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Assessment of the levels of trace metals concentration in some brands of canned tomato paste in Calabar markets

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Abstract
This study was designed to evaluate the levels of trace elements concentration in some brands of canned tomato pastes sold in Calabar markets. 5 brands of canned tomato pastes: Clappa, Tasty Tom, La Mama, La Jonic and Rico Giko were obtained from Watt market, Marian market, Ikot Ishie market, Mbukpa market and Edim Otop market across Calabar, Cross River State and were subjected to Unicam (SOLAR AAS 969) after acid digestion. The levels of the following trace metals: Fe, Cu, Mn, Cr and Ni were determined and the results obtained showed 5.45-8.23mg/kg, 1.87-3.64mg/kg, 0.33-0.49mg/kg, 0.31-0.44mg/kg and 0.09-0.23 mg/kg respectively. The average Cr levels in the five samples were significantly high and exceeded the WHO/FAO daily intake of 0.05mg/kg. The copper concentration, 3.64mg/kg in Rico Giko brand was observed slightly higher than 3.0mg/kg intake/day. The Fe content of La Mama and La Jonic appeared were slightly higher other brands. Manganese levels appeared in the decreasing order of Clappa>La Jonic>Tasty Tom>La Mama>Rico Giko, while the Ni content of the studied tomato pastes agrees strongly with WHO/FAO daily intake recommendations.

Keywords: concentration, metals, levels, tomato, paste

1. Introduction

Cans are alloy used for the distribution or storage of goods, foods and beverages since 18th century as a results of the increasing industrial and agricultural activities. Incidentally, this has led to increased environmental load of metals and subsequent contamination of human foods. The study of metal contents in food stuff is of growing concern because some these metals are required for normal growth while others cannot be tolerated at high concentration since they are extremely toxic to humans (Milacic and Kralj, 2003) [13].

Concerns for the metal content of foods are important for two major reasons; firstly, estimation of dietary requirement for essential metals and secondarily, evaluation of human exposure to toxic elements (Soliman and Zikovsky, 1999 and Iwegbue, 2010) [17, 8]. The hazard of metals to human from consumption of contaminated foods depends on the relative levels of the metal and its speciation. Chromium for instance,may damage the kidney and symptoms of generic alteration hemolytic, gastrointestinal hemorrhage and pulmonary fibrosis. However, copper, zinc and iron are essential elements required for normal growth. But excessive intake of copper and zinc have noted for nephritis, anural and extensive lesions in the kidney (Abou-Arab *et al*., 1999).

The rate of consumption of tomatopaste in foods sold in eateries, fast food vendors, domestic and even in public functions across Nigeria and Calabar being the centre of tourism in particular is a growing concern for Analytical Chemists, Food Scientists and Researchers. There has been reported index of heavy metals concentrations in canned tomatoes across the world (Washeed *et al.,* 2003, David *et al.,* 2008, Itodo and Itodo, 2010 and Boadi *et al.,* 2012) [20, 3, 7, 2], but no complementary research is reported in Calabar, thus making the knowledge of exposure of chemical hazard from canned foods especially tomato paste patchy.

Food contamination by trace metals constitute a significant health hazard since these metals bio concentrate and amplify its concentration in target tissues and organs and to the onset of associated diseases (Nishihara *et al.,* 1985 and Boadi *et al.,* 2012) [2]. Ingested trace metal toxicant at levels above the threshold of risk associated with etiology. Levels of iron and manganese above the threshold of risk associated nervous system dysfunction (Venugopal and Luckey 1975 and Boadi *et al.,* 2012) [2].

Tomatoes are best preserved by making it into paste and canning. Canning makes these products available for consumption by humans living far away from production locations. Tomato originate from the Spanish word: tomate, which in turn comes from Nahuati word “tomatl” meaning fat water or fat thing. It is an edible fruit with red berry of *Solamumlycopersicum* commonly known as a tomato plant which belongs to the night shade family, *Solanaceace.* The species has it origin in Central and South America and is used as food across the globe. It can be eaten raw, cooked and use as ingredient in many dishes, sauces, salad and drinks.

