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Trace Metal Contents in Some Brands of Canned Tomato Paste in Nigerian Market

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ABSTRACT

Concentrations of metals (copper, zinc, lead and iron) were examined in some popular brands of canned tomato paste in Nigerian markets with a view of providing information on the risk associated with the consumption of these products. Samples of some popular brands of tomato pastes canned in metallic containers were analyzed for levels of copper, zinc, lead and iron after acid digestion by atomic absorption spectrophotometry. The mean concentrations (mg kg^{-1}) ranged from <0.9-4.28 for Cu, 0.25-10.75 for Zn, <0.3-1.82 for Pb and <1.0-112.8 for Fe. The concentrations of the metals examined in the samples were present at levels below statutory limits in foods except for lead. This may pose a real danger to consumers, since tomato paste is so commonly consumed and bioaccumulation of Pb can have serious consequence to human health.

Key words: Canned tomato paste, food contamination, trace metal, consumption, popular brands, statutory limits

INTRODUCTION

Industrial and agricultural activities have led a widespread dispersion and increased environmental load of metals and the consequent contamination of human foods (Benova *et al*., 2007; Korenekova *et al*., 2007). The study of metal contents in foodstuffs is of growing concern because some of these metals are required for normal growth while others cannot be tolerated at low concentrations because they are exceptionally toxic to humans (Milacic and Kralj, 2003). Concern for metal contents of human foods are essentially for two principal reasons; estimation of dietary requirement for essential metals and evaluation of human exposure to toxic elements (Iwegbue, 2010; Soliman and Zikovsky, 1999). The hazards of metals to humans from consumption of contaminated foods depend on the relative levels of the metal and its speciation. Lead, for instance, can injure the kidney and cause symptoms of chronic toxicity, including impaired kidney function, hepatic dysfunction and poor reproductive capacity (Abou-Arab *et al*., 1996); moreover, lead can cause reduced intelligence quotient, learning difficulties, slow growth, behavioral abnormalities, hearing difficulties and cognitive functions in human (Dahiya *et al*., 2005). However, copper, zinc and iron are essential and are require for normal growth but excessive intakes of copper and zinc have been implicated for nephritis, anuria and extensive lesions in the kidney (Abou-Arab *et al*., 1996). The margin between essentiality and toxicity of trace metals is usually small (Onianwa *et al*., 1999).

Tomatoes are best preserved by making it into paste and canning. Canning obviously makes these products available for consumption by human living far away from the production sites. In recent years, there has been an influx of different brands of canned tomato paste into the Nigerian market. Most pass through the borders without going through National Agency of Foods and Drug Administration and Control (NAFDAC) screening. Transnational transportation of food items requires proper scrutiny.

In Nigeria and many other countries, tomato pastes make up a significant portion of ingredients used for preparation of stews and soaps, yet there is a paucity of data on metal contents of foods here, so the extend of human dietary exposure to chemical hazards in foods is still patchy. The present study was undertaken to determine the concentrations of copper, zinc, lead and iron in some popular brands of tomato paste sold in Nigerian markets.

MATERIALS AND METHODS

Sampling: Different brands of canned tomato pastes with different batch numbers and packed at different dates were purchased in the months of May to August, 2009 from retail outlets in Agbor and Warri, Nigeria. The choice of brands was carefully made to reflect the variety of brands consumed by different income classes, according to availability at the time of purchase. Twenty six brands were selected and five cans were purchased from each brand for examination.

Analytical determination: Five grams of each sample were placed in 50 mL beakers, into which a 32 mL of mixture of nitric acid, perchloric acid and hydrogen peroxide (6+1+1) was added. The samples were allowed to stand overnight and were then heated at 135°C for 2 h. They were evaporated to dryness slowly (avoiding prolonged baking), cooled and dissolved in 5 mL of 0.25 mol L^{-1} nitric acid and filtered through Whatman No. 42 filter paper. The filtrate was diluted to 25 mL mark with 0.25 mol L^{-1}. Analyses of the samples for Cu, Pb, Zn and Fe were performed by flame atomic absorption spectrophotometry (GBC Scientific equipment SENS AA, Melbourne, Australia) equipped with D_2 background correction devices.

Quality control was assured by the use of procedural blanks, spike and replicates, Reagent blanks were used to the correct all instrument readings. All reagent used (HNO_3 and $HClO_4$) were of the highest purity available. The average spike recoveries of the studied metals were 98.3, 96.4, 89.9 and 95.2% for Cu, Zn, Pb and Fe, respectively.

Statistical analysis: Results are expressed as Mean±Standard Deviation (SD) and one way analysis of variance was carried out using a statistical analysis system (SPSS version 12). Differences in the concentrations of the elements within a given brand were tested with ANOVA. Tukey's multiple-comparison test were used to compare the differences in the mean values of the elements from different brands.

RESULTS AND DISCUSSION

Table 1 presents the mean concentrations of copper (Cu), zinc (Zn), lead (Pb) and iron (Fe) found in the 26 brands of tomato pastes. The results indicate that the observed differences in metal concentrations among the 26 brands are significant.

The levels of metals in canned foods is function of the type and origin of the food, pH of the canned product, oxygen concentration in the headspace, quality of the inside lacquer coating the cans, storage place etc. (Iwegbue *et al*., 2009; Tahan *et al*., 1995; Tarley *et al*., 2001).

