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Phytochemical and Nutritional Comparison of *Telfairia occidentalis* and *Talinum triangulare*

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Abstract
Leafy vegetables such as *Telfairia occidentalis* (commonly known as Ugwu) and *Talinum triangulare* (waterleaf) play a vital role in the diet of many African communities, particularly in Nigeria, due to their rich nutritional and phytochemical profiles. This study conducted a comparative assessment of these vegetables to determine their health benefits. Fresh samples were obtained from Lafia market, prepared, and analyzed using established laboratory procedures. Phytochemical analysis indicated a significant presence of saponins in both vegetables, with Ugwu exhibiting a higher concentration of alkaloids, while waterleaf was found to contain more flavonoids. Additional bioactive compounds such as glycosides, phenols, tannins, terpenoids, and steroids contribute to their medicinal potential. Regarding nutritional composition, Ugwu had high protein levels, carbohydrates, crude fiber, crude lipids, and vitamin C. In contrast, waterleaf had a greater moisture content along with increased amounts of calcium, iron, and magnesium, essential minerals for bone strength, metabolic processes, and general health. This study highlights the nutritional value of both vegetables and their roles in a balanced diet. Further research into therapeutic properties is recommended to promote regular consumption and support the potential use in functional foods and herbal medicines.

Keywords: Comparative Studies, Nutritional Analysis, Phytochemical Compounds, Ugwu, Waterleaf

Introduction
Leafy vegetables are essential ingredients in a healthy diet that provide important vitamins, minerals, and bioactive links that support common well-being (Okunlola et al., 2023). They are particularly rich in fiber, cellulose, hemicellulose, and pectin, contributing to their structural integrity and texture (Ogunlana & Akinmoladun, 2023). In many developing countries, these vegetables serve as important sources of essential nutrients such as iron, calcium, folic acid, and antioxidants, and they play a critical role in promoting dietary diversity and preventing nutrient deficiencies (Singh et al., 2019). In Nigeria, *Telfairia occidentalis* (commonly known as ugwu) and *Talinum triangulare* (waterleaf) are widespread and highly consumed due to their nutritional and medicinal properties (Boko et al., 2021). Ugwu is known for its high protein, iron, calcium, and vitamin A and C content, along with its antioxidant and antimicrobial properties that contribute to the prevention of disease (Akinmoladun & Akinmoladun, 2023). It has been used to manage anemia and enhance lactation in nursing mothers traditionally. And waterleaf is recognized for its high moisture content, and it is a valuable source of folate, vitamin C, vitamin K, magnesium, and potassium (Jiménez et al., 2017). It is associated with a variety of health benefits, including anti-inflammatory, antidiabetic, and blood-purifying effects (Okunlola et al., 2023). Both vegetables have low-calorie content, which enhances weight management, and at the same time, they provide essential nutrients (Vishual et al., 2022). These vegetables are highly popular and widely consumed, but there is limited research in Lafia, Nasarawa State, on their nutritional composition (Kumar et al., 2020). Factors such as soil quality, agricultural methods, and post-harvest handling can influence their nutrient levels, highlighting the need for detailed nutritional analysis to increase awareness on public health and guide nutritional recommendations. This study aims to compare the nutritional composition of ugwu and waterleaf available in Lafia, providing insights into macro- and micronutrient content and their potential role in addressing nutritional deficiencies.

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Materials and Methods

Materials used: The materials utilized in this study included *Telfairia occidentalis* (Ugwu), *Talinum triangulare* (waterleaf), plain tubes, a water bath, a weighing balance, a measuring cylinder, filter paper, test tubes, a funnel, a mortar and pestle, beakers, a stirrer, a desiccator, crucibles, a muffle furnace, a Soxhlet apparatus, flasks, and pipettes. Additionally, reagents were used for proximate and phytochemical analysis, and an atomic absorption spectrophotometer (AAS) was employed for mineral analysis. Sample collection: Fresh samples of *Telfairia occidentalis* and *Talinum triangulare* were purchased from the Lafia market and placed in a clean polythene bag. These samples were then transported to the laboratory at the Department of Science Laboratory Technology, Isa Mustapha Agwai 1 Polytechnic, Lafia, for further analysis. Sample preparation: Picking and washing of the leafy vegetables was done after the collection to ensure they were cleaned from dirt and other foreign particles that could introduce contaminants. Then the samples were shade dried. As soon as the samples were completely dried, they were finely ground using an electric blender to obtain a uniform powder. The pulverized material, which exhibited a dark green coloration, was sieved using a 0.2 mm mesh and stored in airtight containers until needed for further analysis. Phytochemical Screening: The phytochemical composition of *Telfairia occidentalis* and *Talinum triangulare* was analyzed based on the procedures by Debela (2002). Detection of alkaloid: A quantity of 0.5 g of the extract was mixed with 5 mL of 1% aqueous HCl in a water bath and subsequently filtered. One milliliter of the filtrate was transferred into three test tubes, and specific reagents (Mayer's, Wagner's, and Dragendorff's) were added individually. A yellow precipitate confirmed the presence of alkaloids, with the Mayer's reagent showing a white precipitate (Debela, 2002). Detection of flavonoid: A small portion of the aqueous extract was dissolved in dilute NaOH. The development of a yellow solution that turns colorless after the addition of concentrated HCl showed the presence of flavonoids (Debela, 2002). Detection of tannin: Approximately 0.5 g of the extract was mixed with 10 mL of distilled water and filtered. Two milliliters of the filtrate were treated with a few drops of 1% ferric chloride solution. The formation of a blue-black coloration showed the presence of tannins (Debela, 2002).

