APPRAISAL ON NUTRACEUTICAL POTENTIALS OF TWO LESSER-USED EDIBLE LEAFY VEGETABLES (*Vernonia polysphaera* Baker AND *Cleome ciliata* Jacq.) IN AKWA IBOM STATE, NIGERIA

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Abstract: Appraisal on nutraceutical potentials of two lesser-used edible leafy vegetables (*Vernonia polysphaera* Baker and *Cleome ciliata* Jacq.) in Akwa Ibom State was examined. Parameters such as phytochemicals, nutrients, anti-nutrients, minerals, vitamin and photosynthetic pigments were analyzed using standard methods outlined by Association of Official Analytical Chemist. The secondary metabolites in the test plants revealed the presence of alkaloids (6.98±0.00), tannin (0.94±0.46), saponin (0.80±1.05), flavonoids (5.33±0.29) and cardiac glycosides (7.28±0.44) mg/100g in *V. polysphaera* while alkaloids (4.35±0.65), tannin (1.07±0.15), saponins (1.78±0.22), cardiac glycosides (8.47±0.02) and terpenes (7.05±0.36) in mg/100g were recorded in *C. ciliata.* Appreciable amounts of essential elements and nutrients were chronicled, calcium, magnesium, potassium, iron, phosphorus, zinc, crude protein, crude lipid, carbohydrate, ash crude fiber, moisture and caloric values. Anti-nutrients such as phytate, saponin and tannic acids were found in both vegetables in minutes quantities. Oxalate and cyanide were not detected in both plants. Vitamins recorded were axephthol, thiamin, riboflavin and ascorbic acid and were significant (p=0.05). The photosynthetic pigments recorded were chl. a (15.15+0.18), chl. b (10.60+0.71) and carotenoids (7.13+0.07) in *V. polysphaera* while *C. ciliata* had chl. a (13.23+0.52), chl. b (8.20+0.59) and carotenoids (6.17+0.51) mg/kg. Based on the findings of this research, these vegetables could be utilized as food not only for their high nutritional contents, but also as a potential medical plant. *V. polysphaera* and *C. ciliata* being found in the wild with an ability to highly resist drought, can provide cheaper source of vegetables as an alternative to common vegetables during the dry season.

Keywords: Vernonia polysphaera, Cleome ciliata, nutraceutical, Asteraceae, Capparidaceae, vegetable, dietary supplement.

Introduction

Vegetables plays a significance role in the maintenance of good health as source of nutraceuticals, which are usually in short supply in daily diets (Mohammed and Sharif, 2011). The nutraceuticals in vegetables can be absorbed and used as regulatory and protective materials as well as for body building agents (Saidu and Jideobi 2009). Vegetables have become significant part of human diets supplying the body with low calories and substantial concentration of necessary minerals and vitamins. The low caloric content of vegetables is of utmost importance; plants produce food in the leaves but do not store food in such organ. Subsequently, vegetables do not supply abundant energy to the body. The fibers in vegetables are known to aid in digestion and avert constipation (Aliyu, 2006). Fats and oils in vegetables have been reported to lower blood lipids, leading to a lessening in the occurrence of ailments related with coronary artery catastrophe. Plant products that possess nutraceuticals are referred to as medicinal and nutrients valued plants (Odoemena and Ekanem, 2006).

*Vernonia polysphaera***,** family Compositae (Asteraceae) is the largest family of the flowering plants comprising of 950 genera and 23,000 species. The genus *Vernonia* is represented by about 500 species spread all over the world and 49 species in the flora of Ethopia (Mesfin, 2004). *V. polysphaera* possesses a simple and serulate leaves with alternate leaf arrangement. It has a purple and aromatic coloured flower at maturity. It is an herbaceous plant of about 10-70cm tall, much branched, bark green, smooth, becoming fissured, young branches, densely pubescent which lack stipules, petiole 6 mm in diameter with elliptical shape. The leaves are green with a characteristic odour and a bitter taste. The leaf contains steroid glycosides (vernoniosides). It is propagated by seed/stem cuttings (Challand *et al.*, 2009).

