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Levels of Toxic Mineral Elements in Selected Foods Marketed in Nigeria

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A very diverse group of chemicals find their way into foods and food raw materials and some are of interest by virtue of their undesirable or potentially undersirable properties with respect to food safety. Chemically, these substances represent a wide range of compounds from simple inorganic salts, on the one hand, to large macromolecules, on the other (Wogan 1976).

In the more advanced countries of the world, the dangers posed to food safety by elemental toxicants, is well known. Therefore, studies have been conducted to monitor the levels of these toxicants in the environment and foods (Denny and Welsh 1979; Melhuus et al. 1978; Moran 1981).

In Nigeria, a developing country, the information on the toxic elements in foods marketed in the country, is very limited. Increasing urbanization has made such information important. Some studies on some toxic elements in freshwater fish, intertidal and terrestrial molluscs and algae have been conducted (Ndiokwere 1983a; 1983b; 1984).

The present studies examine levels of toxic and potentially toxic elements in some fresh and canned foods marketed in Nigeria.

MATERIALS AND METHODS

The canned foods analyzed were beef, Canada Best and Peak evaporated condensed milk, powdered Nido milk, cabbage (with pork meat and sausage), fish (in tomato sauze, Geisha brand), tomato puree (Vegfru brand) and herb (with pork and spices). The fresh foods analyzed were hulled melon seeds (Citrullus vulgaris), yam tubers (Dioscorea spp.), plantain fingers (Musa paradisiaca), water leaf (Talinum triangulare), bitter leaf

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(*Vernonia amygdalina*), and gari flour (*Manihot* sp.) obtained by light roasting of fermented cassava mash.

The canned foods were purchased at supermarket stores in Benin City, Nigeria, while the fresh foods were purchased at various traditional markets in and around Benin City, Nigeria.

The following mineral elements were analyzed for by atomic absorption spectrophotometry (Varian AG AA, No. 1475); Iron, arsenic, copper, lead, manganese, zinc, cadmium and nickel.

Two g of each sample, in duplicate, were subjected to wet oxidation with 15 ml conc. nitric acid, 10 ml perchloric acid and 5 ml sulphuric acid. The resulting filtered digest was used for the atomic absorption spectrophotometric analyses (Gough 1972). However in the case of nickel, lead and cadmium, the digest was concentrated by chelation-solvent extraction using sodium diethyl dithiocarbamate (Agmeian et al. 1980).

RESULTS AND DISCUSSION

The levels of the various elements in the various foods examined, are presented in Table 1.

The major nutritional importance of iron lies in it being a component of the pigments - haemoglobin, myoglobin and the cytochromes - involved in oxygen transfer in the human body. An excess intake of iron can, however, lead to nutritional siderosis (Bothwell and Bradlow 1960). The iron content of the food samples examined in the present studies, as presented in Table 1, which ranged from 0-16.6 µg/g sample, is well below the 100mg/100g level associated with siderosis.

Essential enzyme systems, including those responsible for the oxidation of ascorbic acid, are dependent on traces of copper. Copper sulfate is widely used for killing algae and bacteria in swimming pools, etc; but in high concentrations at least, it is poisonous to animal and man. A concentration of 1.5 ppm should not be exceeded in drinking water (Davidson et al. 1973). The levels of copper in the foods indicated in Table 1 are well below the recommended general limit of 20 µg/g (Pearson 1976).

Zinc is an essential component of at least, eight enzyme systems; these include carbonic anhydrase, carboxypeptidase and alcohol dehydrogenase (Davidson et al. 1973), but zinc has emetic action when ingested in high amounts. The range of zinc (0.02-1.09, µg/g) in

Table 1. Levels (µg/g sample, averages of duplicate readings) of toxic and potentially toxic elements in selected foods marketed in Nigeria

Samples	Fe	Cu	Zn	Mn	Pb	Cd	Ni	As
Canada Best milk	0.65	0.05	0.31	0.01	0.83	0.02	n.d.	0.04
Peak milk	0.50	0.038	0.28	0.01	0.25	0.02	n.d	0.02
Powdered Nido milk	0.70	0 05	0.32	0.001	0.30	0.03	-	0.01
Cabbage + pork + sausage	16.60	0.50	0.52	0.40	1.30	0.20	0.80	-
Fish in tomato sauce (Geisha brand)	15.90	1.00	1.09	0.42	1.56	-	n.d	-
Vegfru tomato puree	12.53	1.08	0.91	n.d	1.58	0.15	0.46	-
Herb + pork + spices	11.13	0.20	0.93	0.92	1.82	0.17	n.d	-
Beef	11.83	1.38	0.91	1.43	1.30	0.12	2.80	-
Melon seed	1.60	0.63	0.32	0.11	0.43	0.03	-	0.01
Yam tubers	1.05	n.d	0.02	n.d.	0.35	0.01	-	n.d
Plantain	1.15	n.d.	0.03	0.04	0.20	n.d.	-	0.04
Gari flour	0.95	n.d.	0.01	0.02	0.11	0.01	-	n.d.
Water leaf	n.d	0.04	0.11	0.19	0.25	0.01	-	0.31
Bitter leaf	n.d	0.2	0.09	0.79	0.30	0.02	-	0.02

n.d. = not detected
\- = not determined

the food samples analyzed is clearly below the recommended general limit of 50 ppm (Pearson 1976). Manganese is concerned in a number of enzyme systems, including arginase, oxidative phosphyorylation, fatty acid and cholesterol synthesis. On the negative side, manganese poisoning occurs in workers at manganese mines. The signs and symptoms are those of a generalized disease of the central nervous system and in some respects the condition resembles Wilson's disease (Davidson et al. 1973). With respect to this type of toxicity, the levels of this mineral element, as presented in the Table, appear safe.

Lead is a toxic element affecting neurological and psychomotor functions (Pueschel 1974), among other deleterious effects. Again, however, with a statutory limit of 2 µg/g (Pearson 1976), all the food items examined in the present studies may be described as safe. But the fish-in-tomato-sauce, tomato puree and the herb-plus-pork-plus-spices, food items (Table 1) appear dangerously close to the statutory limit, probably as a result of leaching from can to food.

Cadmium is another recognized toxic element which may induce nausea and vomitting, prostrate cancer and functional and morphological changes in many body organs (Lauwerys 1978). The range of cadmium in the foods (0-0.03 µg/g), as shown in Table 1, does not seem to indicate a risk to health.

Nickel alloys are widely used for lining cooking vessels, pasteurization equipment, etc. A nickel catalyst is used in the hydrogenation of oils for making margarine (Davidson <u>et al</u>. 1973). Although nickel is regarded by many as <u>not</u> toxic to man, nickel carbonyl is thought to be important in cancer of the respiratory system. In accordance with the results in Table 1, only three of the food items examined showed the presence of nickel and these were at levels apparently not high enough to induce cancer (Doll et al. 1970).

Arsenic is a toxic element for which the statutory general limit is 1µg/g and for which statutory limits for specific foods ranging from 0.1-5 µg/g have been established (Pearson 1976). It is observed in Table 1 that all the food items screened for arsenic had levels below these statutory limits.

The levels of elements in a food sample may be due to transfer from environment (aerial, aquatic and soil) to food, contamination from processing equipment and reagents, accidental contamination during storage and marketing, leaching from container to food, and the natural occurrences of the various elements in the food. Therefore, the results presented in these studies are not necessarily indications of either good or bad manufacturing practices by the food processors concerned, especially with respect to those products for which the brand names have been identified.

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