Journal of Medicinal Plants Studies
www.PlantsJournal.com

ISSN (E): 2320-3862
ISSN (P): 2394-0530
NAAS Rating: 3.53
www.plantsjournal.com
JMPS 2020; 8(3): 80-84

Received: 25-03-2020
Accepted: 27-04-2020

Adu AA
Department of Botany, Lagos State University, Nigeria

Aderinola OJ
Department of Zoology and Environmental Biology, Lagos State University, Nigeria

Mekuleyi GO
Department of Fisheries, Lagos State University, Nigeria

Adebayo PO
Department of Botany, Lagos State University, Nigeria

Corresponding Author:
Adu AA
Department of Botany, Lagos State University, Nigeria

Comparative assessment of heavy metals concentration in leaf, stem and root of water leaf (*Talinum triangulare)* (Jacq Willd, 1799) Grown on the soil of Cassidy's Dumpsite and Farmland in Ojo, Lagos state

Adu AA, Aderinola OJ, Mekuleyi GO and Adebayo PO

Abstract
This study assessed the levels of heavy metals(lead (Pb), cadmium (Cd), chromium (Cr), nickel (Ni) and arsenic (As), manganese (Mn), copper (Cu), iron (Fe), and zinc (Zn)) present in water leaf (*Talinum triangulare*) from a dumpsite(DS) in Cassidy and a farmland (FL) in Ojo, Lagos, Nigeria between August-November, 2019. Samples of waterleaf and soil obtained from DS and FL were digested and analysed using standard method. Only Fe and Zn in the leaf and stem had significant ($p<0.05$) different between the DS and FL. The values are (93.68±1.19mg/kg, 62.51±83.56mg/kg) for the leaf and (54.26±2.56mg/kg, 49.38±1.87mg/kg) for the stem. Also, Fe in the root of *T. triangulare* grown on DS were higher ($p<0.05$) than that grown on farmland. The concentration of contamination factor (CF) and enrichment factor for both DS and FL indicated low degree of contamination. Though, the metals were still within the WHO permissible limits, high contamination of *T. triangulare* with Fe and Zn could pose health problem for consumer. However, *T. triangulare* in this study especially from the farmland could be recommended for people with deficiency in Fe and Zn.

Keywords: Metals, safety, sites, recommendation

Introduction

Naturally, heavy metals occur in the ecosystem with different variations in concentrations. However, environmental pollution by heavy metals, even at low concentration and the long-term cumulative health effects that go with it is of major health concerns all over the world. Heavy metals have received the attention of researchers all over the world, mainly due to their harmful effects on plant and other living organisms (Tahar and Keltoum, 2011) [1]. The presence of heavy metals in the environment is of great ecological significance due to their toxicity at certain concentrations, translocation through food chains and non biodegradability which is responsible for their accumulation in the biosphere (Adedokun *et al*., 2016) [2]. Apart from direct introduction of metallic waste into the soil via domestic and industrial effluents, level of heavy metals in soils and forms in which they exist could be influenced by pedogenic processes(Herawati *et al*., 2000) [3]. Various studies have shown that dumpsite soils in south-western Nigeria and other part of the country support plant growth and biodiversity and as such they have been extensively used for cultivating varieties of edible vegetables and plant based foodstuffs (Benson and Ebong, 2005) [4]. However, these practices pose serious health and environmental concern due to the anthropogenic contaminations of these waste soils with intolerable level of chemical materials (Ellis and Salt, 2003) [5].

Green leafy vegetables constitute an indispensable part of diet in Nigeria and Africa at large Earlier studies by Fafunso and Bassir (1977) [6] estimated per capita daily consumption of fresh vegetables in Nigeria to be 65g, while later studies showed consumption to be as high as 360g per day (Sobukola *et al*., 2010; Doherty *et al*., 2011) [7, 8]. Sequel to large consumption rate of vegetables in Nigeria, frequently assessment of their safety status for consumption cannot be over emphasized. Therefore the present study aimed to examine the level of heavy metals in soil and Talinum triangulare from dumpsite and farmland in Ojo Local Government Area in Lagos State, Nigeria in a bid to ascertain its safety for human use and consumption.

