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Phytochemical and nutritional composition of ethanol-water leaf extracts of *Justicia secunda* and *Jatropha tanjorensis*

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Abstract

The study analyzed phytochemical and nutritional compositions of ethanol-water leaf extracts of *Justicia secunda* and *Jatropha tanjorensis* using standard methods. In both plants significant amounts of alkaloids, tannin and flavonoids were seen. *J. tanjorensis* had higher amount of saponin and cardiac glycoside. The quantitative phytochemical and anti-nutrient evaluation revealed *J.tanjorensis* had higher amount of phytochemicals including sapogenin, anthocyanin and anti-nutrient factors such as tannin, phytate and oxalate. The proximate analysis yielded carbohydrate as being most abundant in both plants with *J.tanjorensis* having higher (62.22 ±0.14%) against (61.52±0.12 %) seen in *J.secunda.* Fibre composition of both plants was low with 4.62±0.04% in *J.secunda* and 5.22±0.05% in *J.tanjorensis*. The most prevalent mineral element in *J.secunda* was magnesium (9.39±0.10mg/kg dry weight) while potassium (8.58±0.10mg/kg dry weight) was most prevalent in *J.tanjorensis*. Manganese was the least abundant in both plants. Eighteen different amino acids were found. His (4.76 ±0.08 µg/g) was the most abundant essential amino acid (EAA) in *J.secunda*, while Phe (5.78 0.04 µg/g) was the most abundant EAA in *J.tanjorensis*. Gly (4.85±0.03µg/g) and Pro (4.78±0.04 µg/g) was the most prevalent NEAAs in *J.secunda* and *J.tanjorensis*, respectively. The finding validates the richness of both plants in essential phytochemicals and other beneficial plant-based nutrients, and explains their traditional use in forkloric medicine practice.

Keywords: *Justicia secunda*; *Jatropha tanjorensis*; Phytochemicals; Nutritional compositions; Anti-nutrient; Proximate composition

1. Introduction

Plants have been used for medicinal purposes for thousands of years, and their therapeutic benefits have been recognized by many cultures around the world [1].For millennia, people have benefitted greatly from plants, both in their native forms and as extracts [2, 3]. The active constituents in plants responsible for their medicinal properties are often referred to as phytochemicals [4]. Phytochemicals are secondary metabolites produced by plants with groups or examples such as alkaloids, flavonoids, glycosides, terpenoids, phenolics and saponins [5].The ceaseless study of these secondary plant metabolites has yielded ground-breaking results in the area of pharmacology [6]. Phytochemicals have been found to exhibit various pharmacological properties, including anti-inflammatory, anti-cancer, anti-viral, antimicrobial and anti-oxidant activities [7,8].These properties make phytochemicals attractive targets for drug development and have led to an increased interest in the study of these compounds.

Justicia secunda and *Jatropha tanjorensis* are among the common medicinal plants believed to have abundant reserve of bioactive compounds and are used in different parts of Nigeria for their numerous biological effects in the body. *J. secunda* vahl also known as St John`s bush is a perennial herbaceous plant of the family "Acanthaceae"[9].Aqueous leaf extract of *J. secunda* is characteristically pink to purple due to abundance of polyphenols such as anthocyanin or

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tannins[10].The leaf is reputed for its haematinic, anti-anaemic and anti-sickling activity[11,9]. According to [12], the anti-sickling activity of the leaf is attributed to its richness in anthocyanin. The antioxidant and anti-inflammatory activities of the leaf is also known [10, 13]. *Jatropha tanjorensis,* on the other hand belongs to the "Euphorbiaceae" family [14]. It is popularly known as "Reverend father`s vegetable" or "Catholic vegetable" [15].It is commonly known as "Hospital too far" among Nigerians owing to its quick miraculous haematinic activities in anaemic conditions. Its anti-anaemic and hematological activity is popular and has been well researched [16-18]. Other studies have investigated the antidiabetic, pro-antioxidant and antioxidant activity of the leaf [19, 20].

