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Determination of the Heavy Metal Contents of Vernonia Amygdalina (Bitter Leaf) Collected from Eke Okigwe Market in Imo State, South-eastern Nigeria

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Abstract

This study was designed to investigate the heavy metal contents of Vernonia amygdalina (bitter leaf) collected from Eke Okigwe Market in Imo State, South-Eastern Nigeria. Heavy metals including mercury (Hg), Cadmium (Cd), Manganese (Mn) and Lead (Pb) present in the vegetable were analyzed using Atomic Absorption Spectrophotometer (ASS). The results revealed that Mn (3.495±0.001) and Cd (0.001±0.008) mg/100g each present in the vegetable differed significantly compared with WHO allowable limits respectively ($P<0.05$). However, both Hg and Pb concentrations were not detected in the vegetable sample. Therefore, caution may be needed in the consumption of V. amygdalina in this area so as to avert the resultant deleterious effect of the bioaccumulation of these heavy metals in the human system.

Keywords: Mn, Pb, Hg, Cd, Vernonia amygdalina (bitter leaf), Eke Okigwe Market, WHO, ASS.

INTRODUCTION

Heavy metals are generally referred to as those metals which possess a specific density of more than 5g/cm^{3}and adversely affect the environment and living organisms (Jarup, 2003). Of great importance is the fact that heavy metals, otherwise called toxic metals such as lead, cadmium, mercury, manganese, arsenic are detrimental to human health for a variety of reasons and unfortunately are found prevalent in the environment as a result of the activities of man in the modern society. Heavy metals are significant environmental pollutants and their toxicity is a problem of increasing significance for ecological, evolutionary, nutritional and environmental reasons (Jaishanker *et al*., 2013) and they ranking amongst the major contaminants of leafy vegetables (Mapanda *et al*., 2005). These leaf vegetables are very essential protective food and are useful for the maintenance of health, prevention and treatment of diseases (D'Mello, 2003). *Vernonia amygdalina* is one of such leafy vegetables which are known for its enormous medicinal and health potentials. *Vernonia amygdalina* is a shrub that grows throughout Africa

Vol. 2, No. 05; 2018

ISSN: 2581-3366

and South-Asia and belongs to the family Asteraceace (Marcia and Ariane, 2013). It is commonly called bitter leaves because of its bitter taste and is used as vegetables in soups. The bitter taste of *V. amygdalina* has been attributed to its antinutritional components such as alkaloids, saponins, glycosides and tannins (Bonsi *et al.,* 1995).

In Nigeria, bitter leaf is known as Ewuro' in Yoruba, 'Onugbu in Igbo, and 'Chusar-doki' in Hausa (EGedigwe, 2010). *V. amygdalina* has been reported to contain a number of phytochemicals including saponins, flavonoids, alkaloids, terpenes, steroids, coumarins, phenolic acids, lignans, xanthones, anthraguinones, edotides and sesquiterpenes (Eleyinmi *et al*., 2008; Ugochukwu *et al*., 2015). Also, *V. amygdalina* has been shown to possess significant amount of proteins (Udensi *et al*., 2002), carbohydrates (Ejoh *et al*., 2007; Yekeen *et al.,* 2011), fiber (Udensi *et al.,* 2002; Ejoh *et al*., 2007; Eleyinmi *et al.,* 2008), calcium, iron, potassium, phosphorus, manganese, copper and cobalt (Bonsi *et al*., 1995; Ejoh *et al.,* 2007; Eleyinmi *et al*., 2008). Furthermore, *V. amygdalina* has been reported to possess antifungal (Wedge *et al.,* 2000), antimalaria (Nyan *et al*., 2008), anticancer (Howard *et al*., 2006; Oyugi *et al.,* 2009), antioxidant (Iwalokun *et al.,* 2006; Adaramoye *et al.,* 2008), antidiabetic (Atangwho *et al.,* 2007; Okolie *et al.,* 2008), hepatoprotective (Arhoghro *et al.,* 2009; Adesanoye and Farombi, 2009; Iwo *et al*., 2017), hypolipidemic (Adaramoye *et al.,* 2008), analgesic activity (Njan *et al.,* 2008),
and anti-inflammatory properties (Ibrahim *et al*., 2001). However, despite all these numerous health benefits of *V. amygdalina,* it tends to bio accumulate heavy metals and intake of heavy metal contaminated vegetables pose a risk to human health and well being. More so, a number of studies have shown heavy metals as important contaminants of vegetables (Singh *et al.,* 2006; Singh and Kumar, 2006; Sharma*et al*., 2006). Therefore, this study investigated the heavy metal contents of *V. amygdalina* leaf collected from Eke Okigwe Market in Imo State, South-Eastern Nigeria.

MATERIALS AND METHODS

Study area and sample collection

The samples of *Vernonia amygdalina* (bitter leaf) were randomly collected from Eke Okigwe Market in Imo State, South-Eastern Nigeria.

