THE EFFECT OF EXPLORATION ACTIVITIES ON MINERAL ELEMENTS IN FLUTED PUMPKIN LEAVES

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ABSTRACT

The aim of this study was to investigate the effect of exploration activities on the mineral elements in Telfairia Occidentalis leaves. We have mapped out four locations which include three in Delta state under the influence of exploration activity and the last one in Edo State which is free from this activity. Surfer 19 was used to contour the data measured using Global Positioning System (GPS) device during field work. Hanna pH meter was used to note pH result while electrical conductivity meter measures the amount of salt concentration in the leaves. The result indicates that the leaves content is alkaline with little salt content. When a diet is alkaline, it is essential for the maintenance of good health. These two parameters are linearly related with the correlation coefficient of approximately 0.9. The major equipment used for the analysis of mineral element concentration is Atomic Absorption Spectrophotometer (AAS) 969. The result presents elements like potassium, calcium, magnesium and sodium as those with high concentration, but when considered the percentage contribution to recommended dietary allowance, the most appreciable nutrient element among them is magnesium. Magnesium is important element in connection with ischemic heart disease, protein formation and cellular replication. However, the results obtained in our research indicate that the leaves collected in the areas influenced by exploration activities contain high concentration of mineral element than those taken from the free zone.

Keywords*: Effect, Exploration, Mineral Elements, Fluted Pumpkin Leaves, pH.*

INTRODUCTION

Minerals are those essential elements that support the human body to grow and function so to maintain good health. These include calcium, phosphorus, potassium, sodium, chloride, magnesium, iron, zinc, iodine, chromium, copper, fluoride, molybdenum, manganese and selenium. Sodium, potassium, magnesium and chloride can function as electrolytes. When the body is thirsty, it does not have adequate fluid and electrolytes. Nutrient minerals are elements are not produced biochemically by breathing organisms. Plants obtained their own from the soil; almost all the minerals in a human intake originated from consumption of plants and animals or intake of water (U. S. National Institutes of Health, 2016a). As a set, mineral is one of the four assemblages of needed nutrients (Berdanier et al., 2016). The five most needed minerals in the body are calcium, phosphorus, potassium, sodium, and magnesium (U. S. National Institutes of Health, 2016b).

Calcium is a mineral which is present in numerous diets; it is deposited in bones and teeth to support and strengthens them. The body desires calcium to aid muscles and blood carriers contract and expand and to direct messages via the nervous system. Calcium is also used to aid the release of hormones and enzymes which relate nearly all functions in the human body. Magnesium is a mineral which naturally exist in several diets. It benefits the regulation of the body muscle and nerve function, blood sugar level and blood pressure. It also assists the body to produce protein, healthy bones, and DNA. Phosphorus is a mineral that helps keep the bones healthy, blood vessels and muscles functioning. It is frequently present in food with protein content like meat, fish, nuts, beans etc. Potassium helps cells, nerves and muscles discharge their responsibilities perfectly. It supports the body to regulator blood pressure, heart rhythm and the volume of water in cells as well as digestion (U. S. National Institute of Health, 2019).

Fluted pumpkin (*Telfairia Occidentalis*) leaf is an essential leaf that is common in West Africa. It is part of daily nourishments in several homes which is vital as source of vitamins and minerals needed for human wellbeing. It is a vegetable that yields fruits. They are used to increase the nutritional quality of soups. It is vital for protein, oil, fats, minerals and vitamins. The leaves are used in the making of most delicacies in southern Nigeria; one of which is "Edikang ikong soup" in Efiks and Ibibios languages in Cross River and Akwa Ibom States correspondingly. The exterior morphology of vegetables may not be safe from impurities like heavy metals or the microbial flora of the leaves (Modi *et al*., 2007). Fluted pumpkin seed oil (FPSO) has been told to hold some necessary properties (vitamin A, tannins, linoleic acid, oleic acid and alkaloids) which subdue lipid peroxidation

(Akintayo, 1997; Bensoussan *et al*., 1998; Glenville, 2006). The seed comprises oil used for cooking (Okoli and Nyanayo, 1988; Horsfall and Spiff, 2005). It has a greater specific gravity likened to other generally known vegetable oil. Its little acid presence also shows that the oil is palatable (Agatemor, 2006).

