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Mineral Elements in *Colocasia esculenta* L. Schot and Soil Characteristics around a Major Construction Site in Otuoke, Bayelsa State, Nigeria.

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ABSTRACT

Background: Mineral elements in *Colocasia esculenta* L. Schot and soil characteristics were examined around a major construction site in Otuoke, Bayelsa State, Nigeria. This study was conducted to examine the effects of construction activities on chemical properties of soil and mineral element contents of the test crop.

Methods: The study area was sectioned into the construction site (S1 and S2) and the control site (S0). Plant materials and soil samples obtained from the three experimental locations were analyzed for mineral nutrients and physico-chemical characteristics, respectively, using standard procedures.

Results: The results of this study revealed that the pH values of location 1-S1 and location 2-S2 were significantly lower than that of location 0 (S0)-control. The contents of organic matter, total nitrogen, available phosphorus, calcium and magnesium significantly ($P< 0.05$) increased with increase in distance from the construction site. The nitrogen, phosphorus, calcium and magnesium contents in *C. esculenta* significantly ($P< 0.05$) increased with increase in distance from the construction site. The potassium, copper, iron and lead contents in plant material decreased with increase in distance from the construction site.

Conclusion: This study suggests that the construction activities have negative effects on the test crop (*C. esculenta*) due to the toxic pollutants usually generated from such operations. Therefore, toxic wastes generated during construction operations should be properly disposed without contamination to cultivated soils.

Key words— **Mineral elements; *Colocasia esculenta;* Soil; Construction site; Bayelsa State.**

1. INTRODUCTION

Colocasia esculenta L. Schot commonly called cocoyam and Taro in many parts of the world belongs to the family Araceae, and is regarded as a major root crop [1]. It is an underground stem and is known to be one of the oldest crops used by man with its origin from Asia [2,3]. It is an herbaceous plant with a characteristic growth of about 1-2m in height, and has a vegetative propagule of an underground corm with leaves growing from the lower portion [4]. Taro thrives well in areas of harsh environmental conditions, hence contributes significantly to food security. It is economical to rear in terms of cultivation inputs and requires less ecological and maintenance practices in areas with adequate rainfall [5]. Taro is used to generate taro flour usually utilized in the production of infant food formulae. The leaf of taro is rich in various vitamins such as vitamin A, vitamin C, B_2 (riboflavin), and vitamin B_1 [6,7]. It is a crop that serves as a substitute to yam and cassava due to its carbohydrate contents, especially during dry season in West Africa [8]. The crop is widely cultivated for consumption of both leaves and tubers as well as its therapeutic applications. Its leaf juice has been reported to be rubefacient, stimulant, styptic and its utilization in treatment of internal haemorrhages, adenitis, otalgia and buboes. Antihelminthic, anti-diabetic and anti-inflammator activities have been recorded in leaves of this species. The juice obtained from corm is demulcent, laxative and anodyne. [9]. The plant is widely accepted due to its rich contents of starch in the tubers as well as its leafy vegetable, which has high minerals and vitamins contents such as phosphorus, calcium, vitamin C, iron, riboflavin, thiamine and niacin [10]. important, particularly, in areas where species potentials are faced with sources of strong disturbances such as destructive practices, pollution, invasive species, mass mortality outbreaks, bush fires, flooding, and poor development plans and programs leading to profound structural and functional changes [12,13]. Plants are known to contribute significantly to the sustenance and improvement of quality of human life, particularly in generating the vital ecosystem services as well as providing important components of medicines,

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seasoning, beverages, cosmetics, and dyes [11]. It is on this note that conservation of plants becomes increasingly The study area Otuoke is a developing area with vast lands characterized by intensive agricultural and building construction activities. Therefore, this study was conducted in order to evaluate the elemental components of *Colocasia esculenta* and soil characteristics around a major building construction site in Otuoke, Bayelsa State, Nigeria.

2. MATERIALS AND METHODS

2.1 Materials

2.1.1 *Equipment*

Automatic weighing balance, refrigerator, and spectrophotometer. glass wares used include; test tubes, beaker, conical flask, reagents used include; distilled water, petroleum ether, sulphuric acid, sodium hydroxide, anhydrous sodium sulphate, ethyl acetate, ferrous sulphate, ferrous chloride, aluminum chloride, ammonia solution,. Other materials include; aluminum foil, spatula and spectrophotometer.