1.1 Levels of trace elements in tomatoes

Studies have revealed significant concentrations of trace elements in tomatoes. For instance, in Nigeria, a study on canned tomatoes paste sold in Ibadan showed Al concentrations in the range of (17.8–26.7)mg/kg, which differs from the same Al content of 0.3 to 3.2mg/kg sold in Brazil (Onianwa *et al.,*1997). In Turkey, canned sliced tomato content of Cd^{2+}, $Cu^{2+}Pb^{2+}$ and Zn^{2+} was reported to contain 0.308 – 0.318mg/L, 0.000 – 1.968mg/L, 0.262 – 0.372mg/L

and 3.627 – 3.777mg/L respectively. The Cu^{2+}content of tomato Salso was also in the same study to be 3.074mg/L (Kocak *et al.*, 2005) [11]. Another study by Turker and Yuksed (1997) revealed Fe (6.8±1)mg/kg, Cu (6.1±1.2)mg/kg and Zn (7.4±1)mg/kg concentration in canned tomato paste Studies on different kinds of tomatoes in Britain showed that Mn contained 0.9mg/kg, 0.5-1.6mg/kg, 1.9 and 2.2mg/kg and 2.2 - 6.1mg/kg for canned tomatoes, canned tomato juice, tomato ketchups, tomato paste, puce and sauce respectively(Wenlock *et al.*, 1979) [21].

2. Materials and methods

2.1 Sample collection

5 tins samples in each of the brand of the five brands of canned tomato paste were randomly purchased from Watt market, Marian market, Edim Otop market, Mbukpa market and Ikot Ishie market, all in Calabar, Cross River State, Nigeria.

2.2 Sample preparation

5g of the samples were washed into a 250ml beaker and mixed together with HCl and HNO_3in the ratio of (1:3) and 20ml of distilled water was added and then heated with aheated mantle at 90^{o}C until a clear solution obtained. The solution was filtered into a 100ml volumetric flask using Whatman No 42 filter paper and made up to the mark with distilled water, before being analysed using Unicam Atomic Absorption Spectrophotometer (SOLAR 969). The overall analytical procedures were determined in three replicate values.

3. Result and Discussions

3.1 Results

Table 1 shows the results of the levels of trace elements of canned tomatoes brands sod in Calabar. Statistical was carried out and the results documented accordingly.

Table 1: Results of the levels of trace elements concentration in canned tomatoes brands sold in Calabar

Sample ID	Fe(mg/kg)	Cu(mg/kg)	Mn(mg/kg)	Cr(mg/kg)	Ni(mg/kg)
Clappa	5.94±5.03	1.87±1.28	0.49±0.12	0.36±0.45	0.09±0.05
Tasty Tom	5.76±4.68	1.93±0.98	0.39±0.09	0.44±0.59	0.19±0.07
La Jonic	8.02±7.66	3.3±1.8	0.4±0.10	0.31±0.62	0.19±0.09
La Mama	8.23±7.87	3.04±1.28	0.36±0.12	0.41±0.50	0.16±0.09
RicGiko	5.45±3.91	3.64±2.51	0.33±0.45	0.35±0.45	0.23±0.09
WHO/FAO	15mg/kg	3mg/kg	5mg/kg	0.05mg/kg	0.2mg/kg

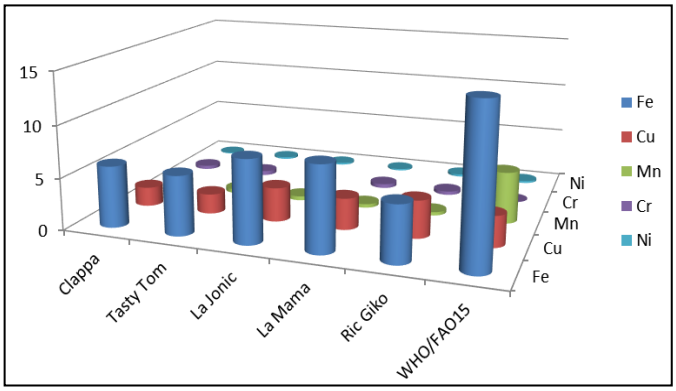

Fig 1: Cylindrical column chart of the levels of Fe, Cu, Mn, Cr, and Ni concentrations in different brands of canned tomato pastes