The aim is to compare nutrient elements present in leaves from exploration sites with the ones free from exploration activity and determine their percentage contributions to Recommended Dietary Allowance (RDA). The choice was based on the fact that it is one of the most consumed vegetable in Nigeria. Environmental pollution has posted a general and dangerous challenge to this leaf due to industrial and human actions. Widespread low to high contamination of large areas of agricultural land is a specific problem from indiscriminate sludge discharge from industries, crude oil pollution and wastes (Ogboi, 2012). Activities of oil exploration and other industries cause gas flaring, endless oil spills, and industrial effluence which affect both the aquatic and terrestrial ecosystem (Omofonmwan and Odia, 2009). Human activities have intensely altered the stability of biochemical and geological cycles of most heavy metals. A valuation of environmental threat caused by soil pollution is significant due to the circumstance that metals are harmful to human wellbeing and if exists in the soil for a lengthy period, may impact on the food chain in huge quantity (Radmila et al., 2013).

THEORETICAL BACKGROUND/PREVIOUS WORK

Tindal (1986) stated and was noted by Osadebe et al. (2015) that fluted pumpkin (Telfairia Occidentialis) leaf is one of the essential vegetables planted in Nigeria with massive nutritional, medicinal and industrial values which is about 29% rich in protein, 18% in fat and about 20% rich in minerals and vitamins. This evidence makes the leaf suitable as food supplement (Oderinde *et al*., 1990).

Nwangwa *et al*. (2007) showed that *Telfairia Occidentalis* can restore testicular damage and increase spermatogenesis. It is high in anti-oxidant and free radical scavenger properties and that may add to the reason some people use the leave extract in oxidative damage circumstances like tonic by women that have just put to birth; the high iron content in the leaf benefits the replacement of lost blood and may be used for treatment or managing of anaemia, chronic fatigue and diabetes (Alada, 2000).

Many other researchers have worked on the potentials of *Telfairia Occidentalis* (fluted pumpkin) leaf and other leaves. Okpalamma et al. (2013) stated that the intake of 100g of pumpkin leaf per day would meet the RDA of some minerals and vitamins. Idris (2011) findings revealed that *Telfairia Occidentalis* leaves are good sources of iron, copper, potassium and manganese. They said adequate eating of this plant leaves may prevent adverse effects of dietary shortages. Mohd et al. (2016) conducted a research on the mineral and proximate investigation of fluted pumpkin leaves and concluded that the leaves contain sodium, magnesium, calcium, potassium, copper and zinc in significant amount which showed that the leaves are good sources of nutrients for local consumption. Koubova et al. (2018) highlighted the recommendations of RDA/AI^ values in mg/day (milligram) for those within the age of 31 to 50 years as Mg (Magnesium) = 320, P (Phosporus) = 700, K (Potassium) = 4700^, Ca (Calcium) = 1000, Na (Sodium) = 1500^ for females and also Mg (Magnesium) = 420, P (Phosporus) = 700, K (Potassium) = 4700^, Ca (Calcium) = 1000, Na (Sodium) = 1500^ for males. AI^ is Adequate Intake. However, Idris (2011) and Idris et al. (2011) have considered the mathematical expression suggested by NRC (1989) for assessment of contribution to RDA (%). This information is stated in Equation 1.

$$Con.\,to\,RDA = \frac{Concentration\ of\ element \times 100\%}{RDA} \qquad (1)$$

RDA is Recommended Dietary Allowance

Con. is Contribution

GEOLOGY AND LOCATION

Ethiope East is one of the Local Government Area in Delta State of Nigeria whose headquarter is at Isiokolo. It stretches from the bank of River Ethiope to a few kilometers into the inter-land. The area is made up of three districts such as Abraka, Agbon and Isiokolo making up 67 villages. It has an area of 3.80 x 10^2 km^2 and a population of about 2.00792 x 10^5. The two Ethiope East locations studied (Figure 1) are on latitude 5.64291^0N, longitude 6.06958^0E (Ehroinke gas station) and latitude 5.64251^0N, longitude 6.06961^0E (Ehroinke flow station). These locations are 16.5m and 14.9m above sea level [in altitude] respectively. It has heavy rainfall over eight months of the year (Okolie, 2011).