In Nigeria, *V. polysphaera* is commonly found in the South East ecological zones of Cross River, Akwa Ibom, Bayelsa, Anambra, Abia, Imo and Enugu States and also in some countries in Africa: Togo, Kenya, Tanzania, Cameroon and Ghana. Some species are found among the flora of North America with others being found in South America. The aquatic species are not common, but are found in Akwa Ibom State (Etukudo, 2003).

The leaf is an accompaniment of egusi soup, though they are not well consumed like other leafy vegetables. The leaf is consumed as food by the larvae of some *Lepidoptera* species. The branches are used as chewing stick (Harold, 1999). *V. polysphaera* is a medicinal plant with several uses attributed used as anti-diabetic, in fever reduction and recently a non-pharmaceutical solution to persistent fever, headache and joint pains associated with AIDS (Swerdlow, 2000). Leaf decoction is taken to treat pneumonia, increase breast milk in nursing mothers, cure acute coughs (Sonni, 2002). Root decoction is drunk lavishly to neutralize poison while root bark and stem infusion can treat malaria fever in addition to diarrhoea and dysentery just like the bitter species. The leaf juice treats ringworm and other skin infections (Swerdlow, 2000).

Clome ciliata (Capparidaceae), also called consumption weed, a branched annual creeper to climber with spear-

headed palmately compound leaf with the height of about 5-10 metres. The plant is gathered from the wild for local use as food and medicine for both human and animals. *C. ciliata* is occasionally cultivated in India, where it is gaining popularity as a low-cost substitute for cumin. Its cultivation is promoted for degraded or marginal agricultural land where it can be cultivated with less difficulty than traditional crops. Consumption weed has a purple flower and are ephemeral, opening in the morning and closing in the afternoon at high temperature. *Clomes* start flowering 3-4 weeks after germination and the life cycle is about 3 months (Dabire *et al*., 2008*)*.

The leaves and young shoots are cooked as vegetable. The pungent seed can be pickled or used as a mustard or cumin substitute in curries, pickling spices, vegetables and pulses. The juice of the plant is used as a condiment. An oil obtained from the seeds is used for cooking variety of dishes (Etukudo, 2003). The plant is used as a stimulant in food in order to improve appetite. The leaves are diaphoretic, rubefacient and vesicant. Plant decoction is used as an expectorant and digestive stimulant to treat colic and dysentery in human and animals. Chewing the leaves for a week is said to improve a woman's chances of becoming pregnant. The leaves are used as an external application to treat wounds and ulcers, relieve rheumatism and act as a counter-irritant to treat herpes infections. The juice of the leaves relieves ear aches. The leaf decoction is used to treat rheumatism, gonorrhoea, diarrhoea and dysentery. A decoction of the seeds is used as a wash to treat piles (Bedi, 1998 and Pandey, 2000). Information on nutraceutical potentials of lesser-used edible leafy vegetables (*Vernonia polysphaera* and *Cleome ciliata*) are limited. Therefore, the need for this research is necessary. It is therefore foreseen that the results of its findings will offer a scientific justification for the lesser-used vegetables and consequently fill existing knowledge gap within the edible leafy vegetables.

Materials and Methods

Fresh leaves of *Vernonia polysphaera* and *Cleome ciliata* (Figures 1 and 2) were collected from Mbak Etoi in Uyo Local Government Area in Akwa Ibom State, Nigeria on March 16th, 2022 by the corresponding author. The plants were identified and authenticated by a Plant Taxonomists, Department of Botany and Ecological Studies, University of Uyo, Uyo, Nigeria. The voucher specimens were prepared and deposited in the University of Uyo Herbarium with Herbarium number: Okon, UUH3014 (*Vernonia polysphaera*) and Okon, UUH3015 (*Cleome ciliata*).

