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RESEARCH ARTICLE

Assessment of Nutritive and Anti-Nutritive Composition of *Ocimum gratissimum* (Scent) Leaves

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Abstract

Objective: This study aimed to evaluate the nutritive composition and anti-nutritional factors of *Ocimum gratissimum* (scent leaf) to assess its nutritional quality and potential health implications when consumed as a vegetable.

Materials and Methods: Fresh leaves of *Ocimum gratissimum* were analyzed using standard analytical procedures to determine their proximate composition, mineral content and anti-nutritional constituents, including oxalate, nitrate and cyanide.

Results: The proximate analysis revealed that *Ocimum gratissimum* leaves contained 77.70% moisture, 3.14% ash, 4.09% crude fat, 5.36% crude protein, 5.48% crude fibre, 4.23% carbohydrate and an energy value of 314.36 kJ. Mineral analysis showed calcium and magnesium contents of 15.00 mg/100 g and 23.00 mg/100 g, respectively. The low sodium-to-potassium (Na/K) ratio suggests that consumption of the leaves may not predispose individuals to hypertension. Furthermore, the levels of oxalate, nitrate and cyanide were found to be below the World Health Organization (WHO) recommended limits.

Conclusion: The findings indicate that *Ocimum gratissimum* leaves are a nutritionally valuable vegetable with low levels of anti-nutritional factors. The consumption of scent leaf is therefore unlikely to pose health risks and may contribute beneficially to dietary mineral and nutrient intake.

INTRODUCTION

Malnutrition remains a significant global public health challenge, particularly in developing countries such as Nigeria, where a substantial proportion of adults and children suffer from undernutrition. This situation has stimulated increasing interest in the investigation of indigenous plant resources with potential nutritional value[1,2]. Numerous indigenous plant species with high nutritive potential have been documented in the literature[3,4]. *Ocimum gratissimum* (scent leaf) is one such plant that has been reported to possess considerable nutritional and medicinal significance.

Ocimum gratissimum is widely distributed across tropical Africa, particularly in Nigeria. It belongs to the family Lamiaceae and is one of the most abundant species within the genus *Ocimum*, where it is extensively cultivated. The plant is characterized by a distinctive aroma and is commonly used as a spice, herbal remedy and traditional medicine in various cultures[5]. In Nigeria, it is known by different local names: the Igbo people of eastern Nigeria refer to it as *Nchonwu*, the Yoruba people of western Nigeria call it *Efinrin ajase*, while the Hausa people of northern Nigeria know it as *Daidoya*. Botanically, *O. gratissimum* is a perennial shrub with a woody base, attaining an average height of 1-3 m. Its leaves are broad and narrowly ovate, typically measuring 5-13 cm in length and 3-9 cm in width and the plant is distinguished by its lime-green, slightly pubescent foliage.

Scent leaf is commonly cultivated in home gardens and farmlands and is also found growing wild in forested areas. The plant is highly adaptable to a wide range of soil types and

is nutritionally rich, containing various macronutrients, micronutrients and phytochemicals[6]. In Nigeria, *O. gratissimum* is widely utilized for both nutritional and therapeutic purposes. In coastal regions, it is traditionally employed in the treatment of epilepsy, high fever and diarrhea, whereas in savannah regions, leaf decoctions are used in the management of mental illness. Among the Igbo people of eastern Nigeria, scent leaf is used in neonatal care, particularly for maintaining sterility of the umbilical cord wound. Additionally, the plant is valued for its antifungal and antibacterial properties and is widely used as a seasoning in food preparation.

The present study was therefore designed to investigate the proximate composition, nutritive and anti-nutritive factors and mineral content of *Ocimum gratissimum* leaves, with a view to assessing their potential contribution to human nutrition and health.

MATERIALS AND METHODS

Sample collection and preparation: Fresh leaves of *Ocimum gratissimum* (scent leaf) were purchased from Ihiagwa Market, a major vegetable market located in Owerri West Local Government Area, Imo State, Nigeria. The leaves were thoroughly washed, air-dried and ground into a fine powder using a laboratory grinder. The powdered sample was sieved through a 250 µm mesh to obtain a uniform particle size and subsequently stored in clean plastic containers at room temperature until analysis.

Proximate analysis: The moisture, ash and crude fibre contents of *Ocimum gratissimum* samples were determined using standard analytical procedures as described by the Association of Official Analytical Chemists (AOAC)[7]. Moisture content was determined by oven-drying 2 g of the sample at 105°C for 24 hrs until a constant weight was achieved. Ash content was determined by incinerating 2 g of the sample in a muffle furnace at 500°C for 2 hrs.

