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Evaluation of nutritive and anti-nutritive composition of *Talinum triangular*e (water leaf) leaves

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Abstract
Talinum Triangulare (Water leaf) leaves were analyzed for their nutritive values. The result showed that Talinum Triangulare leaves have moisture content 84.87%, ash content 0.61%, crude fat content 1.56%, crude protein content 3.98%, crude fibre content 7.66%, carbohydrate content 1.77% and available energy 155.47kJ. The mineral content for the analyzed samples showed presence of essential minerals potassium, iron and zinc. The low sodium – to – potassium (Na/k) ratio is an important dietary indicator for the prevention and management of hypertension. The result of the analysis indicates that oxalate, nitrate and cyanide concentrations were below World Health Organization (WHO) recommended limits.

Keywords: *Talinum triangulare*, nutritive values, mineral composition, healthy diet, health risks

Introduction

Vegetables are the fresh, edible and succulent parts of herbaceous plants. They are special food crops that contain a lot of ingredients that help for healthy growth of the body. They contain appreciable amount of dietary fibres and minerals. Numerous indigenous plant species with high nutritive potential have been documented in the literature (Olaofe *et al*; 2006, Ogungbele, 2006) [34, 37]. Malnutrition have been a problem in developing countries especially Nigeria, where substantial proportion of adults and children suffer from under nutrition. In view of this, investigation of indigenous plant species with potential nutritional value have been documented (Uthpala *et al*, 2020, Shanta *et al*, 2024) [43, 48]. The amount of nutrient constituents in commonly used leafy vegetables species have been studied to some extent (Kola, 2024; Kumari, 2023) [28].

Water Leaf (*Talinum Triangulare*) is a leafy vegetable that belong to the Talinaceae family. Water leaf originate from tropical Africa and widely grown in west Africa. It has succulent stems ranging from 30-100cm height. Water leaf is well adopted to different ecological conditions and can thrive in both moist and dry environments. In its natural habitat, water leaf often grows as a weed in farm lands and is common in cultivated land, including road sides and near people's homes (Bioltif, 2020) [15]. The Yorubas of Western Nigeria call it Gure, while the Igbos of Eastern Nigeria call it Inine. It is widely consumed for its nutritional and medicinal benefits (Adewunmi *et al*; 1987) [2]. In Nigeria, it is widely distributed in the Southern ecological zones. Its leaves are used as softener of other vegetable species in preparing local vegetable soup.

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

Materials and Method

Sample collection and Preparation

Fresh leaves of *Talinum triangulare* (water 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 and air-dried for 2-3 days and ground into a fine powder using a laboratory grinder. The powdered sample was sieved through a 250µm mesh to obtain a uniform particle size and stored in clean plastic container at room temperature until use.

Proximate analysis

The moisture, ash and crude fibre contents of *Talinum triangulare* leaves were determined using standard analytical procedures as described by the Association of Official Analytical Chemists (AOAC, 2023) [29]. Moisture content was determined by Oven-drying 2g of the sample at 105 ^{o}C for 24hrs until a constant weight was achieved. Ash content was determined by incinerating 2g of the sample in a muffle furnace at 500 ^{o}C for 2hrs

Crude fat content was determined using the soxhlet extraction method with petroleum either (boiling range 40-50 ^{o}C) as extracting solvent (Egan *et al*.;1981) [20]. Crude protein content was determined by Kjeldahl Method, as described by (AOAC, 2023). Carbohydrate content was estimated by difference using the formula:

Carbohydrate (%) = 100 – (moisture % + Ash % + Fat % + crude fibre + crude protein %)

Anti-nutrient analysis

The oxalate, cyanide and nitrate contents of *Talinum triangulare* samples were determined using. Standard Chemical Methods described by (AOAC, 2023). For oxalate determination 2g 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 540nm as described by (AOAC,2023) The sample suspension was incubated at 45 ^{o}C for 1hr prior to analysis. Nitrate content was determined by weighing 2g of the sample into 15ml centrifuge tube, followed by the addition of 100ml of distilled water. The suspension was incubated at 45 ^{o}C for 1hr in accordance with (AOAC, 2023) procedure.

Mineral Analysis

The Mineral composition of *Talinum triangulare* sample were determined following the methods recommended by AOAC. 1g of each sample was digested using 12cm ^{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) (Rangasamy *et al*; 2025) [42]. 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 result of the proximate composition of *Talinum triangulare* leaf samples are presented in Table 1.

