Analysis of Proximate and Phytomicrobial Properties of Fluted Pumpkin and white Leadwort Obtained from Some Botanical Gardens in Warri South Local Government

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ABSTRACT

Fluted pumpkin (Telfairia occidentalis) is a leafy vegetable cultivated and consumed for its valuable nutrients and minerals, which are effective against micronutrient deficiencies. At the same time, white leadwort (Plumbago zeylanica) is an important medicinal plant used in traditional systems of medicine to treat gonorrhoea, syphilis, tuberculosis, rheumatic pain, swellings, piles, diarrhoea, skin diseases, and leprosy. They possess antibacterial and anti-fungal properties. Dried samples and extracts of fluted pumpkin (Telfairia occidentalis) and white leadwort (Plumbago zeylanica) were analysed for protein, fat, fibre, carbohydrate, moisture, and ash. Pumkin had a higher value for moisture content (43.11%) and a lower value for fat (1.97%), while Leadwort had a higher value for fibre (31.76%) and a lower value for protein (4.82%). Phytochemical analysis of pumpkin constituent Alkaloids (0.81%), Saponins (0.59%) and flavonoids (0.04%), while that of lead-wort was Alkaloids (0.39%), Saponins (0.68%) and flavonoids (0.03%). Fluted pumpkin (Telfairia occidentalis) showed a higher percentage of phytochemical content than white leadwort (Plumbago mechanical). Therefore, both Telfairia occidentalis and Plumbago zeylanica may be considered as rich in proximate and phytochemical and potential

INTRODUCTION

Background to the Study

Food security is a function of the population with a corresponding rate of crop production to suffice their need for nutrition. Food security is having adequate, safe, and nourishing food to satisfy nutritional needs. The human population has remained on the rise with a consequent decrease in arable lands for the cultivation of crops (Agogbua et al., 2022). In Nigeria, vegetables are found in the Southeast region, where vegetables are combined in their diet as soup, but in the Southwest, they are separately used as decoction or infusion and therefore taken as medicine. They contain nutrients in the right proportions, which could make them be referred to as balanced diets; therefore, people are encouraged to eat vegetables, especially when sick. Vegetables are rich in vitamins, minerals, antioxidants, fibres, carbohydrates and secondary metabolites; these are crucial for maintaining optimal health and preventing chronic diseases (Ayoola et al., 2020). The leaves, fruits and seeds of vegetables in Nigeria are edible (by boiling, roasting or baking) and have high nutritional qualities. Most of these plant parts are used as medicine. (Akpasi et al., 2023)

The use of plants for medicinal purposes dates back to traditional medicine, where they were used to treat various ailments and diseases. The medicinal value of plants lies in some chemical substances that produce a definite physiological action on the human body (Sumitra et al., 2013). In recent years, scientists have intensified their efforts to explore the nutritional and medicinal properties of plants to develop new treatments and health-promoting products (Supuran, 2023)
Botanical gardens conserve plant diversity as plants can be grown and studied there. This study focuses on two

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plants, Plumbago zeylanica (leadwort) and Telfairia occidenttalis (Ugu Leaf), from a botanical garden in Warri, Delta State, Nigeria. "Ugwu" is the Igbo term for the fluted pumpkin (Tellfairia occidentalis), which is a creeping leafy plant with enormous lobed leaves and lengthy, winding tendrils. Telfairia occidentalis is classified in the tribe Joliffieae of the subfamily Cucurbitaceae. It is grown in many nations of West Africa but is mainly cultivated in southeastern Nigeria, and it is used primarily in soups and herbal medicines (Agbai, 2023). This green vegetable is a good source of vitamin C, phytochemicals, dietary fiber, carotenoids, folate, and certain minerals but has low lipid, dietary fiber, carotenoids, folate, and certain minerals, but have low lipid, carbohydrate and protein concentration (Oboh et al., 2009) . It is a nutrient-rich vegetable widely grown in Nigeria. Its leaves are packed with iron, vitamins, minerals, antioxidants, and phytochemicals, making it an excellent addition to a healthy diet. The leaves can be applied topically to treat burns, hematinic and act as an analgesic. Pulp has historically been used to help with stomach issues like dyspepsia and intestinal irritation. Pumpkin fruit is high in Vitamin A, which is important for vision, growth, and disease prevention. It also has notable amounts of lycopene, dietary fiber, vitamin C, and vitamin E (Akpasi et al., 2023).
Young leaves mixed with coconut water and dyspepsia salt can be stored to treat convulsions, and their extract helps manage high cholesterol, liver problems, and weak immune systems. However, seed oil can raise lipid levels if eaten too much. In areas where Telfairia occidentalis is consumed frequently, there are few cases of protein-energy malnutrition. Its use in reproduction is rising, as it may help with testicular damage and sperm production. The leaves' extract is popular for fighting oxidative damage, and in Nigeria, fresh leaves are made into juice for postpartum women. The root has properties similar to chloroquine and can suppress certain bacteria but is also toxic and used as a rodenticide (Omimakinde et al., 2018).

