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AN ASSESSMENT OF NUTRIENTS AND PHYTOCONSTITUENTSIN JATROPHA TANJORENSIS LEAF–STALK

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Abstract. The leaf stalk of *Jatropha tanjorensis* was analyzed for its nutritional andphytochemical compositions using standard analytical procedures. The proximate composition of the sample showed 38.48% carbohydrate and 23.44% ash content. Vitamin C (51.78 mg/100g) was the most abundant vitamin in the sample. The result of the mineral composition showed potassium (974.2 mg/100g) as the most abundant mineral and magnesium (0.81 mg/100g) as the least abundant. Phytochemical analysis indicated the presence of alkaloids, flavonoids, polyphenols, saponins and phytate.A total of eighteen (18) amino acids were found with glutamic acid having the highest concentration of 16.28g/100g of protein, while tryptophan was found to be the lowest with a concentration of 1.32g/100g of protein. Thepolyunsaturatedfatty acidswere found in high concentration. These results revealed that the stalk of *Jatropha tanjorensis* contains an appreciable amount of nutrients and phytochemicals capable of promoting good health.

Key words: *Jatropha tanjorensis*, leaf–stalk, chemical composition, Nutrient, Phytochemical.

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Introduction

Some plants, apart from serving as food, have also been known to exhibit medicinal properties [1]. Proteins and fats as well as vitamins and minerals are made available to man and other animals through green plants [2]. There are many plants including green leafy vegetables that have several health benefits and nutritional value for mankind [3]. Nigeria is endowed with a variety of indigenous green leafy vegetables which are consumed by various groups for different reasons; they serve as an indispensable partof the human diet. It supplies the body with nutrients and certain hormone precursors. *Jatropha tanjorensis* is an exotic plant which belongs to the *euphobiacea* family and is widely grown in Southern Nigeria. It has been given different local names by different peoplefrom different geographical regions and some of these names include; 'Iyana–ipaja','Lapalapa', 'catholic' vegetable and 'hospitaltoofar' which is popularly called by the local peoplein Benin [4]. Earlier studies on *J. tanjorensis* leaf revealed that it contains bioactive properties such as alkaloids, flavonoids, tannins, saponins [5].It also contains important mineral elements such as iron, potassium etc. [6]. Numerous studies have reported several therapeutic effects of *J. tanjorensis* which have necessitated the preliminary analysis of its constituents. Notwithstanding numerous studies on the leaf of *J. tanjorensis*, no study to date has characterized the nutritional analysis or phytoconstituents of *J. tanjorensis* leaf–stalk. Therefore, this study was carried out to investigate the nutrient and phytochemical compositions of *J. tanjorensis* leaf stalk.

Materials

1. Collection of plant materials and Identification

A fresh plant sample of *Jatropha tanjorensis* was obtained from a compound around Rukpokwu, Port Harcourt in Obio/Akpor L.G.A of Rivers State. The plant was identified by Mr. ChimezieEkeke at the Department of Plant Science and Biotechnology, University of Port Harcourt, Rivers State.

2. Sample preparation

The fresh plant sample was separated, by detaching the leaf from the stalk and the stalk from the stem. The stalk of the fresh plant was sliced into bits, air–dried at room temperature (25°C–27°C), ground using a grinding mill with Tigmax petrol engine –(GX 160–5.5HP) into a powdered form which was then sieved to obtain a smooth powder size <0.05mm.

Methods

1. Proximate analysis and mineral contents determination

The leaf–stalk of *J. tanjorensis* was analysed for proximate composition following the AOAC, [8] method. The minerals were determined using Varian AA240 Atomic Absorption Spectrophotometer according to the method of AOAC [8].

2. Determination of Vitamin

With slight modification, 100g of the sample wasanalysed for vitamin contents as described by AOAC [9].Aqueous extracts (1ml) were used for the determination of the water soluble vitamins, while n–hexane served as the extraction medium for the determination of fat soluble vitamins. A gas chromatography machine (HP6890) was used for the analysis of the vitamins, under the following conditions;

Detector: pulse flame photometric detector (PFPD) maintained at a temperature of 320°C.