Table 1: Proximate composition of *Talinum triangulare* (dry weight %) [α]

Parameters	*Talinum triangulare* (water leaf)
Moisture content	84.87 ± 0.01
Ash content	0.61 ± 0.02
Crude fat content	1.56 ± 0.02
Crude protein content	3.98 ± 0.01
Crude fibre content	7.66 ± 0.02
Available carbohydrate	1.77 ± 0.02
Available energy (KJ)b	155.47 ± 0.02

[a]Values are mean± standard deviation of triplicate determination.
[c]Calculated metabolisable energy (KJ/100g sample):
(Protein x 17+ fat x37+ carbohydrate x 17)

The result revealed that *Talinum triangulare* leaves contained moisture content 84.87%. This value is higher than the moisture content 79.0% of fluted pumpkin (*Telfaire occidentalis)* reported by (Akpasi *et al*; 2023). Akinmoladun *et al* (2007) [6, 8] working on Alstonia boonei reported moisture content 72.0%. Alinnor *et al* (2026) [12] reported 77.70% moisture content in leaves of *ocimum gratissimum*. However, (Olaofe *et al*; 2006) [37] reported a moisture content of 3.46% for Bombacoposis glabra seeds.

Ogungbele (2006) [34] recorded 3.40% moisture content in some edible seeds. Alinnor and Oze (2011) [11] reported moisture content 11.87% for *Pentaclethra Macrophylla* (African oil bean) seeds.

The low moisture content in seeds when compared to high moisture content in vegetables reflects inherent storage stability of seeds. Moisture content is an important indicator of water activity, which directly influences the stability and susceptibility of food materials to microbial contamination (Davey, 1989) [18]. The high moisture content observed in *Talinum triangulare* leaves suggests that they may have a limited shelf life due to increased water activity. Since microorganism thrive in moist environments. Leafy vegetable with high moisture content are more prone to spoilage and therefore require appropriate preservative methods such as refrigeration, drying or freezing to enhance storage stability. The high moisture content of water leaf makes it a good source of hydration in the diet.

The ash content of *Talinum traiangulare* leaves obtained in this study was 0.61%. Okerulu *et al* (2017) [36] reported ash content of 5.70% in leaves of Pterocarpus soyauxil. Alinnor *et al* (2026) [12] working on *Ocimum gratissimum* leaves reported ash content 3.14%. Fowomola (2010) [23] reported ash content 2.62% in *magnifera indica* seed. It has been reported (Ogbede *et al*; 2015) [33] that fresh leafy vegetables of *Brassica Oleracae var. Capitate L.* has ash content 1.05%. The ash content reported in this study was very low. Ash content is a measure of the total mineral composition of a food sample.

This study revealed that *Talinum triangulare* leaves contain crude fat content 1.56%. Onuguh *et al* (2022) [39] reported crude fat content 0.45% in leaves of *Telfairia occidentalis* (Fluted pumpkin). It has been reported (Alinnor *et al*; 2026) [12] that *Ocimum gratissimum* leaves contain crude flat content 4.09%, which is considerable higher than the fat content obtained in this study. In contrast, (Alinnor *et al*; 2011) [11] reported a substantially higher fat content of 46.95% in *pentaclethra macrophylla benth* (African oil bean) seeds, reflecting the generally higher lipid concentration found in seeds compared to leafy vegetables. In view of low-fat content of *Talinum triangulare* leaves observed in this study, the vegetable will be helpful for individuals managing body weight.

The protein content of *Talinum triangulare* leave obtained in this study was 3.98%. This value is higher than the crude protein content of 1.94% reported for *Brassica Oleracea var. capitata* leaves by (Ogbede *et al*; 2025). However, (Alinnor *et al*; 2026) [12] reported crude protein content 5.36% in *Ocimum gratissimum* leaves. Usanobun ad Egharebra (2014) and (Omimakinde *et al*; 2018) [38] reported substantially higher crude protein content of 21.14 and 22.97%, respectively in *Telfairia Occidentalis* leaves. Akinyele *et al*; (2020) and Okerulu *et al* (2020) [35] reported crude protein content 26.5% and 29.5% in leaves of *Pterocarpus Mildbraedii* and *Pterocarpus soyauxii*, respectively. The result of this study indicates that *Talinum triangulare* leaves could be used as an alternative source of protein in diet/protein supplement especially in under developed countries such as Nigeria where majority of the populace live in starch food and cereals

