. 5.0cm³ portion of the acid mixture was later added and the temperature increased to about 100⁰C and maintained until approximately 5cm³ solution remained. The solution was allowed to cool (cold digest usually looks colourless or yellowish) and a few drops of hydrogen peroxide were added and heated gently until the digest was clear. The final digested solution was transferred into 50cm³ calibrated flask and diluted to volume with deionized water. A blank digest was carried out in the same way.

Analysis

Aliquots of the digest were analysed for the trace elements and heavy metals by flame (Varian Techron AA-5 type) Atomic Absorption spectrometry using the standard addition method. Copper was analysed by using NBS certified reference materials that were digested together with the samples and analysed quantitatively using the same procedure. Concentrated nitric acid was obtained, chemical stock solutions (1000 ppm) of the various elements were used to make working standard, while distilled deionized water was used to dilute samples and standards.

RESULTS AND DISCUSSION

The animals were fed for about six weeks and their weight gain is as shown in table 2. The animals in the various cages were fed at the same time and given same quantity of food at a time. They equally have access to water *ad libitum*. After the two (2) weeks of feeding the rats with their ration, they were then placed on the experimental feeds for six (6) weeks. The weight gain by the rats ranges from 31.08% to 46.29%.

The similar weight gain by the animals fed with the experimental feeds and those fed on animal ration could be attributed to a possible reduction in the pollutant concentration, which could also be connected to the processing regime. Animals fed with the ration gained more weight. This could likely be due to the presence of more nutrients in the feed unlike those of the experimental fed of garri made from cassava uprooted from the polluted areas, which could have high concentration of anti-nutritive factors (chemical pollutants) and other compositions.

Table 2: Average Body Weight Gain by the Rats

Weeks	1	2	3	4	5	6	Total gain (g)	Wt. (%)	Total Wt. gain
Feed 1	189.12 ±10.01	199.10 ±4.53	235.50 ±7.13	238.60 ±16.57	246.40 ±10.20	273.23 ±7.15	84.11±3.21	44.47±2.31	
Feed 2	196.10 ±9.42	203.22 ±10.11	211.02 ±6.21	224.41 ±7.16	241.11 ±6.01	257.04 ±9.11	60.94±4.11	31.08±3.11	
Feed 3	179.33 ±8.32	194.10 ±8.91	214.50 ±2.16	229.41 ±9.14	241.11 ±10.31	249.22 ±4.13	69.89±6.32	38.97±7.12	
Feed 4	200.35 ±4.32	221.31 ±4.17	241.21 ±6.12	255.52 ±4.22	268.30 ±8.92	293.10 ±6.40	92.75±5.22	46.29±4.18	

Legend Feed 1 – Garri from cassava sourced in Eket; Feed 2 – Garri from cassava sourced in Ibno; Feed 3 – Garri from blends of cassava sourced from the two towns; Feed 4 – Normal ration of rats

As seen in the table 3, there were high concentrations of toxic metals. Toxic metals such as nickel, cadmium, lead, iron and chromium were found in high quantities in the raw materials (both cassava and smoked fish). The concentrations of these harmful metals were more felt in the smoked fish than the cassava except for nickel and chromium. This might probably be because the fish might have accumulated more toxicants during smoking (in the presence of flared gas) in addition to the high concentration load it might have collected from polluted water bodies. This is similar to what was reported by Enujuigha, (2001), that bioaccumulation of some of these heavy metals may lead to food poisoning, and WRI, (1994), that ingestion of food contaminated with metals over extended period of time can cause serious effect which may lead to irreversible health damage. Also, the large quantity of the heavy metal content recorded in the fish sample was in line with what ITOPE, (2001) reported that fishes living near shore waters and juveniles in shallow water nursery ground may be at greater risk to exposure from dispersed or dissolved oil. Some nutritive metals were also found in the raw materials, which is an indication that it not all about toxic metals only. Trace amount of Mercury (Hg) and Arsenic (As) were also identified, which could be as a result of the processing being done in the vicinity of the pollution. Slight differences were also noticed in the raw cassava from the towns in terms of their metal contents. It was observed that cassava tubers sourced from Eket were more contaminated than those sourced from Ibno, which could be attributed to the number of oil processing or oil movement in the area.