Preparation of Plant Extract

The fresh leaves of *Vernonia polysphaera* and *Cleome ciliata* were separately washed, shade–dried and extracted with 70% ethanol (v/v) by cold extraction for 72 hours. The filtrate were evaporated to dryness by heating in a water bath at 40°C to yield of semi-dry extract. The extracts were re-suspended in 250 ml distil water and stored in 100 ml beaker in a refrigerator until ready for phytochemical screening (Sofowora, 2008).

Figure 1: *Vernonia polysphaera* leaves and

Figure 2: ***Clome ciliata*** **leaves and flowers**

Qualitative and Quantitative Phytochemical Screening

This experiment was performed in the Postgraduate Laboratory, Department of Pharmacognosy and Natural Medicine, University of Uyo, Akwa Ibom State. Chemical tests were carried-out on the ethanol extract using standard procedures to identify the secondary metabolites outlined by Sofowora (2008) and Trease and Evans (2009).

Determination of Nutrients, Minerals and Vitamins Compositions

The samples were analyzed chemically for moisture content, crude protein, fat (lipids), crude fibre, carbohydrate and ash content according to the methods described by AOAC (2004). Tannin, oxalate, phytate and cyanide, vitamins A, B1, B2 and C were determined according to the methods of AOAC (2004) and Onuwuka (2005). The minerals such as potassium (K), Magnesium (Mg), calcium (Ca), phosphorus (P), Zinc (Zn) and Iron (Fe) were determined by the atomic absorption spectrophotometer (Unicam 939 AAS, Sherwood Scientific, UK) (AOAC, 2004). All the analyses were carried-out in triplicates.

Determination of Photosynthetic Pigment

The chlorophyll content of *Vernonia polysphaera* and *Cleome ciliata* were taken using SPAD-502 atLEAF digital chlorophyll meter, Plantech Instruments, New Delhi (Okon *et al.*, 2021).

Statistical Analysis

Data obtained were processed, summarized and expressed as mean ± standard error of the mean of three replicates and was subjected to statistical analysis using two-way analysis of variance (ANOVA) and student' *t*-test using SPSS version 17.0. Probability limit was set at 95% level of significance (p=0.05) as described by Ogwumike (2002) and Ubom (2004).

Results and Discussion

Qualitative and quantitative phytochemical screening of *Vernonia polysphaera* and *Cleome ciliata* are summarized in Tables 1 and 2. Alkaloids (6.98±0.00 mg/100g), tannins (0.94±0.46 mg/100g), saponins (0.80±1.05 mg/100g), flavonoids (5.33±0.29 mg/100g) and gardiac glycosides (7.28±0.44 mg/100g) were detected in *V. polysphaera*. Confirmatory test in qualitative phytochemical screening using Dragendorff's and Mayer's reagent, foam, frot, Shinoda's, Salkowski and Lieberman's test were detected in abundance. Wagner's reagent, picric acid, sodium bicarbonate, ammonia and Keller–Killani's test were moderate while ferric chloride, bromine water and sodium hydroxide test were found to be trace amount. Similarly, *Cleome ciliata* samples revealed the presence of Alkaloids (4.35±0.65 mg/100g), tannins (1.07±0.15 mg/100g), saponins (1.78±0.22 mg/100g), gardiac glycosides (8.47±0.02 mg/100g) and terpenes (7.04±0.36 mg/100g). Also, Salkowski's, Keller–Killani's and Lieberman's Burchards test were in abundance, Dragendorff's, Mayer's and Wagner's reagent, Lieberman's test were moderate while picric acid, ferric chloride, bromine water, foam, frot, sodium bicarbonate and sodium hydroxide were in trace. The results of quantitative analysis were significant (p=0.05). The presence of these metabolites in *V. polysphaera* and *C. ciliata* classifies them as medicinal plants.