Detection of steroid: The aqueous crude extracts were combined with chloroform, and a few drops of concentrated H_2SO_4 were added. After thorough shaking and settling, a red coloration at the lower phase confirmed the presence of steroids (Trease & Evans, 2002). Detection of saponin: 1 g of the extract was boiled with 5 mL of distilled water and then filtered. 3 mL of distilled water was added to the filtrate and vigorously shaken for about five minutes. The persistence of frothing showed the presence of saponins (Debela, 2002). Detection of terpenoid: 0.5 g of the extract was weighed into 2 mL of chloroform, followed by 3 mL of concentrated H_2SO_4. The presence of terpenoids was shown by the appearance of a reddish-brown color at the interface (Trease & Evans, 2002). Detection of phenol: A few drops of neutral 5% ferric chloride solution were added to 50 mg of the extract and dissolved in 5 mL of distilled water. A dark green color indicates the presence of phenolic compounds (Trease & Evans, 2002). Cardiac glycoside detection: 100 mg of the extract was dissolved in 1 ml of glacial acetic acid containing one drop of ferric chloride solution. This was cautiously layered with 1 ml of concentrated H_2SO_4. A brown ring at the interface showed the presence of deoxysugars characteristic of cardiac glycosides (Trease & Evans, 2002).

Proximate Analysis

Determination of moisture content: Following Udo & Oguwele's (1986) method, 2 g of the powdered leaves were weighed into a pre-weighed crucible and dried at 105°C for 3 hours. The drying process was repeated until a certain weight was achieved. The percentage of moisture content was calculated using the formula: Moisture (%) = $(W_1-W_2) / (W_1-W_0) \times 100$

Determination of ash content: The method by James (1995) was used. 2 g of dried powdered leaves was weighed into a crucible and placed in a muffle furnace at 550° C for five hours. The resulting ash was weighed, and the percentage ash content was determined using the equation:
Ash (%) = $(W_2-W_0) / (W_1-W_0) \times 100$

Determination of crude lipid: Soxhlet extraction method was used for this determination. The ground sample was weighed into a porous thimble and subjected to petroleum ether extraction. After complete evaporation of the solvent, the crude lipid content was determined using:
Crude lipid (%) = $(W_1-W_2) / W_0 \times 100$

Determination of crude fibre: 2 g of the sample were treated with acid and alkali solutions, filtered, and dried. The dried residue was ashed at 550° C, and the percentage crude fiber was calculated as: Crude fibre (%) = $(W_1-W_2) / W_0 \times 100$

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Determination of true protein: After boiling and filtration processes, the precipitate was subjected to Kjeldahl digestion. Then the nitrogen content was determined using N (%) = (Vs-Vb × Nacid × 0.01401) / W × 100. The true protein content was calculated by multiplying the nitrogen content by a conversion factor of 6.60.

Determination of carbohydrate content: The total carbohydrate content was estimated by the differential method: CHO (%) = 100% - (% crude protein + % crude lipid + % crude fibre + % ash + % moisture) (Debela, 2002).

Vitamin and mineral analysis: The vitamin content of *Telfairia occidentalis* and *Talinum triangulare* was analyzed using standard colorimetric and titrimetric methods. The mineral content, including calcium (Ca), magnesium (Mg), and iron (Fe), was determined using an atomic absorption spectrophotometer after digestion with nitric and perchloric acid. The mineral concentrations were calculated based on standard calibration curves, as described by Ezekwe et al. (2020).

Results

Table 1: Phytochemical components in ugwu and waterleaf

S/N	Phytochemical	Ugwu (*Telfairia occidentalis*)	Waterleaf (*Talinum triangulare*)
1	Alkaloids	+++	++
2	Flavonoids	++	+++
3	Glycosides	++	++
4	Phenols	++	++
5	Tannins	++	+
6	Terpenoids	+	++
7	Saponins	+++	+++
8	Steroids	++	++

+++ = High presence, **++** = Moderate presence, **+** = Low presence, **-** = Not detected

Table 2: Comparative analysis of mineral content in waterleaf and ugwu (mg/100g dry weight)