Crude fat content was determined using the Soxhlet extraction method with petroleum ether (boiling range 40-50°C) as the extracting solvent[8]. Crude protein content was determined using the Kjeldahl method, as described by AOAC[7]. Carbohydrate content was estimated by difference using the formula:

$$\text{Carbohydrate (\%)} = 100 - (\text{Moisture \%} + \text{Ash \%} + \text{Fat \%} + \text{Crude \% Fibre \%} + \text{Crude Protein \%})$$

Anti-nutrient analysis: The oxalate, cyanide and nitrate contents of *Ocimum gratissimum* samples were determined using standard chemical methods described by AOAC[7]. For oxalate determination, 2 g of the sample was digested with hydrochloric acid (HCl), after which ammonium chloride (NH_4Cl) was added to render the solution alkaline, followed by titration.

Cyanide content was determined spectrophotometrically at a wavelength of 540 nm as described by AOAC[7]. The sample suspension was incubated at 45°C for 1 hr prior to analysis. Nitrate content was determined by weighing 2 g of the sample into a 15 mL centrifuge tube, followed by the addition of 100 mL of distilled water. The suspension was incubated at 45°C for 1 hr in accordance with AOAC procedures[7].

Mineral analysis: The mineral composition of *Ocimum gratissimum* samples was determined following the methods recommended by AOAC . One gram (1 g) of each sample was digested using 12 cm^3 of an acid mixture consisting of nitric acid (HNO_3), sulphuric acid (H_2SO_4) and perchloric acid ($HClO_4$) in the ratio 9:2:1 (v/v)[9]. After complete digestion, the concentrations of copper, iron, zinc, sodium, potassium, calcium and magnesium were determined using an Atomic Absorption Spectrophotometer (Pye-Unicam 969, Cambridge, UK).

RESULTS AND DISCUSSION

The results of the proximate composition of *Ocimum gratissimum* leaf samples are presented in Table 1. The findings revealed that *O. gratissimum* leaves contained a moisture content of 77.70%. This value is higher than the moisture content of 72.0% reported for *Alstonia boonei* by Akinmoladun *et al.*[10]. Akpasi *et al.*[11] in their study on fluted pumpkin (*Telfairia occidentalis*) leaves, reported a moisture content of 79.0%, which is slightly higher than the value obtained in the present study. Similarly, Dike[12] reported high moisture contents in the leaves of several plant species.

In contrast, Alinnor and Oze[2] reported a moisture content of 11.87% for *Pentaclethra macrophylla* (African oil bean) seeds, which is considerably lower than the value observed in

Table 1: Proximate composition of *Ocimum gratissimum* (dry weight%)[a]

Parameters	*Ocimum gratissimum* (scent leaf)
Moisture content	77.70±0.01
Ash content	3.14±0.02
Crude fat content	4.09±0.02
Crude protein content	5.36±0.01
Crude fibre content	5.48±0.01
Available carbohydrate	4.23±0.02
Available energy (KJ)[b]	314.36±0.03

[a]Values are mean±standard deviation of triplicate determination, [b]Calculated metabolisable energy (KJ/100g sample): (Protein ×17+Fat×37+carbohydrate ×17)

this study. Olaofe *et al.*[3] also reported a moisture content of 3.46% for *Bombacopsis glabra* seeds, while Ogungbenle recorded 3.40% moisture content in some edible seeds. These comparatively low moisture values in seeds reflect their inherent storage stability when compared to leafy vegetables. Moisture content is an important indicator of water activity, which directly influences the stability and susceptibility of food materials to microbial contamination[13]. The relatively high moisture content observed in *O. gratissimum* leaves suggests that they may have a limited shelf life due to increased water activity. Since microorganisms thrive in moist environments, leafy vegetables with high moisture content are more prone to spoilage and therefore require appropriate preservation methods such as refrigeration, drying, or freezing to enhance storage stability.

The ash content of *Ocimum gratissimum* leaves obtained in this study was 3.14%. This value falls within the range of 2.5-3.5% reported for Nigerian dietary spices by Odukoya *et al.*[14] . Elinge *et al.*[15] reported a higher ash content of 5.50% in pumpkin seeds, while Lohdip and Jikmyan[16] recorded an ash content of 9.62% in *Sesamum indicum* L. seeds. Similarly, Okerulu *et al.*[17] reported an ash content of 5.70% in the leaves of *Pterocarpus soyauxii*.

Ash content is a measure of the total mineral composition of a food sample and the value obtained in this study indicates that *Ocimum gratissimum* leaves may serve as a potential source of nutritionally important mineral elements.

The present study revealed that *Ocimum gratissimum* leaves contained a crude fat content of 4.09%, which is considerably higher than the fat content range of 0.25-0.45% reported for *Telfairia occidentalis* (fluted pumpkin) leaves[18]. Oboh[19] reported a comparable fat content of 3.8% in condiments produced from some fermented legumes commonly consumed in Nigeria. In contrast, Olaofe *et al.*[3] reported a substantially higher fat content of 34.8% in *Bombacopsis glabra* seeds, reflecting the generally higher lipid concentration found in seeds compared to leafy vegetables.