Alkaloids are known to protect against chronic diseases (diabetes and liver infections). Naturally occurring alkaloids and their synthetic derivatives have analgesic, antispasmodic and bactericidal activities (Okwu and Okwu, 2004). The presence of this metabolites in the vegetables may be responsible for their medicinal properties. Flavonoids in plant might induce mechanism that affect cancer cells and inhibit tumor invasion (Skene and Phillip, 2006). Dermirezer *et al*. (2001) reported that many plants containing flavonoids are diuretic and are antioxidant. Flavonoids in plants is useful and act as antioxidant, antiviral, anti-malaria, laxative analgesic, anti-microbial and anti-tumor activities (Ibrahim *et al*., 2010). The leaves of *V. polysphaera* and *C. ciliata* can equally be applied in each cases. Saponins are said to have anti-oxidants properties. It also protects the plant against microbes and fungi degradation (Oboh and Masodge, 2009). Although Saponins are haemolytic on red blood cells. Terpenes which were present in leaves, it shows that the plant is a rich source of essential oil. Essential oil can be used as natural flavour additives for food, as fragrance in perfumery and in traditional and alternative medicine such as aeromatherapy. Terpenes in modern clinical studies have supported the role of vegetables as anti-inflammatory and analgesic agent (Singh, 2006). Nassiri and Hoaaein (2008) reported the role of terpenes to produce an antiseptic that is effective against bacterial infections. Saponins protect the body against hypercholesterolemia and possess antibiotic properties while terpenes show analgesic properties (Lewis *et al*., 2001). Tannins, flavonoids and cardiac glycosides in *Peristrophe bicalculata* have the potency to promote haemopoietic indices and to restore the lost blood during excessive bleeding (Esenowo *et al*., 2010). Similar results were obtained in *Uvaria chamae* root extract by Okon *et al*. (2013). Researchers also reports same results from *Morinde citrotolia* and *Digitalis pupurea*. Cardiac glycosides in these plants can be used in the treatment of diseases associated with the heart (Farine *et al*., 1996, Trease and Evans, 2009). These plants are currently used by herbalists to treat tumour (Piett, 2000).

Thus, bioactive compounds in plants accounts for the pharmacological properties such as anti-oxidant, anti-inflammatory, cardio protective, wound healing, anti-diabetic, anti-cancer, antimicrobial and hair growth promoting properties. Also, biologically active compounds found in plants are assumed to be more acceptable and non-hazardous than synthetic compounds (Bhattarai and Jha, 2016). The medicinal value of plants lies in their inherent chemical substances which have a definite physiological action on the human body (Amin-Mir *et al*., 2013).

Table 1: Qualitative Phytochemical Screening of Two lesser-used Edible Leafy Vegetables obtained in various locations in Akwa Ibom State

S/N	Names of Compound	*V. polysphaera*	*C. ciliata*
1.	**Alkaloids:**		
	i. Dragendorff's reagent	+++	++
	ii. Mayer's reagent	+++	++
	iii. Picric acid test	++	+
	iv. Wagner's reagent	++	++
2.	**Tannins:**		
	i. Ferric chloride test	+	+
	ii. Bromine water test	+	+
3.	**Saponins:**		
	i. Foam test	+++	+
	ii. Frot Test	+++	+
	iii. Sodium bicarbonate test	++	+
4.	**Flavonoids:**		
	i. Shinoda's test	+++	ND
	ii. Ammonia test	++	ND
	iii. Sodium hydroxide test	+	ND
5.	**Cardiac glycosides:**		
	i. Salkowski test	+++	+++
	ii. Lieberman's test	+++	++

	iii. Keller – Killani's test	++	+++
6.	**Anthraquinones:**		
	i. Free anthraqinnes	ND	ND
	ii. Combine anthraqinnes	ND	ND
7.	**Phlobatannins:**		
	i. Hydrochloric acid test	ND	ND
	ii. Potassium hydroxide test	ND	ND
8.	**Terpenes:**		
	i. Lieberman's Burchards test	ND	+++

ND = Not detected, + = Trace, ++ = Moderate, +++ = Abundant.
Footnote: Qualitative phytochemical screening was carried out using shade-dried leaf sample.

