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Trace Elements in Five Commonly Consumed Leafy Vegetables Cultivated in Ikorodu Area of Lagos State Nigeria

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ABSTRACT

Vegetables play important roles in human nutrition and health, particularly as sources of Vitamins, Minerals, dietary fiber and dependable anti-oxidative. Five commonly consumed leafy vegetables; *Telfairia Occidentalis* (Fluted pumpkin, "Ugwu"), *Corchorus Olitorius* (Jute plant "Ewedu"), *Talinum triangulare* (water leaf), *Amaranthus Hybridus* (African spinach, "efo tete") and *Celosia argentea* ("Soko", Lagos spinach) cultivated around Ikorodu area of Lagos State, Nigeria were selected for the study. They were digested and analyse using Atomic Absorption Spectrophotometer (AAS) for the following; Iron (Fe), Copper (Cu), Manganese (Mn), Calcium (Ca), Zinc (Zn), Cobalt (Co), Potassium (K), Sodium (Na), Selenium (Se) and Magnessium (Mg). It was observed from the five investigated vegetables, that all the vegetables were rich in trace elements in appreciable amount. The result obtained showed that the trace metals in the vegetables investigated is of nutritional interest. However, *Talinum triangulare* was found to be highest in Fe, Cu, Co, k, and Se. *Celosea argenta* was highest in Mn and Ca. *Amaranthus hybridus* was highest in Zinc (Zn), *Corchorus Olitorius* was highest in Sodium (Na) while *Telfairia Occidentalis* was highest in Magnesium (Mg). The levels observed are comparable with the literature reported values from various regions across the state and Country.

Key Words: Leafy Vegetables, Minerals, Trace Elements, Human Nutrition & Lagos State

Aims Research Journal Reference Format:
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1. INTRODUCTION

Vegetables is the most common food of human diet in all around the human kind (Basha *et al.,* 2014) which play important roles in human nutrition and health, particularly as sources of vitamins, minerals, dietary fiber and they also take on a dependable anti-oxidative effects. Vegetables are the cheapest and most readily available sources of important proteins, vitamins, minerals and essential amino acid which can easily be supplied in Nigeria diet which is predominantly dominated by starchy staple foods (Adeyemi *et al.,* 2017). Most developing countries depend on starch-based foods as their main staple food for the supply of both energy and protein (Akugbugwo *et al.,* 2007) which accounts in part for protein and mineral deficiency prevalence among the populace as recognized by Food and Agricultural Organization (Ladeji *et al.,* 1995). Vegetables are consumed enormously in many countries and thus constitute one of the important food sources. Among different food systems, vegetables are most exposed food to environmental pollution due to aerial burden. It is therefore necessary to assess the level of trace metal contents in different varieties of vegetables. (Hashmi *et al.,* 2005).

Trace metals can be classified as potentially toxic (arsenic, cadmium, lead, mercury, etc.), probably essential (nickel, vanadium and cobalt) and essential (iron, manganese, copper, zinc, selenium, etc). The role of trace elements in body metabolism are of prime importance. Their deficiency causes diseases, whereas their presence in excess may result in toxicity to human life (ADU *et al.,* 2014). Vegetables take up metals by absorbing them from soil, as well as from deposits on different parts of the vegetables exposed to the air from the environment (Sobukola *et al.,* 2007).

Based on the protective function of vegetables which are necessary for normal functioning of human metabolic processes, there is need to test and analyse these vegetables to ensure that the levels of essential trace elements meet the agreed international requirements. Particularly when the data on the trace metals in vegetable samples at Ikorodu area of Lagos state are limited. Therefore, this study was designed to bridge this gap in knowledge by determining the levels of Iron (Fe), Copper (Cu), Manganese (Mn), Calcium (Ca), Zinc (Zn), Cobalt (Co), Potassium (K), Sodium (Na), Selenium (Se) and Magnessium (Mg) using Atomic Absorption Spectrophotometry in five selected varieties of green leafy vegetables,; *Telfairia Occidentalis* (Fluted pumpkin, "Ugwu"), *Corchorus Olitorius* (Jute plant "Ewedu"), *Talinum triangulare* (water leaf), *Amaranthus Hybridus* (African spinach, "efo tete"), *Celosia argentea* ("Soko", Lagos spinach) popular edibles consumed and cultivated around Ikorodu area of Lagos state, Nigeria.