The crude fibre content of *Talinum triangulare* leaves was 7.66%, which is higher than crude fibre content of 2.50% reported for *cucurbita* maxima (pumpkin) leaves (Fai *et al*; 2013) [22]. It has been reported by (Akinyeye *et al*; 2010) [7] that *Pterocarpus mildbraedii* leaves have fibre content 8.15%. The fibre content of *Pterocarpus Mildbraedii* leaves was slightly higher than the value obtained in this study. Also (Okerulu *et al*; 2020) [35] working on *Pterocarpus soyauxii* leaves reported crude fibre content 17.5%. The value is higher than the value obtained in this study. Fibre has useful role in providing roughage that aids digestion (Eva, 1983) [21].

Dietary fibre reduces the risks of cardiovascular diseases. Report have shown that increase in firbre consumption might have contributed to the reduction in the incidence of certain diseases such as diabetes, coronary heart disease, colon cancer and various digestive disorder (Augustin *et al*; 1978) [14]. Fibre consumption also soften stools and lowers plasma cholesterol level in the body (Norman and Joseph, 1995) [32].

The carbohydrate content of *Talinum triangulare* leaves obtained in present study was 1.77%. Alinnor *et al* (2026) [12] working on *Ocumum gratissimum* leaves reported carbohydrate content 4.23%. Fai *et al* (2013) [22] reported high carbohydrate content 74.0% for *cucurbita maxima* leaves. Ogbede *et al* (2015) [33] reported carbohydrate content 4.52% in *Brassica oleracea var. capitata* leaves. Carbohydrate serve as a major source of energy in 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 (Agoreyo *et al*; 2012) [5].

The calculated *metoabolizable* energy of *Talinum triangulare* leaves in this study was 155.47 KJ/100g. Fai *et al* (2013) [22] reported a metabolizable energy value of 376.7 kcal for *cucurbita maxima* leaves, whereas (Alinnor *et al*; 2026) [12] reported *metabolizable* energy 314.36KJ/100g for *Ocimum gratissimum* leaves. The relatively low metabolizable energy observed in this study may be attributed to low fat and carbohydrate contents of *Talinum triangulare* leaves.

Table 2: Anti – Nutrient level of *Talinum Triangulare* (mg/100g)

Parameters	*Talinum triangulare* (water leaf)
Cyanide	4.40
Nitrate	3.49
Oxalate	3.03

The cyanide content of *Talinum triangulare* leaves determined in this study was 4.40mg/100g as presented in table 2. This value was lower than cyanide content 60.1mg/100g reported for *Telfairia occidentalis* leaves by (Akwaowo *et al*; 2000). Ogbede *et al* (2015) [9, 33] reported cyanide concentration 15.74mg/100g in *Brassica Oleracea var. capitata L.* leaves, which is higher than the value obtained in this study. The cyanide content of *Talinum traingulare* is substantially lower than the World Health Organization (WHO) recommended maximum limit of 40mg for adult (WHO, 2011) [50]. Hydrogen cyanide is a highly toxic compound. At high concentration it will interfer with cellular respiration of inhibiting metal- containing enzymes, especially cytochrome Oxidase which is iron-containing enzyme (UK HSA,2023). Inhibition of this enzyme by cyanide will prevent cells from utilizing oxygen which may lead to cell death. The relatively low cyanide content of *Talinum triangulare* obtained in this study indicates that the consumption of the leaves will not pose any healthy risk.

The nitrate content of *Talinum triangulare* leaves obtained in this study was 3.49mg/100g, which is slighty below the WHO recommended limits of 3.7mg for children and 22mg for adults (WHO, 2024) Uhegbu el at (2011) [45] working on some leafy vegetables reported low nitrate content 2.64mg/100g. Nitrate is a water –soluble inorganic compound that my pose health effect due to its conversion to nitrite in the body. Nitrite can oxidize hemoglobin to *methemoglobin*, a form incapable of transporting oxygen, efficiently leading to *methemoglobinemia.* Also, nitrite can react with amine- containing compounds in food to form nitrosamines, which are recognized as potent carcinogenic agents. The nitrate concentration recorded in this study suggests that the consumption of *Talinum triangulare* leaves does not present health risk.

