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Comparative Analysis of Proximate and Mineral Compositions of *Jatropha tanjorensis* L. and *Telfairia occidentalis* Hook F. Leaves Cultivated in Zaria

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ABSTRACT

This study investigated the proximate and mineral compositions of *J. tanjorensis* and *T. occidentalis.* Proximate analysis was done according to the AOAC methods; Atomic Absorption Spectroscopy (AAS) was used to determine the mineral content of Ca, Cu, Co, Fe, Mg, and Zn, K, P, and Na. The result shows that *J. tanjorensis* leaves had higher carbohydrate (66.38 %), crude fibre (16.93 %), and protein (10.5 %), while *T. occidentalis* had a higher percentage of moisture (11.60 %), ash (18.90 %), and crude fats (15.95 %) content in leaves. Mineral compositions analyses showed that *J. tanjorensis* had higher concentrations (in mg/kg) of Mg (172.60), Co (60.42), K (374.00), Na (141.00), and Zn (19.25), while *T. occidentalis* had higher concentration (in mg/kg) of Fe (77.54), Ca (334.50), P (651.18), and Cu (334.50). The concentrations of all the essential metals were below the permissible limit except for Co when compared with WHO/FAO standards in vegetables. For it was mentioned that *J. tanjorensis*is was better than *T. occidentalis* as the name implies 'kafiugu' by the Hausa tribe (which means the one better than ugu, *T. occidentalis* is called 'ugu' by the Igbo tribe), but based on the proximate and mineral contents analysed, there was no statistically difference between *J. tanjorensis* and *T. occidentalis*. Therefore, it is suggested that both *J. tanjorensis* and *T. occidentalis* leaves can serve as a good source of nutraceuticals for they both nutritious.

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GRAPHICAL ABSTRACT

Introduction

Vegetables are important in human diet because of their high contents of vitamins, minerals, and dietary fibres, which play vital role in human health. Adequate consumption of vegetables is not only protective against some chronic diseases, but also decreases the risk factor of diseases [1]. Daily consumption of vegetable has been associated with overall good health, gastro-intestinal health, and improved vision [2]. In Nigeria, vegetables are included in the human diet as condiments, spices or for medicinal purposes [3], because vegetables are highly beneficial for the maintenance of good health and prevention of diseases [4]. Vegetables content important nutrients which when added to diets it supply the body with lower blood pressure, reduce the risk of heart disease, the protein in vegetables helps in the repair, improvement, and maintenance of body tissue, hormones balancing, and regulate the activities of body cells and organs [5]. It is also used in the prevention and treatment of osteoporosis because of the rich presence of calcium which helps in bone calcification [6]. According to statement by [5] reported that high content of phosphorus makes it useful for keeping off the onset of kidney diseases while magnesium helps brain and nervous system improving cognitive reasoning and memory loss. Although they can be raised comparatively at lower management cost and on poor marginal soil, they have remained underutilized, due to lack of awareness of their nutritional values in favour of the exotic ones [3]. *Jatropha tanjorensis* known as Chaya is traditionally called 'uguoyibo' amongst the Igbo, 'Ijana-ipaja' amongst the Yoruba, 'kafiugu' amongst the Hausa. *Jatropha tanjorensis* is also edible due to its rich minerals and vitamins present in the leaves, all components of the plant, including seeds, leaves, and bark, are used in traditional and folk medicine, as well as veterinary treatment, fresh, or as a decoction [7]. Chaya leaf extract content phyto-chemical elements capable of decreasing blood cholesterol levels [8], making it effective in the treatment of hyperlipidaemia-related cardiovascular illnesses.