Dietary fat serves as an important energy reserve in the body and can be metabolized into glycerol and free fatty acids. Glycerol may subsequently be converted to glucose in the liver and utilized as an energy source. It has been reported that 1 g of fat provides approximately 37 kcal of energy[20]. The moderate fat content observed in *O. gratissimum* leaves therefore suggests a potential contribution to dietary energy intake without excessive lipid consumption.

The crude protein content of *Ocimum gratissimum* leaves obtained in this study was 5.36%. This value is higher than the crude protein content of 1.94% reported for *Brassica oleracea* var. *capitata* leaves by Ogbede *et al.*[21]. However, Usonobun and Egharebva[22] and Omimakinde *et al.*[23] reported substantially higher crude protein contents of 21.14 and 22.97%, respectively, in *Telfairia occidentalis* leaves. The relatively lower protein content observed in the present study may be attributed to poor soil fertility and low nitrogen availability in the cultivation area, as nitrogen is a key element required for protein synthesis in plants. Nonetheless, the crude protein value of 5.36% indicates that *O. gratissimum* leaves can contribute meaningfully to dietary protein intake, thereby supporting their inclusion in local diets to enhance nutritional quality.

The crude fibre content of *Ocimum gratissimum* leaves was found to be 5.48%, which is higher than the fibre content of 2.50% reported for *Cucurbita maxima* (pumpkin) leaves by Fai *et al.*[24]. Previous studies have reported fibre contents of 4.0 and 3.9% for broccoli and carrot, respectively[25]. Aja *et al.*[26] reported higher fibre contents of 12.0 and 8.5% in dry and fresh samples of *Talinum triangulare* (water leaf), respectively. Dietary fibre plays a vital role in providing roughage that facilitates digestion, prolongs satiety and delays glucose absorption, thereby contributing to the regulation of blood glucose levels[27]. Diets low in fibre have been associated with several health disorders, including constipation, irritable bowel syndrome, overweight and obesity, coronary heart disease, diabetes and colon cancer[28].

The carbohydrate content of *Ocimum gratissimum* leaves obtained in this study was 4.23%, which is considerably lower than the carbohydrate content of 74.0% reported for *Cucurbita maxima* leaves by Fai *et al.*[24]. Ogbede *et al.*[21] reported a slightly higher carbohydrate content of 4.52% in *Brassica oleracea* var. *capitata* leaves compared to the value obtained in the present study. Carbohydrates serve as a major source of energy in the human body; however, low carbohydrate levels in fruits and vegetables have been reported to be beneficial for individuals with diabetes and those managing body weight[29].

The calculated metabolizable energy of *Ocimum gratissimum* leaves in this study was 314.36 kJ/100 g. Fai *et al.*[24] reported a higher metabolizable energy value of 376.7 kcal for *Cucurbita maxima* leaves, whereas Ogbede *et al.*[21] reported a much lower metabolizable energy value of 28.72 kcal/100 g for *Brassica oleracea* var. *capitata*. The relatively low metabolizable energy observed in the present study may be attributed to the low fat and carbohydrate contents of *O. gratissimum* leaves.

The cyanide content of *Ocimum gratissimum* leaves determined in this study was 6.97 mg/100 g (Table 2), which is substantially lower than the World Health Organization (WHO) recommended maximum limit of 40 mg for adults[30].

Table 2 Anti-Nutrient level of *Ocimum Gratissimum* (mg/100 g)

Parameters	*Ocimum gratissimum* (scent leaf)
Cyanide	6.97
Nitrate	1.07
Oxalate	1.18

This value is also considerably lower than the cyanide content of 60.1 mg/100 g reported for *Telfairia occidentalis* (fluted pumpkin) by Akwaowo *et al.*[31]. Ogbede *et al.*[21] reported a cyanide concentration of 15.74 mg/100 g in *Brassica oleracea* var. *capitata* L., which is higher than the value obtained in the present study.

Hydrogen cyanide is a highly toxic compound with rapid systemic effects. At elevated concentrations, cyanide interferes with cellular respiration by inhibiting metal-containing enzymes, particularly cytochrome oxidase, an iron-containing enzyme essential for oxidative phosphorylation and cellular energy production[32]. Inhibition of this enzyme prevents cells from utilizing oxygen, leading to cellular hypoxia and eventual cell death, with the cardiovascular, respiratory and central nervous systems being especially vulnerable. However, cyanide occurs naturally at low levels in many commonly consumed foods. The relatively low cyanide content observed in *O. gratissimum* leaves in this study indicates that their consumption is unlikely to pose a health risk.

The nitrate content of *Ocimum gratissimum* leaves obtained in this study was 1.07 mg/100 g, which is below the WHO recommended limits of 3.7 mg for children and 22 mg for adults[33]. Uhegbu *et al.*[34] reported a higher nitrate content of 2.64 mg/100 g in some leafy vegetables. Nitrate is a water-soluble inorganic compound that may pose health concerns due to its conversion to nitrite in the human body. This conversion occurs primarily in the oral cavity across all age groups and in the gastrointestinal tract of infants[35].