2.1.2 Biological Materials

The biological materials used for this research were mainly the leaf samples of *Colocasia esculenta* obtained from the study area.

2.2 Methods

2.2.1 Study Area

The research was carried out in Otuoke, Ogbia Local Government Area of Bayelsa State, Nigeria. Otuoke is located at coordinates: Latitude 4.794° - 4.807°N, and Latitude 6.315° - 6.321°E. Bayelsa state has a riverine and estuarine setting with many of its communities completely surrounded by water, and lies in the heaviest rainfall area of Nigeria, with heavy rain forest and short dry season. The temperature is humid averaging about 300 Celsius with a mean minimum monthly temperature ranging from 25ºC to 31ºC [14,15].

2.2.2 Data Collection

The study area was sectioned into two, namely the construction site (S1 and S2) and the control site (S0). Plant materials (leaves) of the *Colocasia esculenta* were collected from the three (3) sampling locations in triplicates with a total of nine (9) samples, using a completely randomized design. Soil samples of S1 and S2 were collected for determination of soil- Physicochemical properties. S1 samples were collected at 5m and S2 15m away from the construction site, respectively, while S0 (control) samples were collected from an area outside the construction site

2.2.3 Analysis of Soil samples

Top soils of about 0-20cm depth collected from the study area were analyzed for soil-chemical properties (pH, organic carbon, total nitrogen, available phosphorus, calcium, magnesium, potassium, zinc, copper, iron and lead) using standard procedures [16].

2.2.4 Mineral Elements Analysis in Plant Samples

Standard method was used in the analysis of mineral elements in plant materials as described by [17]. Leaf samples of *Colocasia esculenta* were washed several times with water and rinsed with distilled water. They were placed in polybags, and thereafter dried in an oven maintained at 60º C to a constant weight. The dried plant samples were macerated to powder, and stored in sample bottles for analysis. The powdered plant samples were oven dried at 105ºC for 2 hours, 1.0g weighed into a platinum crucible and placed in a muffle furnace maintained at 400ºC. The powdered plant materials were ashed for 5 hours and then dissolved with 10cm^3 of 1M HCL. The solution obtained was filtered through Whatman No. 1 filter paper into 50cm^3 volumetric flask and made up to the required mark with distilled deionized water. Standard reagents for analytical experiment were used, and contents of mineral elements in the solution were determined using Atomic Absorption Spectrophotometer (AAS) of Unicam Model.

2.3 Statistical analysis

The data generated from this study was examined statistically using Analysis of variance (ANOVA) and differences in the means were tested using Least Significant Differences (LSD) at probability level of 5% [18].

3. RESULTS

The physicochemical properties of experimental soil are presented in Table 1. The pH values of location 1-S1 (4.39) and location 2-S2 (4.60) were significantly lower than that of location 0 (S0)-control (5.50). The values of pH at location 1 and location 2 increased with increase in distance from the construction site. In addition, the contents of organic matter, total nitrogen, available phosphorus, calcium and magnesium increased with increase in distance from the construction site. However, these values were significantly ($P < 0.05$) lower than that of the control (S0). The potassium, zinc, copper, iron and lead contents decreased with increase in distance from the construction site, but with values higher than that of the control (S0), except for potassium with values higher than that of S0 (Table 1). The mineral element contents in leaves of *Colocasia esculenta* are presented in Table 2. The nitrogen, phosphorus, calcium and magnesium content in plant material increased with increase in distance from the construction site. The potassium, copper, iron and lead contents in plant material decreased with increase in distance from the construction site (Table 2).

