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Assessment of trace metal elements in selected Plants around the vicinity of Ebedei Gas Flaring Station located at Ebedei Village, Ukwani Local Government Area, Delta State, Nigeria

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ABSTRACT

This study evaluated the trace metal elements in selected plants around the Ebedei Gas Flaring Station, Ukwani Local Government Area, Delta State, Nigeria. The plants analyzed include Azadirachta indica, Cymbopogon citratus, Moringa oleifera, Carica papaya) and Alstonia boonei. The analysis revealed that Alstonia boonei had the highest concentration of copper at 6.87 mg/kg, while the lowest concentration of Lead (0.06 mg/kg) was found in Carica papaya. The trace metal levels in the plants ranged from 0.06 mg/kg for Lead to 6.87 mg/kg for copper, with Azadirachta indica showing moderate levels across all measured metals. These concentrations were within the permissible limits set by WHO for vegetables, indicating no immediate threat to consumers. However, the study highlights the potential for bioaccumulation over time, which could elevate these levels and pose health risks. The study thus recommends conducting regular monitoring of trace metal levels in plants around gas flaring sites to prevent potential health hazards. In addition, soil remediation strategies should be implemented to reduce metal uptake by plants and public awareness campaigns should be carried out to educate the local population on the risks of consuming plants from contaminated areas.

Keywords: *Trace metals, Contamination, Gas flaring stations, Delta State*

Introduction

Trace metal analysis is a crucial part of environmental pollution studies [4, 12, 16].Plants growing in contaminated environments can accumulate trace elements at high quantities, which poses a major risk to people, even though some trace metals are essential for plant nutrition [15]. The core source of trace metals to plants is the air and soil from which metals are taken up by the roots or foliage.Trace metal contamination is of concern due to its effects as a carcinogen. To determine baseline quantities for which anthropogenic effects can be quantified, it is important to understand the distribution of certain trace metals in common plants.Hence, several studies have been reported on the availability and occurrence of trace metals in plants. This includes the study of Ekeanyanwu *et al*. (2010), who reported the distribution of trace metals in some common leafy vegetables and tuber crops grown in the Niger Delta region of Nigeria. The selected vegetables and tuber crops were found to have all of the minerals that were examined in all concentrations. Iron was the most prevalent mineral in the vegetables, with values ranging from 9.7 mg/kg in *Telfera occidentalis* roots to 0.32 mg/kg in *Ocimum gratissimum* roots. Zinc was a mineral that was plentiful in the tuber roots, ranging from 0.62 mg/kg in the stem of *Manihot esculata* to 1.97 mg/kg in the leaves.According to the bio-concentration factor, the majority of the metals in food crops are concentrated in the roots rather than the stems and leaves.According to Ekeanyanwu *et al*. (2010), the high iron concentration in the leaves of *Vernonia amygalina* and *Ocimum gratissimum* may be caused by the involvement of the vegetables in the synthesis of ferrodoxin, which makes them a valuable source of iron. These findings are not entirely in line with observations in the literature that show that lateral roots have the highest concentration of trace metals in food crops, followed by main roots, rhizomes, leaves, and shoots, which have the lowest concentration.[2] provided some trace metal profiles of some fruits in Kokori and Abraka markets, Delta State, Nigeria. The findings showed that the test fruits from Kokori market had increased levels of trace elements such as lead, chromium, cadmium, zinc, manganese, nickel, cobalt and copper than the same fruits from Abraka.

When evaluating the effects of soil contamination on plants' metal uptake, as well as translocation and toxicity or ultra-structural alternations, the types of plant availability and the metal specifications and soils are important to consider [3]. Because of human activities including road transportation, vehicular traffic and industry, the concentration levels of gaseous and trace metals in the atmosphere are constantly changing, making air pollution one of the most serious issues facing the world today [8].

Plants can be directly impacted by air pollution through their leaves or indirectly by the acidity of the soil. When plants are exposed to air pollution, the majority undergo physiological changes before showing obvious harm to their leaves [11]. In sensitive plant species, pollutants can cause reduced growth and yield, stomatal damage, premature senescence, decreased photosynthetic activities and disrupted membrane permeability. Under pollution stress circumstances, a decrease in petiole length and leaf area was noted [5, 17].

There have been reports that some air pollutants raise the amount of chlorophyll [1, 18], while others decrease it [7, 8, 17]. Vegetation is an effective indication of the overall impact of air pollution and the impacts noticed, is a time averaged result that is more trustworthy than the one observed from direct determination of the contaminants in the air over a short period. A considerable number of trees and bushes have been recognized as dust filters to curb the rising urban dust pollution level [14]. For diverse species, plants offer a vast leaf area for air environment impingement, absorption, and accumulation to varying degrees [11]. Since plants are the first to absorb air contaminants, their use as bio-monitors of air pollution has long been established [8]. Plants show varying degree of sensitivity and tolerance to air pollution stress. It was against these backgrounds that this study was conducted to assess the trace metal elements in selected plants around the vicinity of Ebedei gas flaring station located at Ebedei village in Ukwani Local Government Area of Delta State, Nigeria.