Table 1: Commonly consumed vegetables selected for the study

Botanical Name		**Common Name**	**Yoruba Name**
Telfairia occidentalis	*T. occidentalis*	Fluted Pumpkin	'Ugwu"
Corchorus olitorius	*C. olitorius*	Jute Plant	"Ewedu"
Talinum triangulare	*T. triangulare*	water leaf	"Gbure"
Amaranthus hybridus	*A. hybridus*	African spinach	"Efo tete"
Celosia argentea	*C. argentea*	Lagos spinach	"Soko"

2. EXPERIMENTAL

2.1 Study area
This study was conducted at Ikorodu located in North-East city of Lagos Nigeria. The fastest developing suburbs of Lagos state.

2.2 Samples Collection
Five commonly consumed vegetables were collected from a farm at Ikorodu area of Lagos state. They were identified and authenticated prior to the study.

2.3 Pretreatment
All chemicals used were of ultra-high purity analytical grade. All glass wares and containers required for experimentations were first washed with distilled water followed by soaking in 10% nitric acid for few hours. Thus it was ensured that no contamination occurred in them.

2.4 Samples processing and analysis
The collected vegetables were plucked and washed with distilled water to remove dust particles. Samples were then cut into pieces of uniform size, air dried and then oven dried at 80%. Samples were pulverized using blender and stored in an air tight container until further digestion for metal analysis. 2g of each part of the processed samples weighed and were subjected to dry ashing in a well-cleaned porcelain crucible at 550°C in a Gallenkhamp muffle furnace. The resultant ash was dissolved in 5ml of $HNO_3/HCl/H_2O$ (1:2:3) and was heated gently on a hot plate until brown fumes disappeared. To the remaining material in the crucible, 5 ml of de-ionized water was added and heated until a colourless solution was obtained (Mohammed and Mann, 2012). The mineral solution in each crucible was transferred into a 100 ml volumetric flask by filtration through Whatman Grade No. 42 filter paper and the volume was made to the mark with de-ionized water. This solution was used for elemental analysis by atomic absorption spectrophotometer (AAS). The concentration of each element in the sample was calculated in the percentage of dry matter, that is, mg/100 g sample and was used to determine the quantity of mineral elements in each of the plants sample. Appropriate quality assurance procedures and precautions were taken to ensure reliability of data.

3. RESULTS AND DISCUSSION

Figure 1 shows the concentration of ten trace elements investigated in green leafy vegetables commonly consumed in Lagos state Nigeria. Trace elements are present in the body in very low amounts, usually less than 1micro-organism per gram of the tissue (Kaplan *et al.,* 1993). The results showed that Iron is present in all the five vegetable samples. Two of the vegetables had Fe levels above the recommended dietary allowance however, highest concentration of Iron was found in *Talinum triangulare* (29.44mg/g) when compared with other vegetables. Iron plays important roles in several metabolic activities, where it acts as catalyst and structural constituents of molecules. It is present in amount greater than that of any other trace elements. According to an estimate, 57.6% of the body iron in human being is contained in hemoglobin and 8.9% in myoglobin approximately 33% in non-heme iron complexes including ferritin and hemosiderin.