Column (HP–5) dimensions: 30m x 25mm x 25μm

Carrier gas: Nitrogen (1.0ml/min flow rate at 30psi), split ratio of 20:1

Inlet temperature: 250°C

Oven temperature: 50°C for 2mins maintained at 320°C.

3. Determination of Fatty Acid Contents

Oils were obtained using Soxhlet extraction, with a mixture of n–hexane and isopropanol (3:2) as a solvent. To obtain the fatty acid methyl esters, the concentrated oil extracts were refluxed in H_2SO_4 (2%) in methanol at 70°C for 3 hours and quantitated in Agilent 6890N gas chromatography under the conditions: Flame Ionization Detector as detector type, HP INNOWAX as column type, with dimensions of 30m x 0.25mm x0.25μm. 1 ml split injection at a ratio of 20:1 was adopted, while the inlet and detector temperatures were 250°C and 320°C respectively. Nitrogen was 1.5ml/min as flowrate. The ratio of nitrogen and compressed air pressure were 22psi: 35psi. The preset oven conditions were 2min and 8min constant 1^{st} and 2^{nd} ramping at 12°C/min for 20 min and 15°C/min for 3min respectively. The peaks produced were matched with standard methyl esters for identification while the standard chemstation system was used for the computation of peak area percentages.

4. Amino Acid Determination

The amino acid analysis was carried out using a HPLC amino acid analyzer (Sykam–S7130) according to the method of Ogunka–Nnoka et al., [10].

5. Determination of protein quality parameters

The amino acid groups:Total amino acid (TAA), Total non–essential amino acid (TNEAA), total essential amino acids (TEAA) with His, Total aromatic amino acid (TArAA), Total basic amino acids (TBAA), Total basic amino acids (TBAA), Total acidic amino acids (TAAA), Total Sulphur amino acids (TSAA), and Total branched chain amino acids (TBCAA) were calculated from the amounts detected for each of the related amino acids.

For the calculation of the predicted protein efficiency ratios (P–PER) I, II and III, the formulas of Ijarotimiet al. [11] were adopted and stated below:

I. PER = –0.684 + 0.456 (Leu) – 0.047 (Pro)

II. PER = –0.468 + 0.454 (Leu) –0.105 (Tyr)

III. PER = –1.816 + 0.435 (Met) + 0.780 (Leu) + 0.211 (His) – 0.944 (Tyr).

The essential amino acid index (EAAI) was calculated following the method of Ogunka–Nnokaetal. (10) as shown from the formula below;

$$EAAI = 9\sqrt{\frac{mgoflysin\,1goftestproteinessentialaminoacids + His}{mgoflysin\,1gofreferenceprotein}}$$

6. Determination of phytochemicals

The sample extract were analysed for their constituent phytochemicals using a GC auto system buck 530 chromatographer as stipulated by Agomuo et al. [7]. The operating conditions were as follows:

Column: 100 m x 0.25 mm Hp88 capillary column

Injector: Automatic (1 ml), temperature of 220°C

Oven temperature: 180°C

The components were resolved and quantitated by comparing with internal standards.

Calibration curve for each metal was prepared by plotting the absorbance of standards versus their concentrations.

Results

The results of the proximate composition of *J. tanjorensis* leaf–stalk are presented in Table 1 The result showed 5.39% for moisture, 9.45% for protein, 4.67% for fat, 18.55% for crude fibre, 23.44% for ash and 38.48% for carbohydrates.

Table 1: Proximate composition of *Jatropha tanjorensis* leaf–stalk

Parameter	Composition (%)
Moisture	5.39±0.16
Protein	9.45±0.32
Fat	4.67±0.21
Crude fibre	18.55±0.43
Ash	23.44±0.80
Carbohydrate	38.48±1.11

Values are mean ± standard deviation of triplicate determinations.

