



Variation of Heavy Metals in Canned Geisha and Fouty Mackerel Fish Brands Obtained from Choba Market Port Harcourt, Nigeria

^{*1}IWUOHA, G N.; UPORO, V B.; ONWUACHU, U I.

a Department of Pure and Industrial Chemistry University of Port Harcourt, Rivers State Nigeria.

b Department of Chemistry, Nwafor Orizu College of Education Nsugbe, Anambra State.

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ABSTRACT: Two varieties of canned mackerel fish samples purchased from Choba market, Port Harcourt, Nigeria were pre-treated using dry ashing methods and were analyzed for heavy metals. Cr, Cu, Fe, Mn, Ni, Pb and Zn, were determined using the Atomic Absorption Spectrophotometer (AAS). The range obtained for the elements analyzed in mg/kg (dry weight) are as follows, Cr (0.00-0.0052), Cu(0.00-0.0033), Fe(0.00-0.0379), Mn (0.0016-0.0028), Ni (0.00-0.0018), Pb(0.0004), and Zn(0.01-0.0187). In both brands, the heavy metals levels analyzed were below the Food and Agriculture Organization (FAO) recommended limit of 40 mg/kg and the corresponding Ministry of Agriculture, forestry and fishery of the united kingdom(MAFF) guideline value of 2.0mg/kg. Also based on the (USEPA) health criteria for carcinogens, there are no health risks with respect to Pb, Cr, Cu and Zn concentrations in canned fishes analyzed. The results of this study indicate that mackerel fish have concentrations well below the permissible FAO/WHO levels for these toxic metals. Their contribution to the body burden can be therefore considered negligible and the fish seem to be safe for human consumption. ©JASEM

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There is increasing concern about the quality of canned foods in several parts of the world. The determination of toxic elements in food has prompted studies on their toxicological effects. Heavy metal is a term, given to the group of metals and metalloids with atomic density greater than 5g/cm³, usually associated with pollution and toxicological problems. Abdulrahman stated that “heavy metals” are a group of metals and metalloids (semimetals) associated with contaminations and are potentially toxic. Living organisms require varying amounts of heavy metals. Iron, cobalt, copper, manganese, molybdenum, and zinc are required by humans Alka, (2000). Excessive levels can be damaging to the organism. Other heavy metals such as mercury and lead are toxic metals that have no known vital or beneficial effect on organisms and their accumulation over time in the bodies of animals can cause serious illness Charles and Linden, (1999). Certain elements that are normally toxic are, for certain organisms or under certain conditions, beneficial. Examples include vanadium, tungsten, and even cadmium Alka, (2000).

Heavy metals are natural components of the Earth’s crust. They cannot be degraded or destroyed. To a small extent they enter our bodies via food, drinking water and air. As trace elements, some heavy metals

(e.g. copper, selenium, iron, manganese, zinc) are essential to maintain the metabolism of the human body.

At higher concentrations these heavy metals can lead to poisoning. Heavy metal poisoning could result, for instance, from drinking-water contamination (e.g. from lead pipes), high ambient air concentrations near emission sources, or intake via the food chain. A group of heavy metals are classified as non-essential, because they have no biological, chemical and physiological importance in man e.g. Cadmium (Cd), Mercury (Hg), Lead (Pb), etc Ikem and Egiebor,(2005). Arsenic is a highly toxic element and its presence in food is a matter of concern to the humans. After acute and chronic exposures, it causes a variety of adverse health effects to humans such as dermal changes, respiratory, pulmonary, cardiovascular, gastrointestinal, haematological, hepatic, renal, neurological, developmental, reproductive, immunologic, genotoxic, mutagenic, and carcinogenic effects Mandal and Suzuki (2002).

MATERIALS AND METHODS

Some apparatus used include; oven, weighing balance, heating mantle, volumetric flask, conical flask, spatula, watch glass.

The Geisha sample was homogenized and dried in the oven at 105°C to dryness. 10g of sample was accurately measured in 250ml conical flask and 12ml of conc. HNO_3 in a fume hood was added and covered with a watch glass. Samples were heated in a heating mantle close to dryness and cooled. 10ml each of conc. HNO_3 and HClO_4 were further added. Samples were evaporated gently on a heating mantle until dense white fumes of HClO_4 appeared. The sample was cooled and diluted to 50ml with distilled water and boiled to expel any chlorine or oxide of nitrogen. The sample was cooled, filtered and transferred into 50ml volumetric flask and made up to mark with distilled water.