The present study evaluated the phytochemical, proximate, mineral, anti-nutrient and amino acid compositions of ethanol-water leaf extracts of *J. secunda* and *J. tanjorensis*

2. Material and methods

2.1. Plant Collection and Identification

Fresh leaf samples of *J. secunda* and *J. tanjorensis* were collected from a garden at Ichi-ukwu autonomous community in Isiala Ngwa South, Abia State, South-Eastern Nigeria. The leaves were identified and botanically authenticated by Mr. Iwueze Francis Onyemauche a taxonomist with the department of Forestry and Wildlife, Federal University of Technology, Owerri. Samples of *J. secunda* and *J. tanjorensis* with voucher numbers FUTO/FWT/ERB/2021/63 and FUTO/FWT/ERB/2021/62 respectively were deposited in the Department's herbarium.

2.2. Plant Preparation and Extraction

The fresh leaf samples of *J. secunda* and *J. tanjorensis* were washed with distilled water and air-dried for 3 weeks. The dried leaves were double blended into fine powder using electric blender (ES-BL-090/350W/220-240V/50Hz /China) and stored in a sterile polythene bag until further use. Soxhlet extraction was used and the extraction solvent was ethanol-water (Et-OH) (80:20v/v). About 100g of each powdered leaf sample was placed in the soxhlet apparatus. The extraction was carried out using 1000mL of 80% V/V of Et-OH for 4 hours. After the extraction process, the suspensions were filtered and concentrated using a rotary evaporator (Heidolph Rotavapor, Germany).

2.3. Qualitative Phytochemical Screening

The leaf samples were subjected to qualitative phytochemical analysis to identify the presence of alkaloids, saponins, flavonoids, tannins, resins, glycosides and terpenoids using standard analytical techniques.

2.3.1. Wagner`s reagent test for alkaloids

The filtrate was pipetted into a test tube with 1.0 ml. Wagner's reagent was then pipetted into the test tube in an additional 1.0 ml, carefully mixed, and checked for color change. A reddish brown precipitate indicated the presence of alkaloids [21].

2.3.2. Frothing test for Saponin

In a water bath, 2g of the powdered sample was boiled in 20ml of distilled water and filtered. To produce stable, enduring foam, 10ml of filtrate was combined with 5ml of distilled water and rapidly shaken. Three drops of olive oil were added to the mixture, which was then rapidly shaken before being observed. The formation of an emulsion after the addition of 3 drops of olive oil yielded a positive result [22].

2.3.3. Alkali test for Flavonoids

A test tube was pipetted with 1.0 ml of the extract. The same test tube was then pipetted with 1.0 ml of diluted NaOH solution, stirred, and observed for color change. Formation of precipitate showed positive test[23]

2.3.4. $FeCl_3$ test for Tannins

About 0.5g of each sample was stirred with distilled water of about 10ml and then filtered. To 2ml of the filtrate, few drops of 1% ferric solution was added. Formation of green, blue-black or blue-green precipitate showed positive test [21].

2.3.5. Precipitation Test for Resins

Using 15ml of 90% ethanol, 0.2g of the powdered leaf samples were extracted. In a beaker, the alcoholic extract was then combined with 20ml of distilled water. Precipitate formation yielded a positive result [24].

2.3.6. Test for glycosides

To 10 cm3 of 50% H_2SO_4, 1.0 ml of the extract was added, and the mixture was heated for 5 minutes in boiling H_2O. It was mixed with 10cm3 of Fehling's solution, which was made up of 5cm3 of each solution A and B. A brick- red precipitate indicating presence of glycosides was observed [25].

2.3.7. Salkowiski test for Terpenoids

Concentrated H_2SO_4(3ml) was carefully added to produce a layer after 5.0ml of each extract was carefully added to 2ml of chloroform (Numex, India). A reddish brown coloration of the interface was formed to show positive results for the presence of terpenoids [22].