The cytochrome and catalase enzyme contains about 0.5% of Iron (Jacob and Worwood, 1974). The heme pigments, hemoglobin in erythrocytes and myoglobin in muscles function as oxygen carriers. National research council recommended the dietary allowance of Iron (Fe) for male is 10-12mg and 15mg for female during pregnancy and recommended limit of iron is up to 30mg (Kaplan *et al.,* 1993, Nordberg *et al.,* 2005). All the vegetables contain appreciable amounts of copper within the daily dietary safe limit for human consumption. The highest concentration of copper was seen in *T. triangulare* (1.633mg/g) and lowest concentration in *Corchorus olitorius* (0.203mg/g). Copper is an essential trace element for normal biological activities of aminooxide and tyrosinase enzymes. Excessive intake of copper may lead to heamolysis, hepatotoxic and nephrotoxic effects. According to an estimate 1.5 to 3.0mg/day of dietary copper has been determined to be safe and adequate for human consumption. (Dara, 1993).

The highest concentration of manganese was found in *Celosia argentea* (1.812mg/g) and least concentration in *Amaranthus hybridus* (0.306mg/g). Manganese is essential for normal growth, skeletal formation and for normal reproductive function in mammals and poultry. The estimated safe and adequate daily dietary intake (upper limit) in adults is 11mg/day. Manganese deficiency have been observed to cause diabetes, nervous instability, disorder of bony cartilaginous, growth in infant and children and rheumatic arthritics in adults (Hashmi *et al.,* 2005).

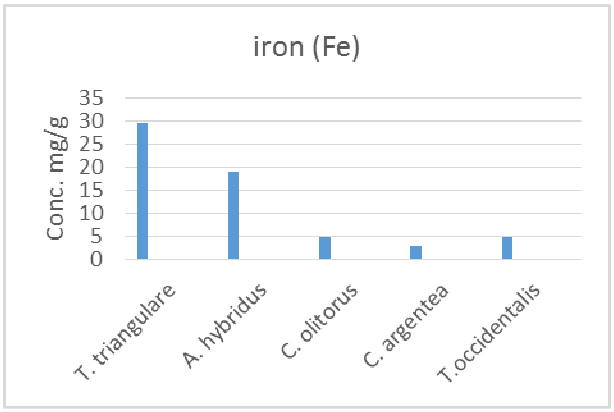
Zinc was present in all the vegetables at levels ranging from 0.396mg/g to 0.696mg/g with *Telfairia occidentalis* (0.396mg/g) having the least concentration and *Amaranthus hybridus* (0.696mg/g) containing the highest concentration. Other studies have reported levels of Zinc in vegetables as high as 0.77 ± 0.38mg/g (Muhammed *et al.,* 2008; Ladipo and Doherty 2011). Zinc is an intracellular cation present in all body tissues and fluids and the second most abundant trace elements next to iron. Zinc is essential for enzymatic and normal functioning of the cell such as in protein synthesis, carbohydrate metabolic cell growth and division. Deficiency of zinc in the diet may be highly detrimental to human health than too much Zinc in the diet. The recommended dietary allowance for zinc is 15mg/day for men and 12mg/day for women (Ladipo and Doherty 2011).

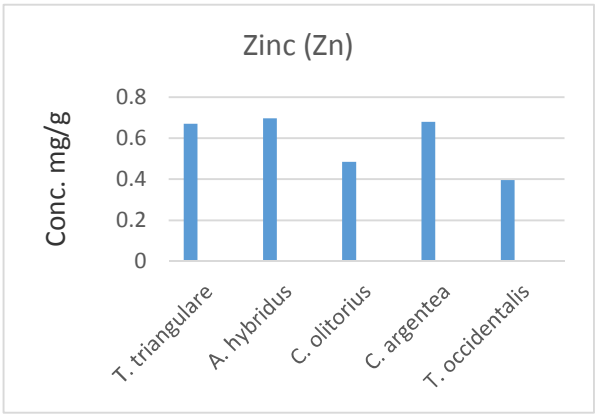
The highest and lowest contents of Co was founded in *Talinum triangulare* (4.675mg/g) and *Celosia argentea* (1.676mg/g), respectively. This is comparable to reported values in literature (Basha *et al.,* 2014). Human dietary intake of Cobalt ranges between 5-55µg/day (Nordberg *et al.,* 2005). The maximum and minimum Calcium (Ca) contents of the samples were found to be 23.568mg/g in *Celosia argentea* and 10.389mg/g *Talinum triangulare* respectively. Calcium plays a key role in cell signaling, blood clotting, muscle contraction and nerve function. Obtained concentration of Potassium (K) in the samples is showing good comparison with the literature. Maximum and minimum potassium content was found in *Talinum triangulare* 839.490mg/g *and Amaranthus hybridus* 37.377mg/g respectively.

