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ANALYSIS OF HEAVY METAL CONTAMINATION IN SOME SELECTED FRUITS MARKETED IN MAIDUGURI, BORNO STATE, NIGERIA

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***Abstract**: The study looked into the determination of heavy metals in fruits (watermelon, orange, apple) marketed Maiduguri, Borno State. The metal includes (Cr, Cu and Pb). The results shows that all the elements are below the standard value of world health organization (WHO) are free for consumptions. This study assesses the heavy metal composition of three selected fruits which shows that sample in A Chromium was found to be 0.01mg/l, Copper with the value of 0.17mg/l and Lead was found to be -0.10 which are all below the standard limit set by WHO. While in sample B Chromium was found to be 0.02mg/l, Copper 0.10mg/l and Lead was not detected in the sample and in Sample C, Chromium was found to be with the value of 0.10mg/l, Copper 0.13mg/l and lead has -0.14mg/l. the results revealed that the heavy metals content of the sampled fruits was lower than the recommended dietary allowance (RDA) standard by WHO. These findings highlight the rich nutritional profile of the sampled fruits. Offering potentials as valuable dietary additives. Further research and consideration of appropriates consumption quantities are necessary to fully harness the bebefits of these fruits in promoting human health and well-being.*

***Keyword:** Chemical, Fruits, Elements, Heavy Metal.*

INTRODUCTION

Fruits are the mature ovaries of plant, typically containing seeds. They are produced by flowering plants to protect seeds during their development and aid in their dispersal. Fruits are usually sweet or sour in taste and are commonly consumed as a food source due to their nutritional benefits. Fruits come in a wide variety of shapes, sizes, colours, and flavours and they are an essential part of a healthy diet due to their high content of vitamins, minerals, fiber, and antioxidants. Some examples of fruits include apples, orange, bananas, strawberries, grapes, and mangoes. Fruits are one of the most important components of the human diet, and it is widely recognised that consuming these foods on a regular basis is one of the best ways to improve one's health. Furthermore, people all over the world have recently become concerned about the benefits of nutrition more fresh fruits rather than red meat for good health because they significantly reduce the incidence of chronic diseases like diabetes, cancer, cardiovascular disease, and other age-related diseases (Prakash et al., 2012). Heavy metal contamination, which is induced by a variety of anthropogenic activities, poses a serious threat to food safety (Ali et al., 2018; Cui et al., 2004).

Agricultural foods are frequently contaminated with contaminants, particularly heavy metals, as a result of direct and indirect industrial operations, automotive pollution, excessive metal-based fertilisation, and pesticide use. Some heavy metals, such as Cd and Pb, on the other hand, have no known positive role in human metabolism and are regarded chemical carcinogens even at extremely low levels of exposure (Jarup, 2003). Heavy metals that are present in very small amounts in the environment are biomagnified and become part of various food chains, where their concentration rises to levels that are dangerous to humans and other living things. However, eating is the main route of human exposure to heavy metals, which constitute one of the potential risks linked with foodstuffs (Mart-Cid et al., 2008). The dietary intake of lead, copper, and chromium through food has been observed to be higher than allowed limits in urban areas, owing to plant origin fruits and vegetables (Yebpella et al., 2011).

Fresh fruits are of great value and widely used for dietary purposes. Importance in the diet because of the presence of vitamins and mineral salts. In addition, they contain water, calcium, iron, sulphur and potassium. They are very important protective food and useful for the maintenance of health and the prevention and treatment of various diseases . However, these plants contain both essential and toxic metals over a wide range of concentrations. Heavy metals have been reported to have positive and negative roles in human life because the body need in low level of construction if this level excess the effect came negative Some like cadmium, lead and mercury are major contaminants of food supply and may be considered the most important problem to our environment while others like iron, zinc and copper are essential for biochemical reactions in the body. Generally, most heavy metals have long biological halflives and have the potential for accumulation in the different organ of body leading to unwanted effect side. There is a strong link between micronutrient nutrition of plants, animals and humans and the uptake and impact of contaminants in these organisms. The content of essential elements in plants is soil being affected by the characteristics of the soil and the ability of plants to selectively accumulate some metals Additional sources of heavy metals for plants are: rainfall in atmospheric polluted areas, traffic density, use oil or treatment to plant to completed the Maturation of some crops or to give crops attractive look to costumer.

