NUTRIENT AND ANTINUTRIENT COMPONENTS OF *JATROPHA TANJORENSIS (J.L ELLIS & SAROJA)*, AN UNCONVENTIONAL VEGETABLE IN NIGERIA*

M.O. BELLO [1], O.S. FALADE [2,+], S.R.A. ADEWUSI [2] and N.O. OLAWORE [1]
1. Department of Pure and Applied Chemistry, Ladoke Akintola University of Technology, Ogbomoso, Nigeria.
2. Department of Chemistry, Obafemi Awolowo University, Ile-Ife, Nigeria.

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Abstract
The proximate composition, mineral composition (Ca, Mg, K, Na, Fe, and Zn), ascorbic acid and antinutrients (Tannin, Trypsin, phytate and oxalate) content of both raw and blanched *Jatropha tanjorensis* (J.L Ellis & Saroja) were reported. The crude protein, crude fibre, ether extract, carbohydrate and ash are 24.6, 9.7, 4.5, 58.8 and 8.1 g per 100 g respectively, for raw sample. The crude protein, crude fibre, and ether extract increased by 24.6, 30.5 and 37.8% respectively, on blanching while blanching reduced carbohydrate and ash by 9.6 and 19% respectively. The vegetable had highest level of calcium (1.14 g per 100 g) while zinc was the lowest (0.04 g per 100g) among the elements analysed. Ascorbic acid was 502.2 mg per 100 g, which reduced by 64% on blanching. The levels of antinutrients are low (1.47 mg/g, 57.1 TIU/g, 0.43 mg/g and 2.46 g per 100 g) for tannin, trypsin, phytate and oxalate respectively, compared with some conventional vegetables. Blanching reduced all these antinutritional factors with the exception of oxalate which was increased by 40%. This vegetable has potential for complementing conventional vegetables.

Key words: *Jatropha tanjorensis*, proximate composition, mineral element, ascorbic acid, antinutritional factors.

1. Introduction

Green leafy vegetables constitute an indispensable constituent of human diets in Africa and West Africa in particular. Generally, they are consumed as cooked complements to the major staples like cassava, cocoyam, guinea corn, maize, millet, rice and plantains (Oguntona, 1986). Indeed, most of the meals based on these staples are considered incomplete without a generous serving of cooked green leaves because other sources of protein are becoming expensive and consequently out of the reach of most common man in Africa.

The conventional vegetables like Amaranth are becoming increasingly expensive and are seasonal. It is therefore necessary to source for cheaper unconventional vegetables that would serve as protein and nutrient sources and would be available even in the absence of conventional ones. One of such unconventional vegetables is *Jatropha tanjorensis* of the family *Euphorbiaceae*, the English name is chaya leaves and the local names are "Efo Iyanapaja" and "ewe Americana". *Jatropha tanjorensis* is popular in Mexico and originated in Central America. It has been introduced into the United States for potential uses as a leafy vegetable and or as a medicinal plant (Kuti *et al.*, 1996). This may inform its local name in Yoruba "ewe Americana"- meaning American leaf. associated with pancreatic enlargement, reduced digestibility, reduced absorption of amino acids and reduced bioavailability of essential minerals (Gatel and Grosjean, 1990).

The purpose of this study was thus to determine the proximate composition, the levels of nutritional and antinutritional compounds in both the raw and blanched forms of the vegetable. These will provide information on the nutritional value as well as the safety or otherwise of this vegetable.

2. Materials and Methods

Fresh leaves of *Jatropha tanjorensis* (chaya) were plucked from the plant within the campus of Obafemi Awolowo University.

The vegetable was washed with distilled water. A portion was diced and dried at 50 °C while the remaining portion was blanched by pouring hot water on it any allowed it to stand for 10 minutes before the broth was decanted as described earlier (Awoyinka *et al.*, 1995). Both the raw and blanched forms were grinded into powder using Kenwood food blender. The powdered samples were placed in desiccators and stored in the refrigerator prior to analysis. Fresh sample was used for ascorbic acid assay.

+ *corresponding author* (email: osfalade@oauife.edu.ng)

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Analytical Procedure:

Proximate analysis was conducted according to the official AOAC methods (1984), and carbohydrates determined by difference. A factor of 6.25 was used to convert nitrogen to protein.

