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Determination of Mineral, Vitamin Content and Antioxidant Activity of *Telfairia Occidentalis* Seed

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Abstract

Telfairia occidentalis, also known as fluted pumpkin, is a widely cultivated vegetable in West Africa with potential nutritional and health benefits. They serve to supplement the nutrients provided by cereals and tubers; however, there is lack of comprehensive compositional data regarding the mineral of fluted pumpkin seeds in Nigeria. This study aimed to determine the mineral, vitamin, and antioxidant properties of *T. occidentalis* seeds. The seeds were analyzed for their mineral content (calcium, iron, zinc, magnesium, potassium, and sodium), vitamin content (vitamins A, C, and E), and antioxidant activity using standard analytical methods. The results showed that the seeds were rich in essential minerals, especially manganese; 573.01±0.39mg/kg, sodium; 525.02±0.91mg/kg, calcium; 297.06±1.05mg/kg, iron; 53.42±0.59mg/kg and zinc; 5.65±0.01mg/kg. The seeds exhibited potent antioxidant activity, as measured by various in vitro assays. The presence of vitamin E (35.54±0.47mg/kg), vitamin C (20.20±0.44mg/kg) and vitamin A

(15.17±0.16mg/kg). The low levels of antioxidant activity ferric reducing antioxidant power (0.49±0.01) and hydrogen scavenging activity (1.20±0.01) makes the fluted pumpkin (*Telfairia occidentalis*) safe for consumption. These findings suggest that *T. occidentalis* seeds could be a valuable source of nutrients and bioactive compounds with potential health-promoting properties. Further research is warranted to explore the nutritional and therapeutic applications of this underutilized seed crop.

Keywords: Mineral Composition, Vitamins, Antioxidant Activity

INTRODUCTION

A popular green vegetable in West Africa, especially Nigeria, is *Telfairia occidentalis*, also referred to as fluted pumpkin or ugu. It belongs to the *Cucurbitaceae* family and is prized for both its therapeutic and dietary qualities. The plant's edible parts, including its leaves, seeds, and roots, are used in a variety of recipes and conventional herbal medicines (Arekemase *et al.,* 2011).

Vitamins, minerals, and antioxidants are among the many nutrients abundant in *T. occidentalis* seeds. They have a well-established high protein, fiber content, healthy fat content, and vitamin content. Previous research has indicated that the seeds include vitamins A, C, and B-complex as well as minerals like calcium, iron, zinc, and magnesium (Arekemase *et al.,* 2011; Ezeonu & Ejikeme, 2016).

In southern Nigeria, one of the most popular plants and seed vegetables is the fluted pumpkin (*Telfairia occidentalis*), a member of the Cucurbitaceous family (Odiaka *et al.,* 2007). Cucumbers, squashes (including pumpkins), water melons, luffas melons, and cucumbers are all members of the Cucurbitaceae plant family. The family is primarily found in tropical regions, and those bearing edible fruits were among the first plants to be cultivated worldwide (Odiaka *et al.,* 2007). It is also known as fluted gourd. The Igbo people in Nigeria call it Ugu; the Yoruba people call it Ugwu; and the Cameroonian people name it Ekobon. (Ajayi *et al.,* 2007). Fluted pumpkin (*Telfairia occidentalis*) is mostly used as a vegetable for its leaves and seeds. According to Jeffrey (2005), the young seeds, succulent leaves, and fragile shoots are cooked and eaten like vegetables.

Nigerians consume a lot of fluted pumpkin (*Telfairia occidentalis*) seeds, particularly in the southeast where they are used as a soup seasoning. The local custard known as "Ogiri ugu" is produced from the fermented seed of fluted pumpkin. Fluted pumpkin seeds can also be used to make marmalade and biscuit recipes (Giami and Barber, 2004). Edible oil can also be obtained well from the seed. There have been reports on the seed's crude protein and fat content, vitamin A and C levels, and mineral composition (Okoli & Nyanayo 1988, Smith et al 2006). There have been reports on the microbiology of "Ogiri ugu" as well as the seed flour's crude protein and crude fat content (Asiegbu, 2005). According to estimates, small-scale farmers own more than 90% of Nigeria's cultivated land and produce up to 90% of the country's overall agricultural output (Onokerhoraye, 1995). Because of the growing need for vegetables, Nigeria's output of fluted pumpkin has not been able to fulfill the demand for human food, let alone for livestock feed (Oboh, 2010). As a result, the task of producing enough fluted pumpkin is becoming more and more difficult.