Table 1: Physicochemical Properties of Experimental Soils

Parameters	**Sampling locations**		
	S0 (Control)	**S1**	**S2**
pH	5.50±0.24	4.39± 0.13	4.60±0.20
Organic carbon (%)	2.16 ±0.10	1.76 ±0.44	2.08±0.18
Total nitrogen (%)	1.48±0.56	1.06 ±0.32	1.24±0.45
Avail. Phosphorus (%)	3.09±0.22	2.04± 0.54	2.13±0.34
Calcium (mg/100g)	4.26±0.12	2.17±0.26	2.52± 0.29
Magnesium (mg/100g)	5.17± 0.16	3.06±0.22	3.34±0.17
Potassium (mg/100g)	1.78±0.18	1.20±0.48	1.07±0.23
Zinc (mg/100g)	0.39±0.27	1.28±0.10	1.19±0.15
Copper (mg/100g)	0.17±0.03	1.43±0.24	1.30±0.29
Iron (mg/100g)	0.08±0.02	1.66±0.03	1.40±0.11
Lead (mg/100g)	0.21±0.05	1.22±0.44	1.09±0.64

Mean ± standard error from three replicates

Table 2: Mineral elements in leaves of *Colocasia esculenta*

Parameters	**Sampling locations**		
	S0 (Control)	**S1**	**S2**
Total nitrogen (%)	1.04±0.13	0.23±0.34	0.29±0.25
Phosphorus (%)	0.07±0.02	0.70±0.05	0.74±0.03
Calcium (mg/100g)	1.94±0.53	1.21±0.70	1.30±0.85
Magnesium (mg/100g)	2.66± 0.43	2.05±0.67	2.17±0.34
Potassium (mg/100g)	2.34±0.18	2.04±0.33	2.02±0.21.
Copper (mg/100g)	0.06±0.02	0.47±0.04	0.36±0.02
Iron (mg/100g)	0.08±0.03	0.20±0.05	0.12±0.02
Lead (mg/100g)	0.04±0.01	0.17±0.03	0.10±0.06

Mean ± standard error from three replicates

4. DISCUSSION

This study revealed that soil chemical properties were negatively affected around the construction site as indicated by the pH values in soils of S1 and S2 relative to the control (S0). pH value has been reported to affect nutrient availability in soil [19]. This could have contributed to the disparities in nutrient contents in soil of control (S0) and that of the construction site (S1 and S2). Therefore, the slightly acidic pH as recorded in the control soil (S0) could have enhanced the nutrient status of soil than that of the S1 and S2 as reported by [20, 21]. In addition, the variation in the contents of elements such as zinc, copper, iron, and lead between the two locations S1 and S2 relative to the control (S0) may be due to the differences in the physical, chemical and biological composition of the site [22].

The bioavailability of soil mineral elements has been reported to have a profound influence on the supply of metallic ions to plants [23]. This clearly indicates the reason for variations in the contents of some mineral elements in tissues of plant between the two locations, S1 and S2 relative to the control location. The entire supply of nutrient to plants is dependent on the soil physical and chemical conditions, which affect the pH, binding and ion exchange of the soil medium [24]. The variations in mineral elements in plant tissues may also be attributed to the contents of acidity and alkalinity of different soil locations, which are directly influenced by the pH value of such soil [25]. In general, the soil is regarded as a medium of plant growth, thus alteration of its physical and chemical characteristics through the introduction of toxic materials could pose a deleterious impact on root development, with a resultant effect on plant vegetative growth and development [26].

5. CONCLUSION

This study revealed that the pH values of soils around the construction site were comparatively lower than that of control. The pH values of soils around the construction site increased with increase in distance from the construction site. In addition, the contents of organic matter, total nitrogen, available phosphorus, calcium and magnesium increased with increase in distance from the construction site. The nitrogen, phosphorus, calcium and magnesium content in plant material increased with increase in distance from the construction site. The potassium, copper, iron and lead contents in plant material decreased with increase in distance from the construction site. This study shows that the construction activities have negative effects on the test crop *Colocasia esculenta* due to the toxic pollutants usually generated from such operations. These activities could also lead to degradation of soil physical and chemical properties which may affect nutrient availability to cultivated crops. Therefore, toxic wastes generated during construction operations should be properly disposed without contamination to cultivated soils.

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Conflict of Interest

There was no conflict of interest between the two Authors.

Contribution of the Authors

Dr. Mbosowo Etukudo was fully in charge of the plant parameters while Dr. Samuel Osim was in charge of Soil Chemical characteristics. The Compilation of this paper was organized collectively by the two authors.

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