Telfairia occidentalis which is also known as fluted pumpkin is traditionally called 'Ugu' amongst the Igbo, 'eweelegede' amongst the Youruba, 'ganyenugu' amongst the Hausa. *Telfairia occidentalis* contents important nutrients such as improves and preserve body tissues such as magnesium, vitamins which helps in connective tissues, muscles, and the nervous system, and also helps to repair tissue, and regulate the acidity of human cells and organs [5]. *Telfairia occidentalis* serves as an anti-diabetic agent, regulating blood glucose levels while also contributing to the increasing of blood in the body system and preventing anaemia. *T. occidentalis* leaves have been utilized to enhance blood production and improve blood levels in the body due to its nutritional and medicinal functions [9]. The amount and kind of dietary fibre content of these vegetables depends on the species, climate, growing conditions, nature of soil, and application of natural or artificial manure [10]. Adequate consumption of leafy vegetables has been reported as an important means of fighting hunger and malnutrition, ensuring food security and generating income for farmers [11]. These two vegetables of interest in this study are being used in many homes because of their nutritional and medicinal functions to the body; this study is on the proximate compositions and essential nutrients concentration present in each of the vegetable leaves in other to determine their values and to recommend their intake. *Jatropha tanjorensis* and *Telfairia occidentalis* green leaves are multipurpose plant, cultivated for medicinal applications, and used as food [12]. Virtually every part of the plant is beneficial and nutritional in various ways; its benefits depend on which part of the plant is being used [13]. The aim of this research is to analysed the comparative analysis of proximate and mineral compositions of *Jatropha tanjorensis* and *Telfairia occidentalis* green leaves, according to the name *Jatropha tanjorensis* leaf is known by the Hausa tribe as 'kafiugu' (which means the one better than ugu), *Telfairia occidentalis* green leaves on the other hand is known as ugu by the Igbo tribe, so therefore this research on to actually find out if *Jatropha tanjorensis* green leaf is better than *Telfairia occidentalis* green leaves as the name implies**.** There has been no statistically provide to back up the statement if actually *Jatropha tanjorensis* green leaf is better than *Telfairia occidentalis* green leaves. The inclusions of *J. tanjorensis* and *T. occidentalis*green leaves in the diets have provided basic nutritional requirements for man. The health promoting and protecting attributes of vegetables are clearly linked to their proximate, nutritive, anti-nutritive content, and antioxidant effects. Endemic vegetables have long been, and continue to be reported to significantly contribute to human diet [14]

Materials and Methods

Study area

Samples were collected from Sabon Gari, PZ, Area BZ, ABUZaria and Horticulture Garden, Area C, ABU Zaria (Fig 1).

Identification and collection of samples

Fresh leaves of Chaya (*Jatropha tanjorensis*) and fluted pumpkin (*Telfairia occendentalis*) were collected at random in from Sabon Gari, PZ, Area BZ, ABU Zaria, and Horticulture Garden, Area C, ABU Zaria; the leaves were identified in the herbarium at the Botany Department in Ahmadu Bello University, (ABU) Zaria, Kaduna State, and voucher numbers (Abu 022873 for *J.tanjorensis* and Abu 02355 for *T.occendentalis*) were issued.