Okpe is also one of the Local Government Area whose capital is Orerokpe (Figure 1) in Delta State, Nigeria. The location considered is from Orerokpe which is on latitude 5.62516^0N and longitude 5.85368^0E and 11.2m above sea level (altitude information). Okpe is also one of the many kingdoms that make up Urhobo tribe which plays host to the Warri Airport. The Okpẹ is situated within latitude 6º and 5º N and longitude $5^0 50^1$ and $6^0 25^1$E. It occupies a large expanse of landmass of about 500sq km of mainland, mangrove, swamp and rivers (Otite, 1982). Within the boundaries of this location, Okpẹ shares borders with Warri, Uvwie (Effurun), and Agbarho on the Southwest. On the Northeast axis, it has boundary with Oghara, Jesse, Benin and Agbon. The Urhiapẹlẹ River, Ethiope River and the Warri River mark its boundaries. Among the other ethnic groups in Delta State, the Okpe have the largest kingdom and peak population density up to 2.48314×10^5 (Onokerhoraye, 1995). The climatic situation of the Okpe is temperate, being neither extremely cold, nor extremely hot. Both the dry season and the rainy season are experienced.

We decided to collect another sample in a non-exploration activity location in Ugbowo, Edo State (Figure 1). The location of sample collection which is 117.2m above sea level is on latitude 6.4143^0N and longitude 5.61354^0E. Edo state is characterized by tropical climate with rainfall all year round. The period of rain concentration is within the months of April to October; dry season prevails between November and March. The mean annual rainfall is always above 2×10^3mm, with relative humidity above 70%. Temperature is high throughout the year, with a yearly temperature of 28^0C (Ikhile and Ikhile, 2003). The urban settlements in Edo State have been categorised into three population classes: high, medium and low (Magnus and Eseigbe, 2012). Urban areas in the high category having human population more than 1.51000×10^5; those in the medium and low categories have populations ranges from 5.1×10^4 to 1.5×10^5 and 2.0×10^4 to 5.0×10^4 respectively.

