



Research Paper

## Heavy Metals Loading of *Teifera Occidentalis* (Fluted Pumpkin) Grown In Ekpan (Host Community of Warri Refinery and Petrochemicals) Nigeria

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### ABSTRACT

This study investigated the heavy metals loading of *Teifera occidentalis* grown in Ekpan Warri refinery and petrochemical host community soil. To achieve this, the research area Ekpan was mapped out into 5 research stations. From each of the research stations, edible portions of *T. occidentalis* were collected from 5 sampling spots bulked, composites drawn, wrapped in an absorbent paper, coded and taken to the laboratory. The analytical standards adopted were USEPA and APHA and the analytical instruments deployed was Agilent atomic absorption spectrophotometer model 240A. The result obtained were as follows; Cu;  $1.08 \pm 0.09\text{mg/kg}$ , Zn;  $2.43 \pm 0.05\text{mg/kg}$ , Mn;  $29.11 \pm 0.68\text{mg/kg}$ , Co;  $2.72 \pm 0.15\text{mg/kg}$ , Cr;  $0.00 \pm 0.00\text{mg/kg}$ . The results of the parameters investigated were further subjected to test of significance with ANOVA with denominator 20 and numerator 4 at 0.05 level of significance. The F. ration P. Value is 1.80 while the F. ratio critical value is 2.87 which reveals that there is no significant difference between the concentration of the metals investigated and WHO maximum allowable concentration. The study recommends that *T. occidentalis* should be cultivated and consumed in Ekpan and its environ because it is safe to do so.

**KEYWORDS:** Warri Refinery Heavy metals, *Teifera occidentalis*, bioaccumulation, biomagnification, human health

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### I. INTRODUCTION

Vegetables are considered very important components of human dietary requirements because of its high concentration of fibre, vitamins and minerals especially electrolyte (Habauzit, Milen Lovie & Moraud 2013; Southern 2000; New; 2001; Shen, Bergen & Chyu, 2017;). Sufficient intake of vegetables have been associated with a reduced risk of chronic disease such as cancer, diabetes, cardio-vascular disease, osteoporosis, mental health and body weight management (Agle, & Cute 2014; Miya Moro, Izumi Tawera, & Kohno 2014; McMarhne, Jacka & Coleman 2013; Dosil- Diaz, Ruano-Rauna, GestelOloro, & Barros-Dios 2008; Annema, Heywoth, & McNaughton 2011).

Increased industrial activities in Peri-urban and rural areas and poor effluents disposals have resulted in the contamination of vegetables grown in such areas (Ke, Koththaile & Spanoghe 2011; Park et al., 2016; Poma, Mamam, & Ingue 2016, Shields, Lee and Murphy 2012, Sim et al., 2017). The pollutants include Persistent Organic Pollutants (POPS), dioxins, Poly-chlorinated biphenyls (PCBS), Pesticides, and heavy metals (Berger et al., 2010<sup>3</sup>, Castro Ibanez, Lopez-Galvez, Gil & Attende 2016; Forttergull & Abdelghari 2013; Cil, Marin, Andujar & Alkende 2001). Heavy metals results in health complications such as cancer, mental loss, cardiovascular disease Itai-Itai, chronic respiratory disease, stroke, diabetes (Asagba 2019, Nwajei 2018; Ros, Bueno & Kampman 2012; Kabat, Park, Hollenback, Schatkim & Rohan 2010; Carteson & Casaro 2011; Veon, Kim, & Sung 2012)

Ekpan plays host to Warri Refinery and petrochemical company with several gas flaring sites in the refinery complex. The sources of petroleum to the environment include tank wash equipment failures, pipes rupture, floods and gasflaring. (Charlesworth, De-Miguel & Ordonez 2010; Clark, Brabander, & Eidel 2006 Hingh, Breword, et al 2004, Khan, Cacao, Zhenga, & Huangazhu, 2008). Petroleum is composed of

hydrogen, carbon, nitrogen, sulphur and varying concentrations of heavy metals (Tesairol et al 2013; camago & Toledo, 2003, Cupr, Bartos, SankaKlonara, Mikes, & Holoubek 2010; Du Wang, Fu & Xia 2010; Peng, Fu, Zhao, & Gao 2011).

