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Characterization of the Heavy Metals in *Tiefera occidentals* (Fluted Pumpkin) Grown in Ekpan (Host Community of Warri Refinery) Nigeria

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Abstract: ***This study investigates the heavy metals content of T. occidentalis grown in Ekpan community, the host of Warri refinery and petrochemicals. The research area was mapped out into research stations from each of the research stations samples were collected, bulked, composites drawn, wrapped in absorbent papers, coded and taken for analysis. The analytical standards adopted were USEPA and APHA and the analytical instrument used for determination was Agilent atomic absorption photospectrometer model 240A. The result obtained were V; 0.74±0.40 mg/kg, Fe; 84.13 ± 0.47 mg/kg, Ni; 1.29 ± 0.36 mg/kg, Pb; 0.65 ± 0.02 mg/kg and Cd; 0.42 ± 0.01 mg/kg. The results of the heavy metals investigated were further subject to test of significance with ANOVA with numerator 4 and denominator 20 at 0.05 level of significance. The F. ratio calculated value is 5.74 while F ratio critical value is 2.87, Thus rejecting H_o which reveals that there is significant difference in the concentration of metals and WHO acceptable limits for the metals investigated. The study recommended that Warri refinery and petrochemical should adopt world best practices in effluents management, gas flaring should be discontinued and remediation should be commissioned, vegetables production should be discontinued.***

Keywords: Warri refinery, Heavy, metals, gas flaring, *Teifera occidentals*, bioaccumulation, human health

1. Introduction

Vegetables have been related epidemiologically with reduced risk of many non-communicable disease. Fibres found in Vegetables have been known to reduce intestinal passage rate byforming bulk leading to a more gradual nutrient absorption. (Kaur, Kapour 2007, "Toluk, Seymour, & Serdulk 2004", Alinia, Hels, & Teetens 2009) Vegetables are important source of important nutrients in human diet, they contain potassium, vitamin C and E, fibres and may phytochemicals (Lox, Anderson, Lean & Mela 2009, Conner, et al 2007, "Callaher 2012", Alsunni, & Bader 2015). Vegetables and fruits are highly rated in the prevention of chronic disease such as hypertension, diabetes, coronary heart disease, cancer and so on (Boskon 2006, Bottelta, et al 2010, Boeing, et al 2012, Bellana, Larsen, Boltai, Wolk & Orsini 2013). Vegetables have also been associated with lower rate of cognitive decline in older ages. (Atowodi 2005, Uilaplana, BaeRady & Vilano 2014, Williams, Edward, & Harmerning 2013).

Global vegetable production have suffered setbacks due to contamination by industrial effluents discharges (Lattimer, & Haab 2010, Anderson, Perryman, Young, & Prior 2010, Kanung Sukkasem, Ng & Minh 2009). These toxicants from industrial discharges include persistant organic pollutant (POPs), polychlorinated biphenyls (PCBs), petroleum tar, pesticide residues, polycyclic aromatic hydrocarbons, heavy metal and others (Sohair, et al 2015, Darko, & Akoro 2008, JuraskeNutel, Stoessel, & Hellweg 2009, Kozowicka, Kaczynski, Rutkowska, Jankowska, & Hrynko 2013, Mi-ra, Hyun, Tae in Moa Jung, & Young 2011).

The presence of heavy metals in vegetables and food result in health complications of cancer, memory loss, heart and skin diseases, brain damage and skeletal Malfunctions (Sipter, Rozsa, Ciruiz, Tatra, & Morvov 2008, Shinn, Bing-Canar, Cailan, Penett, & Binns 2000, Sharma, Agrawal, & Marshall 2007, Qadir, Ghatoor, & Murtiza 2000, Peru, Mico, Pecatala, Sanchez, & Sanchez 2007).