Table 2: Quantitative Phytochemical Screening of Two lesser-used Edible Leafy Vegetables (mg/100g) obtained in various locations in Akwa Ibom State

S/N	Compound	*V. polysphaera*	*C. ciliata*
1.	Alkaloids	6.98 ± 0.00^{a}	4.35 ± 0.65^{b}
2.	Tannins	0.94 ± 0.46^{a}	1.07 ± 0.15^{a}
3.	Saponins	0.80 ± 1.05^{a}	1.78 ± 0.22^{b}
4.	Flavonoids	5.33 ± 0.29^{a}	ND
5.	Cardiac glycosides	7.28 ± 0.44^{a}	8.47 ± 0.02^{b}
6.	Terpenes	ND	7.04 ± 0.36^{a}

Results are means of five determinations on dry weight basis ± Standard Error, ND = Not Detected. $^{a-b}$Mean in the same row with different superscripts are significantly different (P=0.05)

The mineral elements tested in *V. polysphaera* recorded Ca (6.04±0.00), Mg (4.79±0.10), K (8.29±0.00), Fe (10.96±0.56), P (5.68±0.02), Zn (0.10±0.05) in mg/kg and same elements were also examined in *C. ciliata:* Ca (7.80±0.92), Mg (5.82±0.56), K (6.90±0.09), Fe (12.91±0.00), P (6.86±0.22) and Zn (0.04±0.02) in mg/kg. Following the concentration, Fe>K>Ca>P>Mg>Zn and Fe>Ca>K>P>Mg>Zn in *V. polysphaera* and *C. ciliata* respectively. The means ± SD recorded in both plants for Ca, Mg, K and Fe were significant (p=0.05). All the elements tested were within the RDI (FAO/WHO) standard.

Magnesium (Mg) regulates nerves and heart functioning, also increase insulin and decrease blood pressure by dilating arteries and preventing abnormal hearts rhythm. Mg controls blood-glucose levels and supports healthy immune system. Hence, regular in-take of magnesium rich vegetables may control blood glucose level. Potassium had been noted for the prevention and treatment of high blood pressure due to its diuretic nature (Wardlaw, 2004). Zinc plays a vital role in protein synthesis, cellular differentiation, replication, immunity and sexual functions in fertility (Pathak and Kapil, 2004). Fe plays an important role in immune functions, cognitive development, temperature regulation and energy metabolism in both plants and animals (Wardlaw *et al*., 2004). Fe is needed for the synthesis of haemoglobin and myoglobin and it is an important mineral in pregnant and nursing women, infants and elderly people to prevent anaemia and other similar diseases. Regular consumption of iron rich vegetables and foods can prevent iron deficiency anaemia (Geissler and Singh, 2011). Potassium plays a vital role in the regulation of acid base balance in the cell, water retention and is essential for protein biosynthesis by ribosomes. Calcium is one of the minerals present in the structure of the body and in bones. It is necessary for the normal functioning of cardiac muscles, blood coagulation and milk clotting and the regulation of cell permeability as reported by Jain (2006). Ca plays an important part in nerve-impulse transmission and in the mechanism of neuromuscular system (Sanjay *et al*., 2010). Phosphorus is essential component for bone minerals. P is a constituent of cytoplasm and nuclear protein, phospholipids and nucleic acids, as well as taking important part in carbohydrate metabolism in plants. Phosphorus is needed for kidney functioning and transfer of nerve impulse. Deficiency of phosphorus-calcium balance results in osteoporosis, arthritis, pyorrhea, rickets and tooth decay. Calcium and phosphorus are associated with each other for growth and maintenance of bones, teeth and muscles (Turan *et al*., 2003). The calcium level in the leaves studied compares favourably with the value reported in some green leafy vegetables consumed in Nigeria (Ca: 6.41-8.02 mg/kg) and some wild edible leaves grown in Eastern Anatolia (Ca: 5.33-11.16 mg/kg). For good Ca to P intestinal absorption, Ca/P ratio should be close to unity. The values recorded in this study meet this requirement and as such predicates good Ca to P intestinal absorption (Turan *et al*., 2003).