*Teifera occidentalis* is a perennial vine consumed for its nutritive and medical value mostly by the Niger-Deltans and the people of south east Nigeria (Nzei 2013; Obi & Okone 2013; Ejechi & Deyinta 2012; Okpako 2014). The perennial lifecycle of *Teifera occidentalis* exposes it to contamination by environmental toxicants through bioaccumulation and biomagnification and particulate pollutions (Ogochukwu 2015; Ufot & Usen 2011; Ezenwaka 2012 Okator & Ndile 2014, Ugbe & Ugbe 2015). Several studies have been undertaken on the environmental impact of oil exploration and exploitation in the Niger-Delta (Okara 2013; Dara & Ogheneakoke 2014; Hosfall & Clarke 2014; Briggs & Oghara 2012, Major & Idoghor 2014). However research documentations on the effect of the Warri refinery and petrochemicals on crops and vegetables production remain unavailable and this underscores this study.

The focus of this study therefore is the determination of the heavy metals content of *T. occidentalis* grown in Ekpan the host community of Warri refinery and petrochemicals.

The study is guided by the following research questions

1. What are the concentrations of Cu, Zn, Mn, Co and Cr in *T. occidentalis* grown in Ekpan soil
2. Are the concentrations of the heavy metals grown in Ekpan soil within the maximum limits for heavy metals in leafy vegetables as recommended by WHO
3. Can *T. occidentalis* continue to be grown and consumed by schools and inhabitants of Ekpan.

The study is guided by the hypothesis as below.

Ho: There is no significant difference between the heavy metals in *T. occidentalis* grown in Ekpan soil and WHO allowable concentrations for heavy metals in leafy vegetables

#### Study Area:

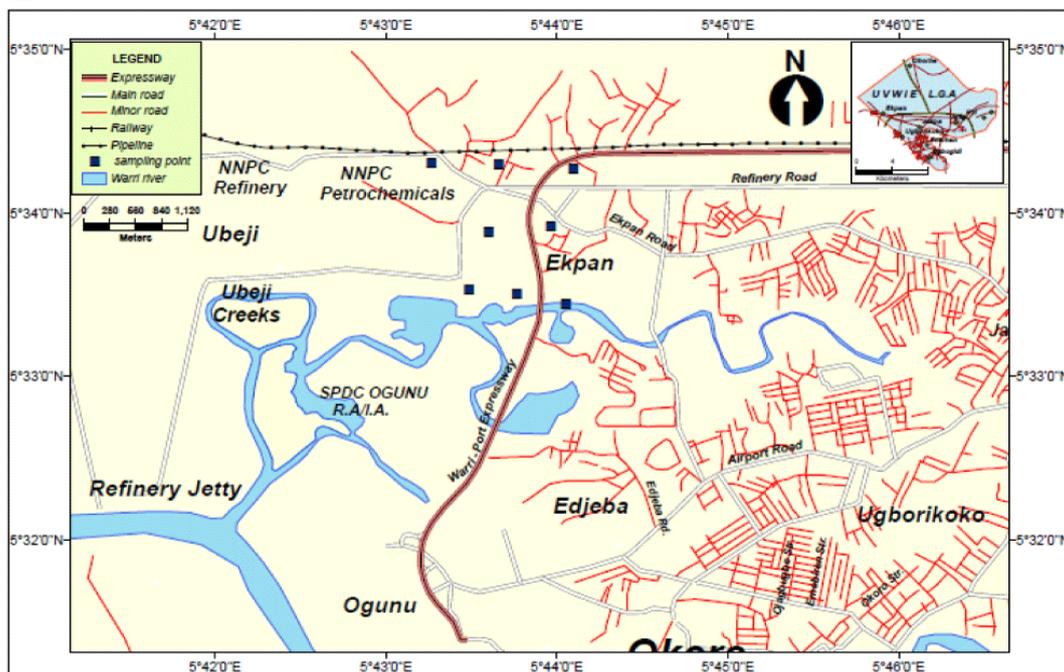


Figure 1: Map of Ekpan showing Warri refinery and petrochemical

Source: Ipeaiyeda, Nwauzor and Akporido (2015)

Ekpan is a community in Uvwie Local Government Area. It is located within the GPS Coordinates of 5.5639°N and 5.7298°E. Ekpan people were originally farmers but with the establishment of Warri refinery and petrochemicals complex in the community, and with the influx of people, they are now mainly petty traders and artisans (Emoghene 2012, Akpeki 2015, Kodeso 2013).