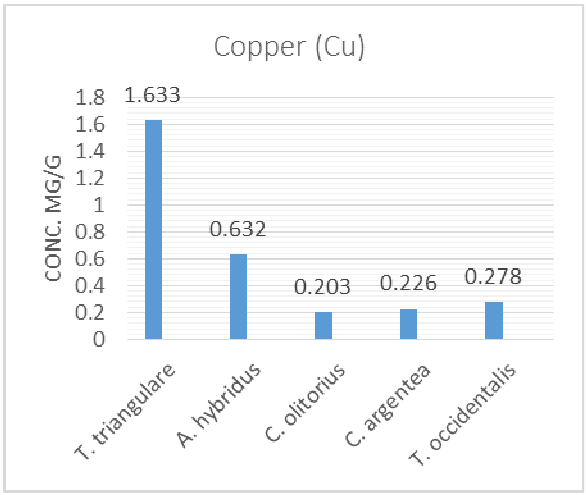
The highest and lowest concentration of Sodium (Na) concentration were found in *Corchorus Olitorius* 39.314mg/g and *Amaranthus hybridus* 12.457mg/g respectively. Sodium plays key roles in the regulation of blood pressure and the activities of muscles and nerves. Potassium is crucial to heart function and plays a key role in skeletal and smooth muscle contraction, making it important for normal digestive and muscular function. Selenium was detected in all the vegetables investigated. The maximum and minimum concentration of selenium was found in *Talinum triangulare (*1.289mg/g) and *Telfairia Occidentalis* (0.042mg/g) respectively. Selenium is a structural component of glutathione peroxidase an antioxidant enzymes that play a critical role in preventing oxidative cell damage.