The anticancer potential of Telfairia occidentalis has been demonstrated through several studies. The crude extract of the seed inhibits oxidative burst activity in whole blood, isolated polymorph nuclear cells (PMNs), and mononuclear cells (MNCs). The presence of phenolic compounds, flavonoids, and other constituents in the leaves contributes to the plant's chemo-suppressive activity. Given the established high antioxidant property of Telfairia occidentalis, it is likely that its anticancer activity is linked to these antioxidant components (Eseyin et al., 2014; Okokon et al., 2012). The plant also shows potential in enhancing male fertility, as it improves sperm mobility, viability, and count and increases testosterone, luteinizing hormone, and testicular weight. Its prophylactic effect on alcohol-induced testicular damage and its beneficial impact on semen quality further highlight its therapeutic value in male fertility (Eseyin et al., 2014; Seungjin et al., 2020).

A study has shown that the ethanol root extract of Telfairia occidentalis possesses antiplasmodial potential and inhibitory effects on some Enterobacteriaceae, while Telfairia occidentalis anti-inflammatory activities were also reported (Oyewole and Abalaka 2012). In the fight against malaria, Telfairia occidentalis has shown significant blood schizonticidal activity, with the root, leaf, and seed extracts demonstrating antiplasmodial activity. The plant's extracts have shown high in vitro synergistic activities with chloroquine and against chloroquine-tolerant Plasmodium berghei isolates, indicating its potential as an alternative antimalarial treatment (Eseyin et al., 2014).

The antimicrobial activity of Telfairia occidentalis is also noteworthy. The leaf extract exhibits antibacterial activity against selected intestinal pathogens such as E. coli, S. faecalis, and S. typhi. The ethanol extract inhibits the growth of various Enterobacteriaceae, and the crude extract shows synergistic effects with antibiotics on a majority of the tested bacteria. The aqueous extracts also demonstrate higher worm inhibitory and destructive activities compared to methanol extracts (Eseyin et al., 2014)

Plumbago zeylanica is a medicinal plant commonly known as “White leadwort” or “chitrak.”. It belongs to the Plumbaginaceae family and is a perennial herb that is found in Uttar Pradesh, West Bengal, Maharashtra, and also in some parts of South India (Mandavkar and Jalalpure, 2011). The root and root bark of this herb are utilised in the preparation of various Ayurvedic medicines. In the traditional system of medicine, it plays a significant protective role in the enlarged liver and spleen. It is a bitter tonic and is suggested as a rejuvenant, well known for its use in chronic colds and coughs. It also finds its use in correcting chronic diseases of the nervous system, viral warts and chronic menstrual disorders. Also, it is recommended for piles, worms, and colitis. The Extract of chitramula is reported as an anticancer drug. The root bark is additionally considered beneficial in obesity. It has been potentially useful for loss of appetite and indigestion. The root is used

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extensively in India and China to treat contusions of extremities, cancer, rheumatoid arthritis, and dysmenorrhea (Parmar, 2024). An alkaloid called plumbagin is found in the roots. It is responsible for various therapeutic properties like antioxidant, antimalarial, antibiotic, anti-fertility, anticancer, and cardiotonic (Parmar, 2024).