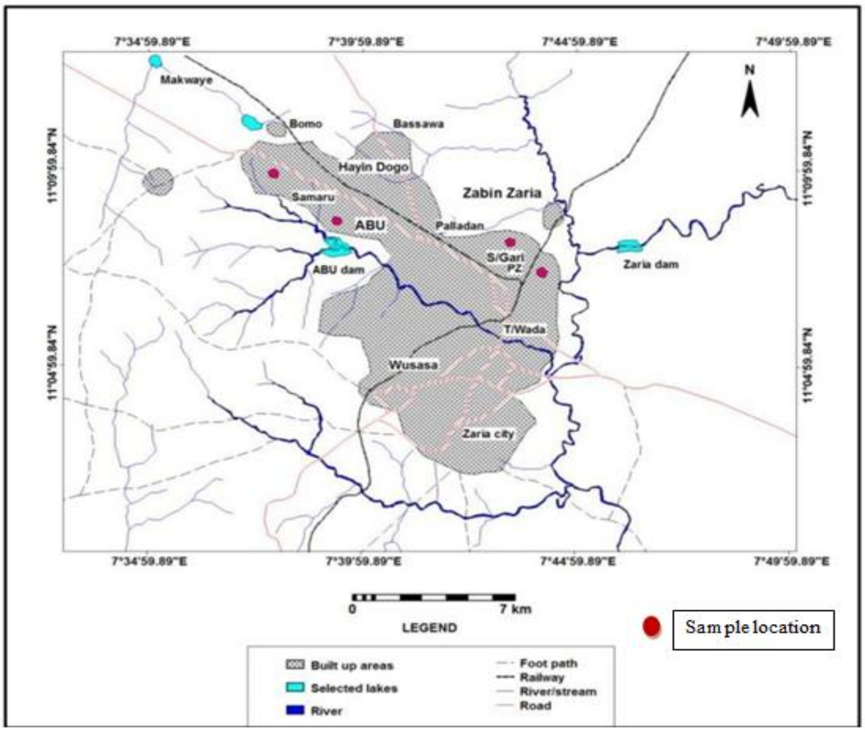

Fig1. Map of Zaria showing sample locations

Preliminary preparation of the leaves

The green vegetables (*J.tanjorensis* and *T.occendentalis*) were collected from the sticks, and cleaned to remove dirty particles. These were bulked and cut into small pieces, and some of the freshly cut pieces of the vegetable were dried at room temperature, while the fresh remaining pieces of the vegetables were used for proximate analysis. The air-dried pieces were milled with mortar and pestle into a fine powder separately, and were passed through a twenty (20) mm mesh sieve. The sample were labelled and later put into a polyethylene bag, and kept in desiccators until required for analysis.

List of apparatus/equipment

The required equipment for this study are as follow: Atomic Absorption Spectrometer, Flame photometer, Soxhlet apparatus, Kjeldahl flask, thimble, Desiccator, Thimble holder, Boric indicator, Beaker, Conical flask, Mechanical shaker, Filter funnel, Plastic bottle, Crucible, White gloves, Clips, muffle furnace, fume cupboard, Nitro Foss distillation apparatus, plastic/aluminium dish, boiling flask, fume cupboard, centrifuge, weighing balance, heating mantle funnel, and Whatman filter paper.

List of reagents

All the reagent used were of analytical grade and they are listed as follow: Hydrochloric acid (purity 37%), Sulphuric acid (purity 98.0%), Nitric acid (purity 68.0%), perchloric acid (purity 68%), sodium hydroxide (purity 70.0%), N-hexane (purity 95.0%), and Boric acid (purity 96.0%).

Plant digestion

Exactly 2.0 g each of the ground leaf samples was weighed out into a Kjaedahl flask, mixed with 20 cm^3 of concentrated sulphuric acid, concentrated perchloric acid and concentrated nitric acid in the ratio 1: 4: 40 by volume, respectively, and left to stand 12 hours. Thereafter, the flask was heated at 70 °C for about 40 min, and then it was increased to 120 °C. The mixture turned black after a while [15]. The digestion was completed when the solution became clear and white fumes appeared. The digest was diluted with 20 cm^3 of distilled water and boiled for 15 min. It was allowed to cool, transferred into 100 cm^3 volumetric flasks, and diluted to the mark with distilled water. The sample solution was filtered through a filter paper into a screw-capped polyethylene bottle for nutrient analysis.

Determination of proximate composition of leaves

The determination of crude protein content, total ash, crude fat, crude fibre, and moisture content were carried out by using [18] methods, while Carbohydrate was obtained by subtracting the sum of other fractioning from 100.

Determination of moisture content

Two crucible dishes were washed and dried to a constant weight in oven at 70 °C. The dishes were later removed and cooled in desiccator and weighed ($w1_x$ and $w1_n$, respectively). Two (2) grams each of the dried vegetable samples was placed in the weighed dishes and labelled ($w2_x$ and $w2_n$, respectively). The dishes containing both vegetable samples were kept in oven for 3 hours at 45 °C; the vegetable samples were removed and cooled in the desiccator and weighed $w3_x$ and $w3_n$, respectively.