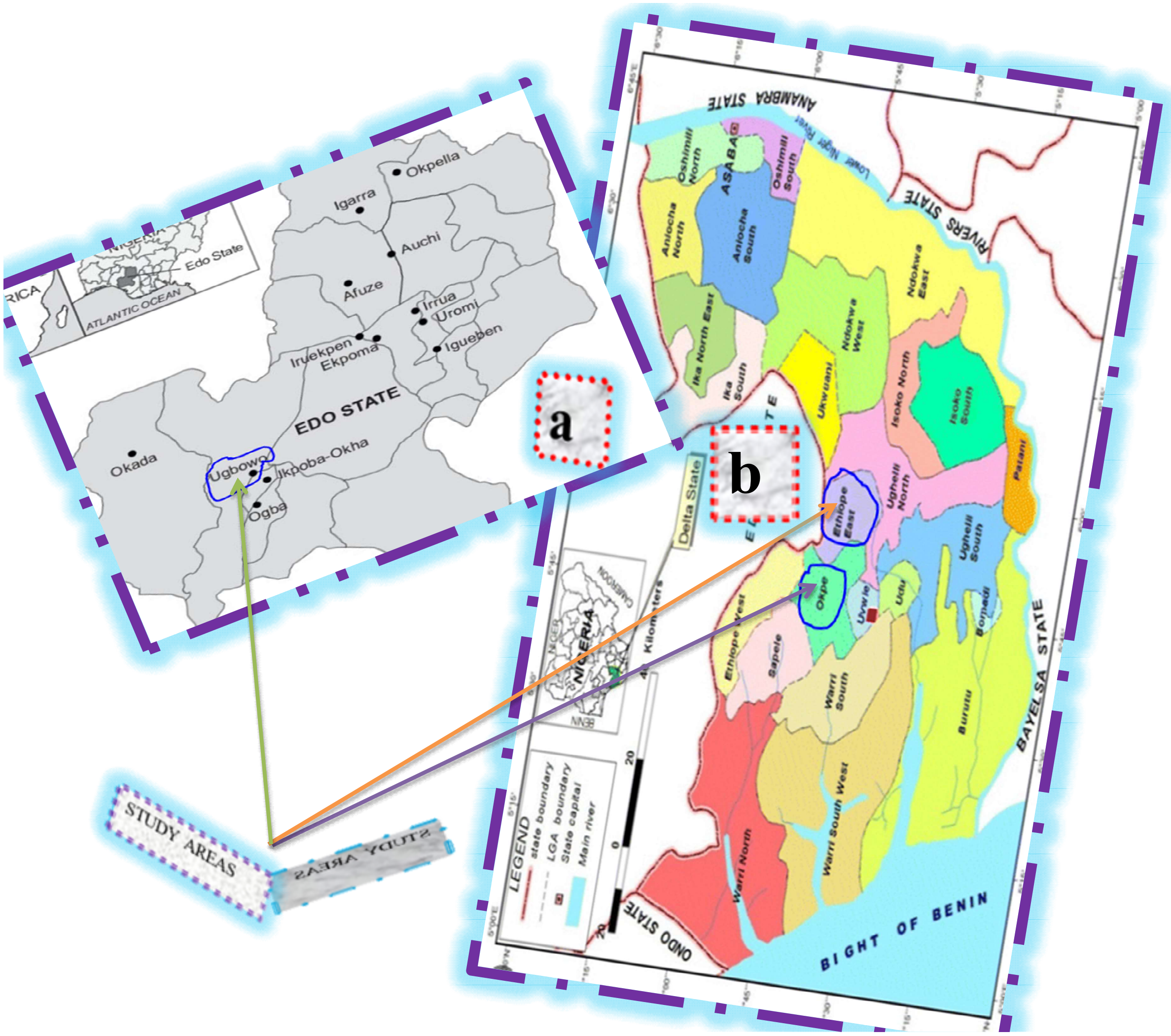

Figure 1: Map of the study area where (a) sample four was collected in Ugbowo (Edo State) (b) samples one and two were obtained in Ethiope east (Delta State) as well as sample three in Okpe (Delta State). Source: Nosazeogie et al. (2018)

MATERIALS AND METHODS

Sample collection

Samples (fluted pumpkin leaves) were obtained from four different locations which include Ehroinke flow station (oil well 2), Ehroinke gas station, Orerokpo and Ugbowo. All the samples are influenced by exploration activities except samples taken from Ugbowo. Sample from flow station was about 50m from the fence of the station. Ones from gas station were about 20 m from the gas fencing parameter. Orerokpo sample was collected at a garden and the last one (Ugbowo sample) from another garden.

Sample preparation

The leaves were washed with distilled water and exposed to sun to dry for three days, after which an oven was used to absolutely dry it at 80^0C for 6 hours. These samples were crushed into powdered form. A weighing balance was used to measure the quantity (0.2g) of each form considered. Mineral content was determined after wet digestion of the samples using standard AOAC method (AOAC, 2005). The concentrations of Ca and Mg in the solutions were determined with Atomic Absorption Spectrophotometer (AAS) 969 (Bulk Scientific, MODEL 210VGP) (AOAC, 1990; Okpalamma et al., 2013). K and Na were examined by flame atomic emission spectrophotometer with NaCl and KCl used to prepare the standards. P was determined with Jenway

6100 spectrophotometer at 450nm using vanadium phosphomolybdate colorimetric method with KH_2PO_4 as standard (Ceirwyn, 1995; Idris, et al. 2011).

Measurement of pH and Electrical conductivity (EC)

The pH meter was calibrated with buffer solutions. The buffers used were buffers 7, 4 and 10. pH meter was immersed in a buffer 7 solution and allowed until the reading stabilizes at 7. The pH meter (Hanna) was then immersed in buffer 4 solution after rinsing with distilled water and also allowed to stabilize at 4. Then lastly, the meter was immersed in buffer 10 solution after rinsing with distilled water and allowed to read 10 on the meter and stabilizes at 10.

5g of powdered form of the sample was pour into an empty beaker and 5ml of distilled water was added to it. The mixture was stirred and allowed to settle for 30 minutes before a pH meter that has been calibrated with buffers (we considered buffers 4, 7 and 10) measures the values. This procedure was repeated for measurement of electrical conductivity and a corresponding meter was used.