S/N	Nutritional Component	Ugwu (*Telfairia occidentalis*) (%)	Waterleaf (*Talinum triangulare*) (%)
1	True protein	3.42 – 4.89	2.78 – 3.85
2	Carbohydrate	7.30 – 9.21	6.40 – 8.50
3	Crude fibre	1.50 – 2.80	0.80 – 2.10
4	Crude lipid	1.20 – 2.50	0.90 – 1.80
5	Ash content	1.80 – 3.50	2.10 – 4.00
6	Moisture content	65.00 – 78.50	82.00 – 90.00
7	Vitamin C (mg/100g)	40.25 – 52.30	31.10 – 45.00
8	Calcium (mg/100g)	150.00 – 230.00	200.00 – 280.00
9	Iron (mg/100g)	1.50 – 3.20	2.80 – 4.50
10	Magnesium (mg/100g)	30.00 – 65.00	40.00 – 85.00

Values are presented as mean ± standard deviation

Discussion

The results of the phytochemical analysis of Ugwu (*Telfairia occidentalis*) and waterleaf (*Talinum triangulare*), as presented in Table 1, show that both plants contain a variety of phytochemicals, such as flavonoids, alkaloids, tannins, steroids, saponins, phenols, terpenoids, and cardiac glycosides. However, these findings contrast with the study by Ogunlana and Akinmoladun (2023), where steroids and saponins have been reported to be absent in both plants. Saponins were particularly abundant among the identified phytochemicals identified in both Ugwu and waterleaf. This observation is inconsistent with the study conducted by Ogbonnaya and Uadia (2016), who reported a high presence of saponins in aqueous extracts of *Telfairia occidentalis* during phytochemical screening in rats. In Ugwu, alkaloids and saponins were the most dominant phytochemicals, with flavonoids and saponins being found at higher concentrations. These results align with the findings of Abideen et al. (2020). The detection of alkaloids in Ugwu is consistent with previous studies that highlight their pharmacological importance, including their anti-inflammatory and analgesic properties (Akinmoladun et al., 2020). Similarly, the presence of steroids and saponins in these vegetables can improve treatment potential, as these connections are often associated with beneficial health effects. It was found that both ugwu and waterleaf contain flavonoids, which are well known for their antioxidant, anti-inflammatory, and anticancer properties (Kumar & Pandey, 2020). This indicates that both vegetables can positively contribute to general health through these mechanisms. Previous studies also highlighted flavonoids' role in improving the nutritional quality of leafy vegetables, supporting their inclusion in a balanced diet (Rao et al., 2022). The presence of tannins in Ugwu and waterleaf

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aligns with their recognized astringent properties and potential health benefits, such as antimicrobial and anti-diarrheal effects (Boko et al., 2021). These findings are in line with previous studies examining the role of tannins in plant-based diets (Singh et al., 2019). Furthermore, the presence of cardiac glycosides in both plants indicate potential applications in cardiovascular health. These connections are known for their efficacy in the treatment of heart-related disease, as they are supported by existing research into their therapeutic effects (Villarreal et al., 2020). The nutritional analysis of ugwu and waterleaf shows that both vegetables are rich sources of essential vitamins and minerals, as shown in Table 2. Ugwu showed higher concentrations of calcium, magnesium, and iron compared to waterleaf. This shows its potential benefits for bone health, muscle function, and fluid balance regulation. In contrast, waterleaf showed a higher vitamin content, particularly in vitamins essential for immune function, vision, and antioxidant activity. These findings are in line with the study by Adewale et al. (2021).

Conclusion

The results of this study suggest that Ugwu and waterleaf have similar profiles of phytochemicals and essential nutrients, including both containing flavonoids, tannins, and cardiac glycosides. Ugwu contains alkaloids but was absent in waterleaf. Furthermore, the plants were free of steroids or saponins. Both vegetables contribute significantly to human nutrition, with Ugwu showing slightly higher mineral content, especially in calcium, magnesium, potassium, and vitamins A and E, indicating its potential advantages for bone and eye health. On the other hand, waterleaf serves as an excellent source of vitamin C. Considering the rich phytochemical composition and nutritional benefits, ugwu and waterleaf should be included in health-promoting properties during diets. Further research is recommended to explore their potential health impacts and to integrate their phytochemical profiles into agricultural and food processing practices.

Recommendations

Based on the study of the comparative phytochemical and nutritional analysis of ugwu (*Telfairia occidentalis*) and waterleaf (*Talinum triangulare*), the following are recommended:

1. Based on their rich nutritional and phytochemical composition, both ugwu (*Telfairia occidentalis*) and waterleaf (*Talinum triangulare*) should be promoted as essential components of a balanced diet.
2. Public health campaigns should be done to educate communities on their benefits, especially for individuals at risk of nutrient deficiencies.
3. Ugwu, with its higher protein, carbohydrate, and vitamin C content, can be recommended for individuals needing enhanced energy and immune support.
4. Waterleaf, with its high moisture and mineral content (calcium, iron, and magnesium), should be encouraged for bone health, anemia prevention, and hydration.
5. Further studies should explore the development of nutraceuticals or herbal formulations incorporating these vegetables.

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