Pre-treatment of samples

The collected vegetable samples were washed thrice with distilled water to remove dust particles. Thereafter, the leaves were dried and ground into a fine powder and stored in polyethylene bags, until used for acid digestion.

Sample preparation

1g of each sample was weighed into a 50ml of hydrogen perioxide (H_2O_2) and 5ml of perchloric acid ($HClO_4$). The entire content was heated in an oven at a temperature of 95 degree centigrade

Vol. 2, No. 05; 2018

ISSN: 2581-3366

until a clear solution was observed in the beaker. Thereafter, the digest was filtered with Whatman No. 42filter paper into a 250ml volumetric flask. Two 5ml portions of distilled water were used to rinse the beaker and content filtered into a 250ml volumetric flask. The filtrate was allowed to cool to room temperature before dilution was made to 250ml mark with distilled water. The digest was analyzed for Hg, Cd, Mn and Pb respectively on buck scientific 210vgp atomic absorption spectrophotometer.

Sample analysis

The atomic absorption spectrophotometric (ASS) method was used for the analysis. Buck scientific 210vgp atomic absorption spectrophotometer was used for the quantification of metalions. The instrument was set up according to the manufacturer's instruction and allowed to equilibrate for about 15 minutes. It was then flushed to zero readings with distilled water, depending on the element being ionized for, the appropriate hollow cathode lamp was put in place and monochromatic was adjusted at the appropriate wavelength. The standard solutions of the test element were first aspirated into the instrument and thereafter, their respective absorbance was recorded. The readings were aspirated into the instrument one after the other; three consecutive times and their absorbance were recorded. The respective composition of samples with respect to the test element was calculated with the formulae while statistical method employed was the student t-test.

$$Emg/100g = 100/W \times N/10^3 \times D$$

W = Weight of the sample used; M = concentration in ppm derived from standard curve, E = the test element and D = dilution factor.

RESULTS

The heavy metal contents of *Vernonia amygdalina* is shown in table 1. The *V. amygdalina* sample was found to contain 3.495±0.001 mg/100g of manganese and 0.001±0.008 mg/100g of cadmium respectively. The concentration of cadmium detected in the *V. amygdalina* sample was significantly lower compared with WHO allowable standard of 0.003 mg/100g ($p<0.05$), while manganese level was significantly higher in the sample than WHO allowable limit of 0.1435mg/100g. However, both mercury and lead were not detected in the vegetable sample.

Table 1: Heavy metal content of *V. amygdalina* (mg/100g)

Metals	Mean ±SD
Mercury	----------
Cadmium	0.001±0.008
Manganese	3.495±0.001

Vol. 2, No. 05; 2018

ISSN: 2581-3366

Lead	----------

*Values are triplicate determinations; ----- = NOT detected; $p<0.05$ is statistically significant.

DISCUSSION

In this study, *Vernonia amygdalina* (bitter leaf) was found to contain 3.495±0.001 mg/100g of manganese concentration which was significantly higher compared with WHO allowable limit (WHO, 1996). This is in consonance with the report of similar studies (Kalagbor *et al*., 2014; Abimbola *et al*., 2015). This suggests that bioaccumulation of manganese may predispose consumers of bitter leaf to neurological disorders associated with manganese overexposure (manganism) such as parkinson's disease (Cersosimo and Koller, 2007).

However, *V. amygdalina* was found to contain lower concentration of Cadimum than WHO allowable limit (WHO, 1996). This is in line with the findings of previous similar studies (Yekeen *et al.*, 2011; Echem and Kaban, 2013). This may suggest that consumers of bitter leaf may be free from the harmful effects of excess cadmium overload in human system. However, it is important to mention that the ingestion of cadmium compounds despite its low concentration in this vegetable can result initially in metal fume fever, which may further progress to chemical pneumonitis and death if little quantities bio accumulates in the body (Hayer, 2007).

In the present study, the concentrations of mercury and lead were not detected in the bitter leaf sample. This result is in contrast with the reports of previous similar studies (Yekeen *et al.*, 2011; Echem and Kaban, 2013; Kalagbor *et al*., 2014; Abimbola *et al*., 2015). This result may imply that consumers of this food material may not be exposed to mercury and lead toxicity since they were not detected in the vegetable sample.

CONCLUSION

Manganese and cadmium concentrations detected in the *V. amygdalina* sample differed significantly than the WHO allowable limits respectively. However, mercury and lead concentration were not detected in the vegetable sample. Therefore, caution may be needed in the consumption of *V. amygdalina* in this area so as to avert the resultant deleterious effect of the bioaccumulation of these heavy metals in the human system.

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Vol. 2, No. 05; 2018

ISSN: 2581-3366

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Vol. 2, No. 05; 2018

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Vol. 2, No. 05; 2018

ISSN: 2581-3366

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