Nitrite can oxidize hemoglobin to methemoglobin, a form incapable of transporting oxygen efficiently, potentially leading to methemoglobinemia. Furthermore, nitrite can react with amine-containing compounds in food to form nitrosamines, which are recognized as potent carcinogenic agents. The nitrate concentration observed in the present study, however, suggests that the consumption of *O. gratissimum* leaves does not present a significant health risk.

The oxalate content of *Ocimum gratissimum* leaves was found to be 1.18 mg/100 g, which is well below the WHO recommended limits of 4 mg for children and 40 mg for adults. Ogbede *et al.*[21] reported a much higher oxalate content of 19.67 mg/100 g in *Brassica oleracea* var. *capitata* L. The oxalate level obtained in this study was higher than the value of 0.92 mg/100 g reported for *Pterocarpus mildbraedii* but lower than the value of 1.56 mg/100 g reported for *Gongronema africanum*[36]. Alinnor *et al.*[37] reported a markedly lower oxalate content of 0.0047 mg/100 g in *Vigna subterranea* L. Thouars compared to the present findings.

Table 3: Mineral composition of *Ocimum gratissimum* samples (mg/100g)

Mineral	*Ocimum gratissimum*
Sodium	1.23
Potassium	9.98
Calcium	15.00
Magnesium	23.00
Iron	2.00
Copper	2.14
Zinc	1.23
Na/K	0.12
Ca/Mg	0.65

Oxalates occur naturally in plants, animals and humans and are recognized as strong oxidizing agents capable of initiating free radical formation. Excessive oxalate levels in the bloodstream may combine with calcium ions to form insoluble calcium oxalate crystals, which can obstruct urinary flow and cause severe pain during excretion. These crystals may also deposit in various tissues, including the bones, joints, blood vessels, lungs, nerves and brain. In bone tissue, oxalate crystal accumulation may displace bone marrow cells, potentially leading to anemia and compromised immune function[38,39]. The low oxalate content observed in *O. gratissimum* leaves in this study suggests that their consumption is unlikely to result in oxalate-related health complications.

Table 3 presents the mineral composition of *Ocimum gratissimum* leaves. The results indicate that the sodium content of *O. gratissimum* was 1.23 mg/100 g. Ibironke and Owotomo[40] reported a substantially higher sodium content of 96.3 mg/100 g in fluted pumpkin (*Telfairia occidentalis*) leaves. The observed differences in sodium content between the two leafy vegetables may be attributed to variations in soil nutrient composition, climatic conditions and genetic characteristics of the plant species. Sodium plays a vital physiological role in maintaining fluid and electrolyte balance, as well as in nerve impulse transmission and muscle contraction in the human body.

Sodium is also involved in the facilitation of glucose absorption, proper cardiac muscle contraction and optimal brain function. Sodium deficiency has been associated with symptoms such as diarrhea, vomiting, headaches and nervous system disturbances, while excessive sodium intake may result in hypertension, increased risk of cardiovascular disease, stroke, kidney damage and peripheral edema. Severe sodium imbalance can also lead to confusion, seizures and coma[41]. The

World Health Organization (WHO) recommends a daily sodium intake of 150 mg for both adults and children[42]. The sodium content observed in *O. gratissimum* leaves in this study was well below the recommended limit, indicating that their consumption is unlikely to pose health risks related to excessive sodium intake. Consequently, *O. gratissimum* leaves may be safely consumed as part of a healthy diet.

The potassium content of *Ocimum gratissimum* leaves was found to be 9.98 mg/100 g. In comparison, Agogbua *et al.*[43] reported a lower potassium content of 0.40 mg/100 g in *Telfairia occidentalis* leaves. Potassium is an essential mineral involved in the regulation of fluid balance, nerve transmission, muscle contraction and cardiac rhythm. Adequate potassium intake has been shown to help maintain normal blood pressure, reduce the risk of stroke and support mental and physiological performance, particularly under conditions of stress. Potassium deficiency may lead to muscle weakness, fatigue, impaired reflexes, cardiac arrhythmias, palpitations and increased risk of stroke, while excessive potassium intake can result in irregular heartbeat and cardiac arrest. The recommended daily intake of potassium is 2000 mg for adults and 1600 mg for children. The potassium content of *O. gratissimum* leaves observed in this study was below WHO recommended levels; however, the leaves may still contribute to dietary potassium intake when consumed as part of a balanced diet.