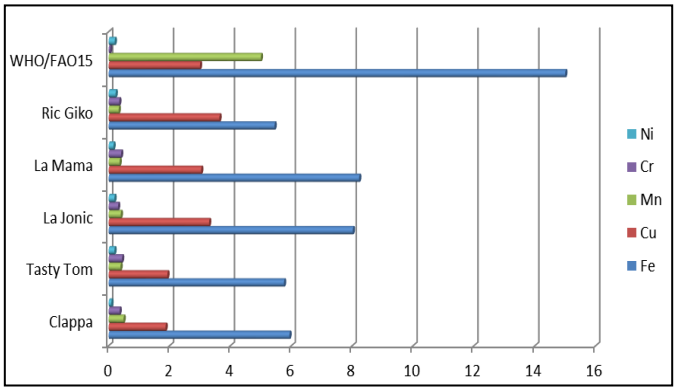

Fig 2: Horizontal Bar Chart showing the levels of selected trace metals concentration in different brands of canned tomato pastes

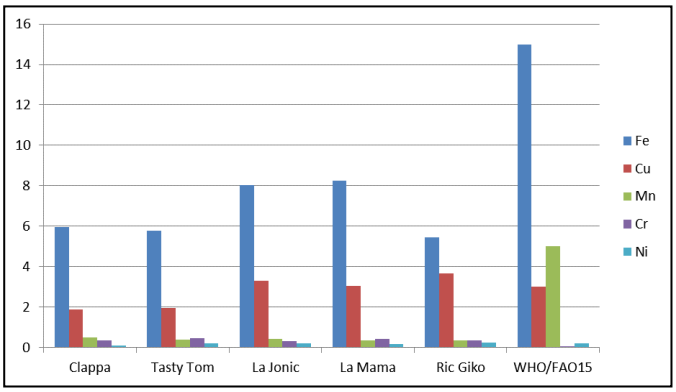

Fig 3: Column chart showing the levels of trace metals concentration in different brands of tomato pastes compared to WHO/FAO limits

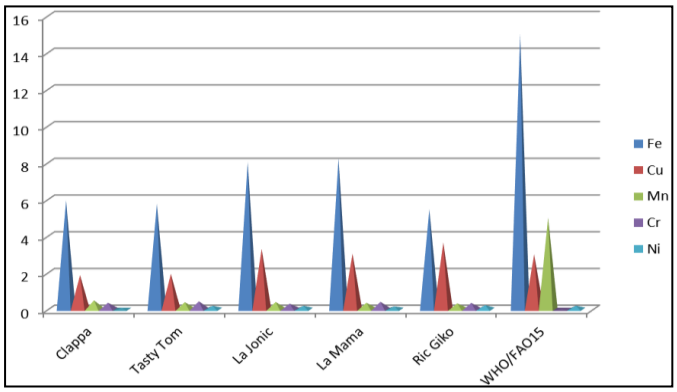

Fig 4: Conical column chart of the levels of trace metals concentration in canned tomato pastes compared to WHO/FAO limits

3.2 Discussion

The levels of trace elements of the present study in canned tomato paste varied significantly with WHO/FAO (1993) [22] daily intake. The levels of Fe in Clappa, Tasty Tom, La Jonic, La Mama and Ric Giko ranged from 5.45±3.91mg/kg for Ric Giko to 8.23±7.87mg/kg for La Mama (Table 1). The obtained results were lower than 63.11-96.10mg/kg reported by Melaku-Zigde (2009) on canned tomato paste but higher than 0.00-0.03379mg/kg reported by Iwuoha *et al.* (2013) [10] on canned Geisha and Founty mackerel. Iron is most times present in many food products and sometimes added to foods. It is a dietary supplement and is a pathway for energy and substrate for metabolism. Globin-haem are transporters of O_2, CO_2, CO and N_2O (e.g haemoglobin and neuroglobin) as stores of O_2 egmygloand and neutroglobin and scavengers of free radicals. The cytochrome P-450oxidase system embraces over 11000 diverse activities including cholesterol and vitamins A, D and K.