Many factors contribute to heavy metal pollution in fruits, including irrigation water, industrial pollutants, the harvesting process, storage, and/or at the point of sale (Huang et al., 2014). Furthermore, food security is a key concern throughout the globe. During the previous eras, the growing response for food security has stimulated explorations concerning risks related to the ingestion of food stuffs adulterated by pesticides, heavy metals, and toxins. The expanding patterns in food contamination are to a countless extent while farming, poor handling and taking care of food at the market, and utilization of polluted wastewater for water systems (Guerra et al., 2012). Consumption of heavy metal-polluted foods may result in the accumulation of these pollutants in various tissues, resulting in both chronic and acute health effects (Jarup, 2003). As a result, it is plausible to believe that eating fruits containing heavy metals poses a health risk to consumers. Therefore, determination of toxic metals, exposure assessment, and the risk characterization of the contaminated food material are all the decisive components in the estimation of health risks.

MATERIALS AND METHODS

In the preparation of reagent, chemicals of analytical grade purity and deionized water were used throughout the analysis. All laboratory apparatus (glass wares and plastic containers) were thoroughly wash with detergent solution, soaked in 0.1M nitric acid and followed by several rinses with tape water, deionized water and finally with the analyte sample.

STUDY AREA

Maiduguri (/maɪˈduːɡʊri/ *my-DOO-guurr-ee*) is the capital and the largest city of Borno State in north-eastern Nigeria, on the continent of Africa. The city sits along the seasonal Ngadda River which disappears into the *Firki* swamps in the areas around Lake Chad. Maiduguri was founded in 1907 as a military outpost by the British Empire during the colonial period. As of 2022, Maiduguri is estimated to have a population of approximately two million people, in the metropolitan area. Area total 105.5km2 (40.7sq mi),elevation 320m (1,050 ft), population 3million,density 7,500/km(19000/sq mi)

Sample Preparation

The sample were prepared by removing dirties and other materials on them. The sample were group into powder and then put them into different clean polythene bags with labeled and keep in the laboratory prior to further analysis.

Sample Analysis

Determination of Chromium (Cr)

Press and hold on botton until spectrophotometer turns on, scroll to an select programmed tests from menu, scroll to and select All tests or another sequence containing 22 chromium from menu, rise a clean tube with sample water fill to the 10ml with sample, insert tube into chamber close lid and select scan blank, remove tube from spectro. Use the 0.1g spoon to add one measure of chromium reagent powder. Cap and shake until powder dissolves. Wait for 3 minutes for full colour development, during waiting period, fold a piece of filter paper in help then half again to form acorns. Push corners together to open end, insert into fuelled. At the end of 3 minutes waiting period, filter sample into a clean tube. Mix insert tube into chamber, close lid and select scan sample. Record your result, press off bottom to turn spectrophotometer off or press exit button to exists to a previous mean or make another menu selection.

Determination of Copper

Rinse or clean vial with solution, use the syringe to add 3ml of sample to the vial, insert the vial into chamber close lid and select scan blank, remove vial from spectro, use the syringe to add 3ml of sample to copper. UDV vial, shake vigorously for 10 minutes.