The oxalate content of *Talinum triangulare* leaves was 3.03mg/100g. The oxalate value obtained in this study was below WHO recommended limits of 4mg for children and 40mg for adults. Ogbede *et al* (2015) [33] working on *Brassica oleracea var. capitata L.* leaves recorded oxalate content 19.67mg/100g. Alinnor *et al* (2026) [12] working on *Ocimum gretissimum* leaves recorded oxalate content 1.18mg/100g, this value is lower than the value obtained in this study. Chima and Igyor (2007) [16] reported oxalate concentration 1.56mg/100g in *Gongronema africanum* leaves.

Oxalates occur naturally in plants and they are recognized as strong oxidizing agents capable of initiating free radical formation. Excessive oxalate concentration in the blood stream 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 as well deposit in tissues such as bones, joints, blood vessels, lungs, brain etc. Oxalate cystals may displace bone marrow cells in bone tissue leading to anemia and also compromise immune function (Curhan, 1999 and Parivar *et al*; 1996) [17, 40]. The low oxalate content observed in *Talinum triangulare* leaves in this study may not pose health hazard.

Table 3: Mineral composition of *Talinum Triangulare* samples (mg/100g)

Mineral	*Talinum triangulare*
Sodium	0.84 ± 0.02
Potassium	6.47 ± 0.01
Calcium	0.084 ± 0.02
Magnesium	0.019 ± 0.01
Iron	1.67 ± 0.01
Copper	1.01 ± 0.02
Zinc	0.841 ± 0.02
Na/K	0.129
Ca/Mg	4.42

Table 3 presents the mineral composition of *Talinum triangulare* leaves. The result of the analysis showed that *Talinum triangulare* leaves contain 0.84mg/100g Sodium. Allinnor *et al* (2026) reported sodium content 1.23mg/100g in *Ocimum gratissimum* leaves, whereas Ibironke and Owotomo (2020) [24] reported high sodium content 96.3mg/100g in leaves of fluted pumpkin (*Telfairia occidentalis*). The World Health Organization (WHO) recommended daily intake of sodium is 150mg for both adults and children (WHO, 2012) [51]. The sodium content observed in *Talinum triangulare* in this study was below the recommended limit, indicating that consumption is unlikely to pose health risks related to excessive sodium intake. Therefore, Talinum *triangulre* leaves may be safely consumed as part of healthy diet.

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 headaches, nervous system disturbances and diarrhea, while excessive sodium intake may result in hypertension, stroke, kidney damage, increased risk of cardiovascular disease and peripheral edema. Severe sodium imbalance can also lead to confusion, seizure and coma (Munteanu and Iliuta, 2011) [30].

The potassium content of *Talinum triangulare* leaves was found to be 6.47mg/100g. The result of this study indicates that potassium content was higher than the value 0.40mg/100g obtained from *Telfairia occidentalis* leaves as reported by (Agogbua *et al*, 2022) [4]. The recommended daily intake of potassium is 2000mg for adults and 1600mg for children. The potassium content of *Talinum triangulare* leaves observed in this study was below WHO

recommended levels. Potassium is an essential mineral involved in the regulation of fluid balance, nerve transmission, muscle contraction and cardiac rhythm. Potassium intake help to maintain normal blood pressure, reduce the risk of stroke and support mental and physiological performance. 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 calcium content of *Talinum triangulare* observed in this study was 0.084mg/100g. Edeoga *et al* (2018) [19] working on *Landolphia ovalifaria* leaves reported high calcium content 37.43mg/100gm. Aletor and Adeogun (1995) [10] reported calcium content 12.6mg/100g in tropical leafy vegetables. The WHO recommended daily calcium intake for both adults and children is 800mg. The calcium content of *Talinum triangulare* was below the recommended daily allowance. 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. 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. Also excessive calcium intake can impair the absorption of other essential minerals such as zinc and iron (Pravina *et al*,. 2013) [41].