The results of the mineral composition of Jatropha tanjorensis are shown in Table 2. There were high concentration of potassium (974.20mg/100g), sodium (291.42mg/100g) and chloride (113.74mg/100g). The zinc content (28.42mg/100g)

was very high compared to the daily recommended allowance, while the iron, phosphorus, calcium, manganese, magnesium and copperwere 10.12mg/100g, 4.33mg/100g, 8.37mg/100g, 16.99mg/100g, 0.90mg/100g and 1.34mg/100g respectively

Table 2: Mineral composition of *Jatropha tanjorensis* leaf–stalk

Mineral	Composition (mg/100g)	** RDA Adult (mg/day)
Zinc	28.42±1.11	11
Iron	10.12±0.50	18
Phosphorus	4.33±0.29	ND
Chloride	116.59±9.12	ND
Sodium	286.49±6.25	1500
Calcium	8.37±0.28	1000
Potassium	974.59±19.50	4700
Manganese	16.99±0.40	2.3
Magnesium	0.90±0.09	420
Copper	1.34±0.22	0.89

Values are mean ± standard deviation of triplicate determinations
ND= Not Detected
***=Food and Nutrition Board, Institute of Medicine, National Academics (2011).*

The results of the vitamin composition of *J. tanjorensis leaf*–stalk are shown in Table 3.Thewater soluble vitamins B_1, B_2, B_3, B_5, B_6, B_9, B_{12} and vitamin C have values of 6.72%, 3.50%, 5.34%, 3.33%, 2.74%, 2.52%, 1.00% and 51.78% respectively. The fat soluble Vitamins (A,D,E,K) were 3.35%,3.98%, 3.43% and 4.22% respectively.

The results of the amino acid composition of J. tanjorensis stalk are presented in Table 4. The results showed leucine (5.22%), lysine (3.60%), Isoleaucine (2.33%), Phenylalanine (4.26%), tryptophan (1.32%), valine (3.36%), methionine (1.78%), arginine (7.48%) threonine (4.38%), histidine (2.37%) for the essential amino acids while proline (2.68%), tyrosine (2.21%), cysteine(2.05%), alanine (3.43%), glutamic acid (16.28%), glycine (5.15%), serine (4.19%), aspartic acid (6.86%) for the non–essential amino acids.

The result of fatty acid composition of *J. tanjorensis* stalk was presented in Table 5. Among the saturated fatty acids, palmitic acid had the highest concentration of 29.95% followed by stearic acid 11.03%, while the least was arachidic acid with the value of 0.01%. For the monounsaturated fatty acids, palmitoleic acid, oleic acid and eicosenoic acid the values were 1.23%, 2.48% and 0.02% respectively. For the polyunsaturated fatty acid, the fatty acids that were found include; linoleic acid (16.98%), gamma–linolenic

Table 3: Vitamin composition of *Jatropha tanjorensis* leaf–stalk

Vitamin	Value (mg/100g)	**RDA Adult (mg/day)
A	3.35×10^{-3}	0.6
D	3.98×10^{-6}	0.005
E	3.43×10^{-2}	10
K	4.22×10^{-4}	0.065
C	51.78	45
B_1	6.72×10^{-2}	1.2
B_2	3.50×10^{-1}	1.3
B_3	5.34×10^{-1}	16
B_5	3.33×10^{-2}	5
B_6	2.74×10^{-2}	1.3
B_9	2.52×10^{-2}	0.4
B_{12}	1.00×10^{-5}	0.0024

**= Food and Nutrition Board, Institute of Medicine, National Academics (1988)

acid (15.66%), alpha–linolenic acid (21.34%), while eicosatrienoic acid, eicosapentaenoic acid,arachidonic acid, and 13,16–docosadienoic acid were seen in a very low quantity of 0.01% each.