Table 1: Mean concentrations (mg kg^{-1} wet weight) of metals in some popular brands of canned tomato pastes in Nigerian market

Sample code	Copper	Zinc	Lead	Iron
A	0.96±0.04	2.26±0.15	<0.30	47.84±0.02
B	0.92±0.05	2.09±0.17	0.69±0.02	9.84±0.02
C	1.18±0.04	2.38±0.18	0.69±0.03	26.9±0.020
D	0.87±0.06	0.89±0.41	0.83±0.02	10.23±1.88
E	0.41±0.01	1.49±0.20	0.99±0.01	15.34±0.02
F	0.59±0.02	4.00±0.47	1.09±0.01	5.96±0.02
G	<0.90	1.21±0.15	0.95±0.01	2.91±0.02
H	1.98±0.03	3.45±0.43	1.08±0.01	38.14±1.38
I	0.91±0.02	10.79±0.25	0.98±0.02	50.49±1.98
J	0.10±0.01	0.27±0.05	1.66±0.01	47.70±0.23
K	1.00±0.01	0.25±0.04	1.00±0.02	6.83±0.02
L	0.98±0.01	0.54±0.01	1.38±0.00	<1.00
M	2.66±0.02	8.83±0.02	1.32±0.00	14.96±0.02
N	1.63±0.01	0.83±0.02	0.72±0.00	30.09±0.02
O	4.28±0.34	2.04±0.04	1.82±0.00	16.38±6.26
P	1.17±0.23	1.21±0.02	1.15±0.01	15.83±0.02
Q	0.92±0.05	2.66±0.02	1.09±0.01	40.73±0.09
R	1.08±0.39	8.63±0.05	1.33±0.00	103.83±0.02
S	1.06±0.44	5.16±0.02	1.45±0.00	109.02±0.02
T	1.11±0.05	0.90±0.02	0.98±0.00	34.77±0.02
U	0.94±0.05	4.53±2.51	0.81±0.01	85.24±0.03
V	0.94±0.04	1.16±0.02	0.67±0.01	2.52±0.02
W	0.96±0.01	2.21±0.02	0.56±0.00	8.72±0.02
X	0.73±0.01	2.47±0.02	1.18±0.01	8.72±0.02
Y	0.79±0.02	4.09±0.02	1.30±0.02	8.59±0.10
Z	0.92±0.04	2.34±0.02	0.39±0.01	112.77±0.03

The concentrations of copper in different brands ranged from <0.9-4.8 mg kg^{-1}. The highest mean concentration of copper was observed in brand O. The permissible limit of copper in foods is 10 mg kg^{-1} (Salama and Radwan, 2005). The concentrations of copper observed in these products were below the permissible limit. Copper concentrations ranging from not detected (nd) to 0.80 mg kg^{-1} was reported for some brands of canned tomato paste in Romania (David *et al*., 2008). Copper serves as an antioxidant and helps the body to remove free radicals, prevent cell structure damage (Salama and Radwan, 2005). It plays an important role in bone formation and skeletal mineralization (Mariam *et al*., 2004). The concentrations of copper found in the present study were higher copper concentrations observed in some brand of tomato pastes in Romania (David *et al*., 2008).

Zinc is a cofactor for many enzymes in the body. The concentrations of zinc in canned tomato paste studied here ranged from 0.25-10.79 mg kg^{-1}, with the highest zinc level in brand I. Apart from brands D, J, K, L, N and T, all other brand examined have zinc concentration above 1.0 mg kg^{-1}. Kocak *et al*. (2005) found zinc concentration ranging from nd-3.777 mg kg^{-1} canned tomato salsa products. In 2008, zinc levels ranging from 4.02-92 mg kg^{-1} were reported for different brands of canned tomato paste in Romania (David *et al*., 2008). Iyaka (2007) reported mean levels zinc in tomato (*Lycopersicon esculentum*) as 6.2 mg kg^{-1}. The concentrations of zinc found the present study were comparable to levels reported by these researchers.

The lead concentrations found in these tomato paste samples ranged from <0.001-1.82 mg kg^{-1}, with highest level being in brand Q. The permissible level of lead in human food is 0.2 mg kg^{-1} (CAC, 2003) and except for brand A, all lead levels found here were above the permissible limit. Lead concentrations ranging from 0.262-0.875 μg L^{-1} have been reported for canned tomato products in Turkey (Kocak *et al.*, 2005). David *et al.* (2008) reported a range of nd-2.10 mg kg^{-1} which are similar to those reported here. The high lead contents in canned tomato paste might be due to the release of lead from the soldering that is often used to seal can in which food is packed (Santhi *et al.*, 2008).

The concentration of iron ranged between <1.0-112.77 mg kg^{-1}. The highest iron concentration was observed in brand 'Z'. No iron was detected in brand 'L'. The recommended dietary allowance value for iron is in the range of 10-18 mg day^{-1} person (Demirezen and Uruc, 2006). The concentrations of iron reported in this study corresponds to 17.53-219.58 mg kg^{-1} ranges reported in some brands of canned tomato pastes in Romania (David *et al.*, 2008).

CONCLUSION

The results indicate that Cu, Fe and Zn in the tomato paste analyzed were below established limits but the concentration of Pb in there tomato pastes were higher than permissible limits. This may pose a real danger to consumers, since tomato paste is so commonly consumed and bioaccumulation of Pb can have serious consequence to human health. There is clearly a need to improve quality control in the processing of this and other canned food products in order to reduce Pb levels.

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