The calcium content of *Ocimum gratissimum* leaves analyzed in this study was 15.0 mg/100 g. Aletor and Adeogun[44] reported a similar calcium content of 12.6 mg/100 g in tropical leafy vegetables. Calcium is essential for bone and teeth development, muscle contraction and nerve signal transmission and it plays a critical role in maintaining normal cardiac muscle function. Adequate calcium intake has been associated with a reduced risk of colon cancer and kidney stone formation, whereas calcium deficiency may result in osteoporosis, tooth loss and periodontal disease. Conversely, excessive calcium intake can impair the absorption of other essential minerals such as zinc and iron[45]. The WHO recommends a daily calcium intake of 800 mg for both adults and children. The calcium content of *O. gratissimum* leaves was below the recommended daily allowance; nevertheless, their consumption may contribute to dietary calcium intake and support healthy growth and physiological function.

The present study revealed that the magnesium content of *Ocimum gratissimum* leaves was 23.0 mg/100 g. Akwaowo *et al.*[31] reported a lower magnesium content of 8.69 mg/100 g in fluted pumpkin (*Telfairia occidentalis*) leaves, whereas Egumgbe *et al.*[46] reported a substantially higher magnesium concentration of 43.20 mg/100 g in *Telfairia occidentalis* seeds. According to the World Health Organization (WHO), the recommended dietary allowance (RDA) for magnesium is 350 mg/day for adults and 170 mg/day for children. The magnesium content observed in *O. gratissimum* leaves was therefore below the WHO recommended levels; however, the leaves may still contribute meaningfully to dietary magnesium intake when consumed as part of a balanced diet.

Magnesium plays a crucial role in bone health through its involvement in calcium metabolism and is essential for the prevention of circulatory disorders. It is also involved in the regulation of blood pressure, insulin secretion and neuromuscular function and has been reported to contribute to the prevention of asthma. Additionally, magnesium is important in collagen synthesis and has been implicated in the management of psychiatric conditions such as stress, anxiety and panic disorders. Magnesium deficiency has been associated with adverse health outcomes, including diarrhea and cardiac arrest[47].

As presented in Table 3, the iron content of *Ocimum gratissimum* leaves analyzed in this study was 2.0 mg/100 g. The recommended dietary allowance for iron is 10 mg/day for adults and children, while adult females require 15 mg/day. The iron content observed in this study was therefore below WHO recommended standards. Idris[48] reported a markedly higher iron content of 18.5 mg/100 g in fluted pumpkin leaves, indicating that iron levels may vary considerably among leafy vegetables. Such variations in iron content can be attributed to factors including soil mineral composition, fertilizer application and plant genotype. Soils rich in iron or supplemented with iron-based fertilizers tend to produce crops with higher iron concentrations, whereas iron-deficient soils may limit mineral uptake by plants.

Iron is an essential micronutrient required for hemoglobin synthesis and the normal functioning of the central nervous system[49]. It plays a vital role in the transport of oxygen from the lungs to body tissues, facilitates the oxidation of carbohydrates, proteins and fats and supports cellular energy production through the formation of Adenosine Triphosphate (ATP). Iron also contributes to antioxidant defense mechanisms by forming part of enzymes such as catalase and is important for cognitive function. Iron deficiency can result in anemia and impaired immune response[50]. Conversely, excessive iron accumulation may lead to serious health complications, including liver disorders (cirrhosis and cancer), heart failure and in severe cases, reproductive dysfunction, reduced libido in men, early menopause and neurological conditions such as Alzheimer's and Parkinson's diseases[51].

The results of this study showed that the copper content of *Ocimum gratissimum* leaves was 2.14 mg/100 g. Idris[48] reported a lower copper concentration of 1.72 mg/100 g in *Telfairia occidentalis* leaves, indicating a comparatively higher copper level in *O. gratissimum*. The Recommended Dietary Allowance (RDA) for copper is 3 mg/day for adults and 2 mg/day for children. The copper content observed in this study was below the WHO recommended intake for adults but comparable to the recommended level for children, suggesting that *Ocimum gratissimum* leaves could serve as a valuable dietary source of copper for children.

Copper is an essential trace element required for enzyme synthesis and biological electron transport systems. It plays a significant role in maintaining the integrity of the skeletal, nervous and cardiovascular systems, supports proper thyroid gland function and contributes to lipid metabolism by reducing Low-density Lipoprotein (LDL) cholesterol while increasing High-density Lipoprotein (HDL) cholesterol. Copper is also involved in melanin production, which is responsible for pigmentation of the skin, hair and eyes and functions as an antioxidant. Copper deficiency has been associated with adverse health effects such as hypopigmentation, cardiac arrhythmias, vascular abnormalities and other disease conditions[52].

The zinc content determined in this study was 1.23 mg/100 g. Akwaowo *et al*,[31] reported a higher zinc content of 6.80 mg/1000 g in *Telfairia occidentalis*. According to WHO recommendations, the daily zinc requirement is 15 mg/day for adults and 10 mg/day for children. The zinc concentration observed in *Ocimum gratissimum* leaves was therefore below WHO recommended levels. Nevertheless, zinc is a critical micronutrient associated with the activity of numerous enzymes, particularly those involved in the synthesis of ribonucleic acid (RNA) and even moderate dietary contributions can support nutritional adequacy when combined with other zinc-containing foods[53].

