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Assessment of Selected Heavy Metals in Edible Palm Oil Sold in Ika Land, Delta State of Nigeria

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ABSTRACT

Food contamination has become a major health problem due to its adverse effects on the human body. Ika Land is known for the production and sales of palm oil. Eleven (11) samples of palm oil were randomly collected; ten (10) samples were collected from the point of sale and one (1) from the oil mill to serve as control. Oils were analyzed for heavy metals (lead, zinc, cadmium, nickel, and copper) using an atomic absorption spectrophotometer. Results showed that all samples contain zinc, an essential trace element with the highest value of 7.00mg/kg, while some samples contain copper (1.00mg/kg) and few contain cadmium (1.00mg/kg). There was neither lead nor nickel detected in all the samples. It is therefore pertinent to conclude that some palm oil produced and sold in Ika land is safe for human consumption.

Keywords: Palm oil, Ika land, Heavy Metals, Delta State, Food

INTRODUCTION

Palm oil (*Elaeis guineensis*) is an oil-producing plant found in West Africa (Otu, 2013). Nigeria is ranked the fifth highest producer of palm oil in the world (Izah *et al.*,2014) with about 55% produced in-country while the other 45% is imported from countries like Malaysia and Indonesia (Ohimain and Izah, 2015). Oil is produced from oil palm fruit which may be brownish-yellow or orange-red crude palm oil extracted from the mesocarp. Palm oil contains vitamins such as tocopherol, carotenoids, and squalene. It also contains carbohydrates but the number of carotenoids decreases after physical refining (Ghazani and Marangoni, 2016). The characteristic deep orange-red colour of the palm oil is due to carotenoids of about 500-700parts per million (Gunstone, 2005) while the semi-solid nature at room temperature is due to triacylglycerol of palmitic and oleic acids present in the oil (Gee, 2007). Basiron and Weng (2004) observed that palm oil is a widely used raw material for the production of soap, candles, bases for lipstick, margarine, waxes, and polish bases, tin plating, lubricants, pharmaceutical products confectionaries, as well as in the preparation of some traditional medicines. Palm oil is also a fundamental component of the diet in many families (Undiandeye and Otaraku, 2017).

Trace elements are needed by the body in minute quantity to carry out its normal physiological functions. They have significant benefits when consumed in the right proportion but their deficiency in diet may constitute health problems that may be devastating. The oxidation of oil is enhanced by the presence of trace metals like copper (Cu), iron (Fe), magnesium (Mg), cobalt (Co), cadmium (Cd), manganese (Mn), and calcium (Ca) (Ekpo *et al.*, 2022) but a certain level of lead (Pb) 5mg/kg, chromium (Cr) 0.3 mg/kg, and cadmium (Cd) 0.2 mg/kg are toxic and are known to induce multiple organ damage even at lower levels of exposure (Oladeji *et al*., 2023). Also, there may be bioaccumulation of environmental pollutants such as heavy metals from contaminated environments from plants (Amasha and Aly, 2019). Although, some heavy metals are essential and required in minute quantity, however, toxicity results when there is a high concentration of these heavy metals that may be either from the environment, equipment during production, or adulteration by marketers to enhance their products (Izah and Srivastava, 2015).

The presence of heavy metals in palm oil can affect its quality and pose a grave danger to consumer's health. There is a paucity of data in the literature on the contamination of palm oil in Ika South and Ika North East local government areas of Delta State. Hence, the objective of this study is to assess the presence of heavy metals in edible palm oil produced and sold in Ika land, Delta State, Nigeria.

MATERIALS AND METHODS

Study Area

Ika Land occupies a total land surface area of 117.45 square kilometres according to National Population Commission. It occupies two local government areas Ika South and Ika North East of Delta State.

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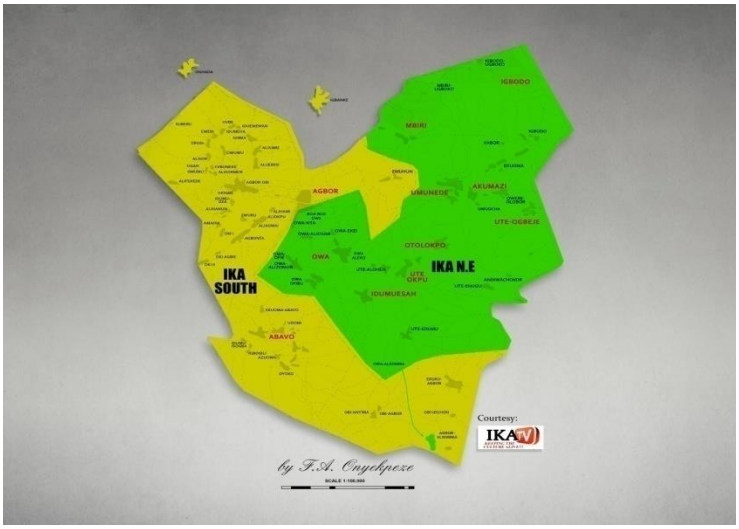

Figure 1: Map of the study location

Sample Collection

A total of eleven (11) palm oil samples were collected with ten (10) as test and one as control. Ten samples were collected from ten different markets in Ika land and one sample of the palm oil was collected from a mill as control. Twenty milliliters (20ml) of the samples were collected in sterile chemical-free sample bottles and then stored at room temperature before digestion.