Analytical grade of reagents was used throughout the research process. Standard solutions of the various metals were prepared from stock solutions for the calibration curves for all the metals. The stability of calibration was checked periodically by analyzing the standard solution. Blank samples made from only reagents without sample were analyzed to get rid of any background concentration metals in the system. The selected heavy metals were then determined using atomic spectrophotometer, Shimadzu AAS (Model 6550).

Standards of the various parameters are subjected through the various methods in order to check the reliability of the data and the following results were obtained (Table ii).

Recovery analysis for all the metals determined gave results above 95%, an indication of the reliability of the results.

RESULTS AND DISCUSSION

Two brands of canned mackerel fish were analyzed for lead, chromium, zinc, nickel, manganese, copper, and iron. Good recoveries of spiked samples demonstrate the accuracy of the method used. The concentrations of chromium, lead, zinc, nickel, copper, manganese, and iron in both brands are presented in table i.

Chromium (III) is an essential nutrient that potentiates insulin action and thus influences carbohydrate, lipid and protein metabolism. However, Chromium (VI) is carcinogenic. The results indicate that the concentration varied between the two brands of canned mackerel analyzed. In this study, chromium concentration in mg/kg was found to be 0.0052 (Table i) in the Geisha canned mackerel brand to the 0.0027mg/kg (Table i) chromium concentration in Founty canned mackerel brand. According to (COMA), Committee on Medical

Aspects of Food and Nutrition, Dietary Reference Values for trivalent chromium lies above 0.025 mg/day for adults and, between 0.0001 and 0.001 mg/kg/day for children and adolescents (COMA, 1991). COMA also noted that no adverse effects were observed at intakes of 1000-2000 mg/day of trivalent chromium. The US National Research Council (NRC) specified an Estimated Safe and Adequate Daily Dietary Intake (ESADDI) of 0.05-0.2 mg/day for adults and 0.01-0.04 mg/day infants (0-0.5 years).

Copper is essential for good health but a very high intake can result in adverse health problems, such as liver and kidney damage. The concentration of the essential heavy metal, Cu in the Geisha brand was found to be 0.0033mg/kg and the concentration in the Founty mackerel brand put at 0.0022mg/kg far below the safe limits set. This variation, however puts to rest the perceived toxicity in new brands of canned mackerel as they are still below safe limits in comparison to standards set by COMA with a Cu concentration of 1.2 mg/day for copper (COMA, 1991). The US safe designation for adults is 1.5mg Cu for adult males and twice that value, 3.0 mg/day for adult females. This suggests that supplements through other foods can be taken orally. Copper supplements are generally only used to correct copper deficiency. Benefits have been claimed for copper-containing supplements as anti-oxidants for general use, and specifically for arthritis and osteoporosis. There is speculation that copper might have a role in preventing age-related decline in tissue function, and possibly in ensuring healthy foetal brain development. It should be known that Cu concentration in the analyzed canned mackerel fish samples were also below the MAFF guideline value of 30mg/kg.

According to FDA (2000), there is no information on the carcinogenicity of manganese. COMA and the WHO were unable to set a specific recommendation for manganese intake. The EU Scientific Committee for Food (SCF) considered a 'safe and adequate intake' to be 1-10 mg/person/day. The US National Research Council (NRC) specified Estimated Safe and Adequate Daily Dietary Intakes (ESADDIs) of 0.3-1, 1-3 and 2-5 mg/day for infants, children and adults respectively. From the results, Geisha brand had 0.0028mg/kg while the Founty brand had manganese levels of 0.0016mg/kg. This shows that both brands give minimum Manganese levels and as such, supplements through other foods be ingested daily. It should be known that manganese levels in foods may also be affected by food processing.

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Estimated average daily iron requirements in the UK are 8.7 and 6.7 mg for males aged 11-18 and 19+ years, respectively (COMA, 1991). For women in the 11-50 years age group the estimated average daily iron requirement is 11.4 mg, whilst that for postmenopausal (50+years) women is 6.7 mg. Estimated average daily requirements for children are 1.3 mg (0-3 months), 3.3 mg (4- 6 months), 6.0 mg (7-12 months), 5.3 mg (1-3 years), 4.7 mg (4-6 years) and 6.7 mg (7-10 years). It has been estimated that the total amounts of iron required for a full gestation is 680 mg. From the results, Geisha brand had 0.0379mg/kg while the Founty brand had iron levels of 0.0302mg/kg. This shows that both brands lies below minimum Fe levels and as such, supplements through other foods be ingested daily.