RESULTS AND DISCUSION

Results

The data obtained from the analysis of the samples collected are presented in Table 1 and compared to the contribution to RDA (Figure 3). The locations of sample collection with corresponding altitude were noted with Global Positioning System (Figure 2). pH and electrical conductivity measurements were made to define the level of alkalinity and salt concentration in the samples; this is seen in Table 2 and both parameters are linearly correlated in Figure 6.

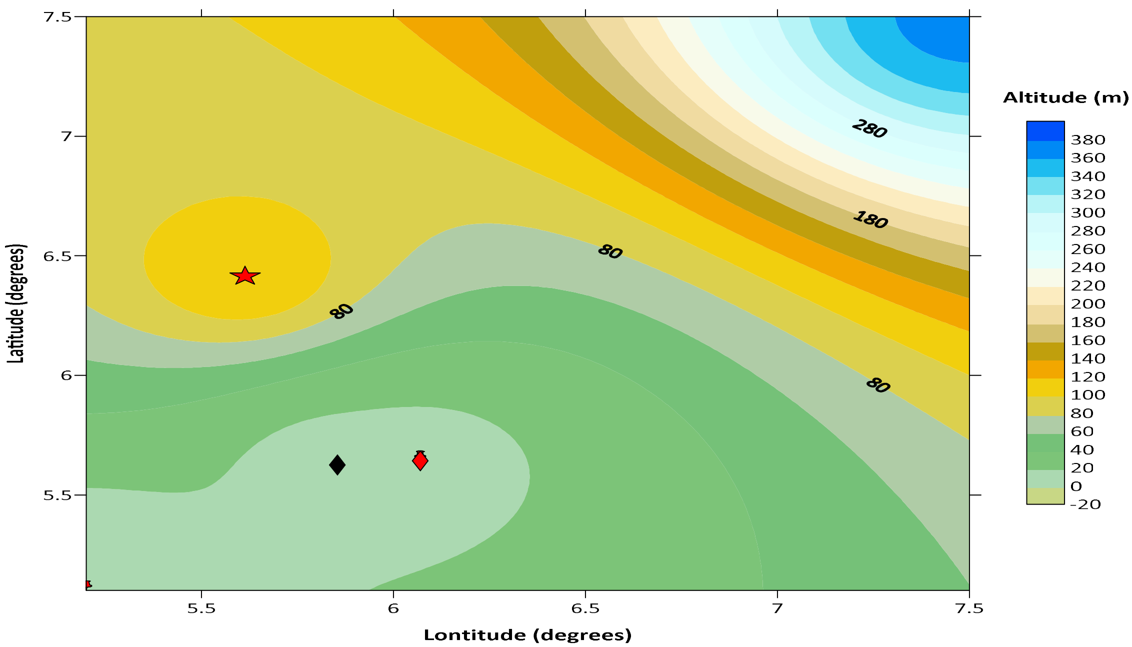

Figure 2: Contour map defining the locations with their corresponding sea levels.

Table 1: Concentration of nutrient elements in the leaves

Locations/Contributions	Ca (mg/day)	Mg (mg/day)	K (mg/day)	Na (mg/day)	P (mg/day)
RDA or AI^ for Female	1000	320	4700^	1500^	700
RDA or AI^ for Male	1000	420	4700^	1500^	700
Ehroinke Gas Station (EGS)	185.6	168.7	187.2	144	2.3
Con. from EGS to RDA or AI^ for Female (%)	18.56	52.72	3.98	9.6	0.33
Con. from EGS to RDA or AI^ for Male (%)	18.56	40.17	3.98	9.6	0.33
Ehroinke Flow Station (EFS)	190.4	173.4	189	145.4	2.8
Con. from EFS to RDA or AI^ for Female (%)	19.04	54.19	4.02	9.69	0.4
Con. from EFS to RDA or AI^ for Male (%)	19.04	41.29	4.02	9.69	0.4
Orerekpe (O)	139.2	118.5	161.2	124	1.6
Con. from O to RDA or AI^ for Female (%)	13.92	37.03	3.43	8.27	0.23
Con. from O to RDA or AI^ for Male (%)	13.92	28.21	3.43	8.27	0.23
Ugbowo (U)	88	56.2	38.7	29.8	1.1
Con. from U to RDA or AI^ for Female (%)	8.8	17.56	0.82	1.99	0.16
Con. from U to RDA or AI^ for Male (%)	8.8	13.38	0.82	1.99	0.16