2.4. Quantitative Phytochemical and Anti-nutrient Screening using Gas Chromatography with Flame Ionization Detector (GC-FID)

The phytochemical analysis was carried out on a BUCK M910 Gas chromatography fitted with a flame ionization detector (FID). A 15-meter RESTEK MXT-1 column (15m x 250µm x 0.15µm) was used. The injector temperature was 280°C, with a splitless injection of 2µL of sample and a linear velocity of 30cms^{-1}, and the carrier gas was Helium 5.0 Psi at a flow rate of 40 ml/min. The oven initially operated at 200°C but was heated to 330°C at a rate of 30°C per minute for 5 minutes. The detector was set at 320°C. The ratio of the area and mass of the internal standard to the area of the identified phytochemicals was used to determine the phytochemicals [26].The concentration of the various phytochemicals contained in the extract was expressed as µg/g.

2.5. Proximate Analysis

Ash, moisture, crude fibre and protein contents were assessed by the methods described by [27]. Crude fat content was determined as described by [28].Carbohydrate content was determined using differential method according to [29].All the estimations were performed in triplicates.

2.6. Mineral Analysis using Atomic Absorption Spectrometry (AAS)

Sample digestion was done according to [30].The mineral compositions were assessed using FS240AA agilent atomic absorption spectrophotometer using the method described by [31].

2.7. Determination of Amino acid composition

The amino acid composition of the leave samples was determined using HPLC by derivatization with phenylisothiocianate and high performance liquid chromatography as described by [32].A Spectra Physics (San Jose, CA) HPLC apparatus with an 8700 XR ternary pump, a 20-µL Rheodyne (Cotati, CA) injection loop, an SP8792 column heater, an 8440 XR UV-vis detector, and a 4290 integrator linked via Labnet to a computer running on WINner 8086 software was used (operating system, MS.DOS version 3.2). A 250 x 4.6 mm column packed with 5 µm Spherisorb C1 8 (Sugelabor, Madrid, Spain) was used for separation. The derivatization was performed according to [33].

2.8. Statistical analysis

Analyses were done in triplicates and results expressed as mean ± SD. Data was analyzed by students' t-test using GraphPad Prism version 5.0.

3. Results and discussion

Table 1 Phytochemicals present in ethanol-water leaf extracts of *Justicia secunda* and *Jatropha tanjorensis*

Parameters	***Justicia secunda***		***Jatropha tanjorensis***	
	Observation	**Remark**	**Observation**	**Remark**
Alkaloid	++	High	++	High
Saponin	+	Low	++	High
Flavonoids	++	High	++	High
Tannin	++	High	++	High
Resin	+	Low	+	Low
Cardiac glycoside	+	Low	++	High
Terpenoids	+	low	+	Low

Key **++** = High **+** =Low

Table 2 Distribution of phytochemicals and antinutrient factors (µg/ml) in ethanol-water leaf extracts of *Justicia secunda* and *Jatropha tanjorensis*

Component (µg/ml)	***Justicia secunda***	***Jatropha tanjorensis***	**T-value**	**P-value**	**Comment**
Sapogenin	6.76 ± 0.24	14.13 ± 0.39	27.88	<0.0001	Significant
Naringenin	4.09 ± 0.09	26.21 ± 0.23	155.10	<0.0001	Significant
Anthocyanin	6.68 ± 0.75	11.35 ± 0.51	8.918	0.0009	Significant
Epihedrine	0.01 ± 0.30	4.67 ± 0.82	9.244	0.0008	Significant
Dihydrocytisine	8.07 ± 0.82	8.38 ± 0.48	0.5651	0.6022	Not Significant
Kaempferol	4.72 ± 0.51	6.09 ± 0.39	3.696	0.0209	Significant
Cynogenic glycoside	5.13 ± 0.54	7.83 ± 0.25	7.859	0.0014	Significant
Aphylidine	5.55 ± 0.23	12.77 ± 0.40	27.10	<0.0001	Significant
Steroid	4.35 ± 0.39	15.75 ± 0.19	45.52	<0.0001	Significant
Tannin	18.88 ± 0.28	26.12 ± 0.15	39.48	<0.0001	Significant
Flavonones	6.58 ± 0.27	9.04 ± 0.17	13.35	0.0002	Significant
Catechin	3.97 ± 0.16	24.40 ± 0.06	207.10	<0.0001	Significant
Flavone	7.08 ± 0.50	7.36 ± 0.35	0.7946	0.4713	Not Significant
Proanthocyanidin	6.21 ± 0.71	8.16 ± 0.19	4.595	0.0101	Significant
Ribalinidine	9.14 ± 0.34	18.27 ± 0.16	42.08	<0.0001	Significant
Spartein	2.76 ± 0.22	4.34 ± 0.18	9.627	0.0007	Significant
Cardiac glycoside	3.00 ± 0.45	10.34 ± 0.43	20.43	<0.0001	Significant
Phytate	4.15 ± 0.59	7.74 ± 0.11	10.36	0.0005	Significant
Oxalate	2.53 ± 0.37	3.22 ± 0.15	2.993	0.0402	Significant
Ammodendrine	5.99 ± 0.28	22.36 ± 0.11	94.25	<0.0001	Significant