Flowers of this plant are used as digestants, and leaves possess aphrodisiac properties. They are used in the treatment of scabies, soreness, and swelling. Leaves have shown their effective role in treating infections and digestive problems such as dysentery. They are also used as stimulants (Shukla et al., 2021).

The root is used extensively in India and China to treat contusions of extremities, cancer, rheumatoid arthritis, and dysmenorrhea (Parmar, 2024). It is responsible for various therapeutic properties like antioxidant, antimalarial, antibiotic, antifertility, anticancer, and cardiotonic (Parmar, 2024). The roots of this plant are demonstrated as laxative, expectorant, tonic, and a good appetiser. Roots are also reported to be beneficial in the treatment of rheumatism, laryngitis, scabies and disease of the spleen. The decoction of the seeds is used for reducing muscular pain (Arpita, 2017).

Plumbago zeylanica, as a potent medicinal agent, can be used in the treatment of skin diseases, joint pain, stubborn chronic rheumatoid arthritis, and numerous growths. It also finds use in correcting chronic menstrual disorders, viral warts, and chronic diseases of the nervous system. Obesity can be resolved using root bark. Plumbago zeylanica contains various bioactive compounds like alkaloids, flavonoids, napthoquinones, glycosides, saponins, steroids, tri-terpenoids, coumarins, phenolic compounds, tannins, carbohydrates, fixed oils, fats, and proteins (Roy and Bharadvaja, 2017). The Plumbago zeylanica plant has several medicinal properties, including anti-bacterial, anti-tumour, and anti-inflammatory effects. It is part of the Plumbaginaceae family, which includes 10 genera and 280 species. Plumbago zeylanica, also known as Ceylon leadwort or chitrak in Ayurveda, is especially valued for its therapeutic benefits. This perennial herb, commonly found in India and Sri Lanka, is cultivated for its attractive flowers (Shukla et al., 2021). Its leaves have aphrodisiac properties and are used to treat scabies, infections, and digestive issues. They can also be applied topically for rheumatic pain and skin conditions.

Additionally, it is important to ascertain the nutritional, medicinal and antimicrobial values of these plants to scientifically validate the use of Telfairia occidentalis and Plumbago zeylanica, and this can have practical implications for community health and well-being in Warri (Delta state, Nigeria) and beyond. These plants may contain bioactive compounds and have therapeutic properties that can provide an alternative solution for various health issues. Hence, this study aims to investigate the nutritional, medicinal and anti-microbial properties of Telfairia occidentalis and Plumbago zeylanica from a botanical garden in Warri. Despite their potential as a source of essential nutrients and therapeutic agents, the nutritional and medicinal properties of Telfairia occidentalis and Plumbago zeylanica and the use of these plants as traditional medicines have not been scientifically validated.

MATERIALS AND METHODS

Research Design: The research design used in carrying out this study is the analytical Method, whereby the vegetable samples collected in different gardens were subjected to laboratory analysis. This is to provide a detailed understanding of the nutritional and medicinal values of the vegetable samples.

Description of the Study Area: The study areas are Edjeba in Warri and Effurun off Warri-Sapele Road by Army Housing Estate, Delta State, Nigeria. Edjeba is located under the Warri South Local Government Area, with georeferenced coordinates of 5031’2.53” N (latitude) and 5045’1.22” E (longitude). The Army Housing Estate is located under the Uvwie Local Government Area, with georeferenced coordinates of 5013’07.9” N (latitude) and 50’36’12.3” E (longitude). These study areas are in the Niger Delta region of Nigeria.