Table 3: Metal Content of Basic Ingredients

Raw materials	METAL ION CONCENTRATION (ppm)									
	Zn	Cd	Cu	Pd	Ni	Fe	Cr	Mn	As	Hg
Raw cassava ₁	221.5	33.75	60.31	148.31	529.42	1382.37	3.91	238.01	9.24	3.22
	±3.32	±0.12	±1.22	±8.00	±10.31	±13.07	±0.01	±8.29	±0.11	±0.10
Smoked fish	92.48	52.39	34.36	286.40	404.75	3184.10	1.83	312.75	9.52	4.93
	±3.13	±3.12	±4.24	±2.32	±8.41	±10.71	±2.40	±7.52	±2.76	±1.30
Raw cassava ₂	234.52	30.31	29.62	136.61	485.69	1374.08	2.78	222.44	7.52	2.52
	±4.70	±0.12	±3.28	±4.53	±7.66	±4.67	±3.44	±5.22	±7.07	±2.71

Raw cassava ₍₁₎ obtained from Eket; Raw cassava ₍₂₎ obtained from Ibno; Smoked fish obtained from the two places. Zn: Zinc; Cd: Cadmium; Cu: Copper; Pb: Lead; Ni: Nickel; Fe: Iron; Cr: Chromium; Mn: Manganese; As: Arsenic; Hg: Mercury.

Alkaline phosphate, serum glutamate oxaloacetate transaminase (SGOT), serum glutamate pyruvate transaminase (SGPT) and creatininereults are as shown in table 4. Short-term represents the concentration after two weeks, while the long-term represents enzyme concentrations after six weeks.

The results show a gradual increase in the level of enzyme as the experiment progresses indicating the level of chemical toxicants on the animals. The increased levels of the enzymes in the feeds indicate severe damage of the intracellular cells called cell lyses, except for feed 4 which was the normal ration of the rat. In a normal functioning system, the levels of these enzymes are normal, but in the case of cell lyses (rupturing of cells), an abnormal increase in the enzyme level is observed because the membrane pockets containing the blood has been ruptured, which invariably releases a lot of enzymes into the serum.

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Table 4: Enzyme Analysis

		SGOT IU/L	SGPT IU/L	ALKALINE P'ase	CREATININE
Feed 1	Short term	165.78	102.42	251.56	0.86
		±3.01	±2.64	±5.87	±0.01
	Long term	201.11	113.65	267.80	1.26
Feed 2	Short term	±9.73	±5.42	±9.42	±0.16
		264.76	254.75	392.18	2.17
	Long term	±5.30	±11.11	±11.11	±1.03
Feed 3	Short term	321.32	289.20	439.37	2.21
		±12.12	±1.04	±11.41	±0.47
	Long term	261.00	149.61	451.89	1.59
Feed 4	Short term	±2.07	±5.01	±10.00	±1.07
		311.20	182.30	521.91	2.01
	Long term	±7.17	±6.19	±10.11	±0.01
Feed 4	Short term	22.12	31.48	26.91	0.31
		±1.08	±3.28	±1.51	±0.02
	Long term	29.96	32.16	31.41	0.32
		±0.03	±0.43	±0.19	±0.01

SGOT: Serum Glutamate Oxaloacetate Transaminase; SGPT: Serum Glutamate Pyruvate Transaminase; Alkaline P'ase: Alkaline Phosphate

CONCLUSION

The study has shown that oil exploration is doing a lot of damage to the safety of the people of the community where oil is being tapped. However, proper processing of food product could be a way of reducing the level of toxic metals in agricultural products sourced from this area. Heat processing method could be a great potential in the reduction of chemical pollutant load. The adoption and use of appropriate processing method could ensure adequate detoxification/reduction of pollutants in food products in polluted areas and other area. It could also be concluded that reduction of chemical pollutant through appropriate processing is essential for the safety and healthy living of people in oil polluted area. This research is also a template for investigating the effect of oil exploration on agricultural produce in other oil producing communities in order to ascertain the level of toxicants on the health safety of the populace.

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