The analysis showed that *Talinum triangulare* has magnesium content 0.019mg/100g. Iheanacho and Udebuani (2009) [26] reported magnesium content 3.60mg/100g and 11.52mg/100g in leafy vegetables *Garcinia Africana* and *Cucurbita Pepo*, respectively. All these values were higher than the value obtained in this study. Akwaowo *et al* (2000) [9] reported magnesium content 8.69mg/100g in Fluted pumpkin leaves. The WHO recommended dietary allowance (RDA) for magnesium is 350mg/day for adults and 170mg/day for children. The magnesium content observed in *Talinum triangulare* leaves was below WHO recommended limit. Magnesium plays a crucial role in bone health through its involvement in calcium metabolism. It helps in the regulation of blood pressure, insulin secretion and neuromuscular function. Magnesium deficiency has been associated with diarrhea and cardiac arrest (Swaminathan, 2003) [44].

Table 3 showed iron content 1.67mg/100g obtained from *Talinum triangulare* leaves. Alinnor *et al* (2026) [12] working on *Ocimum gratissimum* leaves reported iron content 2.0mg/100g. Indris (2012) reported iron content 18.5mg/100g in fluted pumpkin leaves. The iron content of fluted pumpkin leaves is markedly higher than the iron content obtained in this study. The recommended dietary allowance for iron is 10mg/100g for adults and children, while adult females required 15mg/day. The iron content observed in this study was below WHO recommended standard. Iron is required for blood formation and it is important for normal functioning of the central nervous system (Adeyeye and Fagbohon, 2005) [3]. It plays a vital role in the transport of oxygen from the lungs to body tissues. It facilitates the oxidation of carbohydrates, proteins and fats. Iron deficiency can result in anemia and impaired immune response (Watts, 1998) [49].

The results of the analysis revealed that copper content of *Talinum triangulare* was 1.01mg/100g. Alinnor *et al* (2026) [12] reported copper content 2.14mg/100g in leaves of *Ocimum gratissiumu*. The copper concentration of *Ocimum gratissimum* leaves is higher than copper content obtained in this study. Idris (2012) [25] reported copper content 1.72mg/100g in *Telfairia occidentalis* leaves, this value is above copper content obtained in this study. The recommended dietary allowance for copper is 3mg/day for adults and 2mg/day for children. The copper content observed in this study was below the WHO recommended intake for both adults and children. Copper is required in the body for enzyme production and biological electron transport. It plays a vital role in maintaining the integrity of the skeletal, nervous and cardiovascular systems. 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 and vascular abnormalities (Angelova *et al*, 2011).

The analysis of *Talinum Triangulare* leaves revealed that zinc content was 0.841mg/100g. Adeniyi *et al* (2018) [1] working on some Nigeria leafy vegetables reported zinc content 1.20mg/kg and 1.52mg/kg in *Cucurbita maxima* and *crepidiastrum crepidiodes*, respectively. Akwaowo *et al* (2000) [9] reported high zinc content 6.80mg/100g in *Telfairia occidentalis.* According to WHO recommendations, the daily zinc requirement is 15mg/day for adults and 10mg/day for children. The zinc concentration observed in *Talinum traingulare* leaves in this study was below WHO recommended levels. Zinc plays a vital role in male and female reproductive health by supporting prostate function, maintaining sperm count, mobility and assisting in the management of menstrual disorders. It also contributes to sensory perception by activating brain regions involved in taste and smell. Zinc deficiency may result in diarrhea and pneumonia in children, impaired cognitive and memory functions and reduced taste.

The sodium-to-potassium (Na/k) ratio is an important dietary indicator for the prevention and management of hypertension. A food source having Na/k ratio of less than value of **1** has impact in lowering blood pressure. The Na/k value of 0.129 obtained in this study indicates that *Talinum triangulare* will not promote high blood pressure because of low Na/k value. The Ca/Mg ratio for *Talinum triangulare* leaves was 4.42, which is above the recommended value of 1.00, further suggesting a favourable mineral balance with potential cardiovascular health benefits (NRC, 1989).

Conclusion

This study revealed that *Talinum triangulare* leaves contain appreciable amount of protein and dietary fibre as well as essential minerals such as potassium, iron and zinc. The high moisture content of *Talinum triangulare* makes it a good sources of hydration diet. The presence of these nutrients indicates that *Talinum triangulare* leaves can make a meaningful contribution to human dietary requirements and may support overall health and nutritional management. The concentration of anti-nutritional factors detected in *Talinum triangulare* leaves were found to be below the WHO recommended limits, suggesting that consumption of *Talinum triangulare* leaves does not poses any significant health risk.

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