Table 3 Proximate composition (%) of ethanol-water leaf extracts of *Justicia secunda* and *Jatropha tanjorensis*

Parameter (%)	*Justicia secunda*	*Jatropha tanjorensis*	T-value	P-value	Comment
Moisture	6.37 ± 0.09	5.32 ± 0.07	15.95	<0.0001	significant
Fibre	4.62 ± 0.04	5.22 ± 0.05	16.23	<0.0001	significant
Ash	8.89 ± 0.07	9.79 ± 0.09	13.67	0.0002	significant
Fat	8.45 ± 0.03	7.65 ± 0.04	27.71	<0.0001	significant
Protein	10.15 ± 0.10	9.80 ± 0.07	4.966	0.0077	significant
Carbohydrate	61.52 ± 0.12	62.22 ± 0.14	6.575	0.0028	significant

Values are mean ± standard deviation of triplicate determinations.

Table 4 Mineral composition (mg/kg dry weight) of ethanol-water leaf extracts of *Justicia secunda* and *Jatropha tanjorensis*

Parameter (mg/kg dry weight)	*Justicia secunda*	*Jatropha tanjorensis*	T-value	P-value	Comment
Sodium	6.48 ± 0.10	6.99 ± 0.12	5.655	0.0048	Significant
Potassium	8.49 ± 0.08	8.58 ± 0.10	1.217	0.2904	Not Significant
Calcium	5.68 ± 0.07	5.99 ± 0.09	4.709	0.0092	Significant
Magnesium	9.39 ± 0.10	8.48 ± 0.08	12.31	0.0003	Significant
Copper	0.79 ± 0.03	0.67 ± 0.04	4.157	0.0142	Significant
Zinc	0.79 ± 0.04	0.67 ± 0.05	3.246	0.0315	Significant
Iron	1.99 ± 0.08	1.67 ± 0.06	5.543	0.0052	Significant
Manganese	0.57 ± 0.02	0.53 ± 0.03	1.922	0.1270	Not Significant

Values are mean ± standard deviation of triplicate determinations

Table 5 Amino acids composition (µg/g) of ethanol-water leaf extracts of *Justicia secunda* and *Jatropha tanjorensis*