Mineral:

Samples were digested as described earlier (Falade *et al.*, 2003). Each sample (0.5 g) was weighed in triplicate into Kjeldahl flasks and 10 mL of conc. HNO_3 was added and allowed to stand overnight. The samples were then heated carefully until the production of brown nitrogen (IV) oxide fume has ceased. The flasks were cooled and (2-4 mL) of 70 % perchloric acid was added. Heating was continued until the solutions turned colourless. The solutions were transferred into 50 mL standard flasks and diluted to the mark with distilled water. The mineral content was then analyzed by ALPHA 4 Atomic absorption spectrophotometer (Fisons Chem-Tech, Analytical, UK).

Antinutritional factors:

Tannin was determined by the modified Vanillin – HCl method using 1.0 mg/mL of Catechin in 1% HCl - MeOH as standard. The coloured substituted product was measured at 500 nm (Price *et al.*, 1978). Phytate was determined by the anion exchange method as described earlier (Harland and Oberlas, 1986).

Trypsin inhibitor was determined by the method of Kakade *et al.* (1974) as modified by Adewusi and Osuntogun (1991). A synthetic substrate (BAPNA) was subjected to hydrolysis by trypsin to produce yellow coloured p-nitroanilide. The degree of inhibition by the extract was measured at 410 nm using a UV-VIS Spectrophotometer (Unicam Heλios α, UK).

Oxalate was determined titrimetrically as described earlier (Falade *et al.*, 2004) by being precipitated as calcium oxalate and titrated against standard potassium permanganate. The oxalate was calculated as sodium oxalate equivalent.

Ascorbic Acid:

Ascorbic acid was determined colorimetrically as described earlier (Falade *et al.*, 2003), after the formation of the Osazone which was dissolved in 85 % H_2SO4 to give an orange-red coloured solution which is measured at 540 nm using a UV-VIS Spectrophotometer (Unicam Heλios α, UK) and compared to a standard curve prepared from 0-100 mg/L of ascorbic acid.

Statistical analysis:

Results were expressed as mean and standard deviation of three determinations. Data were subjected to unpaired t test (Welch's corrected) to determine the levels of significant difference and considered significant at $p < 0.05$ by using GraphPad InStat version 3.06 for Windows 2003.

3. Results and Discussion

Proximate compositions and ascorbic acid are presented in Table 1. The moisture content of *Jatropha tanjorensis* leaves was within the range of 79-89% reported for some Nigerian vegetables (Falade *et al.*, 2004). Aletor and Adeogun (1995) have reported the crude protein on dry weight basis within the range of 15-30% for most green leafy vegetables. The crude protein (CP) content reported here compared favourably with the value of 26% reported for both *Amaranthus viridis* and *Celosia argentea* (green variety) but higher than 21 % reported for *Cochorus olitorius* (Falade *et al.*, 2004). The increase in the CP value (24.6%) as a result of blanching is an indication that *Jatropha tanjorensis* leave could be a good source of dietary protein.

Leafy vegetables are known to be poor sources of fat. The ether extract reported for the *Jatropha tanjorensis* leaves was the lowest among the proximate components. It was however, higher than the ether extract of 3% reported for green variety of amaranthus and agreed with 4.5% ether extract reported for green variety of *Celosia argentea* (Falade *et al.*, 2004). Leafy vegetables are important sources of fibre among all categories of Nigerians.

Table 1: The proximate composition and ascorbic acid content of raw and blanched *Jatroph tanjorensis* (% dry weight).

	Raw	**Blanched**
Moisture	80.30 ± 0.90 [b]	77.63 ± 0.70 [a]
Protein	24.57 ± 0.18 [a]	29.33 ± 0.27 [b]
Crude Fibre	9.74 ± 0.34 [a]	12.71 ± 1.21 [b]
Ether Extract	4.52 ± 0.28 [a]	6.23 ± 0.71 [b]
Ash	8.08 ± 0.01 [b]	6.54 ± 0.03 [a]
Carbohydrate	58.75 ± 0.35 [b]	53.11 ± 2.98 [a]
Ascorbic Acid (mg per 100 g)	502.20 ± 4.60 [b]	182.91 ± 5.60 [a]

Values are means ± standard deviation of triplicate analysis.

Values in the same row with the same superscripts are not significantly different at the 5 % probability level.

Fibre has been reported to impair mineral availability (Fernandez and Phillips, 1982) though the positive effect of the fibre include the reduction of blood cholesterol and the glycemic index of carbohydrate sources (Liu *et al.*, 2000). The crude fibre content compared favourably with 9.7% reported for both *Adansonia digitata* (Oguntona, 1998) and *Solanum macrocarpon* (Falade *et al.*, 2004).