The moisture percent was calculated as:

$$\left(\frac{W_2-W_3}{W_2-W_1}\right)\times 100 \qquad (1)$$

Where, W_1 was substituted either as W_{1x} or W_{1n}, W_2 was substituted either as W_{2x} or W_{2n}, W_3 was substituted as W_{3x} or W_{3n}, $W1_x$= weight of empty dish for *J.tanjorensis* leaves (g), $W1_n$ = weight of empty dish for *T.occendentalis* leaves (g), $W2_x$= weight of crucible + dried *J.tanjorensis* leaves (g) $W2_n$= weight of crucible + dried *T.occendentalis* leaves (g), W_{3x} = weight of crucible + heat dried *J.tanjorensis* leaves (g), W_{3n} = weight of crucible + heat dried *T.occendentalis* leaves (g)

Determination of ash content

Crucibles were cleansed and dried in the oven. After drying, they were cooled in desiccator and weighed (w_{1x} and w_{1n}). Two (2) grams each of the dried vegetable samples were placed in each crucible and weighed ($w2_x$ and $w2_n$, respectively). The weighed samples were transferred into the muffle furnace for 2 hours at 550 °C, and then removed and cooled in desiccator, and after that it was weighed (w_{3x} and w_{3n}) again.

The ash percent was calculated as:

$$\left(\frac{W_3-W_1}{W_2-W_1}\right)\times 100 \qquad (2)$$

Where, W_1 was substituted either as W_{1x} or W_{1n}, W_2 was substituted either as W_{2x} or W_{2n}, W_3 was substituted as W_{3x} or W_{3n}, W_{1x} = weight (g) of empty crucible for *J.tanjorensis* leaves, W_{1n} = = weight (g) of empty crucible for *T.occendentalis* leaves, W_{2x} = weight of crucible + dried *J.tanjorensis* leaves (g), W_{2n} = weigh of crucible + dried *T.occendentalis* leaves (g), W_{3x} = weight of empty crucible + ashed *J.tanjorensis* leaves (g) W_{3n} = weight of empty crucible + ashed *T.occendentalis* leaves (g)

Determination of crude fibre

Two (2) grams of each dried vegetable samples were placed in a beaker containing 1.2cm^3 of H_2SO_4 per 100 cm^3 of solution and boiled for about 30 minutes; the residues were filtered and washed with hot water, and then the residues were transferred to separate beakers containing 1.2 grams of NaOH per 100 cm^3 of solution and boiled again for about 30 minutes; the residues were then washed with hot water and dried in an oven at 45 °C and weighed (C_2); the weighed vegetable samples were incinerated separately in a furnace at 550 °C, removed and allowed to cool, and weighed again (C_3).

The Fibre percent was calculated as:

$$\left(\frac{C_2-C_3}{W}\right)\times 100 \qquad (3)$$

Where, W = weight of the sample, C_2 = initial weight of sample before incineration, C_3 = final weight of the sample after incineration.

Determination of crude fat

To determine crude fat, 250 cm^3 clean boiling flask was dried in oven, transferred into desiccator, and allowed to cool. Two empty filter papers were weighed and labelled w_{1x} and w_{1n}respectively, and then two (2) grams of each dried vegetable samples were weighed into different labelled thimbles (filter paper): w_{2x} and w_{2n}, respectively. Each boiling flask was filled with N-hexane. Soxhlet apparatus was assembled and allowed to reflux for 8 hours. Each thimble was removed and transferred to an oven to dry, transferred from the oven into a desiccator, and allowed to cool, and then it was weighed and labelled w_3.

