INDUCTIVELY COUPLED PLASMA-ATOMIC EMISSION SPECTROPHOTOMETER (ICP-AES) DETERMINATION OF TRACE ELEMENTS PRESENT IN *Telfairia Occidentalis and Vernonia Amygdalina* OBTAINED FROM ORITA MARKET, ILARO TOWN, YEWA SOUTH LOCAL GOVERNMENT, OGUN STATE

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ABSTRACT

Samples of *Telfairia occidentalis* and *Vernonia amygdaline* were purchased at Orita market in Ilaro town, Ogun state. These vegetables were analysed for the presence of the following trace elements Chromium, Copper, Iron, Selenium and Zinc. The inductively coupled plasma-atomic emission spectrophotometer (ICP-AES) was used to determine the trace element levels. The results revealed that *T. occidentalis* had levels Cu , Fe and Zn to be 0.0235mg/kg, 0.9914 mg/kg and 0.1077mg/kg respectively while *V. amygdaline* had levels of Cu , Fe and Zn to be 0.0375mg/kg, 0.5352mg/kg and 0.1916 mg/kg respectively. Chromium and selenium were not detected in both vegetables. These results showed that the trace elements analysed for were all below the levels that could bring about toxic and unwanted effects. These results also revealed that of the two vegetables, *T. occidentalis* is a better source iron while *V. amygdaline* is a slightly better source of zinc and copper.

Keywords: Trace elements, *Telfairia occidentalis, Vernonia amygdaline*

1.0 INTRODUCTION

Vegetables are an important part of the diet. They are important in the prevention of cardiovascular diseases and certain cancers as well as reducing the risks of obesity and diabetes (Hoejskov, 2014). It is no news that leafy vegetables are abundant in vitamins, minerals and essential amino acids. Green leafy vegetables are an affordable and rich source of proteins as they can make amino acids from readily available source materials like water, carbon dioxide and nitrogen from the atmosphere (Fasuyi, 2006).

Vegetables are relatively cheap in South Western Nigeria because they are grown extensively and have always been a part of the diet. The cultivation and sale of vegetables are a huge source of income to a myriad of people such as the farmers, the sales people as well as the sellers and producers of fertilisers and pesticides (Dike &Odunze, 2016).

Industrialisation has increased environmental pollution, where water, air and the soil are being polluted by different toxic substances. Crops grown on contaminated soils, easily take up these toxic substances example of which are trace elements (Khan, Cao, Zheng, Huang & Zhu, 2015). Copper (Cu), Chromium (Cr), Iron (Fe), Zinc (Zn) and Selenium (Se) are examples of trace elements needed in small quantities for the normal functioning of both plant and animal cells. However, these elements can quickly accumulate to very dangerous and toxic levels due to contamination from anthropogenic activities and if present in foods like vegetables , they can bring about harmful effects to humans who consume them (Uwah, 2017). The concentration of trace elements in plants depend on the characteristics of the soil and how the plant can specifically bioaccumulate the elements (Divrikli, Horzum & Soylak, 2006). In addition, trace elements can also get into vegetables when farmers use contaminated water to wash them before taking them to the market.

With the advent of the education of people to reduce the consumption of processed foods and return to more natural foods such as vegetables, it is important to ensure that these vegetables are safe for consumption and do not cause more harm than good. It is therefore important to the determine the levels of trace elements in vegetables in order to assess their safety for consumption. In view of this, this study aimed at using the Inductively Coupled Plasma Atomic

Emission Spectrophotometer (ICP-AES) to determine the levels of trace elements present in two vegetables (*Telfairia occidentalis* and *Vernonia amygdaline*) available at the Orita market of Ilaro town, Yewa South Local Government, Ogun State.

2.0 MATERIALS AND METHODS

2.1 Plant material and collection: Vegetable samples (fluted pumpkin and Bitter leaf) were purchased from Orita market in Ilaro, Yewa South Local Government, Ogun State, Nigeria. The vegetables were cleaned with tap water and then de-ionised water to remove any dirt and impurities present. After rinsing, the vegetables were air-dried and then crushed using mortar and pestle. The powdered samples were then stored at room temperature in airtight polythene bags in preparation for the wet acid digestion.

2.2 Trace Element Determination: 1g of each sample was weighed and poured in a digestion flask while aqua regia (HNO_3 and HCl) in ratio 1:3 was added. The solution was subjected to heat until a clear solution was obtained. The clear solution was allowed to cool and then filtered into a 100ml standard flask, which was filled to mark with de-ionised water. All reagents were of analytical grades and all samples were run in triplicate using the inductively coupled plasma-absorption emission spectrophotometer (Agilent 710 ICP-AES).

The vegetable samples; Fluted pumpkin (*Telfairia occidentalis*) and Bitter leaf (*Vernonia amygdaline*) were analysed for the following trace elements; Copper, Iron, Chromium, Zinc and Selenium.

2.3 Data Analysis: Data produced from this research study was subjected to statistical tools of analysis using mean for the measurement of central tendency, and standard error of the mean for the measurement of the deviation of the sample mean from the population. In addition, a bar chart was also drawn to visually compare between the concentrations of the trace elements in the two vegetables.

