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Comparative Analyses for Functional Food in *Cucurbita pepo* L. (Pumpkin) and *Telfairia occidentalis* HOOK F. (Fluted Pumpkin)

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ABSTRACT

Telfairia occidentalis and *Cucurbita pepo*, both members of the Cucurbitaceae family, are recognized for their considerable dietary importance. In this study, the two species were comparatively analyzed for their nutritional composition, phytochemical content, and mineral profiles to evaluate their potential as functional foods. Aqueous leaf extracts were subjected to qualitative phytochemical screening, with quantification of total alkaloids, saponins, tannins, flavonoids, and phenols. Standard analytical methods were employed for both mineral and proximate composition analyses. Phytochemical screening indicated the presence of alkaloids, flavonoids, and tannins in the leaf extracts of both *T. occidentalis* and *C. pepo*, whereas phenols were detected only in *T. occidentalis*. All statistical analyses were conducted at a confidence level of $\alpha = 0.05$. In terms of proximate composition, *T. occidentalis* exhibited significantly higher protein, fiber, and ash contents, while *C. pepo* had significantly greater moisture and fat contents. Both species presented high carbohydrate levels, with no significant differences observed. Mineral analysis revealed that *C. pepo* contained significantly higher concentrations (mg kg^{-1}) of calcium, potassium, copper, iron, and nitrate, emphasizing its value as a cost-effective nutritional resource. These findings suggest that *T. occidentalis* possesses greater pharmaceutical potential due to its richer phytochemical profile, whereas *C. pepo* exhibits superior nutritional qualities. This distinction highlights their complementary roles in the development of functional foods. Further studies are recommended to investigate the physiological effects of *C. pepo* and the potential synergistic benefits of combining both species in functional food applications.

Introduction

Hippocrates, often regarded as the father of medicine, articulated the principle *"Let food be thy medicine, and medicine be thy food"* approximately 2,500 years ago. This concept has garnered increasing attention over the past two centuries, paralleling the global rise in health-conscious dietary practices. For centuries, plants have been used not only as nutritional supplements but also for the prevention, management, and treatment of a wide range of ailments. Today, it is estimated that approximately 85% of the global population relies on plants as a primary source of healthcare and as foundational materials for drug development (Jamshidi-Kia et al., 2018).

These properties have positioned many plants at the forefront of the evolving field of functional food. Acham et al. (2018) defined functional foods as substances that supply essential nutrients—often in amounts exceeding those required for basic growth, maintenance, and development—while also

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delivering biologically active compounds that promote health. Similarly, Dable-Tupas et al. (2020) characterized functional foods as natural or processed products containing bioactive components that confer clinically validated health benefits, including the prevention, management, and treatment of chronic diseases, provided they are consumed at effective and non-toxic levels.

Plants rich in physiologically active and non-toxic compounds continue to serve as focal points in modern medical and nutritional research. To date, researchers have documented the medicinal use of more than 50,000 species of higher plants worldwide (Awuchi, 2019). These plants yield a wide array of pharmacologically active substances, including alkaloids, flavonoids, phenolics, tannins, glycosides, gums, resins, and oils (Imoseni, 2018). In addition, they provide essential nutrients such as salts, phosphorus, manganese, carbohydrates, proteins, lipids, iron, potassium, and calcium—each of which plays a vital role in human maintenance, growth, and development.

Telfairia occidentalis, commonly known as fluted pumpkin, is a drought-resistant perennial climbing vine belonging to the Cucurbitaceae family. It is locally referred to as *ugu* among the Igbo and *ikong-ubong* among the Efik and Ibibio ethnic groups. This vegetable is primarily cultivated in the tropical forest zones of West and Central Africa, particularly in Nigeria, Benin Republic, Cameroon, and Sierra Leone. Although it is grown across several West African countries, *T. occidentalis* is indigenous to southeastern Nigeria.