The Niger-Delta is the oil belt of Nigeria. Oil and gas account for 80 percent of Nigeria gross domestic product and 90 percent of her export earnings (Emefiele 2018, Adeosun 2017; Sanusi 2017, Ruwani 2019). The Niger-Delta lies within GPS coordinates of 4°49'60" and 6.0'0". It has about 606 oil fields, 360 or 60 percent off shore and 246 or 40 percent on shore. It plays host to three refineries and petrochemical companies (Princewill 2016, Odili 2014; Wike 2018, Clarke 2016). Ekpen is the host community of Warri Refinery and petrochemical company.

Source of petroleum in the environment include spillages, equipment failure, tank wash, ballast water, gas flaring (Susu, Abowei & Onyeme 2008; Kaladumo, 2015; Dunnet, 2004). Petroleum is composed of carbons, hydrogen, oxygen, sulphur and heavy metals (Naackay, Shiu, Chals, Southwood & Johnson 2005; Pelleher, Burgess, Lito, Kuhn Mckinney, & Ryba 2014)

Teiferaoccidentalis is a perennial vine cultivated mainly in the south east and the Niger Delta. It is the most popular vegetable consumed for its nutritive and medical properties. (Odiaka, 2013, Ozokwor, 2015, Ojieh & Ulogo, 2014). The perennial life cycle of *T. occidentalis* predisposes it to contaminations by toxicants (Okoli & Kelechi, 2013. Nkpado & Ejiofor 2014, Odali, 2017).

Environmental impact studies of oil exploitation in the Nigeria has been properly researched, however, research on the impact of Warri Refinery and petrochemical on agricultural activities of Ekpan people remain unavailable or at best scanty. Thus the need for this study.

The focus of this study is the determination of the heavy metals content of *T. occidentalis* grown in Ekpan, the host community to Warri refinery and petrochemicals. The heavy metals investigated in this study are, V, Fe, Ni, Pb and Cd.

This study is guided by the research questions as follows;

1) What is the concentration of V, Fe, Ni, Pb & Cd in *T. occidentalis* grown in Ekpan?
2) Are the concentrations of the heavy metals in *T. occidentalis* grown in Ekpan within the limit stipulated by WHO for leafy vegetables?
3) Can schools and inhabitants of Ekpan community continue to cultivate and consume T.occidentalis and the other crops cultivated in Ekpan

The study was guided by a hypothesis as thus:
Ho: There is no significant difference in the heavy metals concentration in *T. occidentalis* grown in Ekpan and WHO maximum allowable limits for heavy metals in leafy vegetables.