3.0 RESULTS AND DISCUSSION

3.1 Results

The results from the analysis are presented in tables 1 , 2 and figure 1.

Table 1: Trace element concentrations in *Telfairia occidentalis* and *Vernonia amygdaline*

Elements	***Telfairia occidentalis* (mg/kg)**	***Vernonia amygdaline* (mg/kg)**
Cr	ND	ND
Cu	0.0235±0.0001	0.0375±0.0078
Fe	0.9914±0.5042	0.5352±0.0248
Mg		
Se	ND	ND
Zn	0.1077±0.0028	0.1916±0.0101

Values are in mean ± SEM. ND= Not detected.

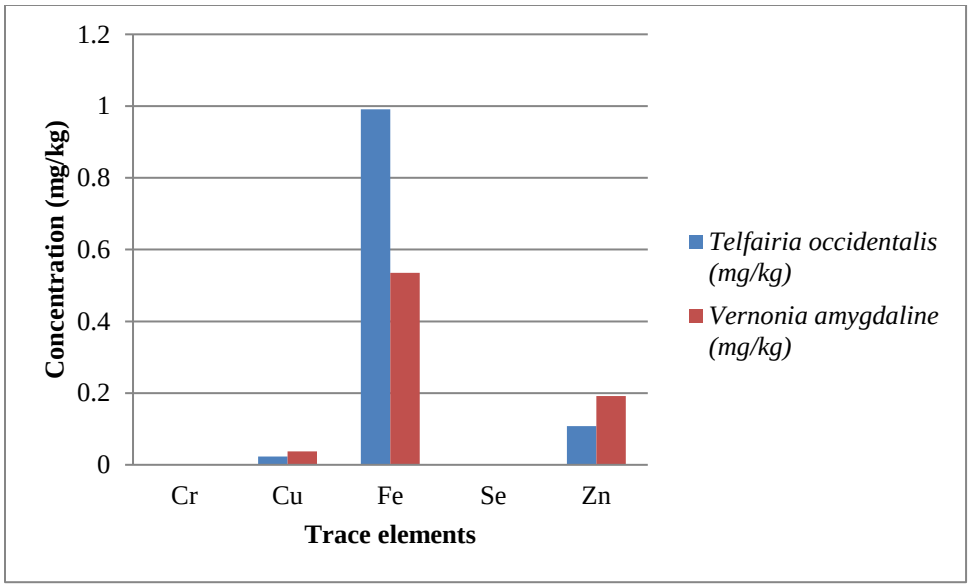

Figure 1. Bar chart representation of the concentrations of trace elements in the two vegetables.

Table 2: WHO/FAO maximum tolerable levels for Cu, Fe and Zn. (WHO/FAO, 2011)

Trace Element	PMTDI (mg/kgbw)
Cu	0.05-0.5
Fe	0.8
Zn	0.3-1

PMTDI: Provisional Maximum Tolerable Daily Intake. Bw: Body weight.

3.2 Discussion

The results in table 1 and figure 1 show the concentrations of Cu, Cr, Fe, Se and Zn in Fluted pumpkin (*Telferia occidentalis*) and Bitter leaf (*Vernonia amygdaline*) obtained from Orita market in Ilaro, Ogun state. The values are given as mean ± SEM and the results are means of duplicate values. The trace element levels were based on the dry weight of the vegetables. Table 2 shows the levels of essentiality and the maximum permissible limits of the trace elements as provided by WHO. For values with ranges as in Cu and Zn the lower limit values are the levels of essentiality while the upper limit values are the maximum permissible limits. Chromium and Selenium were not detected in any of the vegetables analysed. In both vegetables, Iron had the highest concentration while Copper had the lowest concentration. Between the two vegetables analysed, *Telferia occidentalis* popularly known as Ugwu, had almost double the amount of Fe found in Bitter leaf. However, Bitter leaf had higher concentrations of Zinc and Copper. The concentration of Cu in both vegetables was the least. In the order of decreasing concentration for both vegetables we have; Fe>Zn>Cu.

The presence of copper in proteins and enzymes has established its essentiality as an element (Goldhaber,2003). It is important for the growth of connective tissue, bone and nerve covers. It is also involved in the metabolism of Iron and energy (Fraga, 2005). Excess intake of Cu is likely to bring about nausea, jaundice, diarrhoea, emesis, haemoglobinuria and/or haematuria, jaundice, oliguria/anuria, hypotension, coma and death (WHO, 2011). According to WHO, the fatal oral dose of Cu is 200mg/kg.

The results obtained in this study for *Telferia occidentalis* was lower than that of Oyekanmi, Farombi and Adebayo (2014) who reported values in the range of 0.2- 5.8 mg/kg from selected local governments in Osun state but was similar to that reported by Uka, Chukwuka and Afope (2013) who reported values in the range of 0.02-0.07mg/kg. The concentrations of Cu in the vegetables studied are well below both the level of essentiality and the maximum permissible limit as provided by WHO.