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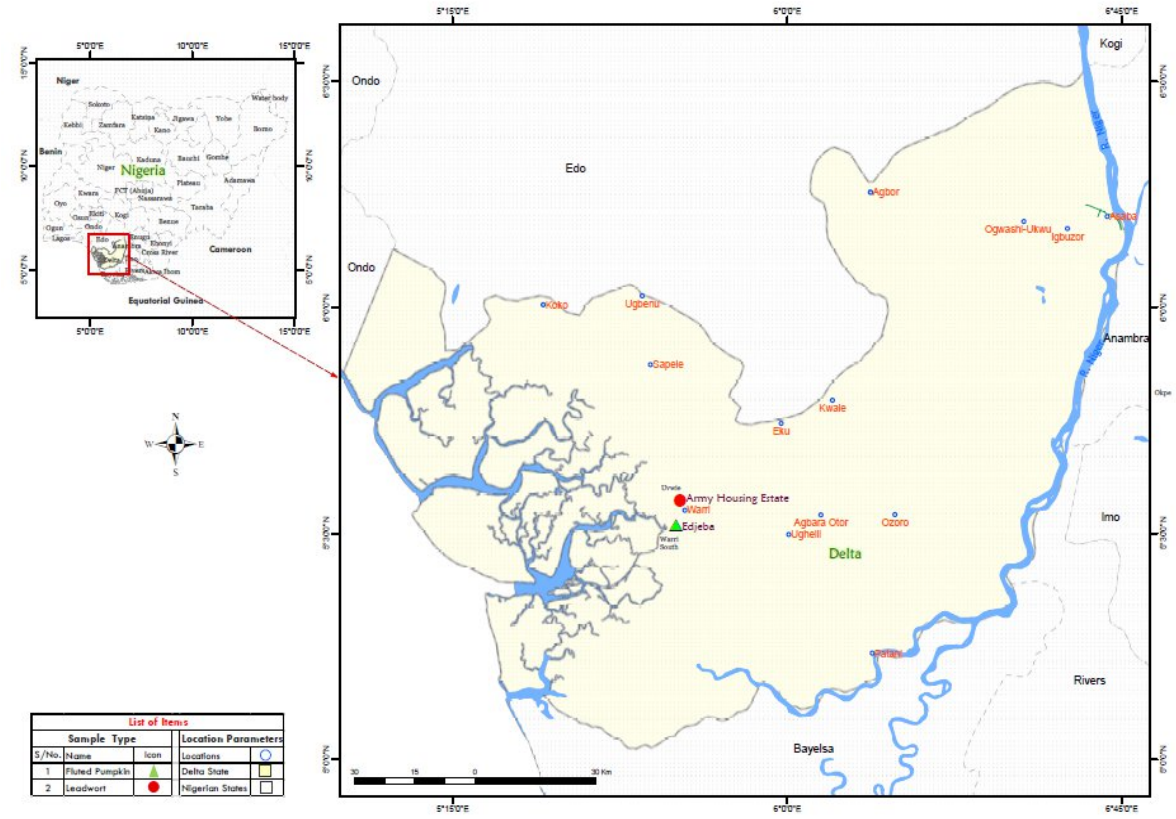

Fig. 3: Location Map showing the Sampling Area of Fluted Pumpkin and leadwort

Sample Collection: The vegetable samples were collected at two different study areas. Pumpkin leaves were collected from a garden in the Edjeba area, under Warri South Local Government, while the White Leadwort leaves were collected from a garden in Effurun off Warri-Sapele road by Army Housing Estate, Delta State, Nigeria. These vegetable leaves were harvested fresh, preserved in polythene bags, and transported to the laboratory for analysis.

Sample Preparation: The fresh vegetable samples were identified, washed with clean water and reweighed. Then, the samples were air-dried except for the moisture content parameter, which was subjected to oven drying. Then ground by pulverization method using a mortar and pestle, after which they were sieved through a mesh of 2mm diameter, and stored in an air-tight polythene bag, and kept in desiccators until the time for analysis.

Methods of Analysis: The proximate composition of the vegetable samples was determined using the Association of Official Analytical Chemists methods (AOAC, 2004).

Determination of Moisture Content: The moisture content of the vegetable samples was determined using AOAC standard methods (2004). The crucibles were washed, dried at 105°C for 30 minutes, and then cooled in a desiccator. Their weights were recorded as W1. Next, 2.0 g of finely ground vegetable samples were added to the crucibles, and their weights were noted as W2. The sample and crucible were dried at 100°C for 4 hours, then cooled for 30 minutes until constant weights were reached, recorded as W3. The moisture content was calculated using the appropriate formula:

$$\% \text{ Moisture} = \frac{(W2 - W3)}{(W2 - W1)} \times 100$$

Where, W1 = Initial weight of empty crucible,

W2 = Weight of crucible + sample before drying and

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W3 = Final weight of crucible + sample after drying