Materials and Method

Site Description

The selected sites for this study as presented in Plates 1 and 2 was a dumpsite in Cassidy and a farmland both located in Ojo Local Government Area of Lagos state, Nigeria. Cassidy is a community in Ojo, situated along the Lagos Badagry Expressway. Cassidy is noted for its daily market where all kinds of trade transaction take place. The dumpsite is also known as the Jakande field and has been in existence for over 30 years. Various plants that grows naturally on the dumpsite included tomatoes, bitter leaf, water leaf, pawpaw etc. On the other hand, the farmland at Post service, Ojo, is situated directly opposite Lagos State University. The farm is propagated annually.

Plate 1: *Talinum triangulare* on Cassidy Dumpsite, Ojo, Lagos

Plate 2: *Talinum triangulare* on farmland located at Post service, Ojo, Lagos.

Collection of Samples

Samples of *T. triangulare* from each study site were uprooted, while the soil particles were collected from the roots. The plants were then divided into leaf, stem and root. They were kept in a paper bag, tied and labeled with a masking tape and a marker. Thereafter, soil and plant samples were taken to the laboratory for heavy metal analysis. Analytical Reagent grade chemicals were used in all tests.

Pre-treatment of Plant and Soil Samples

The leaves, stems and roots of the plant samples were separately cleaned by gentle washing with distilled water., air-dried in the laboratory for three days, and processed further by ashing and then used to quantify the heavy metals in the leaves, stem, and root. A 5g of each of the dried sample was weighed into a porcelain crucible and ashed in a muffle furnace at 550 ^{0}c, for 4 hr. Thereafter, the residue was allowed to cool, and then dissolved with 5 ml of dilute (1:1) nitric acid. The mixture was diluted to 25 ml with distilled water, solution being filtered through Whatman #1 filter paper. While the filtrate was saved for the determination of the metals. Also 5g each of the soil samples from the dumpsite and the control sites were prepared and digested using standard methods prior to heavy metal analysis.

Calibration and Measurement of Metals (Cd, Cu, Cr, Pb, Fe, As, Mn, Ni, Zn)

Calibration standards were prepare by diluting the appropriate certified reference standard solutions (100 mg/L) with deionized water to contain 0.050 - 1.00mg/L of each of the multi-element mix of the metals standards from Accu Standard Inc. The certified reference standard calibration mix was a 100 mg/L multi-element standard purchased commercially (Accu Standard, Inc, USA). The examined metals (Cd, Cu, Cr, Pb, Fe, As, Mn, Ni, Zn) were determined on filtrate of sample digestate by atomic absorption spectrometry while test results were validated with calibration curves obtained with certified metal standards (Accu Standard Inc, USA).

Determination of Contamination and Enrichment Factors

The Contamination Factor (CF) in the soil over a period of time is expressed as: Cm/Cb, where Cm=Concentration of a particular metal in soil, and Cb is the reference background metal. $CF<1$=low degree of contamination, $1\leq CF<3$=moderate degree of contamination, $3\leq CF<6$=considerable degree of contamination, and $CF\geq 6$=very high degree of contamination.

Enrichment factor is expressed as EF=(Ci/Cie) s/(Ci/Cie) rs Where Ci=content of element i in the sample of interest or the selected reference sample. Cie=content of immobile element in the sample or selected reference sample. (Ci/Cie) s=heavy metal to immobile element ratio in the samples of interest or examined environment. (Ci/Cie) rs=heavy metal to immobile element ratio in the selected reference sample. In this study, sample reference metal used is iron (Fe) due to its high concentration in the earth while the farmland is used as control station, as it contains element with low occurrence variability.