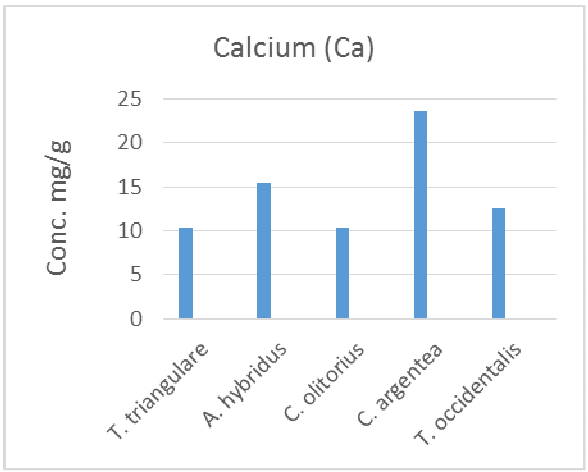
4. CONCLUSION

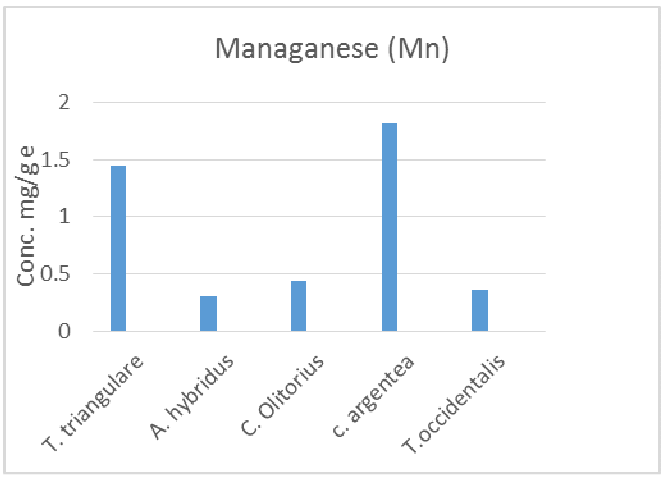
Trace metals such as Zinc, Manganese, and Iron are necessary for the growth and function of the brain. They serve the function of metallo-proteins in neurons and glial cells, while a portion of trace metals exist in the presynaptic vesicles and may be released with neurotransmitters into the synaptic cleft (Takeda, 2004). Trace metals are involved in cell signaling, skeletal, muscle contraction and generally normal body functioning. It was observed from the five investigated vegetables, that all the vegetables were rich in trace elements in appreciable amount comparable with the literature reported values from various regions across the state and country. However, *Talinum triangulare* was found to be highest in Iron (Fe), Copper (Cu), Cobalt (Co), Potasssium (k), and Selenium (Se). *Celosea argenta* was highest in Manganese (Mn) and Calcium (Ca). *Amaranthus hybridus* was highest in Zinc (Zn), *Corchorus Olitorius* was highest in Sodium (Na) while *Telfairia Occidentalis* was highest in Magnesium (Mg). The present study have generated data on trace metals in vegetables cultivated in and around Ikorodu area of Lagos State. The concentration of essential metals in the five investigated vegetables could be considered adequate. The vegetables could therefore be recommended for human consumption.

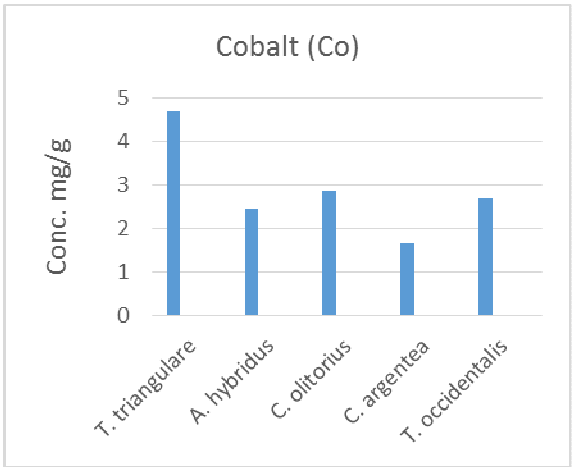

iron (Fe)
Conc. mg/g
35
30
25
20
15
10
5
0
T. triangulare
A. hybridus
C. olitorus
C. argentea
T.occidentalis

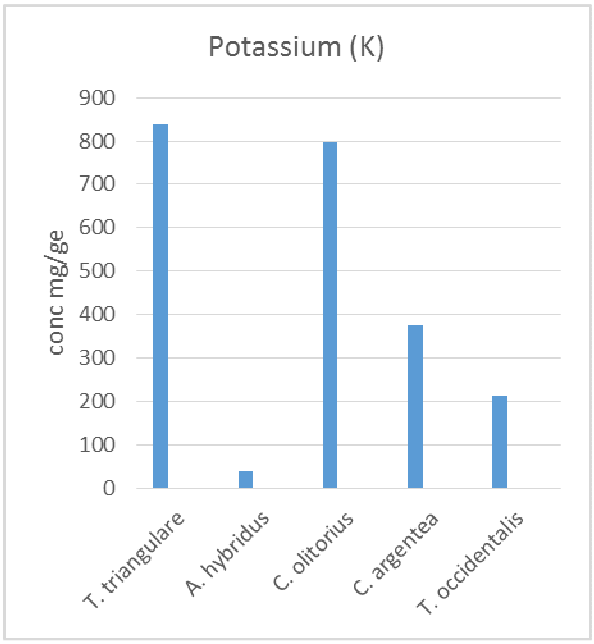

Zinc (Zn)
Conc. mg/g
0.8
0.6
0.4
0.2
0
T. triangulare
A. hybridus
C. olitorius
C. argentea
T. occidentalis