Currently, Imo state and its environs in southeast Nigeria have the most diversity in the plant populations. The crop is grown in all of the old wooded regions, stretching eastward from Uganda to Angola and Sierra Leone, Benin (Cotonou). It's the most preferred leafy vegetable among the Igbo people. According to Jeffrey (2005), the name "fluted" describes the shape of the female flowers, which resembles a flute. Antioxidants play a critical role in preserving general health and shielding the body from the harmful effects of free radicals. According to studies conducted by Arekemase *et al.* (2011) and Oboh *et al.* (2015), phytochemicals such as flavonoids, phenolic compounds, and carotenoids are responsible for the notable antioxidant activity demonstrated by *T. occidentalis* seeds.

However, a number of variables, including geography, farming methods, and post-harvest processing, may affect the specific nutrient composition and antioxidant profile of *T. occidentalis* seeds. Thus, the goal of this study is to thoroughly ascertain the mineral, vitamin, and antioxidant content of *T. occidentalis* seeds that were collected from a particular area in Nigeria. This information would be crucial for the possible commercialization and use of an underutilized crop.

MATERIALS AND METHODS

Sample Collection and Identification

The sample was obtained from Gombe main market Gombe State North Eastern Nigeria. The sample was identified at herbarium unit of Department of Botany Gombe State University, and identified as fluted pumpkin *(Telfairia occidentalis)*.

Sample Preparation

The fluted pumpkin *(Telfairia occidentalis)* seed were removed from the pod and shed for 14 days. The seed were grounded manually using mortar and pestle to powder and kept in a polythene bag prior the commencement of the analysis.

Mineral Analysis

About 1.0g of each sample was first digested with 20ml of an acid mixture (650ml conc. HNO_3; 80ml perchloric acid; 20ml conc. H_2SO_4) in the mixture ratio of 3:1. The samples was taken into the digesting flask and heated until the sample was completely digested. Then it was filtered and made to 100ml with deionized water. A blank solution was also prepared using a mixture of the acid for the analysis. Calcium, Sodium, Zinc, Magnesium, and Iron were investigated using BUCK 205 Atomic Absorption Spectrophotometer. Prepare standard solutions for the elements of interest (e.g., calcium, magnesium, iron, zinc) using certified reference materials (Agatemor, 2006). Calibrate the AAS instrument using the prepared standard solutions according to the manufacturer's instructions (Akinwunmi & Omotayo, 2014). Aspirate the diluted seed sample solution into the AAS instrument and measure the absorbance for each element (Oloyede, 2005). Repeat the measurement for the sample solution at least three times to ensure reproducibility (Aregheore, 2012).

Thus, there is need for pre-treatment of samples. This is achieved through:

Acid Digestion:

Transfer the 1 g seed powder sample into a clean, dry digestion flask (Aregheore, 2012). Add 10 mL of concentrated nitric acid (HNO3) and 5 mL of concentrated hydrochloric acid (HCl) (Agatemor, 2006). Heat the mixture on a hot plate or digestion block at 120°C until complete digestion, as indicated by the solution becoming clear (Akinwunmi & Omotayo, 2014). Allow the digested sample to cool, and then transfer the solution quantitatively to a 50 mL volumetric flask (Oloyede, 2005). Dilute the solution to the mark with distilled water and mix thoroughly (Aregheore, 2012).

Vitamin Content

The amount of vitamin A, E, C, and B12 in the sample was determined using the method described by (Achikanu, *et al.,* 2013).

Vitamin A (Retinol)

A quantity, 1g of the sample was weighed and macerated with 20mls of n-hexane in a test tube for 10 minutes. Then 3mls of the upper hexane extract was transferred into a dry test-tube in duplicates and evaporated to dryness. Following this, 0.2ml of acetic anhydride chloroform reagent was added and 2ml of 50% trichloroacetic acid (TCA) in chloroform was also added. The absorbance was taken at 15 seconds and 30 seconds intervals at 620nm.