The Fat percent was calculated as: $\left(\frac{W2-W3}{W2-W1}\right) \times 100$ (4)

Where, W_1 was substituted either as W_{1x} or W_{1n}, W_2 was substituted either as W_{2x} or W_{2n}, W_3 was substituted as W_{3x} or W_{3n}, W_{1x}= weight of empty dish for *J.tanjorensis* leaves (g), W_{1n}= weight of empty of *T.occendentalis* leaves (g), W_{2x}= weigh of crucible + fresh *J.tanjorensis* leaves (g), W_{2n}= weigh of crucible + *T.occendentalis* leaves (g), W_{3x} = weight of crucible + dried *J.tanjorensis* leaves (g), W_{3n} = weight of crucible + dried *T.occendentalis* leaves (g)

Determination of protein

Digestion

Two (2) grams of each vegetable samples were weighed into Kjeldahl flask; the samples were added with catalyst (copper) and 15 cm^3 concentrated sulphuric acid (H_2SO_4) in the fume cupboard; this was heated until solution assumed a green colour. It was cooled and any black particles at the mouth and neck of the flask were washed away with distilled water. The digested sample was cooled, transferred and rinsed into 100 cm^3 sample bottle and made up with distilled water.

Distillation

The digested sample was measured and put in the digester tube containing 10 cm^3 of NaOH; the digester tube was placed under the heater, 10 cm^3 of Boric acid was measured into a conical flask with two drops of methyl indicator and the conical flask was placed under the receiving tube of the distillation apparatus for distillation process. As the condenser was heating, the sample in the digester tube was boiling while the steam from it was dropping into the conical flask, changing the sample from purple to green; the distillation process was completed, and then the conical flask was removed.

Titration

Exactly 50 cm^3 of HCl was used to titrate the solution obtained in the conical flask and the initial volume was recorded before titration. The final volume in cm^3 was recorded when the colour changed from green to purple.

Nitrogen = $\left(\frac{Final-initial-blank\ (0.2)\times N}{Weight\ of sample\ used(g)}\right)$

% of protein = standard number of proteins × Nitrogen (5)

Where, N (Standard number of nitrogen) = 1.4

Standard number of proteins = 6.25

Determination of carbohydrate

By difference; in this method carbohydrate content was obtained by calculations having estimated all other fractions by proximate analysis. The % of Carbohydrate = 100-(%moisture + %crude fibre+ %crude fat+ %crude protein).

Essential Mineral Elements

The digest from 2.2.4 was used to determine K, Ca, P, Co, Cu, Fe, Mg, Na, and Zn using atomic absorption spectrophotometer (AAS).

Statistical analysis

All determinations were carried out in duplicate and results were reported in mean ± standard deviation. Statistical difference between *J.tanjorensis* and *T.occendentalis* leaves was determined using t-test.