Phytochemical analyses have shown that *Telfairia occidentalis* contains oxalates, saponins, glycosides, flavonoids, alkaloids, and resins, all of which contribute to its antioxidant, anti-inflammatory, antibacterial, hepatoprotective, and hematological properties (Imoseni, 2018). These bioactivities underpin its extensive use in traditional medicine for the treatment of conditions such as convulsions, malaria, anemia, diabetes, and various other ailments. The leaves also contain phenolic compounds, phytosterols, and glycosides with documented chemo-inhibitory effects (Eseyin, 2014).

Cucurbita pepo, commonly known as pumpkin, is another species within the Cucurbitaceae family. Although native to North America, it is widely cultivated in tropical West Africa and several temperate regions due to its recognized nutritional and medicinal value (Özbek and Ergönül, 2020). This plant grows as a large, annual herbaceous vine, characterized by round, lobed leaves covered in fine hairy prickles. Cultivators value *C. pepo* for its edible fruits, seeds, and leaves, as well as for its medicinal applications. The seeds, in particular, are rich in phytochemicals such as alkaloids, flavonoids, and phytosterols, which support the treatment of hyperplasia, prostate cancer, urinary disorders, anemia, and hemorrhoids in countries including Pakistan, Bangladesh, East Africa, Ghana, Sierra Leone, and Nigeria (Verdejo-Lucas and Talavera, 2019). The fruit is traditionally employed in managing a range of ailments—from common conditions like sore throat and fever to more severe disorders, including arthritis and blindness. These therapeutic effects are attributed to its diverse bioactive constituents, such as caffeic acid, cardiac glycosides, *p*-coumaric acid, sinapic acid, resins, and saponins (Krimer-Malešević, 2020; Hazrati et al., 2022).

From a nutritional standpoint, *C. pepo* is a rich source of crude lipids, proteins, fiber, carbohydrates, and essential minerals such as sodium, potassium, phosphorus, iron, zinc, manganese, and β-carotene. Notably, its seeds contain higher concentrations of nutrients than other plant parts. The fresh fruit pulp also provides important vitamins, including vitamin C, niacin, riboflavin, and thiamin (Ayyildiz et al., 2019).

This study compares the nutritional profiles, proximate compositions, and phytochemical constituents of *T. occidentalis* and *C. pepo*. The findings aim to highlight their health-promoting properties and potential applications in pharmaceutical development, underscoring the value of indigenous crops in the advancement of functional foods.

Materials and Methods

This study was conducted in the Biochemistry Laboratory at Covenant University and the University of Lagos Research Laboratory. Fruits of two indigenous Nigerian pumpkin species were procured from Lusada Market, Igbesa, located in Ado-Odo-Ota, Ogun State, Nigeria. Seeds extracted from the fruit pods were subsequently planted in the Covenant University research field.

Leaf samples from *Telfairia occidentalis* and *Cucurbita pepo* were harvested eight weeks after planting. The collected samples were thoroughly rinsed under running tap water, chopped, air-dried, and ground into a fine powder using an electric grinder. The powdered samples were stored in sealed bags in a cool, dark, and dry environment until analysis.

Extraction of plant materials

Aqueous extraction was employed based on its reported superiority in extracting antimicrobial compounds compared to other solvents (Nweze and Nwafor, 2014). One gram of each powdered sample was soaked in 100 mL of distilled water and stored at –80 °C for three days, with regular shaking and stirring to enhance extraction efficiency. The resulting mixture was filtered through filter paper to

separate the plant material from the extract. The obtained aqueous filtrate was used for both qualitative and quantitative phytochemical analyses.

Proximate analysis

Proximate analysis was conducted to evaluate the nutritional composition of both plant species, including measurements of protein, fat, moisture, ash, fiber, and carbohydrates. Moisture content was determined following the methods of Haque et al. (2014) and Omimakinde et al. (2018). Crude fat was estimated using the Soxhlet extraction technique (Omimakinde et al., 2018). Protein content was quantified using the Macro-Kjeldahl distillation method, as described by AOAC (1990). Ash content, representing the inorganic residue left after combustion, was used to estimate the total mineral content of the samples. Crude fiber was measured using sequential acid and alkali hydrolysis. Total carbohydrate content was calculated by difference, subtracting the sum of moisture, fat, protein, ash, and fiber from 100%, as follows:

$$100 - (crude\ protein + crude\ fibre + crude\ fat + ash)$$

Phytochemical screening

Leaf extracts were examined for alkaloids, tannins, saponins, flavonoids, phenolic compounds, phytosterols, cardiac glycosides, and glycosides, as described by Omimakinde et al. (2018).

