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Evaluation of Heavy Metals Level in Selected Fruits Sold At Sekona Market, In Ede South Local Government, Ede, Osun State, Nigeria

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Abstract**:** *Despite array of benefits link to consumption of fresh fruits in human growth and development, the major problem is that most of them are reservoir for heavy metals which their excessive are dangerous and deleterious to function of human and animal system. Therefore, there is need for frequent assessment of level of heavy metal in our fruits to ascertain the level of conformation with the standard intake in human body. The current study is aimed at examine the level of heavy metal in fruits sold at Sekona Market in Ede South Local Government Area Ede, Osun state. Seven samples of the fruits were obtained from Sekona market. The edible portion of the purchased fruit samples were properly separated washed and chopped into small pieces using a knife. The fruits were air-dried and then dried in an oven at 80 °C. Dried samples of the fruits were ground into a fine powder (80 mesh) using a commercial blender. Heavy metals in fruit samples were extracted by acid digestion and analyzed for Lead, Chromium, Cadmium, Nickel, Zinc, Copper and Cobalt using a flame atomic absorption spectrophotometer. The results obtained showed that Banana, Apple, Orange, Watermelon, Cucumber, Pineapple and Carrot had Lead (0.064±0.00, 0.091±0.00, 0.0118±0.01, 0.105±0.01, 0.211±0.03, 0.130±0.02 and 0.151±0.01mg/kg), Chromium (0.073±0.00, 0.085±0.00, 0.125±0.04, 0.163±0.02, 0.190±0.00, 0.116±0.01 and 0.170±0.01 mg/kg), Cadmium (0.071±0.00, 0.047±0.00, 0.051±0.00, 0.025±0.00, 0.050±0.01, 0.062±0.00 and 0.043±0.00 mg/kg) and Nickel (0.130±0.01, 0.110±0.00, 0.0155±0.02, 0.230±0.03, 0.185±0.03, 0.165±0.02 and 0.190±0.01), Zinc (1.282±0.04, 1.206±0.17, 2.00±0.04, 2.625±0.03, 2.840±0.02, 2.300±0.03 and 2.580±0.04 mg/kg), Copper (0.065±0.00, 0.040±0.03, 0.120±0.03, 0.330±0.02, 0.240±0.00, 0.300±0.00 and 0.260±0.01 mg/kg) and Cobalt (0.063±0.00, 0.042±0.02, 0.090±0.01, 0.102±0.02, 0.145±0.01, 0.163±0.01 and 0.180±0.02 mg/L). The level of heavy metals in fruits examined is within the required stipulated standard of heavy metals permissible level except in few Cases.*

Keywords: Fruits, Heavy metals, food quality, Analysis and Acid digestion

1. INTRODUCTION

Fresh fruits are of great importance and generally used by human for dietary purposes. Fruits are useful in human and animal diet due to its nutritional composition which includes vitamins, mineral salts, water, calcium, iron, sulphur and potassium. They are essential protective foods that are useful for the health maintenance and for prevention of diseases and treatment of various human and animal ailments. Fruits also play vital roles in keeping body fresh and also for healthy human body

Food safety is one of the major concerns across the globe. In the past decades, the high demands for safety of food have stimulated works in respect of the problems linked with consumption of food products as a result of pesticides, heavy metals and/or toxins contamination. The attitude of individual to rising contamination of fruits through different sources by heavy metals is not encouraging and this has impacted negatively on human health. Severe ailments and a lot of risks are fall out of this negligence on part of farmers and concerns authority.

The Earth's crust compositions include heavy metals which are non-biodegradable but stable; however they are most times accumulated in soils and sediments [1]. Heavy metals are easily taken up by plants in the environment and their route to the soil has been linked to irrigation water, industrial effluents and indiscriminate dumping of chemicals and other wastes. Since plants require water and other necessary minerals for growth, they have shown a great ability to accumulate metals from the environment [2].