Amino acids (µg/g)	*Justicia secunda*	*Jatropha tanjorensis*	T-value	P-value	Comments
Essential Amino Acids					
Valine (Val)	4.75 ± 0.03	4.74 ± 0.03	0.4083	0.7040	Not Significant
Threonine (Thr)	3.57 ± 0.08	2.98 ± 0.03	11.96	0.0003	Significant
Isoleucine (Ile)	2.85 ± 0.04	4.74 ± 0.07	40.60	<0.0001	Significant
Leucine (Leu)	2.65 ± 0.09	2.98 ± 0.03	6.025	0.0038	Significant
Lysine (Lys)	3.85 ± 0.04	3.74 ± 0.09	1.934	0.1252	Not Significant
Methionine (Met)	1.50 ± 0.03	1.54 ± 0.02	1.922	0.1270	Not Significant
Phenylalanine (Phe)	3.74 ± 0.09	5.78 ± 0.04	35.88	<0.0001	Significant
Histidine (His)	4.76 ± 0.08	2.89 ± 0.05	34.33	<0.0001	Significant
Tryptophan (Trp)	1.79 ± 0.09	1.24 ± 0.05	9.253	0.0008	Significant
Non-Essential Amino Acids					
Glycine (Gly)	4.85 ± 0.03	2.44 ± 0.09	44.00	<0.0001	Significant
Alanine (Ala)	3.84 ± 0.07	2.38 ± 0.02	34.74	<0.0001	Significant
Serine (Ser)	2.57 ± 0.04	3.84 ± 0.09	22.33	<0.0001	Significant

Proline (Pro)	3.69 ± 0.09	4.78 ± 0.04	19.17	<0.0001	Significant
Aspartate (Asp)	2.89 ± 0.03	2.21 ± 0.08	13.79	0.0002	Significant
Glutamate (Glu)	2.75 ± 0.03	4.69 ± 0.04	67.20	<0.0001	Significant
Arginine (Arg)	2.74 ± 0.05	3.49 ± 0.06	16.63	<0.0001	Significant
Tyrosine (Tyr)	2.92 ± 0.02	2.97 ± 0.09	1.369	0.2428	Not Significant
Cystine (Cys)	2.74 ± 0.03	1.44 ± 0.06	33.57	<0.0001	Significant

Table 1 shows the results of the qualitative phytochemical screening of ethanol-water leaf extracts of *J. secunda* and *J. tanjorensis*. From the table, it can be observed that both plant extracts contain high levels of alkaloids, flavonoids, and tannins. *Jatropha tanjorensis* extract was found to have higher levels of saponins, cardiac glycosides, and terpenoids, compared to *Justicia secunda*. The result is comparable to those of [34,35] and [36] who reported the presence of the similar phytochemicals as revealed by this study in various leave extracts of *J. secunda* and *J. tanjorensis* respectively. These phytochemicals are secondary metabolites isolated from plants that have been shown to provide health benefits for humans, such as the prevention or treatment of diseases [37]. Alkaloids are a class of plant-friendly compounds. They are useful for warding off parasites and predators [38] and have also been shown to have anti-asthmatic, anticancer, and antimalarial properties [39] .While alkaloids can be toxic, they have been shown to have vasodilatory, antihyperglycemic, cholinomimetic, antiarrhythmic[40], antimicrobial, and analgesic characteristics[41,42] . Tannins are important secondary metabolites of plants with different medicinal importance. Because of their astringent and haemostatic qualities, they help wounds heal faster and reduce mucus membrane inflammation [37].Additionally, tannins have been shown to be powerful and long-lasting antioxidants [43].Tannins impede digestion of proteins in foods by forming complexes with digestive enzymes [44]. Saponins, on the other hand, are a type of potent expectorant that are crucial in the treatment of inflammations of the upper respiratory tract. Anti-fungal and anti-diabetic activities have also been attributed to them [45]. Saponins are characteristically foamy hence known as natural detergents. Cholesterol-lowering effects of saponins have also been studied [46].Terpenoids are thought to be the most prevalent chemicals in natural products, with a variety of medicinal and pharmacological functions such as anti-tumor, anti-inflammatory, antibacterial, antiviral, and hypoglycemic properties [47].They have also been shown to have wide anti-cancer capabilities [48].Cardiac glycosides are steroids that have the capability to operate specifically and strongly on the heart muscles. A minute amount is just potent enough to stimulate healing of a heart that has been damaged by disease [49].They are crucial for treating congestive heart failure. Without increasing oxygen consumption, they promote free cardiac contraction. As a result, the myocardium improves its pumping ability and can keep up with the needs of the cardiovascular system [50].