Quantitative determination of phytochemicals

Total saponins

Five grams of each powdered leaf sample were placed in a 25 mL conical flask containing 20% ethanol. The samples were heated and stirred at 55 °C for four hours using an incubator shaker to facilitate extraction. The resulting mixture was filtered through filter paper, and 5 mL of diethyl ether was added to the filtrate. The solution was vigorously shaken and allowed to stand until phase separation occurred. The upper layer was carefully pipetted and discarded. Subsequently, 15 mL of *n*-butanol was added to the remaining solution, inducing another phase separation. The top layer was again pipetted and discarded. The solution was allowed to settle, after which 2.5 mL of 5% sodium chloride (NaCl) was added. The resulting supernatant was pipetted off, and the remaining solution was transferred to a pre-weighed conical flask (W1). The contents were then evaporated to dryness using a hotplate stirrer. After cooling, the flask was reweighed (W2) to determine the final yield.

$$Total\ Saponins\ (mg\ g^{-1}) = W2 - W1$$

Total flavonoids

The aqueous extract obtained from the phytochemical study was used to determine total flavonoid content. A 0.25 mL aliquot of each extract was diluted with 1 mL of distilled water. To this, 0.15 mL of aluminum chloride solution was added. After 6 min, 75 µL of 5% sodium nitrite was introduced, followed by the addition of 0.5 mL of 0.1 M sodium hydroxide after an additional 5 min. Finally, 2.5 mL of distilled water was added, and the mixture was thoroughly mixed. The absorbance was measured at 510 nm using a spectrophotometer. A quercetin standard (5–25 µg mL^{-1}) was used for calibration, and the results were expressed as milligrams of flavonoids per gram of dried material (mg g^{-1}).

Total phenolic content

To determine total phenolic content, varying volumes (12–50 µL) of the aqueous extract were mixed with 4.9 mL of distilled water and 0.5 mL of Folin–Ciocalteu reagent in a test tube. Extract concentrations of 100, 75, 50, and 25 µg mL^{-1} were prepared. After 3 min, 0.25 mL of sodium carbonate was added. The mixture was incubated at 50 °C for 30 min, and absorbance was measured at 760 nm. Total phenol content was calculated using a catechol standard and expressed as milligrams of catechol equivalent per gram of extract (mg CE g^{-1}).

Total alkaloids

One gram of each powdered sample was weighed into a 250 mL beaker, followed by the addition of 40 mL of 10% acetic acid in ethanol. The mixture was covered and left to stand for 4 h. After filtration, the filtrate was concentrated on a water bath to one-quarter of its original volume. Concentrated ammonium hydroxide was added dropwise until complete precipitation occurred. The precipitate was collected using filter paper, washed with dilute ammonium hydroxide, dried, and weighed. The alkaloid content was recorded as milligrams per gram of dry weight (mg g^{-1}).

Total tannins

For tannin determination, 1 mL of the extract was transferred into a test tube and diluted to 2 mL with distilled water. A blank containing 1 mL of distilled water was also prepared. To the sample, 0.5 mL of Folin's phenol reagent (1:2 dilution) and 5 mL of 35% sodium carbonate were added. The mixture was incubated at room temperature for 5 minutes, resulting in the development of a blue color. Absorbance was measured at 640 nm. Tannin content was determined using a standard calibration curve of gallic acid (1 mg mL^{-1}) and expressed as milligrams per gram of extract (mg g^{-1}).

Determination of mineral composition

The concentrations of magnesium (Mg), zinc (Zn), iron (Fe), copper (Cu), sodium (Na), potassium (K), and manganese (Mn) were determined using the dry ash method followed by Atomic Absorption Spectroscopy (AAS). Five grams of each powdered leaf sample were placed in a pre-weighed crucible with a lid and ashed at 105 °C for 2 h in a muffle furnace. This method was preferred over acid digestion due to its improved accuracy. After ashing, 10 mL of 10% nitric acid was added to each sample. The mixture was filtered through Whatman No. 1 filter paper, and the filtrate was diluted to 50 mL with distilled water in a volumetric flask. The samples were analyzed using an Atomic Absorption Spectrophotometer with element-specific hollow cathode lamps.