Heavy metals perform dual roles in human health and both functions are of merits and demerits based on the quantities they are in human body. Those metals are beneficial to human growth provided quantities available are within those required for human growth, a situation where they exceeded the normal quantities then they became toxic and detrimental to human growth. Heavy metals exhibit specific signs of toxicity; Cadmium, Lead, Copper, Mercury, Zinc, Arsenic poisoning are associated with gastrointestinal disorders, diarrhea, stomatitis, heamoglobinuria, pneumonia, ataxia on human body [3].

The effects of heavy metals on human and animals could be neurotoxic, carcinogenic, mutagenic or teratogenic [4]. Those that are needed at minimal quantities (Trace elements) do not play a vital role in the metabolic regulations of the human body provided they are present in required amounts. In doing so, they act as both co-enzymes and cofactors in human systems which play various roles in growth, metabolism and immune system development [5].

The problems associated with abnormal or presence of heavy metals in human body beyond required amounts has caused a lot of set back and havoc to human and other living things and there is limited effort to checkmate and proffer lasting solutions to this menace as there is increasing disposal of chemicals at wills, alarming dumping of wastes to rivers and irrigation of plants with unhygienic water. As part of measure to put an end to this rising practices, there is need for awareness, campaign, training of farmers and people should be enlightening on likely problems associated with this uncared attitudes.

The current study is focusing on evaluation of heavy metals in selected fruits Sold at Sekona market in Ede South Local Government, Osun State Nigeria. Sekona market is one of the popular and largest markets in Ede South local Government and the market is in an open place, situated at road side along Ede –Ife axis where exposure to vehicular emission is high. Hence, there is need to analyze the fruits vended in this market to ensure that the levels of heavy metals constituents meet the international requirements.

2. MATERIALS AND METHODS

2.1 Collection of samples

Apples, bananas, Orange, Watermelon, Cucumber, Pineapple and Carrot were purchased from Sekona market in Ede South Local Government Area, Osun State, Nigeria. The area lies within Latitude and Longitude of 7.42$^{'}$59.99$^{''}$ N and Longitude 4.27$^{'}$ 9.99$^{''}$ E respectively. They were kept in sterile polythene bag and taken to the laboratory for analysis.

2.2 Pretreatment

After collection, the samples were brought to the laboratory and processed further for analysis. Edible portions of the samples were used for analysis while bruised or rotten samples were removed.

2.3 Washing of samples

The edible portion the different fruits collected were properly separated from non-edible part and washed to remove dust particles. The fruits samples were then chopped into small pieces using a knife. They were initially spread on trays for air-dried and subsequent dried in an oven at 80 °C.

2.4 Grinding of samples:

Dried samples of the fruits were grounded into a fine powder (80 mesh) using a commercial blender and stored in polyethylene bags, until used for acid digestion.

2.5 Acid Digestion

Heavy metals in fruits samples were extracted following acid digestion procedure as follows: 1.0 g of the dry weight of each the sample of the fruits collected at the market was weighed into a digestion tube and 10ml of 98% nitric acid was added. This was then placed in a water bath and allowed to boil for about 72 hours. After which digestion was completed, the resulting pale yellow solution was made up to 25ml with de-ionized water and stored. This was followed by making of the composite of the samples.

2.6 Heavy Metals Analysis

The vegetal solution were analyzed for Lead (Pb), Chromium (Cr), Cadmium (Cd), Nickel (Ni), Zinc (Zn), Copper (Cu), and Cobalt (Co) using a flame atomic absorption spectrophotometer (AAS, Perkin Elmer model 2130).A certified standard reference materials was used to ensure accuracy and the analytical values were within the range of certified value. Blank and standards were run after five determinations to calibrate the instrument.

2.7 Statistical Analysis

The results of the analysis were carried out in triplicate and Standard deviation of the mean were taken for all the samples

3. RESULTS AND DISCUSSION

Nutritive values of agricultural materials are affected by heavy metals and the effect of heavy metal on human and animal is deleterious. In a bid to ensure safety and quality of our foods, International regulatory body and World Health Organization set the maximum permissible limit of toxic metals in human food, hence it is essential to focus on how to control the concentrations of heavy metals in food [6]