Table 3: Mineral Contents of the two lesser-used Edible Leafy Vegetables obtained in various locations in Akwa Ibom State

S/N	Mineral (mg/kg)	*V. polysphaera*	*C. ciliata*	RDI (FAO/WHO, 2010)
1.	Ca	6.04±0.00[a]	7.80±0.92[b]	3.8-13.5
2.	Mg	4.79±0.10[a]	5.82±0.56[b]	2.6-25.0
3.	K	8.29±0.00[a]	6.90±0.09[b]	8.5-22.8
4.	Fe	10.96±0.56[a]	12.91±0.00[b]	6.2-22.30
5.	P	5.68±0.02[a]	6.86±0.22[a]	3.2-12.2
6.	Zn	0.10±0.05[a]	0.04±0.02[a]	0.01-7.2

Result are means of five determinations on dry weight basis ± Standard Error,
[a-e] Means in the same row with different superscripts are significantly different (p=0.05)
RDI: Reference Daily Intake, K = Potassium, Ca = Calcium, Fe = Iron,
Mg = Magnessium, P = Phosphorus, Zn = Zinc.
Footnote: Mineral composition was carried out on shade-dried leaf sample.

Proximate compositions like crude lipid, ash, crude fiber, moisture content and caloric values in *V. polysphaera* and *C. ciliata* were significant (p=0.05). The crude protein and carbohydrates (CHO) contents in both vegetables were very high. The values recorded compete favorably when compared with the values of RDI (FAO/WHO) for food nutrition (Table 4). The level of anti-nutrients in *V. polysphaera* and *C. ciliata* leaves were very low as recorded in tannic acid and saponins (Fig. 3). Oxalate and cyanide were not detected in both vegetables. Vitamins B1 (thiamin), B2 (riboflavin) and C (ascorbic acid) were significant (p=0.05). Vitamin A (axepthol) in the two plants *V. polysphaera* and *C. ciliata* recorded 10.02±0.21 and 10.69±0.04 mg/100g, respectively (Fig. 4). Protein builds and repair body tissues, regulates body processes and help in formation of enzymes and hormones. Proteins aid in the formation of antibodies that enable the body to fight infections and serves as a major energy supplier (Brosnan, 2003). Fibre intake decrease serum cholesterol and reduce the risk of coronary heart disease, hypertension, diabetes, colon and breast cancer (Ramula and Rao, 2003). World Health Organisation (WHO) recommends fiber intake of 22-23kg for every 1000 Kcal of diet which is needed for digestion and effective elimination of waste in human (Olson, 1999). Carbohydrate is the energy provider required for smooth functioning of the body especially for the vegetarians (Akubugwo *et al*., 2007). Consuming high concentration of oxalate may result in kidney disease (Hassan and Umar, 2004). Phytate is an anti-nutritional factor which prevent various fruits and vegetables, it high concentration is known to reduce mineral content in vegetables/fruits (Weaver and Kannan, 2002). Excessive ingestion of hydrogen cyanide can be very poisonous as it interferes with electron flow in the mitochondria thereby inhibiting energy generation in the body (Kolodziej and Kiderlen, 2005).

Vitamin A is important for normal vision, gene expression, growth and immune function by its maintenance of epithelial cell function (Lukaski, 2004). Vitamin B1 maintains good appetite and aid in digestion and also for essential co-enzyme in Kerbs' cycle. Vitamin B2 is useful as a co-enzyme in tissue oxidation. It serves as a co-enzyme in respiration and involved in metabolism of protein, fat and CHO in plants (Verma, 2009). Ascorbic acid (Vit. C) is a well-known antioxidant, its physiological and biochemical actions is due to electron donor by donating electrons. It prevents other compound from being oxidized (Padyatty *et al*., 2003). Ascorbic acid is required for the prevention of scurving and maintenance of healthy skin, gums and blood vessels. Deficiency of vitamin C causes bruising, bleeding, dry skin and depression (Olson, 1999). With the significant values recorded for minerals, nutrients, anti-nutrients and vitamins in *V. polysphaera* and *C. ciliata* leaves, it could be useful in human diet to fulfil WHO recommendation.