Results and Discussion

Proximate composition of J. tanjorensis and T. occidentalis leaves

Vegetables like all other plants have a diverse spectrum of chemical compounds with varying compositions [14]. The rate and extent of change in the composition of an individual vegetable, which is mostly constituted of live tissues that are metabolically active, is determined by the physiological role and stage of the organ in concern [16]. The mean percentage of proximate contents of plant leaf samples of *J. tanjorensis* and *T. occidentalis* consisting of moisture, ash, fat, protein, fibre, and carbohydrate were obtained and presented in Table 1. The analysis carried out showed that carbohydrates, fibre, and protein were higher in *J. tanjorensis* leaves, while moisture, ash, and fat were higher in *T. occidentalis* leaves. The higher carbohydrate content in *J. Tanjorensis* (66.38 %) as compared to *T. occidentalis* (48.18 %) shows that *J. tanjorensis* had higher carbohydrate content than *T. occidentalis*, according to result reported by [14] on *J. tanjorensis* leaf agrees with the result in this study as *J. tanjorensis* had higher carbohydrate content than *T. occidentalis. J. tanjorensis* is mentioned to be a good source of carbohydrates. However, *J. tanjorensis* showed higher fibre content of (16.93 %) when compared to *T. occidentalis* (10.63 %). This implies that *J. tanjorensis* is a better source of fiber when compared to *T. occidentalis* with the result obtained in this study. Fibre aids and speeds up the excretion of waste and toxic from the body by increasing the activity of antioxidant and detox enzymes in your liver, by preventing them from sitting in the intestine for long, which could cause a build-up and lead to several diseases [17]. The protein content revealed that *J. tanjorensis* (10.50 %) showed relatively higher protein content when compared to *T. occidentalis* (5.38 %). The protein content of *T. occidentalis* leaves (8.72 %) obtained by [16] was similar to that obtained in this study, low content of protein was recorded, this agrees to the result of this study were protein content in *T. occidentalis* was lower than *J. tanjorensis.* The moisture content obtained in this study shows that *T. occidentalis* (11.60 %) had higher moisture content when compared to *J. tanjorensis* (5.10 %), the high moisture content in *T. occidentalis* leaf makes it an important nutrient for the normal functioning of enzymes and general metabolic processes [18]. High moisture content of vegetables makes them a good aid for the digestion of food [20]. Meanwhile, the higher ash content in *T. occidentalis* (18.90 %) showed richer minerals when compared to *J. tanjorensis* (3.23 %) in this study, the ash contents obtained from this study showed that both leaves are rich in ash content, and consumption of these leaves in right proportion could help in the prevention of micronutrient deficiency. However, the fat composition in both leaves shows that *T. occidentalis* (15.95 %) had higher fat content when compared to *J. tanjorensis* (14.80 %), this implies that both vegetables have a good percentage for fat content which makes both leaves good for consumption, the result obtained is in agreement with the general observation that leafy vegetables are lipid-containing foods that play significant role in avoiding obesity [21].The proximate composition obtained from this study showed that both leaves are rich with good ash content. This suggests its richness in mineral elements.

Table1. Proximate composition

Samples	Plant samples					
	%Moisture	% Ash	% fat	%Protein	%Fibre	%Carbohydrate
Telfairia occidentalis	11.60 ± 0.42	18.90 ± 0.42	15.95 ± 0.64	5.38 ± 0.18	10.63 ± 0.67	48.18± 0.46
Jatropha tanjorensis	5.10 ± 0.07	3.23 ± 0.04	14.80 ± 0.14	10.50 ± 0.00	16.93 ± 0.95	66.38 ± 0.25

Each value is the mean ± standard deviation of duplicates and is not significantly different at p ≥ 0.05

Table2. T-test for *J. tanjorensis and T. occidentalis* Proximate Analysis

t-Test: Paired Two Sample for Means		
	J.tanjorensis	*T.occidentalis*
Mean	19.49	18.44
Variance	555.90032	233.84492
Observations	6	6
Pearson Correlation	0.906697682	
Hypothesized Mean Difference	0	
Df	5	
t Stat	0.220600763	
P(T<=t) one-tail	0.417064115	
t Critical one-tail	2.015048373	
P(T<=t) two-tail	0.834128231	
t Critical two-tail	2.570581836	

Thus, consumption of this plant leaves in right proportion could help in the prevention of micronutrient deficiency [22].

The paired sample test of the proximate analysis (moisture, ash, protein, fibre, fat, and carbohydrate) of Table 1 showed Student's t-test analysis revealed that there were no significant differences (P > 0.05) between *J. tanjorensis* and *T. occidentalis* leaves.

Essential element composition of J.tanjorensis and T.occidentalis leaves

The essential element contents of *T. occidentalis* and *J. tanjorensis* leaves samples revealed in Table 3 that *J. tanjorensis* leaves had higher concentration of nutrients such as zinc, potassium, cobalt, magnesium, and sodium than *T. occidentalis* leaves, while *T. occidentalis* leaves showed higher concentration of essential elements such as copper, calcium, iron, and phosphorus [19]. Standard in vegetables showed that the elements found in both leaves were within the stipulated limits, with the exception of Co which was higher than the [23] standard in vegetables, as presented in Table 3.