The results of the phytochemical analysis of *J. tanjorensis* stalk are shown in Table 6.There was a high concentration of ribalinidine(20.50%), followed by tannin(17.25%), rutin(14.26%), catechin(11.17%), kaempferol(7.93%), lunamarine(7.485%), epicatechin(6.23%), anthocyanin (5.89%), sapogenin (4.33%), saponin(3.24%), phenol(2.18%) and phytate(1.58%), while the lowestwas spartein(0.0002%).

Table 4: Amino acids composition of *Jatropha tanjorensis* leaf–stalk

Parameter	Concentration(g/100g)
Essential amino acids(EAA)	
Leucine	5.22
Lysine	3.60
Isoleucine	2.33
Phenylalanine	4.26
Tryptophan	1.32
Valine	3.36
Methionine	1.78
Arginine	7.48
Threaonine	4.38
Histidine	2.37
Non-essential amino acids (NEAA)	
Proline	2.68
Tyrosine	2.21
Cysteine	2.05
Alanine	3.43
Glutamic acid	16.28
Glycine	5.15
Serine	4.19
Aspartic acid	6.86
Glutamine	N.A
Asparagine	N.A
AMINO ACID GROUPS	
Total amino acid (TAA)	78.97
Total non-essential amino acid (TNEA)	42.85
Total essential amino acid (TEAA) with histidine	36.10
Total essential amino acid (TEAA) without His	33.73
Total aromatic amino acid (TArAA)	7.79
Total basic amino acid (TBAA)	13.45
Total acidic amino acids (TAAA)	23.14
Total Sulphur amino acid (TSAA)	3.83
Total branched chain amino acids (TBCAA)	10.91
Protein quality indices	
Predicted protein efficiency ratios (P-PER$_S$) 1	1.57
Predicted protein efficiency ratios (P-PER$_S$) 11	1.67
Predicted protein efficiency ratios (P-PER$_S$) 111	1.44
Essential amino acid index (EAAI)	3.18

Table 5: Fatty acid composition of *Jatropha tanjorensis* leaf–stalk

Name	Formula	Amount (%)
Saturated fatty acids		
Palmitic acid	C16:0	29.95
Stearic acid	C18:0	11.03
Arachidic acid	C20:0	0.01
Monounsaturated fatty acids		
Palmitoleic acid	C16:1(cis-9)	1.23
Oleic acid	C18:1(cis-9)	2.48
Eicosenoic acid	C20:1(cis-11)	0.02
Polyunsaturated fatty acids		
Linoleic acid	C18:2(cis-9,13)	16.98
Gamma-linolenic acid	C18:3(cis-6,9,12)	15.66
Alpha-linolenic acid	C18:3(cis-9,12,15)	21.34
Eicosatrienoic acid	C20:3(cis-8,11,14)	0.01
Eicosapentaenoic acid	C20:4(cis-11,14,17)	0.01
Arachidonic acid	C20:4(cis-5,8,11,14)	0.01
13,16-Docosadienoic acid	C22:2(cis-13,16)	0.01
Eicosapentaenoic acid	C20:5(cis-5,8,11,14,17)	0.01

Table 6: Phytochemical composition of *Jatropha tanjorensis* leaf–stalk

Component	Concentration (µg/g)
Alkaloids	
Sparteine	0.0002
Ribalinidine	20.50
Lunamarine	7.48
Flavonoid	
Anthocyanin	5.89
Rutin	14.26
Kaempferol	7.93
Polyphenols	
Phenol	2.18
Catechin	11.17
Epicatechin	6.23
Antinutrients	
Tannin	17.25
Saponin	3.24
Sapogenin	4.33
Phytate	1.58
Total	**100**