3.1 Lead (Pb)

In the current work, the results observed for Lead in all fruits tested varied from 0.064±0.00 to 0.211±0.03 mg/kg, with highest value of 0.211±0.03 mg/kg for Cucumber, followed by 0.151±0.01 mg/kg for Carrot, 0.130±0.02 mg/kg for Pineapple, 0.118±0.01 mg/kg for Orange, 0.105±0.01 mg/kg for Watermelon, Apple had 0.091±0.00 mg/kg while least lead content (0.064±0.00) was found in Banana (Table 1a). In a related to the current work, Mohamed and Khairia [7] reported the following concentrations (0.108, 0.106 and 0.128 mg/kg) for lead in watermelon, orange and Pineapple. The result reported for fruits in this study may be link to lead through pollutants in irrigation water, farm soil or pollution through the highways traffic [7].

3.2 Chromium (Cr)

They can be found in rocks, animals, plants, and soil; also they can be found in liquid, solid, or gas states. The values obtained for the fruits examined in this work ranged from 0.073±0.00 to 0.190 mg/kg (Table 1a). The highest Chromium concentration of 0.190±0.00 was found in Cucumber, followed by Carrot with 0.170±0.01 mg/kg value, 0.163±0.02 mg/kg was obtained for Watermelon, 0.125±0.004 was recorded for Orange, Pineapple had 0.116± mg/kg, 0.085±0.00 was observed for Apple while the least value of 0.073±0.00 was found in banana (Table 1a). All the values recorded for fruits are still within the safe limit of 0.2mg/kg stipulated by FAO/WHO [5].

3.3 Cadmium (Cd)

The report of this study showed Cadmium values ranging from 0.025±0.00 to 0.071±0.00 mg/kg (Table 1a). The highest values of 0.071±0.00 recorded for Banana, followed by 0.062±0.00 value for Pineapple, 0.051±0.00 and 0.050 mg/kg for Orange and Cucumber, 0.047±0.00 was obtained for Apple, Carrot had 0.043±0.00 value of Cadmium while least value of 0.025±0.00 mg/kg was observed for Watermelon (Table 1a). In similar to the above study, Sobukola *et al*. [6] reported cadmium content of 0.02, 0.04 and 0.02 mg/kg for Watermelon, Orange and banana respectively. Also, in related to the current study, Jassir *et al*. [1] reported that Watermelon, Orange and banana contained Cadmium contents of 0.0004, 0.0009 and 0.001 mg/kg. The various reported content of Cadmium in the fruits may be due to different capacities of fruits to absorb metals. The contents of cadmium in all fruits examined in this study was found to be within the safe limit of WHO/FAO

3.4 Nickel (Ni)

Nickel are naturally occurs in plant and animal flesh. They play a vital role as the activation of some enzyme systems in human body (in trace amount), but at higher quantities they are toxic [8]. The values of Nickel recorded in the tested fruits during this study ranging from 0.110±0.00 to 0.230±0.03 mg/L (Table 1a). The maximum values of 0.230 mg/L was obtained in Watermelon, preceded by 0.190±0.01 mg/kg, Cucumber had 0.185±0.03 mg/kg value for nickel, 0.165±0.02 and 0.155±0.02 values were obtained in Pineapple and Orange, 0.130±0.01 mg/kg was found in Banana while the minimum value of 0.110±0.00 mg/kg was obtained from Apple (Table 1a).

Table 1a: Concentration of Heavy metals (Lead, Chromium, Cadmium, and Nickel) in selected Fruits at Sekona Market, Ede South Local Government, Osun state

Sample	Lead (mg/kg)	Chromium (mg/kg)	Cadmium (mg/kg)	Nickel (mg/kg)
Banana	0.064±0.00	0.073±0.00	0.071±0.00	0.130±0.01
Apple	0.091±0.00	0.085±0.00	0.047±0.00	0.110±0.00
Orange	0.118±0.01	0.125±0.004	0.051±0.00	0.155±0.02
Watermelon	0.105±0.01	0.163±0.02	0.025±0.00	0.230±0.03
Cucumber	0.211±0.03	0.190±0.00	0.050±0.01	0.185±0.03
Pineapple	0.130±0.02	0.116±0.01	0.062±0.00	0.165±0.02
Carrot	0.151±0.01	0.170±0.01	0.043±0.00	0.190±0.01

