



Proximate, Anti-Nutrient and Vitamin Composition of Full-Fat and Defatted Seed Flour of *Telfairia occidentalis*

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ABSTRACT

Studies were conducted to determine the proximate and anti-nutrient composition of full-fat and defatted seed flour of *Telfairia occidentalis* (fluted pumpkin) using standard procedures. The defatted seed flour (DSF) indicated higher protein content (46.55%) while the full-fat seed flour (FSF) presented a value of 10.20%. The lipid (35.78%), carbohydrate (42.27%), and caloric values (531.90 Kcal/100 g) obtained for FSF were respectively higher than values of similar determinations for DSF. The anti-nutritional analyses of the FSF showed slightly higher oxalate content (44.00 mg/100 g) while cyanide, phytate and tannin levels were higher in DSF. The vitamin A composition of FSF (9.18 mg/100 g) was higher than that of DSF (0.84 mg/100 g) while DSF indicated higher vitamin C (74.44 mg/100g) content. These results revealed that the seed flour of *Telfairia occidentalis* contains an appreciable amount of nutrients and vitamins. The levels of toxicants in both FSF and DSF samples were low and below toxic levels. The seed flour of *Telfairia occidentalis* can be exploited as a cheap and valuable source of vegetable protein in fortified food products formulation.

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Introduction

Vegetables serve as an indispensable constituent of human diet, supplying the body with minerals, vitamins and certain hormone precursors, in addition to protein and energy (Oyenuga and Fetuga, 1975). *Telfairia occidentalis* (fluted pumpkin) is a popular edible leaf and seed vegetable which belongs to the family *Cucurbitaceae*. It is widely cultivated throughout West Africa and is reputed for its very palatable and nutritious leaves and seeds. The leaves are rich in vitamins and minerals such as calcium, phosphorus and iron (Eseyin et al., 2014a). The seed oils have found great use in domestic cooking (Akoroda, 1990). Previous studies have shown that the leaves of *T. occidentalis* contain vitamins such as thiamine, riboflavin, nicotinamide and ascorbic acid. The leaves have also been found to contain some amino acids such as alanine, aspartate, glycine, and leucine (Fasuyi and Nonyerem, 2007; Tindall, 1968).

The medicinal potentials of various parts of *T. occidentalis* have been widely reported by previous investigators. These potentials include: anticonvulsant (Gbile, 1986), antioxidant and hepatoprotective activity (Obloh, 2005; Obloh, 2006; Bolaji and Olabode, 2011), antidiabetic activity (Aderibigbe et al., 1999; Emudianghe and Aderibigbe, 2002; Eseyin et al., 2007;

Eseyin et al., 2010a; Eseyin et al., 2010b; Eseyin et al., 2010c; Eseyin et al., 2014b), anti-cancer (Ejike and Ezeanyika, 2011a; Ejike and Ezeanyika, 2011b; Okokon et al., 2012a), anti-inflammatory and analgesic (Oluwole et al., 2003; Okokon et al., 2012b), hematological (Iweala and Obidoa, 2009; Fasuyi and Nonyerem, 2007; Hamlin and Latunde-Dada, 2011; Alada, 2000; Odede et al., 2010; Osuntoki and Sanusi, 2007). Specifically, the antimicrobial properties *T. occidentalis* have also been reported (Okokon et al., 2007; Okokon, et al., 2009; Odoemena and Essien, 1995; Noumedem et al., 2013).

A previous study has identified phytochemicals such as tannins, saponins, flavanoids and phenolics in the plant (Ekpenyong et al., 2012). The chemical composition of various parts of *T. occidentalis* has also been reported (Essien et al., 1992; Akwaowo et al., 2000; Okokon et al., 2012). To our knowledge, there is no report on the proximate and anti-nutrient composition of full-fat and defatted seed flour of *Telfairia occidentalis* despite its widespread acceptability as food. In this present study, the proximate, vitamin and anti-nutrient composition of full-fat and defatted seed flour of *Telfairia occidentalis* from Nigeria has been evaluated using standard methods.

Material and Methods

Plant material: Healthy and mature fluted pumpkin seeds were purchased from four farms in Bori, Khana Local Government Area of Rivers State, Nigeria. Plant identification, authentication and specimen referencing were done at the Department of Botany and Ecological Studies, University of Uyo, Uyo, Nigeria. A voucher specimen has been deposited at the Herbarium of the Department of Botany and Ecological Studies.

Telfairia occidentalis seed flour production: Pumpkin seeds were manually extracted from the pod, washed, air-dried and manually decorticated. The air-dried seeds were crushed into powder using an electric blender (Kenwood BL 480, United Kingdom) and divided into two equal portions. One portion (1 kg) was defatted by soaking the ground seeds in 5 L of *n*-hexane for 36 h at room temperature; with a change of solvent every 8 h. The defatted flour mixture was filtered, concentrated to dryness using a rotary evaporator at 40°C and ground to pass through a 355MICS sieve. The second portion (1 kg) was not defatted. The flours were packaged in air-tight containers, designated as full-fat seed flour (FSF) and defatted seed flour (DSF) and kept in a refrigerator at 4°C until use. All reagents and chemicals used in this work were of analytical (AnalaR) grade and were purchased from Sigma-Aldrich chemical company, United Kingdom.