Determination of Ash Content: The total ash content of the vegetable sample was determined using the incineration method described by AOAC (2004). About 2.0 g of the finely ground dried sample was placed in a porcelain crucible and incinerated at 600°C for 6 hours in a muffle furnace (Model 1184A Fisher Scientific, Houston, TX). After cooling the ash in a desiccator, it was reweighed to calculate the percentage of ash content in the sample:

$$\% \text{ Ash} = \frac{\text{Weight of Ash}}{\text{Weight of the rare sample}} \times 100$$

Determination of Crude: Fibre Crude fibre was determined using the AOAC (2004) method. About 2.0 g of the vegetable sample was hydrolyzed with petroleum ether, then boiled for 30 minutes with 200 ml of 1.25% H_2SO_4 solution. After filtration through a fluted funnel, the residue was washed with boiled water. It was then boiled again for 30 minutes with 200 ml of 1.25% NaOH solution, washed with boiled distilled water, and filtered through a Gooch crucible. The residue was dried at 10000°C for 2 hours in an oven. The percentage of crude fibre was calculated using the appropriate formula:

$$\% \text{ Crude fiber} = \frac{\text{(Wt. after drying)}}{\text{(Wt. of the sample)}} \times 100$$

Determination of Fat: The total fat content in vegetable samples was determined using Soxhlet extraction with methanol and ethanol. Boiling flasks (250 ml) were dried in an oven at 105–110°C for about 30 minutes and then cooled in a desiccator. Approximately 2.0 g of each sample was placed into labeled thimbles. The dried flasks were weighed and filled with about 300 ml of petroleum ether (boiling point 40–60°C), with the thimbles plugged with cotton wool. The Soxhlet apparatus was assembled and refluxed for 6 hours. Afterwards, the thimble was removed, and the petroleum ether was collected for reuse. Following extraction, the flask was dried at 105–110°C for 1 hour, cooled in a desiccator, and reweighed. The percentage of fat in the vegetable sample was then calculated using the appropriate formula:

$$\% \text{ fat} = \frac{\text{Weight of fat}}{\text{Weight of sample}} \times 100$$

Determination of Protein: The Micro-Kjeldahl method was used to determine the crude protein content of the vegetable samples as outlined by AOAC (2004), which comprises two essential steps: protein digestion and distillation.

a. Protein Digestion: Begin by weighing 2.0 g of the vegetable sample and placing it in a Kjeldahl flask. Add 1.0 g of copper sulfate, a small amount of selenium catalyst, and 25 ml of concentrated sulfuric acid. Heat the mixture gently in a fume cupboard until it achieves a green colour, maintaining a temperature above 420°C for approximately 30 minutes. Once cooled, wash down any black particles at the neck of the flask with distilled water. Transfer the digest to a 250 ml volumetric flask, perform several rinses with distilled water, and bring the volume up to the mark before proceeding to distillation.

b. Protein Distillation: Steam the Markham distillation apparatus for 15 minutes before use. Position a conical flask containing 5 ml of boric acid indicator under the condenser. Pipet approximately 5.0 ml of the digest into the apparatus, washing it down with distilled water, and then add 50 ml of 60% sodium hydroxide. Steam the mixture for about 5-10 minutes to collect ammonium sulfate in the receiving flask. Finally, treat the solution in the receiving flask with 0.01 M hydrochloric acid, running a blank sample concurrently.

Calculate the percentage of nitrogen using the specified formulas:

$$\% \text{ fat} = \frac{\text{Weight of fat}}{\text{Weight of sample}} \times 100$$

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Where,
Vs = Volume (ml) of acid required to titrate the sample;
Vb = Volume (ml) of acid required to titrate the blank;
M-acid = Molarity of acid;
W = Weight of the sample (g).
Then, the percentage crude protein in the vegetable sample was calculated from the % Nitrogen as: % crude protein = % N x F
Where F(the conversion factor), is equivalent to 6.25.

Determination of Carbohydrate: The carbohydrate content in vegetable samples was found by adding the amounts of protein, fat, fibre, moisture, and ash, then subtracting from 100.