For the determination of nitrate (NO_3^-) and phosphorus (P), 5 g of each sample was similarly ashed in a muffle furnace at 105 °C for 2 h. The residues were dissolved in distilled water, filtered, and made up to 50 mL in a standard volumetric flask. These samples were analyzed using a UV-Visible spectrophotometer, and the concentrations were calculated based on calibration curves.

Determination of vitamin C content

The vitamin C content of the samples was determined using standard iodometric titration methods. Iodine reagent was prepared by dissolving potassium iodide and potassium iodate in 200 mL of distilled water, followed by the addition of 30 mL of 3 M H_2SO_4. The solution volume was then adjusted to 500 mL. The resulting reagent was transferred to a burette and titrated against 5 mL of 1% ascorbic acid, with three drops of 1% starch solution added. Titration continued until a blue starch-iodine color change was observed. The titer value at the color change point was recorded. The same procedure was applied to the sample extracts.

$$Vitamin\ C\ concentration\ (g\ 100\ mL^{-1}) = \frac{y}{b}$$

where y = titer (mL) from the titration of sample extracts and b = titer (mL) from the titration of the standard ascorbic solution.

Statistical analysis

The data obtained from the various analyses were subjected to an independent sample T-test in SPSS software to ascertain if there were significant differences between the values of the vegetable crops across all parameters.

Results

Qualitative phytochemical studies

The results of the qualitative phytochemical screening of the studied vegetable crops are presented in Table 1. The phytochemical analysis of the aqueous extract revealed the presence of five out of ten phytochemicals in *T. occidentalis*, and three out of ten in *C. pepo*. Alkaloids, saponins, and flavonoids were present in the leaves of both vegetables, while tannins and phenols were also detected in *T. occidentalis*.

Table 1. Qualitative phytochemical screening of *T. occidentalis* and *C. pepo* aqueous extracts.

Phytochemicals	*Telfairia occidentalis*	*Cucurbita pepo*
lkaloids	+	+
Tannins	+	-
Saponins	+	+
Phenols	+	-
Flavonoids	+	+
Glycosides	-	-
Cardiac Glycosides	-	-
Quinones	-	-
Steroids	-	-
Coumarins	-	-

+ = present; - = absent.

Quantitative phytochemical analysis

The results of the quantitative analysis, presented in Table 2, further confirm the presence of the phytochemicals. The analysis shows that tannins are present in *T. occidentalis* and *C. pepo* at concentrations of 0.070 ± 0.001 mg g^{-1} and 0.029 ± 0.002 mg g^{-1}, respectively, with *T. occidentalis* showing significantly higher levels (P<0.05). The alkaloid content was significantly higher in *T. occidentalis* (0.200 ± 0.001 mg g^{-1}) compared to *C. pepo* (0.100 ± 0.000 mg g^{-1}). No statistical difference was observed in the saponin content between *T. occidentalis* (0.300 ± 0.058 mg g^{-1}) and *C. pepo* (0.200 ± 0.006 mg g^{-1}). Flavonoids were significantly higher in *T. occidentalis* (0.105 ± 0.003 mg g^{-1}) than in *C. pepo* (0.041 ± 0.002 mg g^{-1}), and the phenolic content in *T. occidentalis* leaves (0.132 ± 0.001 mg g^{-1}) was also higher than in *C. pepo* (0.014 ± 0.001 mg g^{-1}).

Table 2. Quantitative phytochemical screening of *T. occidentalis* and *C. pepo* aqueous extracts.