Table 4: Nutrients Composition of the two lesser-used Edible Leafy Vegetables obtained in various locations in Akwa Ibom State

S/N	Nutrients (%)	*V. polysphaera*	*C. ciliata*	RDI (FAO/WHO, 2010)
1.	Crude Protein	10.10±0.03[a]	11.20±0.00[a]	5.5-14.8
2.	Crude Lipid	3.10±0.05[a]	4.20±0.62[b]	3.1-8.8
3.	Ash	7.30±0.03[a]	3.10±2.09[b]	1.5-4.0
4.	Crude Fiber	19.80±0.41[a]	21.70±0.07[b]	16.8-24.6
5.	Carbohydrate (CHO)	51.60±0.41[a]	52.30±0.32[a]	18.0-56.8
6.	Moisture Content	8.10±0.18[a]	7.50±0.10[b]	6.5-18.9
7	Caloric Value (Kcal)	292.00±0.82[a]	387.12±0.03[b]	140.0-465.0

Results are means of five determinations on dry weight basis ± Standard Error,
RDI = Reference Daily Intake. [a-b] Means in the same row with different superscripts are significantly different (p=0.05),
Footnote: Nutrients analysis was carried out on shade-dried leaf sample.

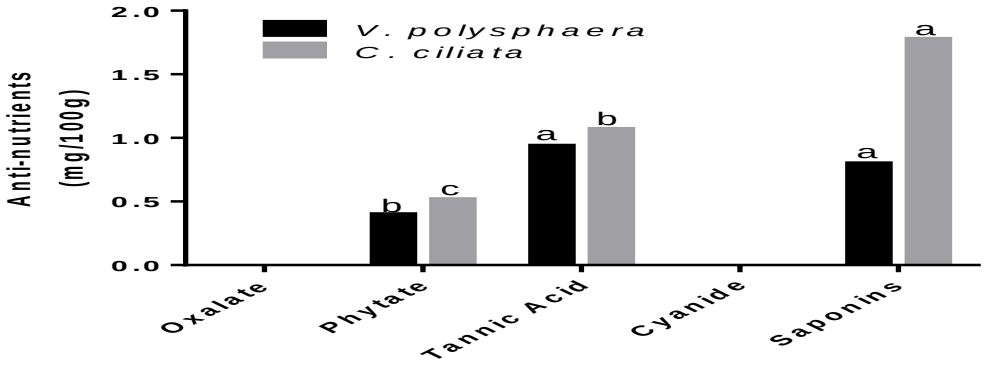

Figure 1: Anti-nutrients Composition of the two leeser-used Edible Leafy Vegetables obtained in various locations in Akwa Ibom State

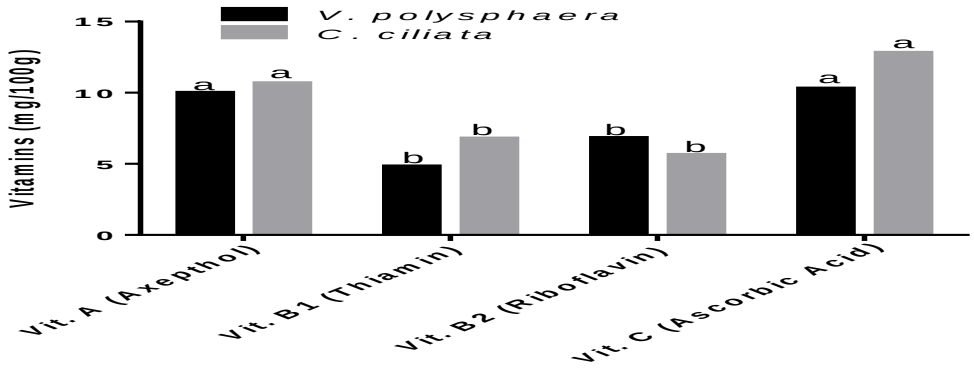

Figure 2: Vitamin Composition of the twolesser-used Edible Leafy Vegetables obtained in various locations in Akwa Ibom State