% carbohydrate =100 – (% moisture + % crude fiber + % protein + % Fat + % ash).

Phytochemical Analysis
A modified method of Sofowara (1993) was used for the determination of Alkaloids, flavonoids and saponins.

Alkaloid

2. 0 g of dried leaf extract was weighed and combined with 200 ml of 10% acetic acid in ethanol. The mixture was covered and allowed to sit for four hours. After being filtered, the solution was evaporated in a water bath to a quarter of its original volume. The extract was supplemented with the concentrated NH_4OH until precipitation was finished. The mixture was then filtered after being rinsed with dilute NH4OH. After being dried and weighed, the alkaloid concentration of the residue was measured.
Alkaloid (%) = Weight of precipitate x 1 x 100

Weight of the rare sample

Flavonoid

With 100 mL of 80% aqueous methanol, 2.0g of leaf plant powder was repeatedly extracted for one day. The entire solution was then filtered via the Whatman filter paper. After that, the filtrate was put into a crucible, dried in a water bath, and then weighed until it was consistent. The flavonoid concentration in the plant leaf specimen was calculated using the weight measured.

Flavonoid (%) = Weight of dried sample x 100

Weight of original sample

Saponin

After being shaken in 50 ml of 20% ethanol for 30 minutes, the 2. 0 g of dried leaf powder was heated in the solution. a four-hour water bath at 55 °C. The combination was filtered using Whatman filter paper. The accumulated residue was reextracted using an additional 200 ml of 20% aqueous ethanol. The filtrates were mixed and concentrated in a water bath at 90°C to a volume of 40 ml. The concentrate was poured into a separating funnel, 20 ml of diethyl ether ((C2H5)2O) was added, and the mixture was vigorously shaken. The aqueous layer was kept in a beaker while the ether layer, which was the top layer, was discarded. Sixty millilitres of n-butanol was introduced into a separating funnel, and the mixture was shaken vigorously. The lower layer of the extract was discarded, while the upper layer of the $C_4H_{10}O$ extract was kept. Ten millilitres of 5% aqueous sodium chloride were used to wash the $C_4H_{10}O$ layer twice. The remaining solution was gathered, dried in an oven at 40 °C to a consistent weight, and then evaporated in a water bath.

Saponin (%) = Weight of residue x 100

Weight of the rare sample

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Data Analysis

The results were statistically analysed using ANOVA (Analysis of Variance), where the mean, standard error, and standard deviation were considered.

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RESULTS AND DISCUSSION

Results

The detailed results of the laboratory analysis of vegetable samples are presented below. The proximate and phytochemical compositions of both pumpkin and leadwort are statistically presented in Tables 1 and 2. Table 1(proximate composition) revealed the presence of protein, Fat, fibre, Carbohydrate, Moisture and Ash content of various percentages. Table 2 (phytochemical compositions) results indicated the presence of saponins, alkaloids, and flavonoids. Graphical representations are also shown below in Figs. 1 and 2.

Table 1: Average Results of Nutritional Composition (Proximate Analysis) of the Vegetable Samples

Protein Content	%	6.19 (±0.02)	4.82 (±0.01)
Fat Content	%	1.97 (±0.02)	2.97 (±0.01)
Fibre Content	%	23.81 (±0.01)	31.76 (±0.02)
Carbohydrate	%	16.87 (±0.01)	13.97 (±0.01)
Moisture Content	%	43.11 (±0.01)	39.85 (±0.01)
Ash Content	%	8.07 (±0.01)	6.65 (±0.02)

Table 2: Average Results of Phytochemicals in the Vegetable Samples

Alkaloids Content	%	0.81 (±0.01)	0.39 (±0.01)
Saponins Content	%	0.59 (±0.01)	0.68 (±0.01)
Flevonoids Content	%	0.04 (±0.01)	0.03 (±0.01)