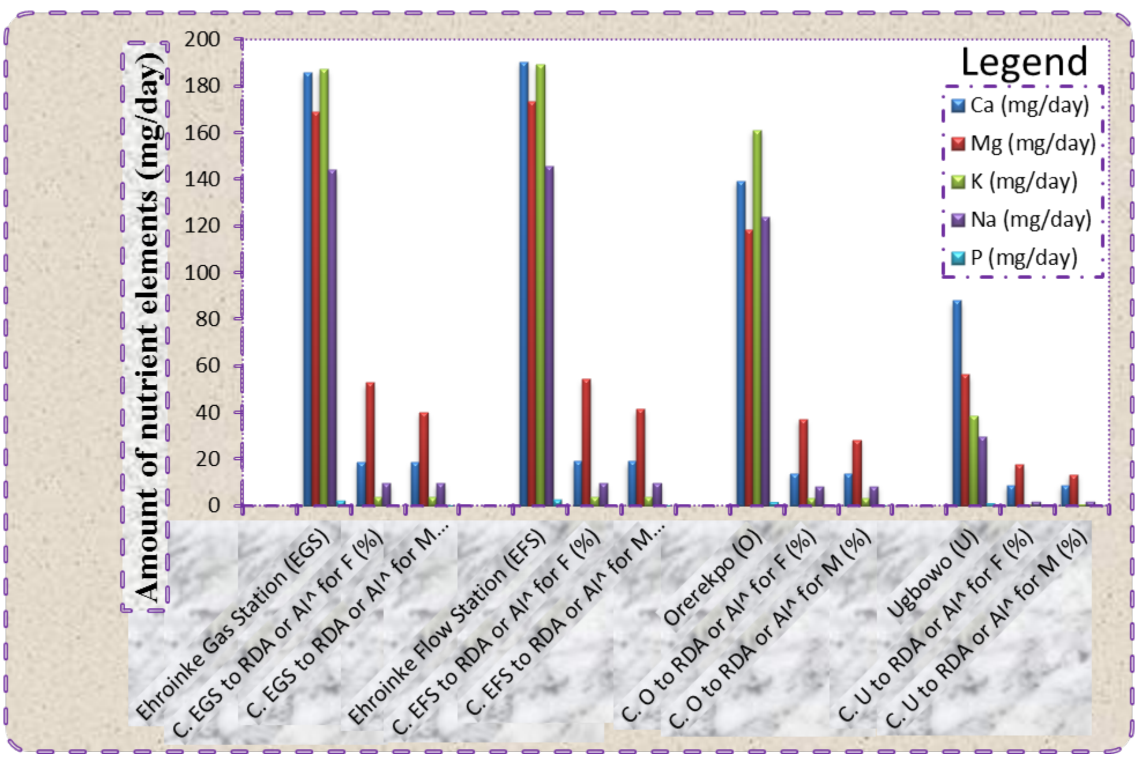

Figure 3: Contribution of mineral elements to RDA at different study locations

Table 2: pH and conductivity results

Locations	pH	Electrical Conductivity (µs/cm)
Ehroinke Gas station	8.22	720
Ehroinke Flow station	8.24	727
Orerekpo	8.27	620
Ugbowo	8.04	149