Based on enrichment factor, 5 contamination categories are recognized namely $EF<2$=minimal enrichment, $2\leq EF<5$=moderate enrichment, $5\leq EF<20$=significant enrichment, $20\leq EF<40$=very high enrichment, and $EF>40$=extremely high enrichment.

Statistical Analysis

All data were computed using Statistical Package for Social Science (SPSS, Version 20) while the mean concentration of heavy metals at both sites were analysed using t-test and the level of significance at 95% confidence was set at $p \leq 0.05$. Also, Enrichment Factor and Contamination Factor (CF) were analyzed using standard equations and formulars.

Results

Heavy Metal Concentrations in the Plant and Soil

Table 1 showed the heavy metals concentration in soil, stem, leaves, and root of *Talinium triangulare* growing around a dumpsite (Cassidy) and a farmland in Ojo, Lagos state, Nigeria. There were no significant differences ($p>0.05$) between Arsenic (As), Copper (Cu), Cadmium (Cd), Chromiuim (Cr), Manganese (Mn), Nickel (Ni), and Lead (Pb) found in the root, soil, stem and leaf of *T. triangulare* at both dumpsite and farmland. However, there was significant difference in the Zinc (Zn) and Iron (Fe) recorded in plant and soil from both sites. Iron (Fe) observed in the leaf and stem of *T. triangulare* growing on farmland were significantly higher than Fe concentration in the leaf and stem of *T. triangulare* grown on dumpsite. The values are (93.68±1.19mg/kg, 62.51± 83.56mg/kg) for the leaf and (54.26±2.56mg/kg, 49.38±1.87mg/kg) for the stem at both sites respectively. On the other hand, the concentration of Fe (121.01±1.36mg/kg) obtained in the root of *T. triangulare* grown on dumpsite were higher ($p<0.05$) than that in the root of *T. triangulare* grown on farmland (15.83±0.69 mg/kg). Similarly, the concentration of Fe in the soil from dumpsite (831.35±9.21 mg/kg) was significantly higher ($p<0.05$) than the soil of farmland (19.62±2.18mg/kg). While the concentration of zinc in the leaf and stem of *T.triangulare* grown on farmland were higher than that grown on dumpsite, the concentration of Zn in the soil and root of *T. triangulare* grown on dumpsite were greater than Zn concentration in the soil and root of *T. triangular e* grown on farmland.

Table 1: Summary of heavy metals concentration in *Talinium triangulare* (root, leaves, stem) and soil from dumpsite and farmland in Ojo, Lagos, Nigeria.

		Dumpsite				Farmland		
Metals(mg/kg)	Leaf	Stem	Root	Soil	Leaf	Stem	Root	Soil
Fe	62.51± 3.56[a]	49.38± 1.87[b]	121.01± 1.36[a]	831.35± 9.21[b]	93.68± 1.19[a]	54.26± 2.56[b]	15.83± 0.69[a]	19.62± 2.18[b]
As	0.05± 0.00	0.05± 0.00	0.07± 0.06	0.20± 0.02	0.05± 0.00	0.05± 0.00	0.05± 0.00	0.05± 0.00
Cd	0.12± 0.03	0.05± 0.00	0.28± 0.03	1.06± 0.08	0.05± 0.00	0.05± 0.00	0.05± 0.00	0.05± 0.00
Cr	0.05± 0.01	0.05± 0.00	0.07± 0.05	0.22± 0.04	0.05± 0.00	0.05± 0.00	0.05± 0.00	0.05± 0.00
Cu	1.88± 0.09	0.71± 0.05	1.06± 0.06	0.09± 0.05	0.96± 0.07	0.66± 0.10	1.16± 0.07	0.04± 0.01
Pb	0.44± 0.05	0.15± 0.03	2.15± 0.06	0.08± 0.07	0.05± 0.00	0.05± 0.00	0.11± 0.02	0.05± 0.00
Mn	0.67± 0.09	0.83± 0.05	1.18± 0.09	6.49± 0.54	0.88± 0.10	0.59± 0.02	0.86± 0.05	1.94± 0.10
Ni	0.14± 0.03	0.05± 0.00	0.13± 0.03	0.05± 0.01	0.05± 0.00	0.05± 0.00	0.06± 0.02	0.05± 0.00
Zn	9.54± 0.35[a]	21.63± 0.75[b]	53.44± 1.89[a]	45.86± 3.07[b]	53.83± 2.42[a]	34.15± 1.22[b]	0.98± 0.06[a]	13.31± 0.97[b]