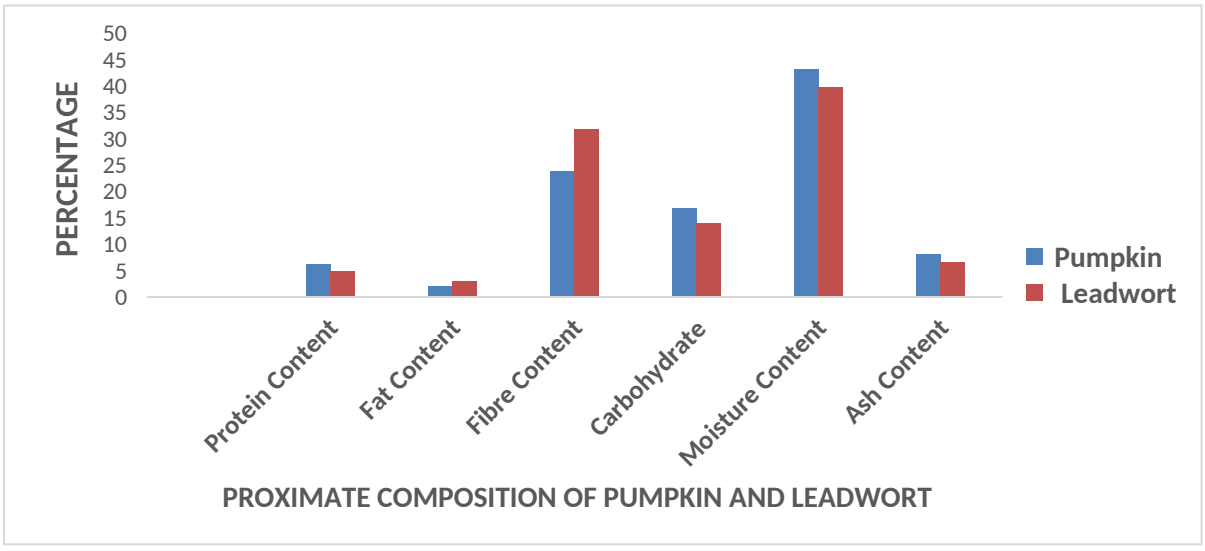

Fig.1: Graphical representation Proximate Composition (Nutritional Analysis) of the Vegetable Sample

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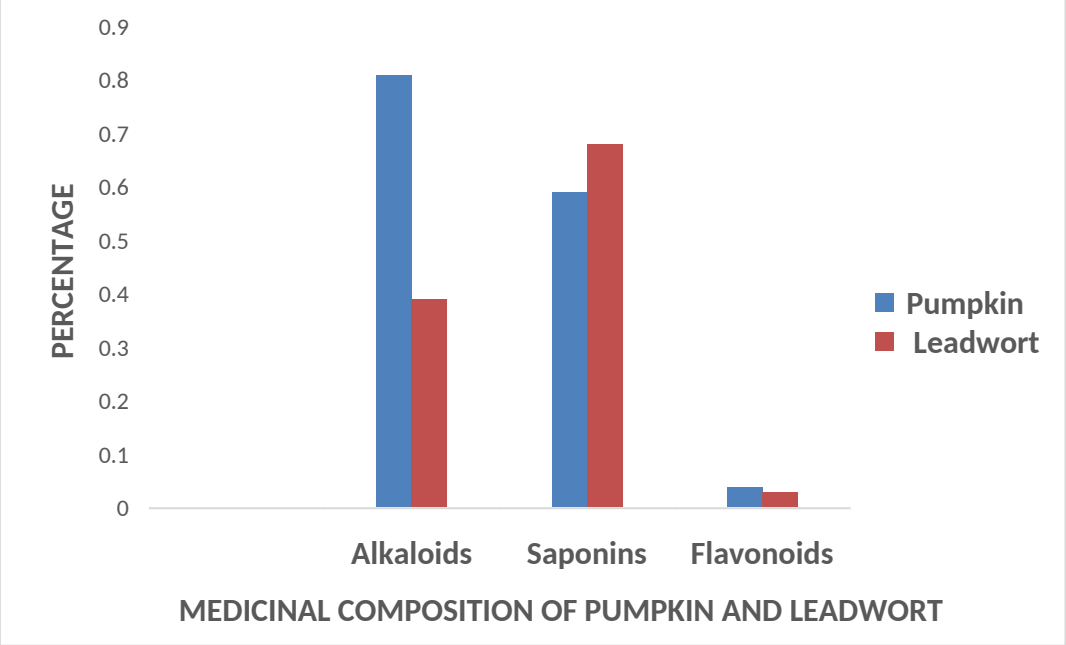

FIG.2: Graphical Representation of Some Phytochemical Components of Pumpkin and Leadwort Vegetables

DISCUSSION

This study has analyzed phytochemical components of the two samples which has variety health benefits while the proximate composition refers to the nutritional constituent of the samples.