Materials and Methods

Study area

The study was carried outin Ebedei village, Ukwani Local Government Area of delta state, Nigeria. Ebedei Village is located within the geographical coordinates of 5^{0} 49' 0" North, 6^{0} 17' 0" East.

Sample collection

The samples which comprised of selected parts (leaves only) of five different plants that were used in the analysis were; Neem plant (*Azadiractha indica*) commonly called "Dogoyaro", Lemon grass (*Cymbopogon citratus*), Moringa (*Moringa oleifera*) Pawpaw (*Carica papaya*) and Pattern wood (*Alstonia boonei*). These plant samples were collected from the surroundings of Ebedei gas flaring station, located at Ebedei in Ukwani Local Government Area of Delta State, Nigeria.

Method of digestion

Samples were oven-dried for three (3) days at 60^{o}C. Dried samples were crushed or grinded into powder. 1.0g of powdered sample was measured into a conical flask. 10cm^{3} of the digestion mixture (a mixture of sulphuric acid, nitric acid and perchloric in a volumetric ratio of 1:4:40) was added to the sample and left for about 24 hours. Thereafter, the flask was heated over a bunsen burner at 70^{o}C for about forty (40) minutes and then the heat was increased to 120^{o}C. The mixture was observed to have turned black but when allowed to settle, a clear solution with white fumes appeared. It was diluted with 10cm of distilled water and boiled for another 15 minutes, allowed to cool, transferred to 50cm^{3} volumetric flasks and made to mark. The reagents were arranged into batches, and the trace metals contents were analyzed using AAS (Atomic Absorption Spectrometer).

Statistical analysis

Trace metal analysis was presented as mean. Differences among the trace metals of plant samples were analyzed using DMRT. ANOVA was done using a probability factor of P≤0.05 to assess significant variations in the levels of trace metals in the plants.

Results

The result (Table 1) showed that the level of Copper (6.83mg/kg) was highest inpattern wood *(Alstonia boonei)* and the least in Lead (0.06mg/kg) in pawpaw (*Carica papaya)* in all the plants samples analyzed. An equal amount of Copper and Chromium was found in *C. papaya*. Comparing with the WHO values of the selected plant samples, there was a significant difference using the DMRT.

Table 1. Concentrations of trace metals in some selected plant samples

Samples	Zn	Pb	Fe	Cu	Mn	Cr	Mean	
Azadiractha indica	3.41^{a}	2.43^{b}	3.62^{b}	5.36^{b}	2.86^{b}	1.96^{b}	3.27^{b}	
Cymbopogon citratus	0.53^{d}	0.32^{c}	1.51^{d}	0.23^{d}	0.63^{e}	0.10^{c}	0.49^{e}	
Moringa oleifera	3.10^{c}	0.19^{d}	0.74^{e}	3.17^{c}	1.92^{c}	0.19^{c}	1.55^{c}	
Carica papaya	0.72^{d}	0.06^{e}	3.11^{c}	0.14^{d}	1.57^{d}	0.14^{c}	0.96^{d}	
Alstonia boonei	3.26^{b}	4.21^{a}	3.96^{a}	6.87^{a}	3.22^{a}	2.63^{a}	4.03^{a}	
WHO limits for vegetables	50.00	10.00	20.00	10.00	200.00	1.50		