COMA was unable to set recommended amounts for nickel intake. However from the results obtained, Geisha brand had concentration of 0.0018mg/kg while the Founty brand had Nickel concentration of 0.0011mg/kg. This levels sure lies below the WHO/FEPA Nickel limits in foods and as such, supplements through other foods should be ingested daily.

Zinc is known to be involved in most metabolic pathways in humans and zinc deficiency can lead to loss of appetite, and other health problems. Zinc is widespread among living organisms, due to its biological significance. The maximum zinc level permitted for fish is 50mg/kg according to Food Codex. The UK required nutritional intake (RNI) ranges set by COMA for zinc are 5.5-9.5 mg/kg/day for adult males and 4.0- 7.0 mg/day for adult females. The US Recommended Daily Allowance (RDA) is 15 mg/day for adult males and 12 mg/day for adult females. These set levels of heavy metals, however are higher in comparison to the levels in the canned mackerel brands analyzed: Geisha had concentration of 0.01-87mg Zn/kg while Founty had 0.105mg/kg of zinc.

Lead is known to induce reduced cognitive development and intellectual performance in children and increased blood pressure and cardiovascular disease in adults. The fact that toxic metals are present in fishes is of particular importance in relation to the FAO/ WHO (1976) standards for Pb as a toxic metal. In Geisha, the lead concentration analyzed was 0.004mg/kg while the heavy metal was not detected in the Founty canned mackerel brand. These levels fall below the estimated lead intake level in foods and hence, supplements through other sources are encouraged but not to toxic levels. Average daily lead intake for adults in the UK is

estimated at 1.6µg from air, 20µg from drinking water and 28µg from food. The permissible doses for an adult are 3mg Pb per week but the recommended doses are only one-fifth of this quantity. It should be noted that the maximum Pb level permitted for canned fishes is 0.2mg/kg according to the European communities (FDA, 2000). Although most people receive the bulk of their lead intake from food, in specific populations other sources may be more important, such as water in areas with lead piping and plumb solvent water, air near point of source emissions, soil, dust, paint flakes in old houses or contaminated land. Lead in the air contributes to lead levels in food through deposition of dust and rain containing the metal, on crops and the soil (Cesar et al., 2003). For the majority of people in the UK, however, dietary lead exposure is well below the provisional tolerable weekly intake recommended by the UN Food and Agriculture Organization and the World Health Organization.

For the selected metals, Cu, Cr, Zn, Fe, Pb, Ni and Mn, the recorded concentrations in mg/Kg were below the levels set by WHO and other standard bodies. It is therefore imperative to perform routine monitoring on the levels of Cr, Cu, Fe, Mn, Ni, Pb and Zn in these well-patronized canned mackerel brands so as to avert encountering metal toxicity. The levels of toxic elements in mackerel fish are related to age, sex, season and place Fricke *et al.*, (1979). It is also reported that cooking reduces the amount of some metals Atta *et al.*, (1997). Moreover, the advances of new packaging technology, especially the use of cans with lacquered walls and mechanical seam, reduce or, in most cases, eliminate the leaching of heavy metals (lead and tin) into the food Ngoddy *et al.*, (1992).

Conclusion And Recommendation: Heavy metal contamination in canned foods has been an important topic. Facility modernization and quality manufacturing are required to prevent heavy metal contamination in mackerel and other canned products and thus the possible health hazards to the consumer. A long-term and/or excessive consumption of foods containing heavy metals above the tolerance levels has a hazardous impact on human health. Since canned foods are widely consumed, they contribute a large fraction to the heavy metals intake and, therefore, strict control of these elements is advisable. For this reason, the steps in all processes must be monitored for preventing the contamination by heavy metals.

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Also, this present analysis confirms the fact that both brands of canned mackerel fish analyzed are safe for human consumption.

However, the shelf life of these brands needs be reduced to avoid oxygen intake by rusted cans and result to leaching of alloyed materials into the food.

Table 1 Means concentrations of heavy metals (mg/kg) in canned mackerel samples.
ND = Not Detectable.

Heavy Metal	Geisha Brand (mg/kg)	Founty Brand (mg/kg)
Cu	0.0033	0.0022
Ni	0.0018	0.0011
Zn	0.0187	0.0105
Mn	0.0028	0.0016
Cr	0.0052	0.0027
Fe	0.0379	0.0302
Pb	0.0004	ND

Table 2 Metal Recovery and Standard Deviation

Analyte	Mean Recovery	Standard deviation n=3
Chromium	96.4	0.00
Copper	95.7	0.01
Nickel	98.5	0.00
Zinc	96.0	0.03
Lead	97.0	0.02
Iron	96.2	0.10
Manganese	96.9	0.02

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