Sample Digestion

Samples were digested using the wet-ashing method (Adepoju-Bello *et al.,* 2012) with modification. Three (3)g of the sample was placed in eleven Kjeldahl flasks, 10ml of mixed acid, Nitric acid (HNO_3) and Perchloric ($HClO_4$) acid in the ratio of 3:1 was added to each flash. The flasks and their content were heated for about 20 minutes at 40^oC and then increased to about 100^oC for another 40 minutes. The samples were allowed to cool, and 20ml of distilled water was added to each sample then filtered into standard volumetric flask. These were then made up to 100ml mark with distilled water.

Heavy Metal Determination

The concentration of lead, zinc, cadmium, Nickel and Copper were determined using Atomic Absorption Spectroscopy [AAS] (Model: GBC Avanta PM A6600.) according to the method described by American Public Health Association (APHA).

Ten milliliters (10ml) of the digested palm oil samples were slowly added to 50ml of distilled water in 100ml volumetric flask. The hollow cathode and deuterium lamp were lit; the monochromator was positioned at the necessary wavelength for the element. The burner head was set to ensure that the centre of the light beam passes over the burner slot. The flame was lit and the flow of fuel and oxidant were changed to make an oxidizing flame (lean blue). De-ionized water was aspirated and the burner head and hollow cathode were warmed for 20 minutes. Calibration blank was aspirated and a zero point was established. A calibration curve was constructed for the standard solution. The unknown samples were aspirated and quality control standards were also aspirated to check for deviation.

Statistical Analysis

Data were analysed statistically using statistical package for social science (SPSS) version 23 and product of IBM Chicago.

RESULTS

The result of our study shows that there was no detectable amount of lead and nickel in all the samples analysed. Also, cadmium is only present in samples C, E, and F while copper is present in samples C, E, F, G, I, and J. On the other hand, Zinc is present in all the samples of oil analysed as shown in Table 1.

Table 1: Concentration of heavy metals in palm oil samples

S/N	Sample	Lead(mg/kg)	Zinc(mg/kg)	Cadmium(mg/kg)	Nickel(mg/kg)	Copper(mg/kg)
1	A	BDL	2.93±0.09	BDL	BDL	BDL
2	B	BDL	5.00±0.50	BDL	BDL	BDL
3	C	BDL	7.00±0.03	1.00±0.01	BDL	0.93±0.02
4	D	BDL	3.97±0.20	BDL	BDL	BDL
5	E	BDL	6.03±0.01	1.00±0.06	BDL	0.90±0.12
6	F	BDL	4.97±0.10	0.97±0.04	BDL	1.00±0.03
7	G	BDL	4.00±0.11	BDL	BDL	0.93±0.01
8	H	BDL	2.93±0.01	BDL	BDL	BDL
9	I	BDL	2.00±0.00	BDL	BDL	1.10±0.04
10	J	BDL	6.00±0.20	BDL	BDL	1.00±0.05
11	K	BDL	5.00±0.03	BDL	BDL	1.00±0.02

BDL = Below Detectable limit

DISCUSSION

Food contamination during processing or before sales has become a major problem due to various health challenges this poses to the general well – being of the populace. Heavy metals have been identified as some of the contaminants frequently encountered. The results revealed that the palm oil samples studied contain heavy metals either in detectable or below detectable level. Zinc was found in all the samples, though it is a heavy but also micronutrient or trace element. Prashanth *et al*. (2015) opined that the recommended daily allowance for zinc is 15-20mg/day. The highest Zinc content was observed in sample C (7.0 mg/kg) and the lowest in sample I (2 mg/kg). This is in tandem with earlier authors (Izah *et al.,* 2017) who did similar work on palm oil. The high zinc concentration may be attributed to Zinc biofortification of fertilizers used in oil palm tree crop for better yield which has bioaccumulated in the edible portion (White and Broadley, 2011). The bioaccumulation of Zinc in human body due to heavy metals contaminated food could affect the immune system and can affect the plasma concentration of high-density lipoprotein (Zhou *et al*, 2016, Hussain *et al.*, 2022). Zhou *et al.* (2016) observed that ingestion of food with high concentration of Zinc above 15-20 mg/kg per day can result in liver damage and gastrointestinal diseases.

Cadmium was observed to be present in sample C (1.00 mg/kg), E (1.00 mg/kg) and F (0.97mg/kg), which is above the permissible limit of 0.2 mg/kg reported by Oladeji *et al.* (2023). This is in contrast to the observation of Izah *et al.* (2017) that observed cadmium below detectable level in a similar work in Yenagoa, Bayelsa State. Cadmium is not an essential element; therefore, its presence signifies contamination which may lead to toxicity. This therefore implies that samples C, E and F are contaminated either during processing or before sales in the market and this will have adverse health challenge such as renal failure on the consumers.

Copper was observed to be present in palm oil labelled C (0.93 mg/kg), E (0.90 mg/kg), F (1.00 mg/kg), G (0.93 mg/kg), I (1.10 mg/kg), J (1.00 mg/kg) and K (1.00 mg/kg) samples. The copper in the various samples is within the permissible limit of 2.5mg/kg as reported by Prashanth *et al*. (2015). Copper is an essential trace element needed by the body for various enzymatic reactions such as superoxide dismutase which is a potent enzymatic antioxidant. Copper is also required by red blood cells and for proper growth. Deficiency of copper can lead to so many health challenges such as anaemia, tremor, liver cirrhosis (Prashanth *et al.,* 2015).

Other heavy metals evaluated such as lead and nickel are below detectable limits, though they may be present in the palm oil samples investigated.

CONCLUSION

It is therefore pertinent to conclude that the palm oil produced and sold in Ika land are free of contaminants and safe for human consumption except for a few samples with cadmium as contaminant.

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