The Proximate Nutrients of the samples had a mean carbohydrate content of 16.87% for

The samples had a mean carbohydrate content of 16.87% for pumpkin with a standard deviation of ±0.01, while leadwort had a lower carbohydrate content of 13.97% with a standard deviation of ±0.01 (Fig. 1). This low carbohydrate content is attributed to the class of food that the vegetable belongs to. Udoh (2017) presented in his report that the carbohydrate content of the full-fat samples ranged between 9.81% and 13.28% while that of the deflated samples ranged between 10.49% and 17.54%. This result is just like that of this study.

The ash content of the sample gives an idea of the mineral elements present in the vegetable sample. In this study, pumpkin vegetable had a high ash content, with the value of 8.07% (± 0.01), while leadwort vegetable had the value of 6.65% (± 0.02).

Among the two sample varieties, Pumpkin had the highest protein content of 6.19% (±0.02), while leadwort had 4.82% (±0.02) (Fig. 1). The result shows that pumpkin contains more protein content than white leadwort. It is worth noting that the amino acid balance of vegetable protein is exceptionally good, which would reduce protein malnutrition. Nzeagwu et al. (2020) reported a higher percentage of protein, ranging from 21.90 % (roasted) to 26.01 % (boiled). The percentage fibre content of the vegetable samples was 23.81% (±0.01) for Pumpkin and 31.76% (±0.02) for leadwort.

Higher percentage moisture content was observed in Pumpkin with a value of 43.11 (±0.01), while the leadwort had a moisture content of 39.85% (±0.01) (Fig. 1). This high moisture content observed in the two vegetables is attributed to the high percentage of water holding capacity of the vegetables Okonwu et al. (2018) reported a high moisture content of 86%, for pumpkin, lower moisture content result to longer shelf life. The percentage fat content of pumpkin had a mean value of 1.97% (±0.02), while the leadwort had a value of 2.97% (±0.01). This study revealed that leadwort had a higher content of fat when compared to pumpkin. Udoh (2017) reported that the fat content of samples ranged between 40.67% and 45.91%. These values, however, were higher than the 1.37% oil content reported by Hamed et al. (2008)

Phytochemical components which are known as bioactive plant chemicals, evaluated in the vegetable samples showed lower concentrations. Pumpkin vegetable had the mean values of 0.81%, 0.59% and 0.04% for alkaloids, saponins and flavonoids, respectively, while white leadwort had values of 0.39%, 0.68% and 0.03%, respectively (Fig. 2). The result, however shows that the percentage of alkaloids (0.81%) and flavonoids (0.04%) are present in the Pumpkin vegetable samples are higher than those found in leadwort vegetables samples while the saponins (0.59%) found in pumpkin are lower than those found in leadwort (0.81%) samples.

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CONCLUSION

This study examined the Proximate analysis and phytochemical composition of two tropical green leafy vegetables, Telfairia occidentalis (Pumpkin) and Plumbago zeylanica (Leadwort), revealing significant variations in their nutritional composition. Telfairia occidentalis demonstrated higher carbohydrate, protein, and mineral (ash) content, while Plumbago zeylanica offered greater fibre and fat levels. The relatively high moisture in Telfairia occidentalis suggests a shorter shelf life, making it susceptible to quicker spoilage. Phytochemical analysis revealed that both samples contain alkaloids, saponins, and flavonoids, but at low concentrations, with potential health benefits such as diabetes, cancer, inflammation, obesity, hepatotoxicity, and other diseases. Therefore, the nutritional and medical composition of Pumpkin and leadwort is necessary for improving the human diet and overall health condition.

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