The contents of Cu in the studied tomato paste appeared in the range of 1.87mg/kg to 3.64mg/kg (Table 1). These agreed strongly with the WHO/FAO daily intake of 3mg/kg for Cu. The copper levels of the present study were higher than 0.000 – 1.9687mg/kg reported by Kocak *et al.* (2005) [11] on canned slice tomato but lower than 2.855-7.77mg/kg reported by Tuzen and Soylak (2007) [18]. However, Cu in La Jonic and Ric Giko were slightly above the WHO/FAO recommendations but fell below it in La Mama and Clappa (Fig 1, 2, 3 and 4). Copper is an essential trace element for plants and animals. It is absorbed in the gut and then transported to the liver bound to albumin and after processing in the liver distributed to other tissues in the second phase, which involves the protein ceruloplasma, carrying the majority of copper in blood. It acts as an antioxidant and helps the body to remove free radicals, prevent cell structural damage (Salama and Radwan, 2005) [15]. Cu plays essential role in bone formation andskeletal mineralization (Mariam *et al.*, 2004) [12].

The levels of Mn from the studied canned tomato pastes revealed: Clappa (0.49±0.12)mg/kg, Tasty Tom (0.39±0.09)mg/kg, La Jonic (0.4±0.1)mg/kg, La Mama (0.36±0.12)mg/kg and Ric Giko (0.33±0.05)mg/kg respectively (Table 1). The result obtained were lower than 11.73-17.95mg/kg reported by Zahrah *et al.* (2014) [16], but higher than 0.0016-0.0028mg/kg reported by Iwuoha *et al.* (2013) [10] on Geisha and Founty mackerel. The level concentrations were below WHO/FAO recommendations (Fig 1, 2, 3 and 4). Mn^{2+} is a cofactor for a large variety of enzymes with many functions. These enzymes are particularly useful in detoxification of superoxide free radicals in organisms that must deal with essential O_2. One of the main functions of Mn is in the oxygen evolving complex of photosynthetic plants. Mn is required for all organisms but is a neurotoxin FDA (2000) [5].

Chromium levels the studied canned tomato pastes show 0.36±0.4mg/kg, 0.44±0.59mg/kg, 0.31±0.62mg/kg, 0.41±0.50mg/kg and 0.35±0.45mg/kg for Clappa, Tasty Tom, La Jonic, La Mama and Ric Giko tomato pastes respectively (Table 1). The results obtained were higher than 0.00-0.0052mg/kg as reported by Iwuoha *et al.* (2013) [10] for canned Geisha and Founty mackerel. The levels of Cr concentrations in all the studied samples were below WHO/FAO daily intake (Fig 1, 2, 3 and 4). Cr at +3 oxidation state becomes essential and initiates insulin action and thus influences carbohydrate lipid and protein metabolism at a reasonable level. From our studies, Cr content of canned tomato paste should be checked by the manufacturing companies, as high level of Cr in canned foods may lead severe health issues such as respiratory problem, birth defects, infertility and tumor formation.

The levels of Ni in the 5 studied canned tomato pastes show that Ric Giko, Tasty Tom, La Jonic, La Mama and Clappa contain 0.23±0.09mg/kg, 0.19±0.07mg/kg, 0.09±0.09mg/kg 0.16±0.09mg/kg and 0.09±0.05mg/kg respectively (Table 1). Similar to Cr, the levels of Ni concentrations in all the studied samples were below WHO/FAO daily intake (Fig 1, 2, 3 and 4).

4. Conclusion

Varied levels of trace metals were obtained across from five different canned tomato pastes. Ni showed the least level in all the studied canned tomato pastes followed by Cr, Mn and Cu, while Fe appeared the highest in all brands of tomato pastes. Fe levels ranged from 4.45±3.9 to 8.23±7.87mg/kg, Cu ranged from 1.87±7.28 to 3.64±2.51mg/kg. Mn levels ranged from 0.33±0.05 to 0.49±0.12mg/kg, while the mean levels of Cr and Ni ranged from 0.31±0.62 to 0.44±0.59mg/kg and 0.09±0.05 to 0.23±0.09mg/kg respectively. The levels of trace metals in 5 canned tomato pastes appeared in a decreasing trend Ni < Cr < Mn < Cr < Fe. A studied trace elements falls within the WHO/FAO permissible daily intake.

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