Iron is an important trace element to all living organisms. It is essential in the production of haem proteins, myogbobin, enzymes and is stored in the bone marrow, spleen and liver (Goldhaber, 2003; WHO, 2011). Iron is also important in the transportation of carbon dioxide and oxygen. Insufficient supply of Iron to the human body can lead to anaemic events which can bring about weakness and a decrease in endurance during strenuous activities (Brewer, 2007). *T. occidentalis* has the higher Fe content among the two vegetables studied and will be a beneficial addition to the diet of anyone who has low iron or is anaemic. The values obtained for Fe in this study are below the maximum value provided by the WHO.

Zinc like other trace elements is crucial to the improvement and growth of living oorganisms. It is important in the reproductive systems of males and also in the proper functioning of nerves (Mohammad & Sharif, 2011). Inadequate intake of zinc can bring about disruptions in the functions of the immune system; affect the healing of injuries, the olfactory organs and taste buds as well as DNA production (Fraga, 2005). Chronic high level ingestion of zinc in humans has been implicated in poor copper intake while acute ingestion can cause stomach problems and vomiting (WHO, 2011). Ogbuji, Ndulaka and David-Chukwu (2016) in a study of widely consumed vegetables in the south-eastern part of Nigeria, reported values for *T. occidentalis and V. amygdaline* to be 0.175mg/kg and 0.132mg/kg. These values are slightly different from those obtained in this study which could be as a result of difference in soil composition or a anthropogenic activities going on in the regions.

4.0 CONCLUSION

This study analysed vegetables; *Telfairia occidentalis and Vernonia amygdaline* also known as fluted pumpkin (Or Ugwu) and bitter leaf for the trace elements- Chromium, copper, iron, selenium and zinc- obtained from Orita market, Ilaro, Ogun state. The results obtained in this study indicates that these vegetables are safe to eat because they contain safe levels of the trace elements determined as their concentrations were below the Provisional Maximum Tolerable Daily Intake as recommended by WHO.

REFERENCES

Brewer,G. (2007). Iron and Copper Toxicity in Diseases of Aging, Particularly Atherosclerosis and Alzheimer's Disease, *Experimental Biology and Medicine* **232** (2), 323-335.

Dike N. I. & A. C. Odunze (2016). Elemental Contents of Spinach and Lettuce from Irrigated Gardens in Kano, Nigeria. *Environment and Pollution*; **5**(1), 73-86.

Divrikli,U.,Horzum,N., Soylak,M. & Elci1,L (2006). Trace heavy metal contents of some spices and herbal plants from western Anatolia, Turkey *International Journal of Food Science and Technology.* **41**, 712–716

Fasuyi , A.O. (2006) Nutritional potentials of some tropical vegetable leaf meals: chemical characterization and functional properties. *African Journal of Biotechnology* . **5**(1), 49-53.

Fraga,C.G. (2005) . Relevance, essentiality and toxicity of trace elements in human health. *Molecular Aspects of Medicine.* **26**(2005). 235–244.

Goldhaber, B. (2003) Trace element risk assessment: essentiality vs. toxicity. *Regulatory Toxicology and Pharmacology* **38** (2003), 232–242.

Hoejskov,P.S. (2014) Importance of fruit and vegetables for public health and food safety. *World Health Organisation* (WHO), *Pacific Regional Workshop on Promotion of Fruit and Vegetables for Health - PROFAV* Nadi, Fiji.

Khan, S., Cao, Q., Zheng, Y.M., Huang,Y.Z., & Zhu,Y.G. (2008). Health risks of heavy metals in contaminated soils and food crops irrigated with wastewater in Beijing,China . *Environmental Pollution* **152** (2008) , 686-692

Mohammed, M.I. & Sharif, N. (2011). Mineral Composition of Some Leafy Vegetables Consumed in Kano, Nigeria. *Nigerian Journal of Basic and Applied Science*, **19**(2), 208-212

Ogbuji C. A., Ndulaka J. C. & David-Chukwu N. P. (2016) Comparative evaluation of mineral compositions of green leafy vegetables consumed in South Eastern. *African Journal of Food Science.* **10**(12) . 374-378.

Oyekanmi,A.M., Farombi, A.G. & Adebayo O.R. (2014). Determination of Trace Element in Raw Leafy Vegetables Grown in Selected Local Government of Osun State. *American Journal of Chemistry*, **4**(1), 38-41

Uka,U.N., Chukwuka, K.S.& Afoke, C. (2013). Heavy metal accumulation by Telfairia occidentalis Grown on waste Dumpsites in South-eastern Nigeria. *Research Journal of Environmental Technology.* **7**(1), 47-53.

Uwah, E.I. (2017) Levels of Some Trace Metals in Two Leafy Vegetable Grown in Mbiaya Uruan, Akwa Ibom State, Nigeria. *International Journal of Innovative Environmental Studies Research.* **5**(2):40-45.

World Health Organisation (2011), *Joint FAO/WHO Food Standards Programme Codex Committee On Contaminants In Foods , Fifth Session The Hague, The Netherlands.*