Discussion

The results obtained after nutritional profiling of the *J. tanjorensis* leaf–stalk encourage its potential nutritional applications. The low moisture content of the leaf–stalk of *J. tanjorensis* suggest that they can be stored for a period of time without spoilage since higher moisture content enhances microbial activities thereby bringing about rotting and the decay of vegetables [12]. However, high moisture content of vegetables facilitates food digestion as well as increases the activity of water soluble enzymes and co–enzymes needed for metabolism of these vegetables [13]. The moisture content obtained in this study was lower than those

for the leaves of *J. tanjorensis* as reported by Okunadeand Adesina [14]. The crude protein content found for the current plant under study was higher when compared to 3.33% indicated for the leaves of *Ocimumgratissimum* [15] but lower compared to 17.44% for *J.tanjorensis* leaves as reported by Okunadeand Adesina [14].Otitojuet al., [12], suggested that plant foods that provides more than 12% of protein for its calorific value are considered good sources of protein;thus, *J.tanjorensis* stalk is fairly a good source of protein. The ash content of *J. tanjorensis* stalk was higher compared to 12.66% reported by Okunadeand Adesina [14] for the leaves of *J. tanjorensis*. The relatively high value of the ash content obtained in the *J. tanjorensis* stalk is an indication that this leafy vegetable could be a good source of minerals for human nutrition. This assertion is in agreement with the report byFagbohun [16] that showed that high ash content in any food substance implies high mineral content. The carbohydrate content of *J. tanjorensis* stalk was lower compared to 62.68% as reported for *J. tanjorensis* leaves but comparable to *Bombaxbonopozense*(39.86%) and *sterculiatragacantha*(33.72%) [15]. The moderately high value of carbohydrate obtained in this study suggests that it could be a good source of energy and body fuel for daily activities.The potassium value (974.59mg/100g) was very high compared to those for the leaves of *J. tanjorensis* reported elsewhere [15]. According to FAO [17], the RDA for potassium for adult is 4700mg/day.Though the value obtained in this study was lower compared to the RDA, the stalk contains appreciableamounts of potassium levels for dietary needs. *J. tanjorensis* leaves according to Okunadeand Adesina [14], produced lower sodium than the *J. tanjorensis* stalk examined in this study, implying that this plant is a moderately good source of sodium. According to FAO [17], the RDA requirement for sodium is 1500mg/day for adults, though lower than the RDA, it can contribute to the sodium requirement of people within this age group. The variation of sodium and potassium is of significant importance to a hypertensive patient as it affectsblood pressure [18]. The iron level of *J. tanjorensis* stalk was higher compared to the leaves (8.65mg/100g) as reported by Egbon [19]. According to FAO [17] the recommended daily allowance for adults was comparable to the stalk of *J. tanjorensis*. This implies that the stalk of this plant can also be a good source of iron especially for this age group. The zinc content of *Jatrophatanjorensis* stalk was higher compared to the recommended daily allowance for an adult according to FAO, [17]. This means that reliance on the stalk of *J. tanjorensis* provides the adequate amount of zinc needed by this age group. FAO/WHO [20] reported that zinc is an essential component of a large number (>300) of enzymes participating in the synthesis and degradation of carbohydrate, lipids, proteins and nucleic acids as well as in the metabolism of other micronutrients. The result obtained for the vitamin analysis as presented in Table 3 shows that vitamin C content was higher when compared with the value obtained byOkunadeand Adesina [14] for *J. tanjorensis* leaves(42.22mg/100g). The RDA for vitamin C according to FAO [21], is 45mg/day for adults. From this result, this vegetable appears to be a good source of vitamin C that could provide adequate amount of vitamin C comparable to the RDA of adults. Also, the availability of reasonable amount of vitamin C in *J. tanjorensis* stalk provides a new source of antioxidants required for the maintenance of health and the prevention of conditions such as stress and prostate cancer [22].