Copper content was higher in *T.occidentalis* (11.95 ± 3.04 mg/kg) when compared to *J.tanjorensis* (11.81 ± 3.03 mg/kg), Copper can be said to be anti-anaemic and essential for the formation of haemoglobin from iron [20]. The level of zinc was higher in *J.tanjorensis* (19.25 ± 4.62 mg/kg) when compared to *T.occidentalis* (17.58 ± 3.31 mg/kg). Zinc is an essential element for protein and nucleic acid synthesis, carbohydrate metabolism, successful pregnancy, delivery, and normal development [24]. The level of iron was higher in *T.occidentalis* (77.54 ± 12.89 mg/kg) when compared to *J.tanjorensis* (348.2 ± 2.90 mg/kg). Sodium content was higher in *J. tanjorensis* (141.00 ± 4.59 mg/kg) when compared to *T. occidentalis* (100.00 ± 3.85 mg/kg), potassium content was higher in *J. tanjorensis* (374.00 ±7.21 mg/kg) when compared to *T. occidentalis* (225.00 ± 2.72 mg/kg), the sodium-to-potassium ratio should be ≤ one, consumption of *J. tanjorensis* and *T. occidentalis* leaf promote normal functioning of the nervous system and prevent high blood pressure due to their sodium-to-potassium ratio obtained. Also, the concentration of magnesium obtained in *J. tanjorensis* (172.60 ± 3.54 mg/kg) was higher than in *T. occidentalis* (170.60 ± 3.04 mg/kg). It helps maintain muscle and nerve functions, keeps heart rhythm steady and supports healthy immune blood, and regulates blood sugar levels [25]. Calcium contents showed that *T. occidentalis* (334.50 ± 2.19 mg/kg) was higher when compared to *J. tanjorensis* (319.42 ± 0.77 mg/kg) in this study. Phosphorus contents in *T. occidentalis* (651.18 ± 12.89 mg/kg) were higher when compared to *J. tanjorensis* (530.59 ± 6.32 mg/kg). *J. tanjorensis* and *T. occidentalis* are good nutrient ratios since food is considered "good" the Ca/P ratio of this study was above 0.5 which was in agreement with that reported by [25] that if Ca/P ratio is above one and "poor" if the ratio is less than 0.5. The cobalt content of *J. tanjorensis* (60.42 ± 8.73 mg/kg) was higher when compared to *T. occidentalis* (60.36 ± 7.21 mg/kg), the Co concentration of both leaves was higher than [26] standard in vegetables when compared, which brings to the reduction of its consumption. All these minerals play vital roles in maintaining electrolyte balance within and between intracellular and extracellular environment including functioning as cofactor for enzymes that require them for their normal catalytic activities [27]. The mineral contents found in plants such as the essential nutrients plays a vital role on the health of humans or animal that feed on plants [28].

Table 3. Mean concentration ± STD of Essential elements in *J. tanjorensis* and *T. occidentalis*

Metal	*J. tanjorensis*	*T. occidentalis*	FAO/WHO STD In vegetable. Max. Permissible limit.
Ca (mg/kg)	319.42	334.50	-
R^2=0.995	± 0.77	±2.19	
Mg (mg/kg)	172.60	170.60	-
R^2=1.000	± 3.54	± 3.04	
K (mg/kg)	374.00	225.00	-
R^2=0.993	±7.21	±2.72	
Na (mg/kg)	141.00	100.00	-
R^2=0.996	± 4.59	± 3.85	
P (mg/kg)	530.59	651.18	-
R^2=0.992	± 6.32	±12.89	
Fe (mg/kg)	71.47	77.54	425.00
R^2=0.932	± 8.68	±12.89	
Cu (mg/kg)	11.81	11.95	
R^2=1.000	± 3.03	±3.04	
Co (mg/kg)	60.42	60.36	50.00
R^2=1.000	±8.73	±7.21	
Zn (mg/kg)	19.25	17.58	100.00
R^2= 0.997	±4.62	±3.31	