3.5 Zinc (Zn)

Zinc is an important element in human health as it is needed to maintain normal growth and development [8]. Zn deficiency in the diet may be highly detrimental to human health than too much of Zn in the diet. In this work, the values obtained for Zinc vary from 1.206±0.17 to 2.840±0.02 mg/L (Table 1b). The maximum value of 2.840±0.02 mg/L was obtained for Cucumber, followed by 2.625±0.03 mg/L obtained for Watermelon, 2.580±0.04 mg/L observed for Carrot, 2.300±0.03 and 2.000±0.04 observed for Pineapple and Orange respectively. Banana had value of 1.282±0.04 mg/L while minimum value of 1.206±0.17 was found in Apple (Table 1b). This study is similar to the work of Karavoltsos *et al.* [9] that reported Zinc levels ranging from 5.35 and 7.40 mg/kg; 2.38 and 2.20 mg/kg; as well as 5.59 and 1.50 mg/kg for watermelon, orange and banana, respectively [2]

3.6 Copper (Cu)

The values reported for Copper in the fruits examined ranged from 0.040±0.03 to 0.330±0.03 mg/kg (Table 1b). The highest value was found in Watermelon (0.330±0.02 mg/kg). Followed by Pineapple (0.300±0.00 mg/kg), preceded by Carrot (0.260±0.01mg/kg), then Cucumber (0.240±0.00), Orange, Banana and Apple had 0.120±0.03, 0.065±0.00 and 0.040±0.03 mg/L values for Copper (Table 1b). The above study is similar to the work of Ogunkunle *et al*., [5] that reported 1.22 and 2.13 mg/kg, 1.27mg/kg content of copper in watermelon, orange and banana. In related vein, Grembecka and Szefer [10] reported copper content of 2.13, 2.51 and 0.95 mg/kg for watermelon, orange and banana. The values of copper recorded for all fruits examined in this work were found within safe limits of 73 mg/kg as stipulated by WHO Standard.

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3.7 Cobalt (Co)

The highest cobalt concentration was found in Carrot (0.180±0.02 mg/L) while the least value of 0.042±mg/L was obtained in Apple (Table 1b). The values recorded for Pineapple, Cucumber, Watermelon, Orange and Banana are 0.163±0.01, 0.145±0.01, 0.102±0.02, 0.090±0.01 and 0.063±0.00 mg/L respectively (Table 1b).

Table 1b: Concentration of Heavy metals (Zinc, Copper and Cobalt) in selected Fruits at Sekona Market, Ede South Local Government, Osun state

Sample	Zinc (mg/kg)	Copper (mg/kg)	Cobalt (mg/kg)
Banana	1.282±0.04	0.065±0.00	0.063±0.00
Apple	1.206±0.17	0.040±0.03	0.042±0.02
Orange	2.000±0.04	0.120±0.03	0.090±0.01
Watermelon	2.625±0.03	0.330±0.02	0.102±0.02
Cucumber	2.840±0.02	0.240±0.00	0.145±0.01
Pineapple	2.300±0.03	0.300±0.00	0.163±0.01
Carrot	2.580±0.04	0.260±0.01	0.180±0.02

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5. CONCLUSIONS

Heavy metals are useful for biochemical, physiological and needed for health maintenance, but their requirement is minimal for advancement of various human functions. The major sources or link to heavy metals is from irrigation water that arises from sewage and industrial fed lakes, abandoned rivers or contaminated ground water. Another source of heavy metals in fruits is attributed to the use of contaminated and polluted water in post handling of the fruit products with disregard the safety guidelines may have enhance the increase in level of the fruits contamination.

As part of measure to curb the rate of influx and contamination level of fruits by heavy metals, there is need for continuous monitoring of heavy metals in fruits because, fruits are the main sources of food supplements for humans in many parts. This study will help us to know the status or level of heavy metals in fruits and also assure masses on quality of available fruits for human consumption. The majority of fruits examined in this study are within the accepted and permissible level of heavy metals as required by WHO acceptable standard except in few cases.

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