**Means with different alphabets within the same column are significant at P ≤ 0.05 using DMRT*

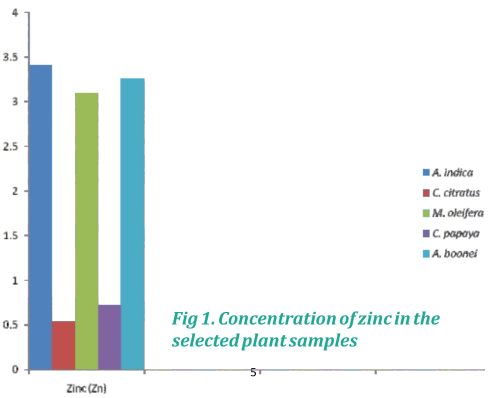

Fig 1. Concentration of zinc in the selected plant samples

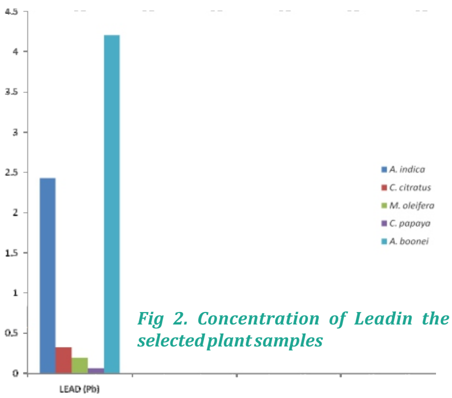

Fig 2. Concentration of Leadin the selected plant samples

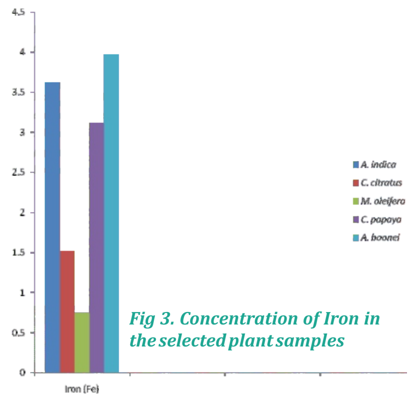

Fig 3. Concentration of Iron in the selected plant samples

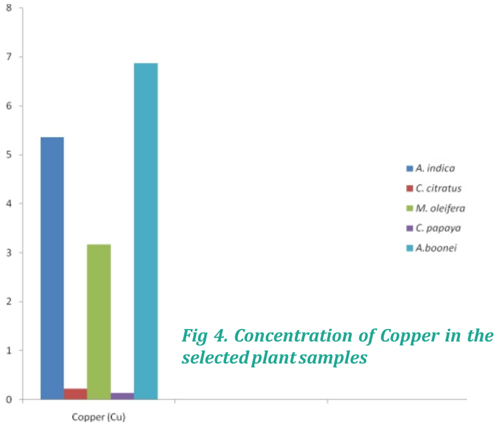

Fig 4. Concentration of Copper in the selected plant samples

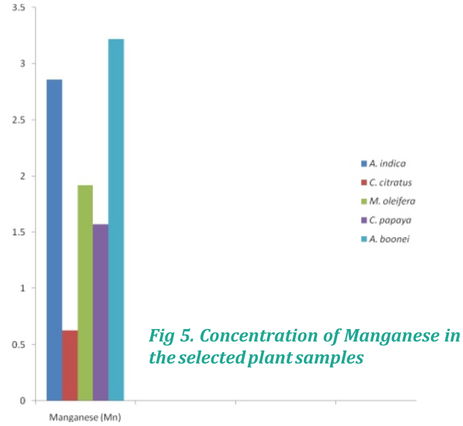

Fig 5. Concentration of Manganese in the selected plant samples

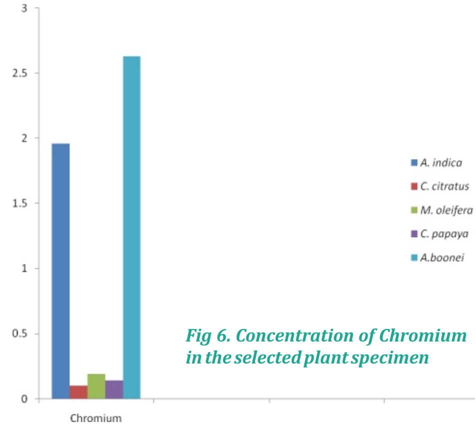

Fig 6. Concentration of Chromium in the selected plant specimen

Discussion

These plants acquire a variety of nutritionally significant mineral elements. Despite being harmful to human health, metals like lead (Pb), which plants cannot use in any way, can build up in plants [13]. The effects of these metals on the environment and human health have been important causes for concern; the availability of these metals in the soil greatly influences how much of them accumulate in plants [10]. One known method of trace metal contamination in plants is cultivation in soils with elevated amounts of trace metals. One possible source of trace metal toxicity to humans and animals has been identified in plants.

The most common poisonous trace metals include lead, mercury, copper and arsenic. Therefore, World Health Organization recommends the presence of trace metals in plants around mining sites before consumption [19]. However, most residents in regions where these plants are found gather them locally for their own or their families' consumption without examining them for the buildup of trace metals. Numerous factors, such as soil metal concentrations, plant types and varieties, plant age, etc., affect how much metals plants absorb. Nonetheless, the dominant element is the metal's concentration in the soil and, consequently, the current environmental circumstances [9].

The result obtained from this study showed that all the values were within the permissible limits set by the [20], however, their bioaccumulation and persistence in the soils may have led to increase uptake by plants which will pose a great danger to the health of consumers of such plants.

Conclusion

Conclusively, this study shows that different species of plants accumulate different levels of trace metals. Although, the concentration of trace metals in the selected plants of the study area was within the permissible limits set by the World Health Organization but with time and a gradual bioaccumulation process, a rise in to a high level is foreseen within their inherent health risks. Therefore, there is a need to always monitor the level of these metals in plants so as to improve their quality, safety, and efficiency in order to avoid the detrimental effects on their consumers.

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