The ash content which is an indication of mineral content of sample was within the range of 5.0-13.0 % reported for some Nigerian vegetables (Falade *et al.*, 2004) but lower than 17.8% reported for amaranthus (Adewusi *et al.*, 1999). However, the increase in some of the nutrients composition on blanching may be due to the extraction of the water soluble components of the vegetable such as carbohydrates into the water used for the blanching hence concentration of other water insoluble components such as fat and some proteins. This is in agreement with earlier observation in some Nigerian vegetables (Adewusi *et al.*, 1999, Falade *et al.*, 2004). Eating green leafy vegetables can protect the body against oxidative stress because of the present of antioxidant compounds such as ascorbic acid and plant polyphenols such as vegetable tannins (Tapiero *et al.*, 2002). Ascorbic acid is an important antioxidant for the skin (Iqbal *et al.*, 2004). It fights wrinkles and helps the body produce and maintain healthy collagen an important component of connective tissue. The level of ascorbic acid in *Jatropha tanjorensis* leaves was on the high side compared with 165, 280, 341, 345 and 405 mg per 100 g reported for *Cochorus olitorious*, *Talinum triangulare*, *Telfaria occidentalis*, *Vernonia amygdalina and Amaranthus hybridus* respectively (Fafunso and Bassir, 1977). The value was also higher than the range of 70-468 mg / 100 g reported for some Nigerian conventional vegetables (Falade *et al.*, 2004). This shows that *Jatropha tanjorensis* could be a better source of dietary ascorbic acid compared with some conventional vegetables. Ascorbic acid has been reported to enhance mineral availability (Oladipo *et al.*, 2005) hence *Jatropha tanjorensis* is expected to enhance mineral availability from composite diets prepared from it.

The major antinutritional factors commonly found in leafy green vegetables are phytic acid and oxalic acid. High levels of either phytate or oxalates have long been known to inhibit the absorption and utilization of minerals (Adewusi and Falade, 1996). In addition to the negative effect of oxalic acid on mineral availability, it has also been implicated as a source of kidney stones (Chai and Liebman, 2004). This compound is not likely to pose any danger in *Jatropha tanjorensis* vegetable when compared with 8.7 and 17.8 g per 100g reported for *Amaranthus viridis* and purple variety of *Celosia argentea* two of the commonly consumed Nigerian vegetables respectively, (Falade *et al.*, 2004) and 10.2 and 32.6 g per 100 g levels reported for cabbage and sweet potato respectively, (Santamaria *et al.*, 1999). The significant increase ($p < 0.0001$) in oxalate (40%) after the blanching of the vegetable is expected. Oxalic acid is known to be sparingly soluble in water while the calcium form is not soluble at all. The increase could then be due to its concentration in the blanched sample. This is in agreement with the earlier observation in which maceration of Vernonia amygdalina lead to 20 % increase in oxalate content (Falade *et al.*, 2004). Phytate has been reported to block the action of a number of digestive enzymes such as pepsin (Knuckles *et al.*, 1989), á-amylase (Knuckles and Betschart, 1987) and lipase (Knuckles, 1988). The phytate content of this vegetable was equally low compared with 1.95 and 2.6 mg/g phytic acid reported for *Piper guineense* and *Vernonia amygdalina* (bitter leaf) respectively, (Udosen and Ukpanah, 1993) and some other plant foods such as cowpea with phytate content of 0.8-1.1 mg/g (Adewusi and Osuntogun, 1991) and 17.2-26.0 mg/g (Oluwatosin, 1999). This shows that the compound is not likely to play important role in the nutritional value of this vegetable. It is interesting to note that all the phytate content of this vegetable was completely removed during blanching while others antinutritional compounds were reduced by the processing. This will tend to underscore the importance of blanching of vegetable before the real cooking. The only concern about this process is the fact that oxalate content was increased by as much as 40%. The 100% reduction of phytate in the blanched vegetable is expected. Phytate is inositol hexaphosphate which is easily hydrolyzed into inositol and phosphate. The products of hydrolysis are leached into the water used for blanching hence the reduction or complete removal of the compound.

The Tannin concentration in this vegetable is judged low when compared with a range of 0.37-10.7 mg/g reported for cowpea species (Adewusi and Falade, 1996).