The result obtained for the amino acid as presented in Table 4 showed that glutamic acid (Glu) had the highest concentration with a value of 16.28mg/100g, followed by arginine (7.48mg/100g) while tryptophan had the least value (1.32mg/100g). The glutamic acid value was higher than the value reported for *Ocimumgratissimum* (10.80mg/100g) by *Olubunmietal.*, [23]. Leucine has a value of (5.22%) which is higher when compared to spinach (3.57%). The importance of leucine as explained by Gold [24] are: healing and repair of muscle tissues, clotting at site of injuries, production of growth hormones, regulation of blood sugar, increasing endurance and provision of energy in the body. Gold [24], explained that phenylalanine is needed in treating brain disorder, normal functioning of the central nervous system, control of symptoms of depression and chronic pain, while tryptophan is important in the manufacture of neurotransmitter, (serotonin) which regulates mood and sleeppatterns, the treatment of jet lag, depression and binge eating [25]. The main fatty acids found in the sample were palmitic acid, stearic acid, linoleic acid, α–linolenic acid, and γ–linolenic acid. Palmitic acid was the most abundant saturated fatty acid found in the leaf stalkwhich was very high when compared to *Anchusaazurea*(10.45%) but higher than *silybummorianum*(28.69%). The WHO claims there is evidence that dietary intake of palmitic acid increases the risk of developing cardiovascular disease. On the contrary, Davis [26] demonstrated that palmitic acid has no hypercholesterolemic effect if the intake of linolenic acid is greater than 4.5% of energy. Among the polyunsaturated fatty acids, the predominant were linoleic acid, α–linolenicacid, γ–linolenic acid. The presence of thesepolyunsaturated fatty acid in the sample, will enhance the consumption of this vegetable due to their importance in the formation of healthy cell membranes, the proper development and functioning of the brain and nervous system and for the production of hormone–like substance called eicosanoids (thromboxane's, leukotriene, and prostaglandins).

These chemicals regulate numerous body functions including blood pressure, blood viscosity, and vasoconstriction, immune and inflammatory responses [27].

The result of the phytochemical content indicated the presence of alkaloids, flavonoids, polyphenols, and antinutrients. Alkaloids play some important metabolic role in living organisms, causing some physiological changes and are involved in protective function in animals, [28]. They have been shown to have important pharmacological functions such as anticancer, psychedelics and antimalarial [12]. Kaempherol an alkaloid, has been shown to have anti–ulcer, anti–inflammatory, antiviral and anti–cancer activities [27]. The leaf–stalk is rich in flavonoids, which are the most common polyphenols found in the human diet and which have been implicated in many human diseases including lipid lowering, hepato protective, anti–inflammatory,antimalarial and antimicrobial activities by acting as antioxidants [29]. Rutin a flavonoid has been shown to have anti–ulcer, antibacterial, antiviral, anti–allergic, and antithrombosis activities [27]. Though tannin decreases protein quality by reducing digestibility and palatability. Other anti–nutritional effects attributed to tannin include damage to the intestinal tract, andinterference with the absorption of iron and a possible carcinogenic effect [30]. However, the presence of tannin is essential for the treatment and prevention of diarrhoea, dysentery, and leucorrhoea [30]. Saponin has been generally reported to be very useful for the treatment of hyperglycemia, hypertension, hypercholesterol, the maintenance of bone health and helps in building up the immune system [27].The presence of these phytoconstituents in the leaf–stalk of J.tanjorensis showed that the plant part under investigation has therapeutic activity and could be a good source of newdrugs. This justifies the use of the stalk of *J.tanjorensis* in folk medicine for the treatment of malaria, typhoid fever, and other ailments.

Conclusion

From the data obtained from the analysis, since the stalk contains substantial amount of nutrients and also for their medicinal uses, it can be inferred that the inclusion of the stalk of *J. tanjorensis* in the human diet can contribute significantly to the nutrient requirement of a person,and also the presence of important phytochemicals which possess anti-inflammatory, antioxidant and other pharmacurative properties supports its use as a therapeutic agent.

Conflict of interest

None.

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