2. Study Area

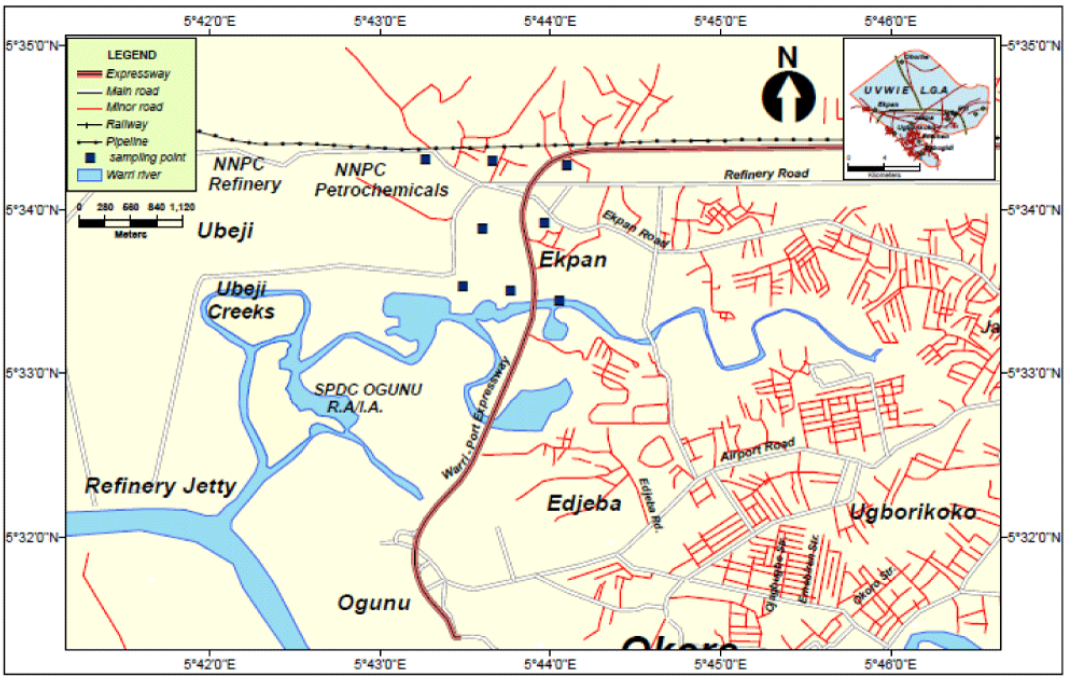

Figure 1: Map of Ekpan showing Warri refinery and petrochemical
Source: Ipeaiyeda, Nwauzorand Akporido (2015)

Ekpan is a community in Uvwie Local Government Area. They are Urhobo in tribe and language. Ekpan lies within coordinates of 5.5639°N and 5.7298°E with a population of 32, 000 (National Population Census, 2005). They were predominantly agrarian but with the location of the refinery in 1987 and influx of people, they are now petty traders and business owners. (Kodeso 2013, Akpeki 2015, Emoghene, 2012).

3. Materials and Methods

The research area Ekpan was mapped into five (5) research stations and these are, refinery area station, NNPC housing complex station, Ekpan secondary school station government hospital station and Ejeba road research station. From each of these research cells edible portion of *Teiferaoccidentalis* were sampled, bulked and composites drawn, wrapped in absorbent paper coded and taken to the laboratory for analysis

Sample Preparations

The samples were oven dried at 40°C to a constant weight. After cooling 5g was weighed out and 25ml aquaregia (3HCL:1HNO_3) was added and digested on a hot plate till sample was 1ml. The solution was then cooled and filtered into 50ml standard flask and made up to mark with distilled water.

Instrumentation

Quantitative determination of heavy metals were carried out using Agilent atomic absorption spectrophotometer model 240A equipped with air/acecylene burner After digestion of the samples hollow cathode lamps of metals of interest were used to determine the metals and background corrections were done using deuterium lamp. Working standard for instrument calibration were 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 contaminations.

4. Results

Results of the analysis of the heavy metals in *T. occidentalis* in Ekpan are as in Table I.

Table I: Results of the heavy metals investigation and WHO maximum permissible concentration in mg/kg

Metal	Concentrations					X	Sd	WHO NiPC
	A	B	C	D	E			
V	0.78	0.73	0.74	0.76	0.68	0.74	0.40	0.05
Fe	84.30	83.28	84.32	84.57	84.35	84.13	0.47	0.30
Ni	1.24	1.31	1.25	1.32	1.26	1.29	0.36	0.70
Pb	0.63	0.64	0.69	0.67	0.65	0.65	0.02	0.03
Cd	0.42	0.41	0.43	0.42	0.44	0.42	0.01	0.10