Table 2 shows the quantitative phytochemical and anti-nutrient compositions of *Justicia secunda* and *Jatropha tanjorensis.* The result indicated a significant difference (P< 0.05) in the values of all phytochemicals and anti-nutrients in both leave extracts except in the values of dihydrocystistine (8.07 ± 0.82 µg/ml and 8.38 ± 0.48 µg/ml) and flavone (7.08 ± 0.50 µg/ml and 7.36 ± 0.35µg/ml) which showed no significant difference (P>0.05). The concentrations of all the identified phytochemicals and anti-nutrient factors were higher in *Jatropha tanjorensis*. The most abundant anti-nutrient detected in both leaf extracts was tannin (18.88 ± 0.28 µg/ml and 26.12 ± 0.15 µg/ml), followed by phytate (4.15 ± 0.59 µg/ml, and 7.74 ± 0.11 µg/ml) and then oxalate (2.53 ± 0.37 µg/ml, and 3.22 ± 0.15 µg/ml). Tannins are regarded as anti-nutrients because they cause proteins to clump together, making them hard to be digested and thereby reducing the amount of amino acids in the body. This happens when the hydroxyl group of tannins and the carbonyl groups of proteins form reversible or irreversible tannin-protein complexes [51]. Ingestion of tannins leads to production of a variety of digestive enzymes which consequently results in reduced protein digestion [52].With reference to the report of [53], the levels of phytate detected in both leaf extracts falls within the tolerable range. [53] had stated that ingestion of 2.5g or more of phytic acid per day could cause a decrease in bioavailability of certain mineral elements such as magnesium, calcium, zinc and iron. The result obtained from this study is lower than that of [35] who reported higher values of tannin, phytate and even cyanogenic glycosides in ethanol leave extracts of *J. carnea* and *J. secunda.* Nwachukwu [54] has also reported a higher value of phytate in *J. tanjorensis.* Phytates have been linked to the elimination of phosphorus and the production of indigestion and flatulence in humans [55]. An insoluble salt is formed when oxalate is present in food, which both irritates the tongue and prevents the body from absorbing divalent metallic cations like calcium and iron [56]. In the case of calcium, it prevents calcium from performing its usual biochemical and physiological duties, such as maintaining healthy bones and teeth, acting as a cofactor in enzyme reactions, clotting factors, and nerve impulse transmission. In addition, eating foods high in oxalate can lead to hyperoxaluria, which increases the likelihood of developing kidney stones [57, 58].

The results of proximate composition (%) of ethanol-water leaf extracts of *Justicia secunda* and *Jatropha tanjorensis* are shown in table 3. The result showed a significant (P< 0.05) difference in the percentage moisture, fibre, ash, fat, protein and carbohydrate composition of both leaves. The results showed that *Justicia secunda* has higher moisture (6.37%), fat (8.45%), and protein (10.15%) while *Jatropha tanjorensis* has higher ash (9.79%) and fibre (5.22%) contents. Both leaves are rich sources of carbohydrates with *Jatropha tanjorensis* having a slightly higher percentage at 62.22% as against 61.52% seen in *Justicia secunda.* It could also be seen that for both leaves, the main nutritional constituent followed this order: carbohydrate (62.22% /61.52%) > protein (10.15%/9.80%) > ash (9.79%/8.89%) > fat (8.45%/7.65%) > moisture (6.37%/5.32%) > fibre (5.22%/4.62). Similar to our findings, [59, 60] have reported carbohydrate as the highest nutritional constituent of *Justicia secunda* leaves. Conversely this study found a higher percentage of carbohydrate than in theirs. [35] reported fibre and ash respectively as the major nutritional constituent of *Justicia secunda* root, as against our findings that, carbohydrate was the major nutritional constituent of ethanol-water leaf extract of *Jatropha tanjorensis* (62.22%). In the same vein, [61] reported protein (41.65%) and fat and oil (36.73%) as the major nutritional constituents in the leaves of *Jatropha tanjorensis.* In an entirely different study, [54] and [62] reported moisture contents of 81.62% and 80.59% respectively as the major nutritional constituents of *Jatropha tanjorensis* leaves. The result suggests that both leaves could serve as good dietary sources of carbohydrate to humans and omnivorous animals, providing a cheap and good source of energy. Carbohydrates yield glucose on hydrolysis which serves as an important and immediate source of energy and may be stored in the liver and muscles to be mobilized and utilized when needed by the body [63].It could also be seen from the result that both leaves are not excellent sources of protein. This is in accordance to [64] who stated that plant foods are considered good sources of protein only if more than 12% of their caloric value is made up of protein. Nevertheless, both leaves could still be fair sources of dietary or protein supplements, especially for vegetarians, people who live in rural areas, and people who are protein deficient. In humans, dietary fibers have a significant impact on blood cholesterol levels [65]. *Justicia secunda* leaves had a fat content of 8.45 ± 0.03% while *Jatropha tanjorensis* leaves had a fat content of 7.65 ± 0.04 %. Because the leaves are low in fat, they can be included in diets for those that aim to lose weight. The findings indicated that *Jatropha tanjorensis* and *Justicia secunda* leaves are poor sources of plant-derived fats. Fats and oil are essential in human health as they serve as sources of energy and components of biological membranes [66]. Any food's moisture content is an indicator of its water activity [67].The amount of moisture in a product determines its stability and vulnerability to microbiological contamination and spoilage [68]. Because both leaves have low moisture content, they can be stored for a longer duration of time without deterioration.