Phytochemicals (mg g-1)	Telfairia occidentalis	Cucurbita pepo
Tannins	0.070 ± 0.001*	0.029 ± 0.002*
Saponins	0.300 ± 0.058	0.200 ± 0.006
Alkaloids	0.200 ± 0.001*	0.100 ± 0.000*
Flavonoids	0.105 ± 0.003*	0.041 ± 0.002*
Phenols	0.132 ± 0.001*	0.014 ± 0.001*

Proximate analysis

The proximate analysis of the two vegetables reveals significant differences across all parameters except for carbohydrates, as shown in Table 3. The moisture content was 8.00 ± 0.73% for *T. occidentalis* and 12.01 ± 0.56% for *C. pepo*, with the latter showing a significantly higher value. The ash content was significantly higher in *T. occidentalis* (10.70 ± 0.37%) compared to *C. pepo* (5.56 ± 0.26%). A significantly higher crude fiber content was observed in *T. occidentalis* (11.30 ± 0.23%) than in *C. pepo* (9.22 ± 0.10%). The fat content, the largest among the macronutrients analyzed, was significantly higher in *C. pepo* (31.45 ± 0.35%) compared to *T. occidentalis* (26.55 ± 0.24%). The protein content was significantly higher (P < 0.05) in *T. occidentalis* (25.01 ± 0.45%) compared to *C. pepo* (21.14 ± 0.47%).

Table 3. Proximate Analysis of *T. occidentalis* and *C. pepo* aqueous extracts.

Proximate	*Telfairia occidentalis*	*Cucurbita pepo*
Protein (%)	25.01 ± 0.45*	21.14 ± 0.47*
Fat (%)	26.55 ± 0.24*	31.45 ± 0.35*
Fibre (%)	11.30 ± 0.23*	9.22 ± 0.10*
Ash (%)	10.70 ± 0.37*	5.56 ± 0.26*
Moisture Content (%)	8.00 ± 0.73*	12.01 ± 0.56*
Carbohydrate (%)	18.44 ± 0.91	20.62 ± 0.95

Values presented in tables are the Mean ± Standard Error Mean of triplicates. *Indicates a significant difference at $\alpha = 0.05$ ($P < 0.05$).

Table 4 presents the analysis of trace elements in the leaves of *T. occidentalis* and *C. pepo*, along with their quantities. *T. occidentalis* leaves showed an iron content of 73.000 ± 0.535 mg kg^{-1}, significantly lower than the 86.270 ± 0.484 mg kg^{-1} found in *C. pepo*. The zinc content was similar in both plants, with no significant difference. The copper content was significantly higher (P < 0.05) in *C. pepo* (88.889 ± 0.474 mg kg^{-1}) compared to *T. occidentalis* (5.583 ± 0.312 mg kg^{-1}). *T. occidentalis* exhibited a significantly higher manganese content (16.500 ± 0.497 mg kg^{-1}) than *C. pepo* (7.778 ± 0.291 mg kg^{-1},

$P < 0.05$). There was no significant difference in phosphorus content between *T. occidentalis* and *C. pepo*. However, a significant difference was observed in nitrate content (1.160 ± 0.102 mg kg^{-1} in *T. occidentalis* and 2.430 ± 0.150 mg kg^{-1} in *C. pepo*, $P < 0.05$). The calcium content was 13.401 ± 0.550 mg kg^{-1} in *C. pepo* and 8.012 ± 0.293 mg kg^{-1} in *T. occidentalis*, while the potassium content was 20.532 ± 0.520 mg kg^{-1} in *C. pepo* and 15.342 ± 0.666 mg kg^{-1} in *T. occidentalis*, with *C. pepo* showing significantly higher levels for both elements. No significant difference ($P > 0.05$) was found in Vitamin C content between *T. occidentalis* (0.004 ± 0.001 g 100 mL^{-1}) and *C. pepo* (0.005 ± 0.002 g 100 mL^{-1}).

Table 4. Mineral Analysis of T. occidentalis and C. pepo aqueous extracts.