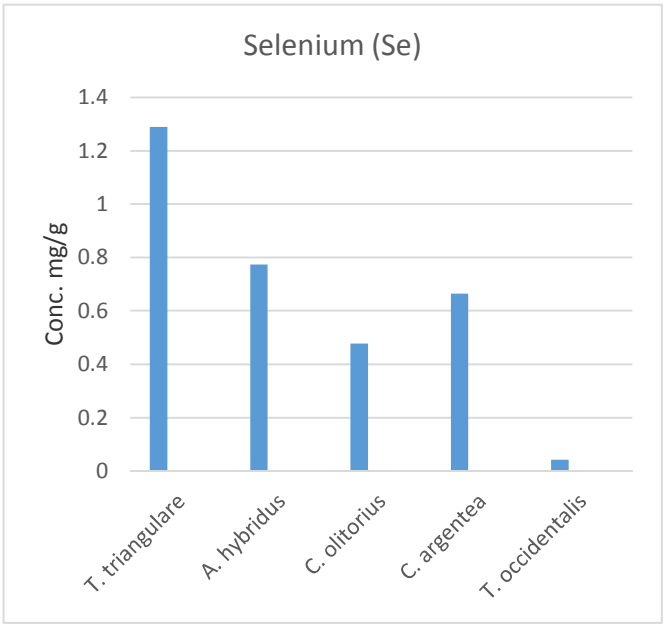

Copper (Cu)
CONC. MG/G
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1.633
0.632
0.203
0.226
0.278
T. triangulare
A. hybridus
C. olitorius
C. argentea
T. occidentalis

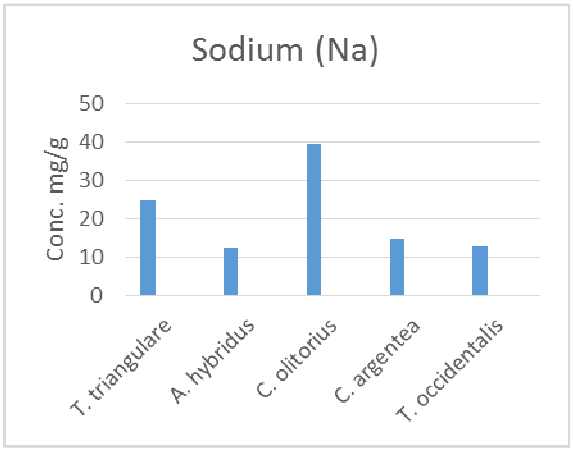

Calcium (Ca)
Conc. mg/g
25
20
15
10
5
0
T. triangulare
A. hybridus
C. olitorius
C. argentea
T. occidentalis


Managanese (Mn)
Conc. mg/g e
2
1.5
1
0.5
0
T. triangulare
A. hybridus
C. Olitorius
c. argentea
T.occidentalis


Cobalt (Co)
Conc. mg/g
5
4
3
2
1
0
T. triangulare
A. hybridus
C. olitorius
C. argentea
T. occidentalis







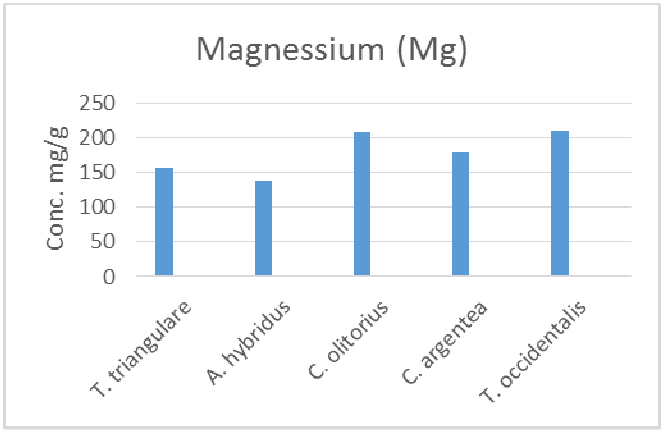


Fig 1: Trace Metal Concentration in selected commonly consumed vegetable samples.

Conflict of Interest
None.

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