Mean ±SD with superscript are significantly different ($p<0.05$)

Frequency Distribution of the Metals between Dumpsite and Farm land

The frequency of heavy metals (Fe, As, Cd, Cr, Pb, Mn, Ni, Zn and Cu) in *T.triangulare* (stem, leaf and root) and soil from the dumpsite and farmland are presented in figure 1 and 2 respectively. At dumpsite, the most frequent metal was Fe in the soil, followed by root while the least Fe content was found in the stem, however As- Ni had similar frequency (Fig.1). On the contrary at the farmland, the modal metal (Fe) was highest in the leaf, followed by the root while the least frequent Fe content was found in the soil (Fig. 2).

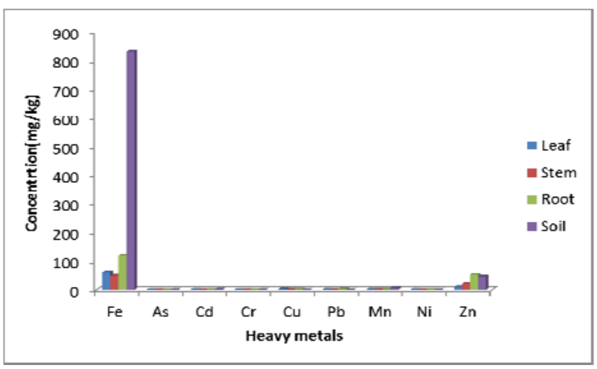

Fig 1: Variation of heavy metal content in soil and *Talinium triangulare* (root, stem and leaves) on dumpsite

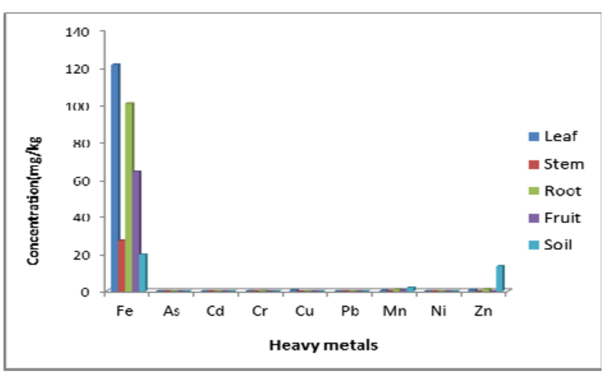

Fig 2: Variation of heavy metal content in soil and Talinium triangulare (root, stem and leaves) of Talinium triangular on the Farmland.

Enrichment and Contamination factors of the Soil Sample

The values of Contamination Factor (CF) in soil from dumpsite are shown in Table 2. They were: Fe (0.022), Cu (0.003), Zn (0.328), Pb (0.0098), Cd (1.321), Cr (0.002), Ni (0.0048), Mn (0.076) and as (0.016). On the other hand, the farmland's soil had CF values of Fe (0.0045), Cu (0.0011), Zn (0.095), Pb (0.0059), Cd (0.0625), Cr (0.0005), Ni (0.0007), and Mn (0.0228) and as (0.0038).

As presented in figure 3, Enrichment Factor (EF) in the soil from the dumpsite are: Fe(1.00), Cu(0.107), Zn(0.083), Pb(0.039), Cd(0.507),Cr(0.107),Ni(0.026),Mn(0.080) and As(0.097).