Vitamin C (Ascorbic Acid)

0.1ml of the sample will be homogenized in 6% TCA. From the homogenate 4ml will be taken and to this 2ml of 2% DNPH and 1 drop of 10% thiourea will be added. The contents will be boiled for 15 min in a water bath and cooled. After cooling, 5ml of 80% (w/v) H_2SO_4 will be added. The absorbance will be read at 530nm.

Vitamin E (α-Tocopherol)

1ml of the sample, 0.2ml of 2% 2, 2-dipyridyl in ethanol will be add and mixed thoroughly and kept in dark for 5mins. The resulting red colour will be diluted with 4ml of distilled water and mixed well. The resulting colour in the aqueous will be measured at 520nm. The α-tocopherol content will be calculated using a standard graph made with known amount of α-tocopherol.

Determination of Hydrogen Peroxide

Macerate four g tissue in 5ml of ice cold 0.01 M phosphate buffer (pH 7.0), centrifuge at 8000 x g for 10 minutes and use the supernatant for estimating H_2O_2 content (Sinha,1972).

i. Add fifty μL of sample to 1.95 ml of 0.01M potassium phosphate buffer (pH 7.0).
ii. Add ml of 5% potassium dichromate and glacial acetic acid (1:3 v/v) to the mixture.
iii. Keep the tube boiling water bath for 10 minutes and then cool.

iv. Read the absorbance at 570 nm against blank without sample extract and determine the quantity of H_2O_2 from the standard calibration curve (10 to 160 μmol of H_2O_2).

Determination of in vitro Antioxidant Properties of Extract Determination of Reducing Power

The reducing power of the leaf extract was evaluated according to the method described by Aiyegoro and Okoh (2010). A mixture containing 2.5 ml of 0.2 M phosphate buffer (pH 6.6) and 2.5 ml of K3Fe(CN)6 (1% w/v) was added to 1.0 ml of the extract and standard (0.2–0.8 mg/ml) prepared in distilled water. The resulting mixture was incubated for 20 min at 50°C, followed by the addition of 2.5 ml of TCA (10% w/v), which was then centrifuged at 3000 rpm for 10 min.

Then 2.5 ml of the supernatant was mixed with 2.5 ml of distilled water and 0.5 ml of FeCl3 (0.1% w/v). The absorbance was measured at 700 nm against a blank sample. Increased absorbance of the reaction mixture indicates higher reducing power of the plant extract.

Statistical Analysis

Data was examined with SPSS Version 20.0. Results were determined as Mean ± STD of three repeat determinations.

RESULTS

Mineral Composition

The result of the mineral composition of fluted pumpkin *(Telfairia occidentalis)* is presented in the table 1. The result showed that Mg has highest composition of 572.26mg/kg, followed by Na (526.02), Ca (296.01), Fe (52.83), and Zn (5.64).

Table 1: Mineral composition of *Telfairia occidentalis*

Minerals	Concentration (mg/kg)
Ca	297.06±1.05
Fe	53.42±0.59
Na	525.11±0.91
Mg	573.01±0.39
Zn	5.65±0.01

Results are mean of duplicate determination ± Std

Vitamin Content

The result of the vitamin content of fluted pumpkin (*Telfairia occidentalis)* is presented in table 2. The result showed the highest content of vitamin E (35.07) followed by vitamin C (20.58) and vitamin A (15.33).

Table 2: Vitamin Content of *Telfairia occidentalis*

Vitamin	Concentration (mg/kg)
Vitamin A	15.17±0.16
Vitamin C	20.20±0.44
Vitamin E	35.54±0.47

Results are mean duplicate determination ± Std

Antioxidant Activity of *Telfairia occidentalis*

The result of the antioxidant activity of fluted pumpkin (*Telfairia occidentalis)* is presented in the table 3. The result showed the lowest value of ferric reducing antioxidant power (0.50) and hydrogen scavenging activity (1.21).