Tannin has also been reported to reduce protein digestion if present in plant foods at level greater than 2 mg/g (Osuntogun *et al.*, 1989). Based on animals' studies, tannins have been considered as anti-nutrients due to a range of adverse effects including reduced feed conversion, reduced micronutrient bioavailability, liver damage and reduced growth (Chung *et al.*, 1998 and Adewusi and Falade, 1996). The level of tannin in this vegetable is below 2 mg/g hence this compound is not likely to have any adverse nutritional effect on human. From medicinal point of view, polyphenol to which tannin belongs has been reported to act as antioxidant by preventing oxidative stress that causes diseases such as coronary heart disease, some types of cancer and inflammation (Tapiero *et al.*, 2002; Kris-Etherton *et al.*, 2002). This shows that *Jatropha*

Table 2: Levels of some mineral nutrients in raw and blanched forms of *Jatropha tanjorensis*. (g per 100 g)

Nutrient	Raw	Blanched	% RDA
Ca	1.14 ± 0.04^{a}	1.13 ± 0.01	800 mg / day
Mg	0.46 ± 0.05^{a}	0.43 ± 0.03^{a}	320 mg / day
K	0.20 ± 0.01^{a}	0.26 ± 0.04^{a}	4.7 g / day
Na	0.15 ± 0.03^{a}	0.15 ± 0.03^{a}	1.2 g / day
Fe	0.16 ± 0.02^{a}	0.13 ± 0.01^{a}	7 mg / day
Zn	0.04 ± 0.01^{a}	0.05 ± 0.02^{a}	12 mg / day

Values are means ± standard deviation of triplicate analysis.
Values in the same row with the same superscripts are not significantly different at the 5 % probability level.

tanjorensis vegetable is likely to have antioxidant activity.

Table 2 reports the levels of the mineral content of the *Jatropha tanjorensis* vegetable.

Mineral deficiency diseases are major health concerns in the developing countries. Most of the minerals are components of blood and enzymes such as Iron and calcium and they help in the maintenance of health (Uauy *et al.*, 1998).

The calcium content was the highest among the minerals analyzed and its value was higher than 0.90, 0.91 and 1.08 g per 100 g reported for *Crassocephalum erepidiodes*, amaranthus and *Vernonia amygdalina* respectively, which are conventional vegetables (Aletor *et al.*, 1995, Adewusi *et al.*, 1999). This shows that this vegetable could be a better source of calcium than some conventional vegetables. The recommended dietary allowance (RDA) for calcium is 800 mg/day (FNB, 1974) which means that about 70 g dry weight of this vegetable alone would provide the RDA for calcium.

The level of zinc, an essential element for protein and nucleic acid synthesis, carbohydrate metabolism, successful pregnancy, delivery and normal development (Wordstron, 1982) was within the range reported earlier for some tropical leafy vegetables (Aletor and Adeogun, 1995) and higher than 0.002 g per 100 g reported for amaranthus (Adewusi *et al.*, 1999). This is another area where this vegetable could complement other food sources because 30 g on dry weight would provide the 12 mg/day RDA for men aged 19-64 years and women 19-54 years of age (NHMRC, 1991).

The level of iron in this vegetable was also higher than 0.013 g per 100 g reported for amaranthus (Adewusi *et al*,. 1999) but within the range of 0.14-0.17 g per 100 g reported for *Hibiscus esculentus*, *Baselia alba* and *Celocia argentia* (Akindahunsi *et al.*, 2005). This would support the assertion that the vegetable has a potential for the enhancement of blood but whether this iron will be available *in vivo* or not is another question. The RDA for iron is 7 mg/day for men and 12-16 mg/day for women (NHMRC, 1991). This vegetable would conveniently provide the RDA of iron for all groups of people.

Magnesium was lower in *Jatropha tanjorensis* vegetable compared with 0.729 g per 100 g reported for amaranthus (Adewusi *et al.*, 1999) but its combination with other food sources rich in this element will provide the RDA of 320 mg per day (Klevay and Milen, 2002).

The level of the electrolyte (sodium) was higher than 0.05 g per 100 g of *Solanum macrocarps* (Faboya 1983). For the RDA of 1.5 g/day of sodium (FNB, 2004) to be attained, exactly 1000 g on dry weight basis of this vegetable will have to be consumed which is not attainable. More than three times this amount will be needed to meet the RDA of 4.7 g/day for K (FNB, 2004). It should be noted that more than the required RDA of sodium can be obtained from table salt.

It is interesting to know that blanching did not lead to significant loss ($p > 0.05$) in any of the elements analysed.

4. Conclusion

Jatropha tanjorensis plant has a potential of make a significant nutritional contribution to Nigerian diets because of its high nutrient content and the low levels of its antinutritional factors. The plant been drought resistant makes it valuable vegetable most especially in areas with low precipitation with attendant shortage of green vegetables. Therefore the cultivation of the plant should be encouraged.

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