Table 2: Contamination factors (CF) in soil from dumpsite Cassidy and farmland in Ojo, Lagos, Nigeria

Metals	Background value	C_f (Dumpsite)	C_f (Farm land)
Fe	38000	0.022	0.0045
Cu	36	0.003	0.0011
Zn	140	0.328	0.095
Pb	85	0.0098	0.0059
Cd	0.8	1.321	0.0625
Cr	100	0.002	0.0005
Mn	85	0.076	0.0228
Ni	68	0.0048	0.0007
As	13	0.016	0.0038

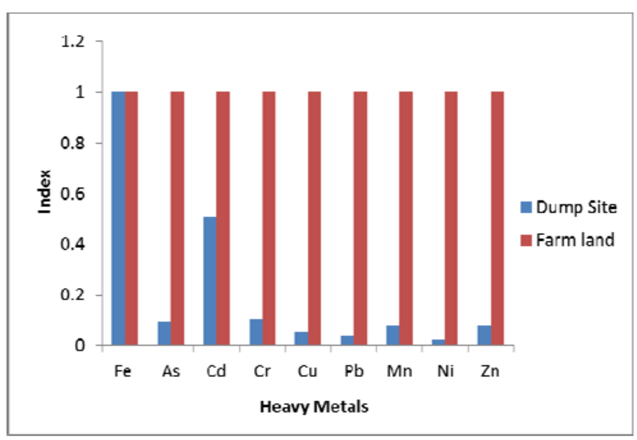

Fig 3: Enrichment Factor of the soil at dumpsite and farmland

Discussion

Results from Table 1, showed that there are no significant differences between Arsenic (As), Copper (Cu), Cadmium (Cd), Chromiuim (Cr), Manganese (Mn), Nickel (Ni), and Lead (Pb) found in the soil, root, stem and leaf of *Talinium triangulare* grown on the dumpsite (DS) and farmland (FL). However, the concentration of Fe found in the leaf of *T. triangulare* from farmland was significantly higher than that from dumpsite. This could be due to accumulation of Fe content in the farmland via continuous cropping or from runoff. The study also showed lower (Fe) in the stem of *T. triangulare* grown on the dumpsite in comparison to the stem of plant grown on the farmland. This could suggest that Fe were more abundant in the soil of the farmland and thus were stored in the stem. In contrast to the present study, waterleaf have the potential to accumulate higher heavy metals from dumpsites (Rajkumar *et al*., 2010; Uwah *et al*., 2009) [9, 10]. Higher concentrations of Fe in the vegetable might be due to the participation of green vegetables in the synthesis of ferrodoxin, which makes them useful sources of Fe. The Pb level in both DS and FL obtained in this study were higher than that reported on vegetable around municipal dumpsite (Eze, 2014) [11]. As presented on Table 1, The concentration of Fe recorded in the soil at both sites in this study were lower than that reported at Iyerekhu farm (Oladebeye *et al.,* 2020) [12] on same plant. Similarly, Zn contents obtained by Ebung *et al.* (2007) [13] on water leaf were higher than those recorded in this study. The concentration of contamination factor (CF) shown in Table 2 for both DS and FL indicated low degree of contamination of the selected metals (except Cd) for this study. However, Cd value showed moderate degree of contamination. This finding was similar to the results on aquatic plants from Ajegunle creek in Nigeria (Mekuleyi *et al*., 2019) [14]. The enrichment factor presented in figure 3 indicated that there was minimal enrichment of the metals on the soil at the dumpsite. This implies that the level of contamination is not lethal. Similar results has been reported by Mekuleyi *et al*. (2019) [14] and Ada et al. (2013) [15] on heavy Metals in three Staple Vegetables Commonly Cultivated along the South Bank of River Benue, Makurdi, Nigeria.