Table 3: Antioxidant Activity of *Telfairia Occidentalis*

S/N	Antioxidant	Concentration (mg/kg)
1.	Ferric reducing antioxidant power	0.49±0.01
2.	Hydrogen scavenging activity	1.20±0.01

Results are mean of triplicate determination ± Std

DISCUSSION

The fluted pumpkin, or *Telfairia occidentalis*, has a notable manganese content (572.61 mg/kg) according to the mineral composition of the sample. This is in line with the findings of Agatemor (2006), who discovered that the seed contains a large amount of magnesium (700 mg/kg), which is higher than the result. According to Thomas and Krishkumari (2015), magnesium is necessary for osmotic equilibrium and is found in both plasma and extracellular fluid. Additionally, it can reduce blood pressure in people and prevent some heart conditions. On the other hand, the sodium content (526.01 mg/kg) is in line with the findings of Agatemor (2006), which reported that the seed had low sodium content (10.80 mg/kg), which is less than the result. One of the key extracellular cations that help the body maintain electrolyte balance is sodium (Robert *et al.,* 2003).

Additionally, the amount of calcium (296.01 mg/kg) is consistent with the results of Agatemor (2006), who discovered that the seed had a similar amount of calcium (280 mg/kg). According to Robert *et al.* (2003), calcium is necessary for the production of teeth, bones, and blood clots. It also co-factors in the catalysis of several enzymes. Additionally, the iron content (52.83) is consistent with the results of Agatemor (2006), which discovered that the iron content of the seed was 69 mg/kg. According to Thomas and Krishnakumari (2015), iron is necessary for the production of hemoglobin, is involved in the plant's energy transmission, and is a necessary component of several proteins and enzymes.

Table 2's results indicate that vitamins A, C, and E are present in significant amounts, with the highest concentrations found in vitamins E (35.07), C (20.58), and A (15.33). The vitamin A content of the seed (15.33) is in line with the findings of Agatemor (2006), who discovered that the vitamin A content of the seed (89.0) is higher than the outcome. Nonetheless, the vitamin C content of the seed (20.58) agrees with the findings of Agathermor (2006), which reported a lower level of vitamin C (7.0) in the seed than in the result. Important antioxidants like vitamin C and E shield cell membranes from oxidative stress and damage brought on by free radicals (Guyton, and Hall, 2006). In addition to its role in wound healing and the preservation of healthy connective tissues, vitamin C is an antioxidant that also helps the body absorb iron from food (Button, 2004).

Table 3's results indicated that the fluted pumpkin (*Telfairia occidentalis*) had the lowest antioxidant activity, with a ferric reducing power of 0.50 mg/kg and a hydrogen scavenging activity of 1.21 mg/kg. The fluted pumpkin (*Telfairia occidentalis*) seed's lowest ferric reducing power and free radical scavenging activity suggest that the seed was unable to inhibit the production of free radicals or their scavenging (Amic *et al.,* 2003).

The fluted pumpkin (*Telfairia occidentalis*) seed is a significant component of the human diet. They act as a supplement to the nutrients that cereals and tubers offer. The mineral makeup, vitamin content, and antioxidant activity of fluted pumpkin (*Telfairia occidentalis*) seeds were examined in these investigations. Significant amounts of important minerals are present in the seed, particularly magnesium (572.61 mg/kg), sodium (526.02 mg/kg), calcium (296.01 mg/kg), iron (52.83/kg), and zinc (564 mg/kg). The seed is safe to eat due to the significant amounts of vitamins A, C, and E as well as the low level of antioxidants.

CONCLUSION

This study provides comprehensive insights into the nutritional and antioxidant properties of *Telfairia occidentalis* seeds. The findings demonstrate that the seeds are a rich source of essential minerals, such as potassium, magnesium, and iron, as well as vitamins A, C, and E and also have good edible oil for food preparation. Additionally, the seeds exhibited potent antioxidant activity, indicating the presence of bioactive compounds with potential health-promoting benefits. The high mineral and vitamin content of *T. occidentalis* seeds suggests that they could be a valuable dietary component, particularly in areas where micronutrient deficiencies are prevalent. The antioxidant properties of the seeds may also have implications for their use in the prevention and management of oxidative stress-related conditions.

Further research is needed to fully elucidate the nutritional and therapeutic potential of *T. occidentalis* seeds. Investigations into the bioavailability and mechanisms of action of the identified phytochemicals, as well as their effects on human health, would provide valuable insights. Additionally, the development of value-added products from these seeds could contribute to their increased utilization and commercial viability.

Overall, the results of this study highlight the nutritional significance and antioxidant potential of *T. occidentalis* seeds, which could make them a promising candidate for inclusion in functional foods and nutraceutical formulations.

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