Determination of Lead (Pb)

Use universal sample holder, press and hold on button until spectrophotometer turns on. Scroll to and select programmed tests, scroll to and select all tests (or another sequence containing 54 lead) from testing menu, scroll and select 54 lead from menu, rinse a tube with sample water, fill to 10ml with sample, insert the tube into chamber, close lid and select scan blank, remove the tube from spectro. Use the syringe to remove 5ml of sample from tube. Discard remaining sample, add the 5ml of sample in a syringe to the tube. Add 5ml ammonium chloride buffer to fill the tube to the 10ml line 5wirt to mix, use the 0.5ml pipette to add 0.5ml par indicator swirt to mix, use the o.5ml pipette to add 0.5ml stabilizing reagent cap and mix, insert tube into chamber close lid and select scan sample. Record results in ppm as reading A, remove tube from spectra. Add drops DDC reagent. Cap and mix, insert tube into chamber, close lid and select scan sample. Record results in ppm as reading B, ppm lead reading A reading B, press off button to turn the spectrophotometer off or press exists bottom to exists to a previous menu or make another menu selection.

RESULTS AND DISCUSSION

S/N	Element (mg/l)	A	B	C	WHO, 2018
1	Cr	0.01	0.02	0.02	0.10
2	Cu	0.17	0.10	0.13	2.00
3	Pb	-0.10	Not Detected	-0.14	0.05 ppm

Key:

Sample A= Watermelon, Sample B= Apple, Sample C=Orange

Discussion of the Results

The results of this study indicated varying concentrations of chromium (Cr), copper (Cu), and lead (Pb) in three different fruit samples—watermelon, apple, and orange. Chromium levels in sample A (watermelon) were recorded at 0.01 mg/l, while sample B (apple) had a slightly higher concentration of 0.02 mg/l, a value that was also found in sample C (orange). These levels of chromium are well below the World Health Organization (WHO) standard of 0.10 mg/l, indicating that the fruits are safe in terms of chromium contamination. Chromium plays an important role in promoting healthy aging, improving metabolic health, and supporting immune functions. It is linked to a reduced risk of chronic diseases like obesity, heart disease, and diabetes, and has been shown to enhance cognitive function and cellular health.

Copper concentrations in sample A (watermelon), sample B (apple), and sample C (orange) were found to be 0.17 mg/l, 0.10 mg/l, and 0.13 mg/l, respectively. These values are all within the WHO limit of 2.00 mg/l. Copper is an essential trace element necessary for the production of collagen, a protein that supports the structure of connective tissues, skin, and bones. It also plays a crucial role in immune function, brain health, and energy production. Copper has antioxidant properties, which help protect cells from oxidative damage, and supports the body's ability to heal wounds. However, excessive copper intake can lead to toxicity, resulting in symptoms such as nausea, vomiting, diarrhea, and potentially liver and kidney damage.

Lead was not detected in sample B (apple) and had a negative value in sample A (watermelon) and sample C (orange), which indicates very low or no contamination of lead in these fruit samples. The WHO standard for lead is set at 0.05 ppm, and it appears that the levels found in the tested samples are significantly below this threshold. Lead exposure is a serious health concern, especially in children, as it can cause developmental delays, cognitive impairment, and neurological damage. Chronic lead exposure has also been linked to cardiovascular diseases, reproductive issues, and kidney damage. Additionally, high lead levels may interfere with brain development, leading to behavioral problems, learning disabilities, and even an increased risk of diseases like Alzheimer's and Parkinson's.

The findings from this study suggest that the selected fruits—watermelon, apple, and orange—are generally safe for consumption in terms of heavy metal contamination. While chromium and copper are essential for various physiological processes, their levels in these fruits remain within safe limits, ensuring no immediate health risk. The absence or very low presence of lead further strengthens the safety of these fruits. However, continued monitoring of heavy metal contamination in food products is crucial to prevent long-term exposure, particularly for vulnerable populations such as children and pregnant women, who are more susceptible to the harmful effects of heavy metals.

Conclusion

The results of this study indicated that the selected fruits—watermelon, apple, and orange—are safe for consumption in terms of heavy metal contamination. Chromium and copper levels in all three samples were well within the safe limits set by the World Health Organization, with no significant risk to human health. Additionally, lead was either undetected or present in negligible amounts, further supporting the safety of these fruits. These findings suggest that the fruits tested are not a source of heavy metal exposure, and their consumption does not pose a significant health risk. However, ongoing monitoring is recommended to ensure food safety and protect public health from potential contamination in the future.

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