Proximate analyses: These analyses were carried out to determine the moisture, ash, crude fibre, crude fat, crude protein content in the full-fat and defatted seed flour of *Telfairia occidentalis*. The moisture content was determined by drying the seed flour in an oven (Gallenkamp OV-330) at 105°C until a constant weight was obtained (AOAC, 1990) (method 14:004). The percentage moisture content was subsequently calculated.

Total ash was determined by Furnace incineration described by AOAC (1990) (method 14:006) using about 1.0 g of oven-dried sample. This analytical method is based on the vaporization of water and volatiles with

burning organic substances in the presence of oxygen in the air to CO₂ at a temperature of 550°C for 5 hours. The % ash content was thereafter calculated.

Crude fibre was determined using the method of (AOAC, 1990) (method 14:020). The percentage crude fiber was also calculated using the relevant formula.

Crude protein content was calculated by converting the nitrogen content determined by Kjeldahl's method (6.2 N). Fat was determined by the method described by the AOAC (1990) using the Soxhlet system. The carbohydrate content was estimated as the difference obtained after subtracting the values of the organic protein, fat, ash and fiber from the total dry matter. The energy values of the samples were obtained by multiplying the values of the crude protein, lipid and carbohydrate by 4, 9 and 4 respectively and taking the sum of the products.

Anti-nutrient composition: The composition of oxalate was determined using the method outlined by Sanchez-Alonso and Lachica (1987) and hydrocyanic acid by that of AOAC (1990). Phytic acid was determined by the method of McCance and Widdowson (1935). The Folin-Denis spectrophotometric method earlier described by Pearson (1976) was used for determination of tannins.

Vitamin determination: Ascorbic acid content was obtained by the method of AOAC (1980) while the vitamin A content was determined by spectrophotometry at 620 nm.

Results and Discussion

Results

The result of proximate composition of full-fat and defatted seed flour of *Telfairia occidentalis* in Table 1, Anti-nutrient profile of full-fat and defatted seed flour of *Telfairia occidentalis* in Table 2 and 3 Result of vitamin composition of full-fat and defatted seed flour of *Telfairia occidentalis* are given in Table 3

Table 1 Result of proximate composition of full-fat and defatted seed flour of *Telfairia occidentalis*

Parameters	Full-fat seed flour (FSF)	Defatted seed flour (DSF)
Ash (%)	5.25 ± 0.004	9.27 ± 0.002
Moisture (%)	3.00 ± 0.001	1.37 ± 0.000
Fibre (%)	3.50 ± 0.002	6.18 ± 0.003
Protein (%)	10.20 ± 0.017	46.55 ± 0.032
Lipid (%)	35.78 ± 0.005	0.85 ± 0.001
Carbohydrate (%)	42.27 ± 0.003	35.78 ± 0.012
Energy (Kcal/100 g)	531.90 ± 1.005	336.97 ± 0.813

Results are Mean ± SD of triplicate determinations in each case.

Table 2 Anti-nutrient profile of full-fat and defatted seed flour of *Telfairia occidentalis*

Parameters (mg/100 g)	Full-fat seed flour (FSF)	Defatted seed flour (DSF)
Cyanide	18.89 ± 0.007	19.23 ± 0.012
Total oxalate	44.00 ± 0.003	35.20 ± 0.002
Soluble Oxalate	26.40 ± 0.018	17.60 ± 0.015
Phytate	14.80 ± 0.011	16.24 ± 0.005
Tannins	2.29 ± 0.001	3.31 ± 0.003

Results are expressed as Mean ± SD of triplicate determinations in each case.

Table 3 Result of vitamin composition of full-fat and defatted seed flour of *Telfairia occidentalis* (mg/100g)

Sample	Vitamin A	Vitamin C
Full-fat seed flour (FSF)	9.18 ± 0.022	57.50 ± 0.621
Defatted seed flour (DSF)	0.84 ± 0.002	74.44 ± 0.005

Results are expressed as Mean ± SD of three determinations in each case.

Discussion

Proximate composition: The result of proximate composition of full-fatted (FSF) and defatted (DSF) seed flour of *Telfairia occidentalis* is shown in Table 1. The result shows a higher value for ash, fibre, and protein content in sample DSF while the values obtained for moisture, lipid and carbohydrate levels were higher in sample FSF. The table also shows sample FSF is richer in energy compared to sample DSF.