Table 4 shows the result of mineral composition of ethanol-water leaf extracts of *Justicia secunda* and *Jatropha tanjorensis*. *Justicia secunda* extract had significantly higher levels of magnesium, copper, zinc, iron, and calcium than *Jatropha tanjorensis* extract. Sodium levels were significantly higher in *Jatropha tanjorensis* extract. Among these mineral elements identified, sodium (Na), potassium (K), calcium (Ca) and magnesium (Mg) are macro minerals while copper (Cu), Zinc (Zn), Iron (Fe) and Manganese (Mn) are essential trace elements or minerals. Expectedly, both leaves contain more macro minerals than microelements. The result of the mineral composition analyses of the leaves of *J. secunda and J. tanjorensis* shown here is not comparable to that of [60] who had earlier reported a higher mineral composition in leaves of *Justicia secunda* except for magnesium which is higher in this study. Another higher mineral composition in *J. secunda* was reported by [62].Their findings indicated the highest amount of calcium (98.10 mg/kg) reported so far in *J. secunda*, followed by iron which they reported as 35.34 mg/kg. They went further to report potassium and zinc as (13.73 mg/kg) and (13.83 mg/kg) respectively. In yet another investigation, [34] reported mineral compositions lesser than the findings from this study both for macro minerals and micro minerals. Okunade and Adesina [69] reported higher sodium (9.33mg/100g), magnesium (33.30 mg/100g), potassium (110.30 mg/100g) and lesser calcium (1.38± mg/100g), iron (1.22 mg/100g), zinc (0.01 mg/100g) in leaves of *Jatropha tanjorensis*. The significant differences observed in the mineral composition of the two plant species may be due to various factors such as soil composition, plant genetics, and environmental factors. The minerals detected in this study are essential for various physiological functions in the human body. Sodium and potassium are complementary macro minerals. As one of the principal electrolytes in the blood, sodium contributes to the contraction of muscles, maintenance of acid-base balance, the transmission of nerve impulses, and the control of plasma volume [70]. *J. secunda and J. tanjorensis* can be relied upon to supply fair amount of sodium as a means of dietary supplementation. Just like sodium, potassium plays pivotal roles in transmission of nerve impulses and contraction of skeletal muscle [71].Calcium promotes blood clotting, muscle contraction and relaxation, vitamin B12 absorption, and strong teeth and bones[71].Magnesium is utilized in a variety of biological processes, serving as a cofactor in over 300 enzyme systems that govern various biochemical processes in the body, including protein synthesis, muscles and neuron functions, blood sugar balance, and blood pressure regulation[72]. Additionally, it aids in the synthesis of RNA, DNA and glutathione, an important antioxidant [73].The recommended dietary allowance (RDA) for magnesium is 400 and 320 mg/day for healthy adult males and females respectively [74] .Cu is an essential trace mineral in both plants and animals[75]. A minute amount of 150mg of this essential mineral is contained in the human body [75]. In the gut, copper is absorbed and subsequently transferred to the liver coupled to albumin. The recommended dietary allowance (RDA) for Cu is 2mg/day in healthy