Minerals (mg kg^{-1})	*Telfairia occidentalis*	*Cucurbita pepo*
Magnesium (Mg)	31.017 ± 0.542	34.010 ± 1.299
Calcium (Ca)	8.012 ± 0.293*	13.401 ± 0.550*
Phosphorus (P)	2.130 ± 0.050	2.200 ± 0.113
Nitrate (NO_3)	1.160 ± 0.102*	2.430 ± 0.150*
Potassium (K)	15.342 ± 0.666*	20.532 ± 0.520*
Copper (Cu)	5.583 ± 0.312*	88.889 ± 0.474*
Iron (Fe)	73.000 ± 0.535*	86.270 ± 0.484*
Zinc (Zn)	78.000 ± 0.517	78.333 ± 0.706
Manganese (Mn)	16.500 ± 0.497*	7.778 ± 0.291*
Vitamin C (g 100 mL^{-1})	0.004 ± 0.001	0.005 ± 0.002

Values presented in tables are the Mean ± Standard Error Mean of triplicates. *Indicates a significant difference at $\alpha = 0.05$ ($P < 0.05$).

Discussion

Leafy vegetables are rich in bioactive compounds and are widely recognized by local communities and cultural groups for their health benefits. In many rural populations, they are integral to traditional medicine, used both to maintain health and to prevent or manage disease (Mungofa et al., 2022; Knez et al., 2024). The qualitative phytochemical analyses conducted in this study confirm the presence of several secondary metabolites in both *T. occidentalis* and *C. pepo*. Both species contain alkaloids, saponins, and flavonoids, while *T. occidentalis* additionally contains phenols and tannins. The phytochemicals identified in *C. pepo* are consistent with previous studies that report the presence of alkaloids, saponins, and flavonoids, which are associated with therapeutic applications in gastrointestinal disorders, wound healing, tumor reduction, and respiratory ailments (Ratnam et al., 2017; Kulczyński et al., 2020; Masawi et al., 2023).

Flavonoids are especially noted for their anti-inflammatory, antitumor, and antioxidant activities. They can promote the synthesis of detoxifying enzymes, support the healing of inflamed or ulcerated tissues, and help prevent carcinogenesis. Alkaloids are regarded as some of the most potent phytochemicals, known for their antispasmodic, antibacterial, antimalarial, and wound-healing effects. Saponins and phenols also exhibit strong antioxidant properties, including the ability to reduce cholesterol and glucose absorption in the gastrointestinal tract and to mitigate oxidative stress—a condition linked to chronic diseases, including cardiovascular disorders (Obembe et al., 2024). Tannins are associated with wound healing and the treatment of intestinal disorders. The presence of alkaloids and saponins in both species supports their antimicrobial, anti-inflammatory, antifungal, anticancer, and local anesthetic potentials, emphasizing their significance in drug development (Heinrich and Amirkia, 2021). Furthermore, flavonoids, due to their oxidative properties, have been shown to possess antiulcer, antiviral, antidiabetic, and cytotoxic activities (Tiwari and Husain, 2017).

The higher phenolic content observed in *T. occidentalis* suggests the presence of reactive metabolites, which have been linked to delaying aging and mitigating oxidative stress associated with chronic diseases such as diabetes, cancer, neurological disorders, and cardiovascular conditions (Minatel et al., 2017). These phytochemicals also exhibit various pharmacological properties, including antibacterial, antidiabetic, and antimicrobial activities (Sharma et al., 2020; Frances et al., 2022). For instance, Oyewole and Abalaka (2012) demonstrated that ethanolic extracts of *T. occidentalis* exhibited bactericidal effects against *Salmonella typhi* and *Escherichia coli*, while Oboh et al. (2010) found that aqueous leaf extracts of the plant inhibited the growth of *Salmonella typhi* and other *Enterobacteriaceae* members, including *E. coli*, *Pseudomonas aeruginosa*, and *Proteus* species.

This study also revealed a significantly higher protein content in *T. occidentalis* compared to *C. pepo*, aligning with the findings of Auwal et al. (2023), who reported a higher crude protein

percentage in *T. occidentalis*. Since plants providing more than 12% protein by calorific value are considered reliable protein sources, the inclusion of these *Cucurbitaceae* leaves in the diet suggests their potential as affordable and accessible sources of dietary protein to support essential physiological functions (Auwal et al., 2023).