This result indicates that ash content of the FSF sample of *Telfairia occidentalis* was higher than that of full-fat seed flours of *Malus sylvestris* (3.66%) and *Citrullus vulgaris* (3.75%) earlier reported (Samia El-Safy et al., 2012). The high ash content is usually an indication of the mineral element deposits preserved in the food materials. The crude lipid content of 0.85% obtained for DSF sample is extremely low compared to that of FSF sample (35.78%). It is equally low when compared to defatted *Citrullus vulgaris* flour (5.5%), reported by Penuel et al., (2013). Dietary fats function in increasing the palatability of food by absorbing and retaining flavors. A diet providing 1-2% of its caloric energy as fat is said to be sufficient to human beings as excess fat consumption is implicated in certain cardiovascular disorders such as atherosclerosis, cancer and aging (Akindahunsi and Salawu, 2005).

The defatted seed flour (DSF) contains higher crude protein when compared to the FSF sample. The crude protein level of 46.55% obtained for DSF sample is also higher than that of defatted *Moringa oleifera* seed flour (17.13%) earlier reported (Olagbemide and Philip, 2014) as well as those of other seed flours of apple (33.79%) and watermelon (30.11%) (Samia El-Safy et al., 2012). This makes the defatted seed flour of *T. occidentalis* a very rich protein source.

The crude fibre contents were considerably low in both samples with that of DSF sample being almost twice that of the FSF sample. A similar range of values was observed for the full-fat seed flour of apple (8.32%) and watermelon (3.47%) (Samia El-Safy et al., 2012). The crude fibre content of defatted seed flour of *T. occidentalis* (6.18%) was however higher than 3.33% obtained for defatted *Moringa oleifera* seed flour (Olagbemide and Philip, 2014). The result also explains that defatting of the seeds improves the fibre content of *T. occidentalis* seeds and the high fibre content may improve bowel function and provide faecal bulk digestion.

The levels of carbohydrate were also appreciable in both samples. This makes the *T. occidentalis* seed flour a rich energy source. The carbohydrate level of 42.27% for FSF was indeed higher than those of the full fat seed flour of *Moringa oleifera* (8.67%) (Olagbemide and Philip, 2014) and apple (23.50%), papaya (22.15%), watermelon (17.62%), guava (10.27%), orange (34.74%) and prickly

pear (13.45%) as earlier reports indicate (Samia El-Safy et al., 2012). However, the carbohydrate level obtained for DSF sample was lower compared to the 57.77% obtained for the defatted seed flour of *Moringa oleifera* (Olagbemide and Philip, 2014).

Antinutrient composition: Levels of hydrogen cyanide, oxalate, phytic acid and tannins in the full-fat seed flour (FSF) and defatted seed flour (DSF) are given in Table 2. The contents of hydrogen cyanide in both samples are low and below the lethal dose of 35 mg/100 g (Munro and Bassir, 1969). Also, the levels of total and soluble oxalate in both samples were extremely low and below the toxic level of 2-5 g/100 g (Onwuka, 2005). These values are however higher than 0.407 mg/100 g obtained for watermelon seed flour (Samia El-Safy et al., 2012). Oxalates are known to complex with calcium to form calcium crystals which get deposited as stones that are associated with blockage of renal tubules (Banso and Adeyemo, 2007). However, processing methods such as proper cooking are known to significantly reduce total oxalate content in vegetables (Akwaowo et al., 2000). Based on our investigation, it could be safely speculated that there is no danger of toxicity associated with oxalate content in the plant under study. The levels of tannins in both samples were slightly higher than the value of 0.17 mg/100g earlier reported for the seed flour of *Cucurbitapepo*, another variety of pumpkin (El-Adawy and Taha, 2001). Also, phytic acid levels for both FSF and DSF samples were quite high compared to the value of 2.27 mg/100 g obtained for the seed flour of *Cucurbitapepo* (El-Adawy and Taha, 2001).

Vitamin composition: The vitamin content of full-fat and defatted seed flour of *Telfairia occidentalis* is shown in Table 3. This result reveals a higher value (74.44 mg/100 g) for vitamin C in the defatted sample (DSF) compared to 57.50 mg/100g observed for the full-fat seed flour (FSF) counterpart. A trace amount of vitamin A was also obtained (0.84 mg/100g) in the DSF sample. It has been reported that edible plants possess chemo-preventive and chemo-protective activities which have been attributed to dietary constituents such as vitamin E, vitamin C, and more recently, polyphenols (Lee et al., 2009). The wound healing property of ascorbic acid has been earlier reported (Bursal et al., 2013) and the values obtained in this study support its usage for wound healing especially for children and women older than 18 years of age as it contributes excellently to their recommended daily intake.

Conclusion

The result of this study has shown that the full-fat and defatted seed flour of *Telfairia occidentalis* (fluted pumpkin) contain an appreciable amounts of

carbohydrate, protein, fibre and fat in addition to variable amounts of vitamin A and C. The low levels of anti-nutrients suggest that the consumption of seed flour of *T. occidentalis* is not harmful and therefore not expected to produce any adverse health effects. This study, therefore, concludes that *T. occidentalis* seed flour can contribute significantly to the human nutritional requirements as dietary supplements both for domestic use and industrially in the production of confectionaries and other food items.

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