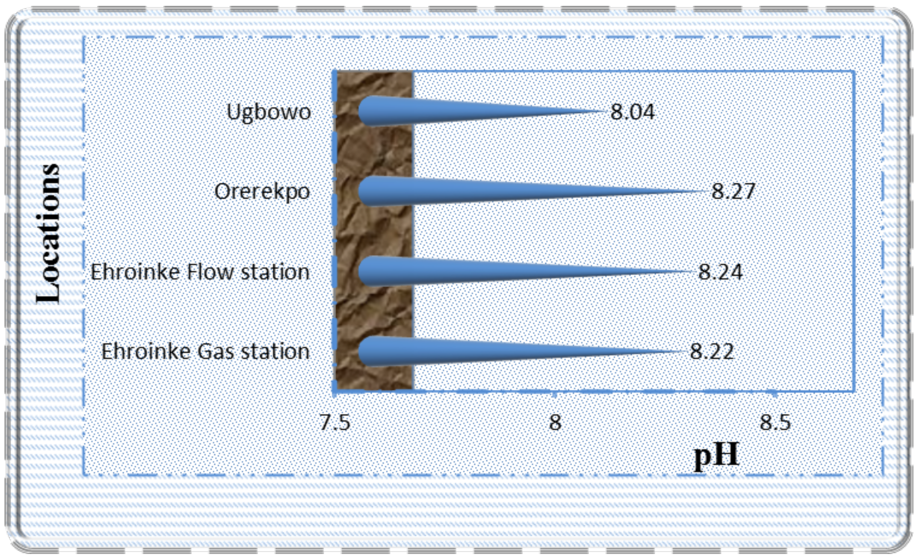

Figure 4: (100^0, 0^0) Locations variation with pH.

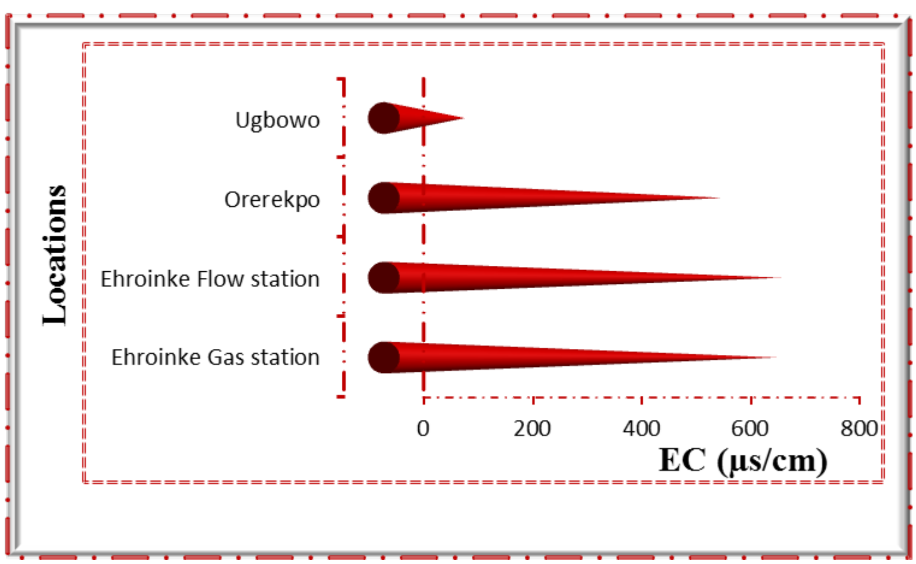

Figure 5: (270^0, 0^0) Locations variation with EC

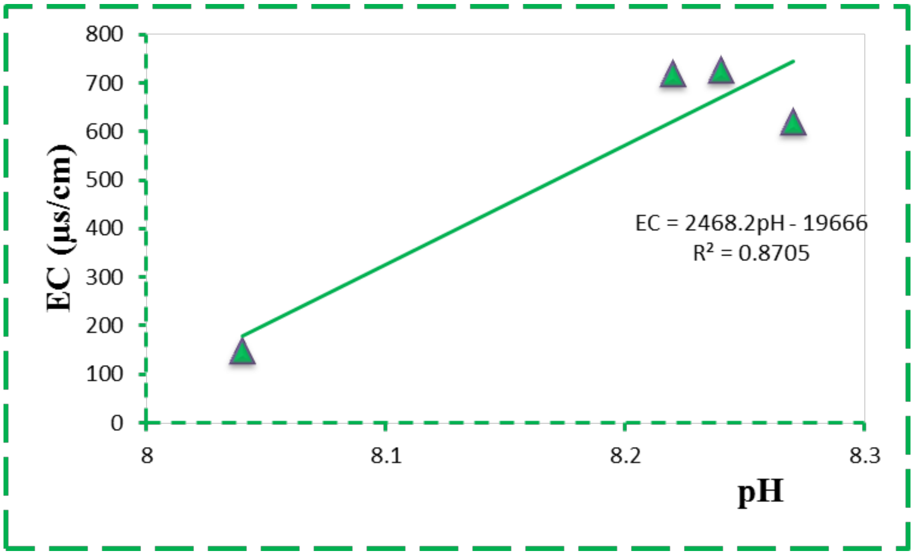

Figure 6: Strong correlation from EC-pH curve.