adults [76]. Zinc is a vital mineral that helps metabolism and cell growth by acting as a cofactor for enzymes. Nearly 300 different enzymes require Zn .The RDA for Zn is 8mg/day for women and 11mg/day for men [77]. Another important mineral assessed was iron. Iron is the most abundant metal in the human body [75].Fe concentration in the body is roughly 3 to 4 grams, which is virtually equivalent to a concentration of 40 to 50 milligrams of iron per kilogram of body weight [78].The most of the iron in the body is housed within hemoglobin. The distinctive red color of blood is attributable to the presence of Fe in the hemoglobin. Iron is also a crucial component of myoglobin. Iron is essential for development, synthesis of certain hormones, connective tissues, normal cellular functions, growth and development [79]. Men and post-menopausal women have an iron RDA of 8mg per day, whereas menstruating women have an iron RDA of 18mg per day [80].This is because of the frequent high blood volume loss during their monthly period. Manganese (Mn) is another important trace mineral found in the body in a minute quantity. About 12mg of Mn can be found in a typical human body. The skeletal system contains roughly 43% of the body's manganese, with the remainder distributed throughout soft tissues such as liver, pancreas, kidneys, brain, and central nervous system [81]. Manganese aids in the formation of bones, sex hormones, connective tissues and blood-clotting factors [82].

Table 5 shows the result of amino acid compositions of ethanol-water leaf extracts *Justicia secunda* and *Jatropha tanjorensis*. Among the eighteen amino acids identified, nine belonged to the special class of essential amino acids (EAA) while the remaining nine were of non-essential amino acids (NEAA). The highest essential amino acid found in *Justicia secunda* was valine followed by histidine, lysine and phenylalanine while phenylalanine, valine, isoleucine and lysine were the highest occurring essential amino acids in *Jatropha tanjorensis* .The highest non-essential amino acids (NEAA) identified in *Justicia secunda* was glycine, followed by alanine, proline and aspartate while proline, glutamate, arginine and tyrosine were the most abundant in *Jatropha tanjorensis*. The result obtained in this study were lower in comparison to the values of amino acids of some important medicinal plants that are also used as blood boosters such as, the seeds of *Mucuna pruriens* [83], *Telfairia occidentalis, Amaranthus hybridus* and *Solanum aethiopicum* [84, 85]. However, the methionine composition of *A. hybridus and T. occidentalis* as reported by [85] were lesser than the values reported in the present study. In another study, [86] identified only four amino acids namely; asparagine, proline, cysteine and histidine in *Jatropha curcas,* an important member of the *Jatropha* family. Amino acids are essential biomolecules required for protein building in the body. Each amino acid whether essential or non-essential plays a critical role in disease prevention as well as in the transportation of nutrients [87].

4. Conclusion

The results obtained from this study have shown the richness of *Justicia secunda* and *Jatropha tanjorensis* in phytochemicals and essential plant-based nutrients. Both plants showed substantial amounts of alkaloids, tannins and flavonoids. *Jatropha tanjorensis* showed higher amount of saponin and cardiac glycoside. Anti-nutrient factors such as phytate and oxalate where also detected in higher quantity in *Jatropha tanjorensis* than in *Justicia secunda*. Both plants contained significant amounts of carbohydrate, amino acids and a fair content of important mineral elements such potassium, magnesium and sodium. These findings therefore validate the richness of both plants in essential phytochemicals and other beneficial plant-based nutrients and so lend credence to their traditional medicine`s usage in treatment and management of diverse ailments and as sources of dietary food supplements.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors declare no conflict of interest.

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