Zinc plays a vital role in male and female reproductive health by supporting prostate function, maintaining sperm count and motility, regulating serum testosterone levels and assisting in the management of menstrual disorders. It also contributes to sensory perception by activating brain regions involved in taste and smell, promotes skin cell regeneration and supports ocular health by preventing cataract formation and night blindness. Zinc deficiency may result in diarrhea and pneumonia in children, impaired cognitive and memory functions and reduced taste and olfactory sensitivity, whereas excessive zinc intake can cause gastrointestinal disturbances such as nausea, vomiting, abdominal cramps and discomfort. High zinc intake may also interfere with the absorption and metabolism of other essential minerals, particularly copper, calcium and iron[54]. Therefore, *Ocimum gratissimum* leaves may contribute to zinc intake for the healthy growth and development of the body.

The sodium-to-potassium (Na/K) ratio is an important dietary indicator for the prevention and management of hypertension. Foods with an Na/K ratio of less than 1.0 are considered beneficial in lowering blood pressure. In this study, *Ocimum gratissimum* exhibited an Na/K ratio of 0.12, indicating that its consumption is unlikely to promote high blood pressure. Similarly, the calcium-to-magnesium (Ca/Mg) ratio obtained for *Ocimum gratissimum* was 0.65, which is below the recommended value of 1.00, further suggesting a favorable mineral balance with potential cardiovascular health benefits[55].

CONCLUSION

The findings of this study demonstrate that *Ocimum gratissimum* leaves contain appreciable levels of protein, dietary fibre and fat, as well as significant amounts of essential minerals, particularly magnesium and calcium. The presence of these nutrients indicates that the leaves can make a meaningful contribution to human dietary requirements and may support overall health and nutritional management. Furthermore, the concentrations of anti-nutritional factors detected in *Ocimum gratissimum* were found to be below the World Health Organization (WHO) recommended limits, suggesting that consumption of the leaves does not pose any significant health risk. Based on these results, *Ocimum gratissimum* leaves can be considered a nutritionally valuable and safe dietary component and their inclusion in regular diets is therefore recommended.

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REFERENCES

1. Singh, F. and B. Diwakar, 1993. Nutritive value and uses of pigeonpea and groundnut. 14th ed., International Crops Research Institute for the Semi-Arid Tropics, Patancheru and hra Pradesh, India, Pages:44.
2. Alinnor, I.J. and R. Oze, 2011. Chemical evaluation of the nutritive value of *Pentaclethra macrophylla benth* (African oil bean) seeds. Pak. J. Nutr., 10: 355-359.