Conclusion

The concentration of heavy metals in this study were in sequence of Fe>Zn for soil and leaf of farmland and dumpsites respectively. However, other metals did not differs in value at both sites. Though, the metals were still within the WHO permissible limits, the high contamination of *T. triangulare* with Fe and Zn could pose health problem for consumer. However, *T. triangulare* in this study especially from the farmland could be recommended for people with deficiency in Fe and Zn.

References

1. Tahar K, Keltoum B. Effects of heavy metals pollution in soil and plant in the industrial area, West Algeria. Journal of Korean Chemical Society. 2011; 55:1018-1023.
2. Adedokun AH, Njoku KL, Akinola MO, Adesuyi AA, Jolaoso AO. Potential Human Health Risk Assessment of Heavy Metals Intake via Consumption of some Leafy Vegetables obtained from Four Market in Lagos Metropolis, Nigeria. Journal of Applied Science and Environment Management. 2016; 20(3):530-539.
3. Herawati N, Suzuki S, Hayashi K, Rivai IF, Koyama H. Cadmium, Copper, and Zinc Levels in Rice and Soil of Japan, Indonesia, and China by Soil Type. Bulletin of Environmental Contamination and Toxicology. 2000; 64(1):33-39.
4. Benson NU, Ebong GA. Heavy metals in vegetables commonly grown in a tropical garden ultisol, Journal of Sustainable Tropical Agricultural Resources. 2005; 16:77-80.
5. Ellis DR, Salt DE. Plants, selenium and human health. Current Opinion in Plant Biology. 2003; 6:273-279.
6. Fafunso M, Bassir O. Variations in the loss of vitamin C in leafy vegetables with various methods of food preparation. Food Chemistry (Elsevier). 1977; 2(1):51-55.
7. Sobukola OP, Adeniran OM, Odedairo AA. Kajihausa OE. Heavy metal levels of some fruits and leafy vegetables from selected markets in Lagos, Nigeria, African Journal of Food Science. 2010; 4(2):389-393.
8. Doherty N, Dickmann M, Mills T. Exploring the motives of company-backed and self-initiated expatriates. The International Journal of Human Resource Management. 2011; 22(3):595-611.
9. Rajkumar M, Ae N, Prasad MNV, Freitas H. Potential of siderophore-producing bacteria for improving heavy metal phytoextraction. Trends in Biotechnology. 2010; 28:142-149.
10. Uwah EI, Ndahi NP, Ogugbuaja VO. Study of the levels of some agricultural pollutants in soils and water leaf (*Talinum triangulare*) obtained in Maiduguri, Nigeria. Journal of Applied Science and Environmental Sanitation. 2009; 4:71-78.
11. Eze MO. Evaluation of Heavy Metal Accumulation in *talinum triangulare* grown around Municipal solid waste dumpsites in Nigeria. Bulletin of Environment, Pharmacology and Life Sciences. 2014; 4(1):92-100.
12. Oladebeye AO, Okunade MB, Oladebeye AA. Elemental Compositions of Tropical Vegetables and Soils in Edo State, Nigeria Using X-ray Fluorescence Technique. Journal of Scientific Research & Reports. 2020; 26(2):27-37.
13. Ebung GA, Etuk HS, Johnson AS. Heavy Metals Accumulation by Talinum triangulare grown on Waste Dumpsites in Uyo Metropolis, Akwa Ibom State, Nigeria. Journal of Applied Sciences. 2007; **7**(10):1404-1409.
14. Mekuleyi GO, Anetekhai MA, Aderinola OJ, Adu AA. Environmental Health Status of Some Aquatic Ecosystems in Badagry Division, Lagos, Nigeria. International Journal of Ecotoxicology and Ecobiology. 2019; 4(4):93-102.
15. Adah CA, Abah J, Ubwa ST, Ekele S. Soil Availability and Uptake of Some Heavy Metals by Three Staple Vegetables Commonly Cultivated along the South Bank of River Benue, Makurdi, Nigeria, International Journal of Environment and Bioenergy. 2013; 8(2):56-67.