## II. MATERIALS AND METHODS

The research area Ekpan was mapped out into research stations and these are Ekpan General Hospital research station, NNPC Housing Complex research station, Ekpan Secondary School research station, NNPC refinery area and Ejeba area research stations. From each of these research stations, edible portions of

Teiferaoccidentals were sampled from (5) five sampling sites, bulked, composites drawn, wrapped in absorbent paper coded and taken to the laboratory for analysis.

**Sample preparation**

The vegetable samples were dried at 40°c to a constant weight. After cooling, 5g was weighed and 25ml aqua regia (3Hcl: 1HNO<sub>3</sub>) was added and digested on a hot plate till sample volume was 1ml. The solution was allowed to cool and was filtered into a 50ml standard flask and made up to mark with distilled water.

**Instrumentation**

Quantitative determination of the heavy metals was carried using Agilent atomic absorption photo-spectrometer model 240A equipped with an air/acetylene burner. After digestion of the plant samples, hollow cathode lamps of various metals of interest were used to determine the metals and background correction were done using deuterium lamp. Working standard for instrumentcalibration was prepared from stock solution of 1000ppm, for each metal by serial dilution using double-distilled water. Blank samples were also run to check for background contamination.

**III. RESULTS:**

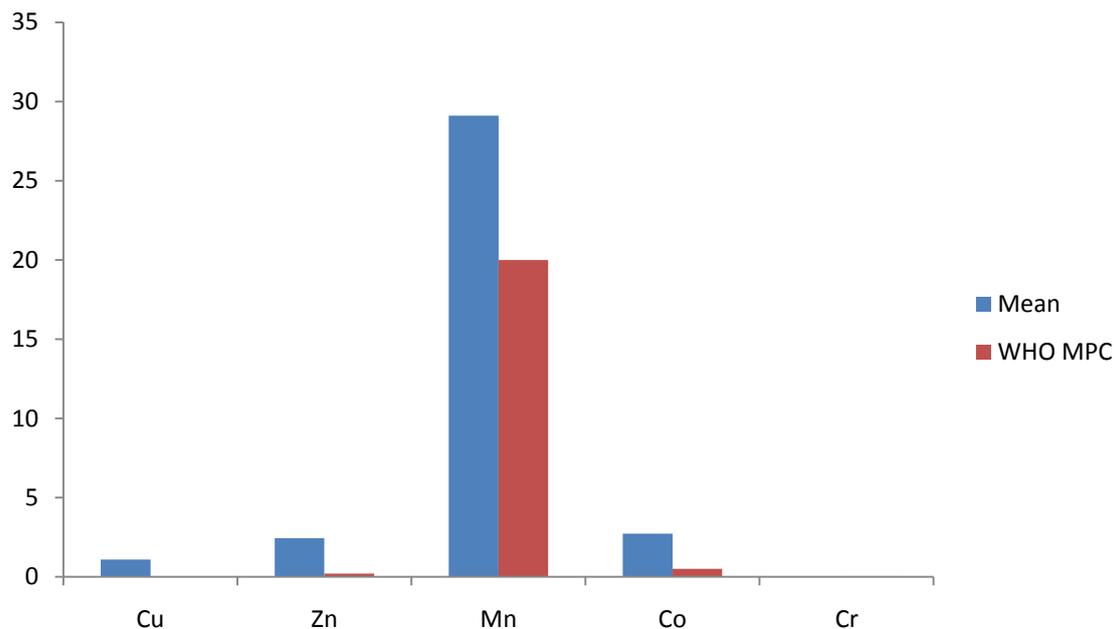
The results of the heavy metals investigated Cu, Zn, Mn, Co and Cr are as in Table I