3. Olaofe, O., E.T. Akintayo, E.I. Adeyeye and H.O. Adubiaro, 2006. Proximate composition and functional properties of bulma cotton (*Bombcapsis glabra*) seeds. Egypt. J. Food Sci., 34: 81-90.
4. Ogungbele, H.N., 2006. Chemical composition functional properties and amino acid composition of some edible oil seeds. Riv. Ital. Sostanze Grasse, 83: 81-86.
5. Adachukwu, I.P. and O.N. Yusuf, 2014. A review of the Ethnotherapeutics of medicinal plants used in traditional/alternative medicinal practice in Eastern Nigeria. Int. J. Curr. Microbiol. Appl. Sci., 3: 675-683.
6. Adumanya, O.C.U., G.A. Obi-Aduman and M.O. Chukwu, 2012. The vitamin and mineral contents of okpa prepared with fluted pumpkin and scent leaves. Res. J. Appl. Sci., 7: 272-274.
7. Latimer, G.W., 2023. Official methods of analysis of AOAC international. 22th ed., Oxford University Press, New York, ISBN: 9780197610138, 9780197610145. Pages:360.
8. Egan, H., R.S. Kirk and R. Sawyer, 1981. Pearson's chemical analysis of foods. 8th ed., Churchill Livingstone, Minnesota, United States, ISBN: 044302149X, 9780443021497. Pages:591.
9. Rangasamy, E., M. Muniasamy and A. Prakash, 2025. Assessment of ten potentially toxic metal in tea leaves from selected tea gardens in Southern Western Ghats, India. J. Trace Elem. Miner., Vol. 13. 10.1016/j.jtemin.2025.100250
10. Akinmoladun, A.C., E.O. Ibukun, E. Afor, B.L. Akinrinlola, T.R. Onibon and E.O. Farombi *et al*, 2007. Chemical constituents and antioxidant activity of Alstonia boonei. Afr. J. Biotechnol., 6: 1197-1201.
11. Akpasi, S.O., K.M. Oghenejoboh, H.O. Shoyiga, S.L. Kiambi and T.P. Mahlangu, 2023. Investigation of the nutrient composition of fluted pumpkin (*Telfairia Occidentalis*) under herbicide treatment. Sustainability, Vol. 15. 10.3390/su15043383
12. Dike, M., 2010. Proximate and nutrient compositions of some fruits, seeds and leaves of some plant species at Umudike, Nigeria. ARPN-J. Agric. Biol. Sci., 5: 7-16.
13. Davey, K.R., 1989. A predictive model for combined temperature and water activity on microbial growth during the growth phase. J. Appl. Bacteriol., 67: 483-488.
14. Odukoya, A.O., O.O. Ilori, M.O. Sofidiya, O. Aniunoh, B.M. Lawal and I.O. Tade, 2005. Antioxidant activity of Nigerian dietary spices. Electronic J. Environ., Agric. Food Chem., 4: 1086-1093.
15. Elinge, C.M., A. Muhammad, F.A. Atiku, A.U. Itodo, I.J. Peni and A.N. Mbongo *et al*, 2012. Proximate, mineral and anti-nutrient composition of pumpkin (*Cucurbitapepo* L) seeds extract. Int. J. Plant Res., 2: 146-150.
16. Lohdip, A.M. and M.S. Jikmyan, 2019. Proximate and amino acid analyses of the stem of *Sesamum indicum* L. (black seed specie) pedaliaceae. J. Chem. Soc. Nigeria, 44: 65-70.
17. Okerulu, I.O., C.T. Onyema, V.I. Onwukeme and C.M. Ezeh, 2017. Assessment of phytochemicals, proximate and elemental composition of *Pterocarpus soyauxii* (Oha) leaves. Am. J. Anal. Chem., 8: 406-415.
18. Onuguh, I.C., E.U. Ikhuoria and J.U. Obibuzo, 2022. Comparative proximate analysis of T. Occidentalis (fluted pumpkin) leaves sold in three different markets in Benin city, Nigeria. Int. J. Agric. Anim. Prod., 2: 7-12.
19. Oboh, G., 2006. Nutrient and antinutrient composition of condiments produced from some fermented underutilized legumes. J. Food Biochem., 30: 579-588.
20. Gaman, P.M. and K.B. Sherrington, 1990. The science of food: An introduction to food science, nutrition and microbiology. 3rd ed., Pergamon Press, Ann Arbor, Michigan, USA, ISBN: 0080361552, 9780080361550. Pages:269.
21. Ogbede, S.C., A.N. Saidu, A.Y. Kabiru and M.B. Busari, 2015. Nutrient and anti-nutrient compositions of *Brassica oleracae* Var. *Capitata* L.. IOSR J. Pharm., 5: 19-25.
22. Usunobun, U. and E. Egharebva, 2014. Phytochemical analysis, proximate and mineral composition and *in vitro* antioxidant activities in Telfairia Occidentalis aqueous leaf extract. J. Basic Appl. Sci., 1: 74-87.
23. Omimakinde, A.J., I. Oguntimehin, E.A. Omimakinde and O. Olaniran, 2018. Comparison of the proximate and some selected phytochemicals composition of fluted pumpkin (*Telfairia Occidentalis*) leaves and pods. Int. Biol. Biomed. J., 4: 206-212.
24. Fai, F.Y., W.L. Adanbature, A. Yahaya and Y.M. Ausman, 2013. Proximate and some mineral analysis of pumpkin (*Cucurbita maxima*) leaf. J. Physical Sci. Environ. Saf., 3: 9-16.
25. Roe, M., S. Church, H. Pinchen and P. Finglas, 2013. Nutrient analysis of fruit and vegetables–Analytical Report. Department for Environment, Food & Rural Affairs. https://assets.publishing.service.gov.uk/media/5a7b24aa40f0b66a2fc0572d/Nutrient_analysis_of_fruit_and_vegetables_-_Analytical_Report.pdf
26. Aja, P.M., A.N.C. Okaka, U.A. Ibiam, A.J. Uraku and P.N. Onu, 2010. Proximate analysis of *Talinum triangulare* (water leaf) leaves and its softening principle. Pak. J. Nutr., 9: 524-526.
27. Pereira, M.A., A.I. Kartashov, C.B. Ebbeling, L.V. Horn, M.L. Slattery and D.S. Ludwig *et al*, 2005. Fast-food habits, weight gain and insulin resistance (the cardia study): 15-year prospective analysis. Lancet, 365: 36-42.
28. Wu, H., K.M. Dwyer, Z. Fan, A. Shircore, J. Fan and J.H. Dwyer, 2003. Dietary fiber and progression of atherosclerosis: The Los Angeles atherosclerosis study. Am. J. Clin. Nutr., 78: 1085-1091.
29. Agoreyo, B.O., E.S. Obansa and E.O. Obanor, 2012. Comparative nutritional and phytochemical analyses of two varieties of *Solanum melongena*. Sci. World J., 7: 5-8.
30. WHO, 2011. Evaluation of certain food additives – Chemical 1086. World Health Organization. https://apps.who.int/food-additives-contaminants-jecfa-database/Home/Chemical/1086
31. Akwaowo, E.U., B.A. Ndon and E.U. Etuk, 2000. Minerals and antinutrients in fluted pumpkin (*Telfairia Occidentalis Hook F.*). Food Chem., 70: 235-240.