Both species exhibited high moisture content, with *C. pepo* showing slightly higher values. While high moisture enhances digestibility, it also increases the susceptibility of the plant material to spoilage due to elevated water activity, thus reducing shelf life (Omimakinde et al., 2018). The ash content, representing total mineral content, was greater in *T. occidentalis*, indicating a richer mineral profile that may help prevent micronutrient deficiencies. This observation corroborates the findings of Igboecheonwu et al. (2024), who noted that high ash levels reflect elevated inorganic mineral content, which supports metabolic processes, growth, and development. Similar reports of higher ash content in *T. occidentalis* have been made by Onuguh et al. (2022) and Ezema et al. (2024).

The crude fiber content of *T. occidentalis* in this study was lower than the values reported by Auwal et al. (2023) and Omimakinde et al. (2018), but higher than that documented by Igboecheonwu et al. (2024). The relatively high fiber level suggests a potential role in improving digestion, regulating body weight, and managing cholesterol levels more effectively than *C. pepo*. Dietary fiber enhances waste and toxin elimination by stimulating antioxidant and detoxifying enzyme activity in the liver, thus preventing toxic build-up in the colon and lowering the risk of chronic illnesses (Igboecheonwu et al., 2024).

In contrast, *C. pepo* exhibited a higher fat content, which contributes to its palatability and makes it particularly suitable for culinary applications such as soups and sauces due to its flavor retention capabilities. Both species also contained carbohydrates, a vital macronutrient essential for energy production, blood glucose regulation, insulin activity, and lipid metabolism. Balanced carbohydrate intake relative to other macronutrients is crucial, as both excessive and insufficient consumption can negatively affect physiological and metabolic processes, increasing the risk of obesity and type 2 diabetes (Holesh et al., 2021).

This study also evaluated the concentrations of four trace elements—iron (Fe), zinc (Zn), copper (Cu), and manganese (Mn)—alongside four macroelements—magnesium (Mg), calcium (Ca), phosphorus (P), and potassium (K). Notably, the levels of copper and iron were higher in the leaves of *C. pepo* compared to *T. occidentalis*. While both elements are essential micronutrients involved in enzymatic functions and oxygen transport, elevated levels—particularly in *C. pepo*—may pose health risks. Excessive accumulation of copper and iron can lead to toxicity, manifesting as organ damage, neurological impairment, and potentially fatal outcomes if left unaddressed (Teschke, 2024).

Additional nutrients assessed included nitrate (NO_3^-) and vitamin C. Macroelements, required in substantial amounts, are fundamental for sustaining homeostasis and supporting neurological, muscular, and myocardial functions. The trace and macroelement concentrations recorded in this study are consistent with those reported in previous research (Ma et al., 2018; Weyh et al., 2022). However, the vitamin C content in both plant species was comparatively lower than the levels observed in *Vernonia amygdalina* (0.053 g 100 mL^{-1}), *Gnetum africanum* (0.037 g 100 mL^{-1}), and *Talinum triangulare* (0.086 g 100 mL^{-1}), as reported by Adebayo (2019). These differences may be attributed to variations in sample preparation and processing techniques.

Conclusion

This study determined the nutritional and pharmacological significance of *Telfairia occidentalis* and *Cucurbita pepo*, both members of the Cucurbitaceae family, and highlights their potential for incorporation into regular diets as functional foods or dietary ingredients. While *T. occidentalis* demonstrates greater pharmacological relevance, *C. pepo* exhibits notable nutritional advantages. From a mineral and yield standpoint, *C. pepo* leaves offer considerable, yet underutilized, dietary potential. Even in small quantities, they provide essential nutrients—including carbohydrates, iron, calcium, potassium, and copper—at levels sufficient to meet recommended dietary intake. These attributes position *C. pepo* as a promising alternative to the more widely consumed *T. occidentalis* ('ugwu'), particularly for its potential anti-anemic effects. The relatively higher fat content in *C. pepo* further enhances its palatability and flavor retention, making it especially suitable for culinary applications such as soups and sauces. Future research should examine the physiological effects of the elevated mineral content in *C. pepo* and investigate the synergistic nutritional and functional food value of both vegetables when consumed together.

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Authors Contributions

Conceptualization and Supervision; OOO, Methodology and Data collection; PIA, writing;

reviewing, and editing; TTO.

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