Discussion

We have collected some samples of fluted pumpkin leaves for studies to examine the effect of exploration activities on them and compare to the ones that are not exposed to influence of this activities. We have studied the nutrient elements of the samples collected from four different locations which include Ehroinke Gas station on latitude 5.64291^0N and longitude 6.06958^0E which is 16.5m above sea level, Ehroinke flow station on latitude 5.64251^0N and longitude 6.06961^0E (14.9m above sea level), Orerokpe which is on latitude 5.62516^0N and longitude 5.85368^0E and 11.2m above sea level and lastly, Ugbowo about 117.2m above sea level on latitude 6.4143^0N and longitude 5.61354^0E. This result was measured using Global Positioning System (GPS) device and presented in a contour map as seen in Figure 2. The contour Map was created using Surfer 19, which shows the locations and altitude where the fluted pumpkin leaves were obtained for analysis. The symbol (♦) on the contour map indicates the locations at Ehroinke gas station and flow station, the symbol (♦) shows the location at Orerekpe and (★) indicates the location in Ugbowo, Edo state which is free from exploration activities.

From Table 1, samples obtained from Ehroinke flow station seem to have the highest concentration (amount) of mineral elements available on the leaves though samples from Ehroinke Gas station also approach this level of concentration. The result of elements concentration in leaves from Orerekpe is highly appreciable. However, samples taken from Ugbowo revealed little amount of nutrient elements present. These observations simply show that leaves exposed to the influence of exploration activities could contribute highly to the presence of nutrient elements.

Figure 3 presents a clear picture of these mineral elements contribution to RDA. Ca and K are really dominating with high values including Mg when compared to other elements in the chart. When this dominance is compared to RDA contribution, Mg is seen as the leading element in the case of both male and female in all locations. Therefore, we can say that this leaf is essential for energy production, protein formation and cellular replication as it is a good source of magnesium. This is expected since Mg is a component of leaves chlorophyll (Idris, 2011). Mg is also important element in connection with ischemic heart disease (Mohd et al., 2016). However, Ca, Na and K have also contributed some amount of minerals to RDA. In the case of Ca, this is necessary for building strong and healthy bones (Idris, 2011) and as a good diet for lactating mothers such that as the child is nursed, Ca is sourced from the mother via the breast milk (Idris et al., 2011). In the case of Na, this leaf could be recommended for hypertensive patients (Umar et al., 2007). It is involved in the regulation of plasma volume, acid-base balance, nerve and muscle contraction (Mohd et al., 2016; Akpanyung, 2005). The little K present may contribute to depress blood pressure (Umar et al., 2007). The leaf is poor in phosphorus concentration where neither exploration activity is experience nor non-exploration influence. In other words, our body does not necessarily need really large doses as this could cause stomach problems (upsets), heart rhythm disorder and diarrhoea depending the element involved (www.lenntech.com/recommended-daily-intake.htm).

pH (Figure 4) and EC (Figure 5) values were also noted which defines the alkaline nature of the content in all the locations and strongly correlates linearly with the result of EC (Figure 6) to give a correlation coefficient of 0.87 (approximately 0.9). The clear result of pH and EC measurements is presented in Table 2. The pH of fluted pumpkin leaves is slightly above 8.0 and indicate alkaline. A diet that is predominantly alkaline is essential for the maintenance of sustained health (Jaffe and Donovan, 1993). When an alkaline environment is maintained in the body, metabolic, enzymatic and immunologic and repair mechanisms function at their best. Electrical conductivity is a guide to salt presence and a pointer of electrolyte concentration in the solution (Ding et al., 2018).

CONCLUSION

This study revealed that the important mineral elements are present in the fluted pumpkin leaves which are influenced positively when exposed to exploration activities. The most dominant elements are potassium, calcium, magnesium and sodium but their percentage contribution to recommended dietary allowance presents magnesium as the most nutrient element. The pH measured, classifies the leaves as alkaline which contain little salt as noted during electrical conductivity measurement. Both parameters correlated linearly with the coefficient of 0.87.

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