32. UK Health Security Agency, 2023. Hydrogen cyanide: Toxicological overview. https://www.gov.uk/government/publications/hydrogen-cyanide-properties-incident-management-and-toxicology/hydrogen-cyanide-toxicological-overview
33. WHO and FAO, 2024. JECFA Database – Chemical 709. Joint FAO/WHO Expert Committee on Food Additives. https://apps.who.int/food-additives-contaminants-jecfa-database/Home/Chemical/709
34. Uhegbu, F.O., I. Elekwa, E.E.J. Iweal and I. Kanu, 2011. Cyanide, nitrate and nitrite content of some leafy vegetables and fruits commonly consumed in the South-East of Nigeria. Pak. J. Nutr., 10: 1190-1194.
35. Klaassen, C.D., 2001. Casarett & doull's toxicology: The basic science of poisons. 6th ed., McGraw-Hill, Philadelphia, USA, ISBN: 0071347216, 978-0071347211. Pages:1275.
36. Chima, C.E. and M.A. Igyor, 2007. Micronutrients and anti-nutritional contents of selected tropical vegetables grown in Southeast, Nigeria. Niger. Food J., 25: 111-116.
37. Alinnor, I.J., M. Chijioke-Okere and N.C. Nwagbo, 2021. Assessment of nutritive and anti–nutritive values and mineral content of *Vigna subterranean* L *Thouars* (bambara nut) seeds. Int. Res. J. Pure Appl. Chem., 22: 20-28.
38. Curhan, G.C., 1999. Epidemiologic evidence for the role of oxalate in idiopathic nephrolithiasis. J. Endourology, 13: 629-631.
39. Parivar, F., R.K. Low and M.L. Stoller, 1996. The influence of diet on urinary stone disease. J. Urology, 155: 432-440.
40. Ibironke, S.I. and I. Owotomo, 2020. Effect of processing on the nutritive value of fluted pumpkin vegetable leaves (ugu) and seed nutrients (*Telfairia Occidentalis*) on the health of wister rats. Acta Sci. Nutr. Health, 4: 127-131.
41. Munteanu, C. and A. Iliuta, 2011. The role of sodium in the body. Balneo Res. J., 2: 70-74.
42. WHO, 2012. Guideline: Sodium intake for adults and children. World Health Organization. https://iris.who.int/handle/10665/77985
43. Agogbua, J.U., L.A. Akonye, S.I. Mensah and K. Okonwu, 2022. Bioactive compounds and mineral contents of *Telfairia Occidentalis* hooker fil. Grown in urea solutions. J. Appl. Sci. Environ. Manage., 26: 595-602.
44. Aletor, V.A. and O.A. Adeogun, 1995. Nutrient and anti-nutrient components of some tropical leafy vegetables. Food Chem., 53: 375-379.
45. Pravina, P., D. Sayaji and M. Avinash, 2013. Calcium and its role in human body. Int. J. Res. Pharm. Biomed. Sci., 4: 659-668.
46. Egumgbe, U.D., A.G. Ezegbe, C.M. Asogwa and B.O. Mbah, 2022. Nutrient and phytochemical composition of *Telfairia Occidentalis* seed processed by boiling, roasting and fermentation methods. J. Family Soc. Res., 1: 113-122.
47. Swaminathan, R., 2003. Magnesium metabolism and its disorders. Clin. Biochemist Rev., 24: 47-66.
48. Idris, S., 2012. Compositional studies of *Telfairia Occidentalis* leaves. Am. J. Chem., 1: 56-59.
49. Adeyeye, E.I. and E.D. Fagbohun, 2005. Proximate, mineral and phytate profiles of some selected spices found in Nigeria. Pak. J. Sci. Ind. Res., 41: 14-22.
50. Watts, D.L., 1988. The nutritional relationships of Iron. J. OrthoMol. Med., 3: 110-116.
51. Sadrzadeh, S.M.H. and Y. Saffari, 2004. Iron and brain disorders. Pathol. Patterns Rev., 121: S64-S70.
52. Angelova, M., S. Asenova, V. Nedkova and R. Koleva-Kolarova, 2011. Copper in the human organism. Trakia J. Sci., 9: 88-98.
53. Maret, W., 2013. Zinc biochemistry: From a single zinc enzyme to a key element of life. Adv. Nutr., 4: 82-91.
54. Das, M. and R. Das, 2012. Need of education and awareness towards zinc supplementation: A review. Int. J. Nutr. Metab., 4: 45-50.
55. National Research Council, 1989. Recommended dietary allowances. 10th ed., National Academies Press, Washington, D.C., ISBN: 9780309046336. Pages: 302.