The mean result of the metals are then presented graphically in Figure 1

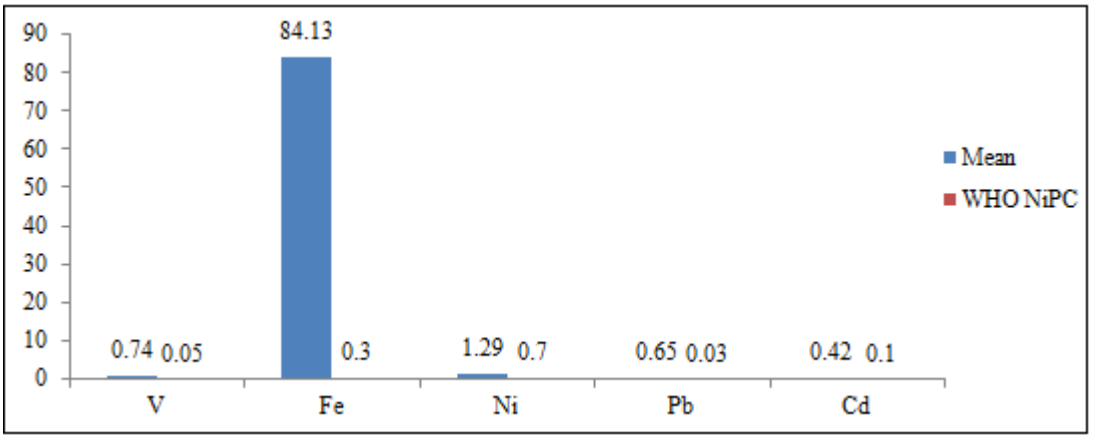

Figure I: The heavy metals in mg/kg and World Health Organization maximum permissible concentration

The concentration of the metals in decreasing order are Fe>Ni>V>Pb>Cd.

The results of the heavy metals context in the T. occidentals in Ekpan were further subjected to test of significance with ANOVA with denominator 20 and numerator 4 at 0.05 level of significance. The F ratio P. value is 5.74 while the F. ratio critical value is 2.87. H_O is thus rejected. This reveals that there is significant difference between the concentration of the metals investigated and WHO maximum allowable concentrations of the heavy metals investigated.

5. Discussion of Findings

The results of the heavy metals concentration in T. occidentals in Ekpan were further subjected to treatment with statistical tools of mean, standard derivation and the results obtained were as follows. The mean concentration of V is 0.74 $\pm$ 0.40 mg/kg. The WHO maximum permissible concentration of V for leafy vegetable is 0.05mg/kg. The concentration of V is higher than the acceptable limit. High concentration of V in leafy vegetables have been reported. (Angelora, Wanover, Delibatova & Ivanov, 2004, Arora, *et al* 2008). The mean concentration of Fe is 84.13 $\pm$ 0.47 mg/kg. The WHO maximum allowable concentration of Fe for leafy vegetables is 0.30mg/kg. Thus the concentration of Fe is higher than recommended. Elevated concentrations of Fe in leafy vegetables have been documented (Pruvest, Donay, Herve, & Waterlet 2006, Qadir, Ghatoor, & Nautaza 2000). The concentration of Ni in *T. occidentalis* grown in Ekpan is 1.29 $\pm$ 0.36mg/kg while the WHO maximum allowable limit for Ni in leafy vegetables is 0.70mg/kg. The concentration of Ni is higher than acceptable limit. Increased concentration of Ni in leafy vegetables have been recorded (Ge, Murray, & Hendeghet 2000). The concentration of Pb the investigation reveals is 0.65$\pm$ 0.02 mg/kg. The WHO maximum permissible concentration of Pb in leafy vegetables is 0.03mg/kg. The Pb in T. occidentals in Ekpan in higher than acceptable limit. High concentration of Pb in leafy vegetables was reported (Murray, Pinchin, & Machie 2011, Mandara, Mang, Nyamangara, & Ciller 2005). Cd mean concentration in the *T occidentalis* investigated is 0.42 $\pm$0.07 mg/kg. The WHO maximum permissible concentration for Cd in leafy vegetables is 0.10mg/kg. The concentration of Cd is higher than the acceptable limit for leafy vegetables. High Cd content in leafy vegetables have been recorded (Micrabito, et al 2007, Flazrat & Khan 2018).

6. Conclusion

Location of refinery in Ekpan is a very welcomed development because it is the fulcrum and driver of most other sectors of the economy. However, laudable the location of the refinery is, the health of the host community should be given a priority. **The activities of Warri refinery and petrochemicals have resulted in eventual degradation of the environment of Ekpan will in-advently take tolls on the health of citizens which areinimical to their existence.** Against the backdrop of the outcome of this investigation, the study recommends as thus:

Warri refinery and petrochemical operator should adopt the world best practices on management of their effluents, to reduce pollution of the environment, continuous gas flaring at the complex should be discontinued rather gas to liquid and gas gathering should be adopted.

Environmental remediation should be carried to resuscitate the soil for healthy living. *T. occidentalis* cultivation and consumption should be discontinued until the remediation is concluded.

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