**Table 1** results of the heavy metals investigated and WHO MPC in mg/kg

| Metals | Metal Concentrations |       |       |       |       | Concentrations |      |      |         |
|--------|----------------------|-------|-------|-------|-------|----------------|------|------|---------|
|        | Concentrations       |       |       |       |       | X              | Sd   | Ver  | WHO MPC |
|        | A                    | B     | C     | D     | E     |                |      |      |         |
| Cu     | 1.18                 | 1.02  | 1.20  | 0.98  | 1.05  | 1.08           | 0.09 | 0.01 | 0.20    |
| Zn     | 2.45                 | 2.57  | 2.42  | 2.34  | 2.43  | 2.43           | 0.06 | 0.00 | 20.0    |
| Mn     | 29.56                | 28.97 | 27.96 | 29.42 | 29.58 | 29.11          | 0.68 | 0.46 | 0.50    |
| Co     | 26.95                | 2.91  | 2.65  | 2.70  | 2.53  | 2.72           | 0.15 | 0.23 | 0.05    |
| Cr     | 0.00                 | 0.00  | 0.00  | 0.00  | 0.00  | 0.00           | 0.00 | 0.00 | 0.10    |

The mean result of the metals investigated were presented graphically as in figure 1

**Figure 1:**The mean concentrations the metals investigated.



Concentrations of the metals in decreasing order are as follows;Mn>Co>Zn>Cu>Cr.

The results of the heavy metals were for the subjected to test of significance with ANOVA with denominator 20 and numerator 4 at 0.05 level of significance. The F. ratio calculated is 1.80 while F. ratio critical value is 2.87. This means that HO is acceptable that there is no significant difference between the concentrations of the metals investigated and WHO maximum allowable concentration. This reveals that the concentration of the metals investigation in Ekpan soil is within acceptable threshold T. occidentals can be grown and consumed in Ekpan and its environment.

#### IV. DISCUSSION:

The results of the heavy metals investigated were treated with the statistical instruments of mean, standard deviation and the results obtained are as follows. The mean concentration of Cu is  $1.08 \pm 0.09$ mg/kg, while the World Health Organization maximum permissible concentration for Cu in leafy vegetable is 0.20mg/kg. Cu concentration is higher than the recommended. High Cu content in leafy vegetables has been recorded. (Sharma, Agraisal, & Narshal 2007; Reno, Nico, Recatalia, Sanchez, & Sanchez 2007) Zn mean concentration in the T. occidentalis investigation is  $2.43 \pm 0.05$ mg/kg. WHO maximum allowable concentration of Zn for vegetables is 20.00mg/kg. The concentration of Zn is within the acceptable threshold. Low concentration of Zn in leafy vegetables have been reported (Murray, Pinchin, & Mactre 2011; Provot, Donay, Herve, & Waterlot 2006). The mean concentration of Mn in the samples investigated is  $29.11 \pm 0.68$ mg/kg. The WHO maximum permissible concentration for Mn is 0.5mg/kg. The mean concentration of Mn is higher than acceptable level in leafy vegetables. A seminar result have been reported (Sipter, Rozsa, Gruiz, Tatrai, & Movai 2008; Shinn, Bing-Canar, Cailas, Penett, & Binns 2000). The concentration of Co the investigation revealed in  $2.72 \pm 0.25$ mg/kg. The WHO allowable concentration for Co in leafy vegetables is 0.5mg/kg. This is higher than the acceptable limit for leafy vegetables. Increased concentration of Co in leafy vegetables was documented (Yoron & Romling 2004; La-vecchia, Alhen, & Zarani 2001). The Cr mean concentration in the samples is  $0.00 \pm 0.00$ mg/kg. WHO maximum allowable concentration for Cr is 0.01mg/kg. The result reveals non detection of Cr in vegetables samples investigation. Non-detection of Cr in fruits and vegetables have been recorded (Saumel, et al 2012; Nuelke, Laydlaw, & Gonzalez 2011)

#### V. CONCLUSION:

The quest of every nation is to achieve growth in industrial and agricultural sector of its economy. Such growth is only sustainable when it is done with the world best practices as a template so as to ensure pristine environment. The presence of Warri refinery and petrochemical has not incurred much damage on the environment of Ekpan. They are enjoined to continue to operate within the ambit of set-down rules so as to protect the environment from degradation. Based on the outcome of the investigation, the study thus recommends the following;

1. Warri refinery and petrochemical should continue to operate within the set down rules and standards
2. Teifera Occidentalis and other crops can be cultivated by the citizens and schools within Ekpan
3. Environmental monitoring should be instituted to ensure continued compliance.

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