Based on the results of this study, it was evident that the two leaves sample analysed showed that the concentration of essential elements from both leaves sample is the concentration of Zn, Fe, and Cu were found to be below in vegetables and the maximum permissible limit of 100.00, 425.00 and 73.00 for Zn, Fe, and Cu, respectively [29]. However, the concentration of Co level was above 50.00 maximum permissible limit for Co. *J.tanjorensis* and *T.occidentalis* leaves had the potential to make a significant nutritional contribution to diets [30]. Its high proximate and nutrient contents obtained from this study showed that both leaves indicated that consumption of these vegetables would contribute immensely towards meeting human nutritional needs for normal body growth and adequate protection against diseases caused by malnutrition [31]. Therefore the cultivation of both *J.tanjorensis* and *T.occidentalis* leaves should be encouraged so as to help ensure more production of vegetables which will reduce the high cost of vegetables in the market by enhancing vegetable production [32]. The vegetable stems of both leaves should be analysis based on their proximate and mineral compositions.

Table 4 on paired sample t-test of the essential content (zinc, cobalt, copper, iron, phosphorus, calcium, magnesium, potassium, and sodium) showed that Student's t-test analysis revealed that, there were no significant differences (P > 0.05) between *J. tanjorensis* and *T. occidentalis* leaves from the result analysed.

The total analysis below (proximate and essential contents) shows that Student's t-test analysis revealed that there was no significant differences (P> 0.05) between *T. occidentalis* and *J.tanjoresis* sampled leaves from the results analysed.

Table5. T-test for both proximate and essential elements analysis of *J.tanjorensis* and *T.occidentalis* leaves

Table 4. T-test for essential elements of *J. tanjorensis and T. occidentalis* leaves

t-Test: Paired Two Sample for Means		
	J.tanjorensis	***T. occidentalis***
Mean	2619.045546	2292.56
Variance	47262331.39	21065697.24
Observations	9	9
Pearson Correlation	0.873120371	
Hypothesized Mean Difference	0	
df	8	
t Stat	0.732666191	
P(T<=t) one-tailed	0.214062554	
t Critical one-tailed	1.674548031	
P(T<=t) two-tailed	0.385125103	
t Critical two-tailed	2.216004131	

Table 5. T-test for both proximate and essential elements analysis of *J.tanjorensis* and *T.occidentalis* leaves

	T.occidentalis	*J.tanjorensis*
Mean	1394.91	1845.62
Variance	15105232.79	34589218.54
Observations	15.00	15.00
Hypothesized Mean Difference	0.00	
df	14.00	
t Stat	0.25	
P(T<=t) one-tail	0.40	
t Critical one-tail	1.71	
P(T<=t) two-tail	0.81	
t Critical two-tail	2.06	

Conclusion

This study revealed that *J.tanjorensis* and *T.occidentalis* leaves are important sources of proximate and nutritional content which are in line with the global demands for food; therefore, from the essential contents analysed in this study both leaves cobalt content was higher than that recommended by the FAO/WHO standard in vegetable maximum to be (50 mg/kg).

Therefore, it is not advisable to eat both vegetables in combined form or regularly due to its level of cobalt obtained, better still as mixtures in a controlled ratio. Also, they could be packaged and taken as infusions in the form of tea (green tea) for good health. *J.tanjorensis* leaf known by Hausa tribe as 'kafiugu' (which means the one better than ugu),

T.occidentalis, on the other hand, is known as 'ugu' by Igbo tribe, so on conclusion to whether *J.tanjorensis* leaf is better than *T.occidentalis* leaf, based on proximate and mineral compositions analysed, both leaves showed that there was no statistical significant difference between both leaves analysed. The ability of both leaves to detoxify heavy metals at different concentrations should be investigated.

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