The photosynthetic pigment of *V. polysphaera* and *C. ciliata* were significant at p=0.05. The concentration of chl. a, chl. b, carotenoids and total chlorophyll were higher in *V. polysphaera* than in *C. ciliata* (Fig. 5).

Chlorophyll is a useful product of magnesium. Chlorophylls are present in the chloroplasts of plant cells where photosynthesis takes place. Proteins are arranged in the thylakoid membranes of the chloroplast which work together with chlorophyll by absorbing sunlight in plants. This produce energy in the form of ATP which then goes through the Calvin cycle and fixes the CO_2 to produce sugars. Oxygen is also produced as a by-product of photosynthesis. This oxygen is then used up by plants for cellular respiration and is also released into the environment supporting other living beings (Jain, 2006 and Verma, 2009). In photosynthesis, chlorophyll absorbs energy and then transforms water and carbon dioxide into oxygen and carbohydrates. The process of photosynthesis converts solar energy into a usable form for plants, and the animals that eat them, forming the foundation of some food chains. The whole practice of monitoring plant health in-situ is based on the assessment of its chlorophyll and photosynthetic contents which also help determine the productivity of photosynthesis in such plants (Okon *et al*., 2021).

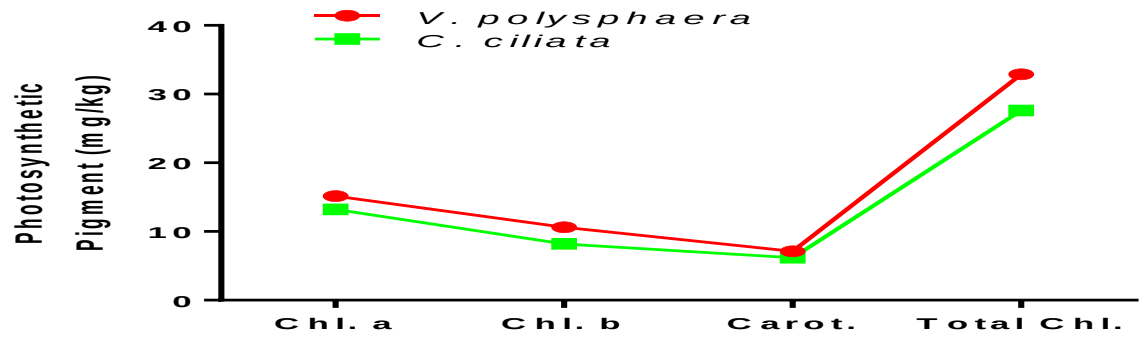

Figure 3: Photosynthetic Pigment Concentration of Different Edible Leafy Vegetables

Conclusion

This research shows that the leafy vegetables *V. polysphaera* and *C. ciliata* contained important secondary metabolites, nutrients, essential mineral elements and vitamins, little or no anti-nutrients. The data obtained recorded valuable compounds that felt within the permissible limit reference daily intake (RDI) by WHO and FAO making it suitable in food supplementation. The consumption of food made by medicinal plant parts are of immense benefit as it provides health benefit and protection from diseases by virtue of their medicinal potentials. The phytochemicals contained in these vegetables have been linked to many positive effects on human health, including coronary heart diseases, diabetes, high blood pressure and degenerative diseases. Thus, these vegetables could be utilized not only for their high nutritional contents as food but also as a potential medical plant. *V. polysphaera* and *C. ciliata* being found in the wild with an ability to highly resist drought, it can provide cheaper source of vegetables as an alternative to common vegetables during the dry season.

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