NUTRIENT COMPOSITION AND ANTINUTRITIONAL FACTORS OF *DIALIUM GUINEENSE* WILLD FRUIT PULP*

O.T. ADEPOJU+ and L.O. ONASANYA

Department of Chemistry, The Polytechnic, Ibadan, Oyo state, Nigeria.

(Recieved: July 2007; Accepted: April 2008)

Abstract

Dialium guineense fruit pulp, eaten raw in dry form by some tribes in Nigeria was studied for its proximate chemical, vitamin and mineral composition, and antinutritional factors using standard methods of AOAC (1995). 100g portion of the dry fruit pulp was found to contain 4.0 g moisture, 8.3 g crude protein, 4.9 g crude lipids, 3.2 g ash, 0.6 g crude fibre, 79.6 g carbohydrates; and yielded 289.0 Kcal of energy. The pulp was fairly high in potassium (260 mg), sodium (390 mg), magnesium (300 mg) and iron (4.1 mg); low in calcium (47.0 mg) and phosphorus (42.9 mg) per 100 g pulp respectively. The pulp was also low in antinutritional factors but poor in vitamins. Except for moisture and carbohydrates, the unripe sample was lower in all the nutrients studied. The dry fruit pulp can serve as a food supplement or snack for its consumers as a means of meeting part of their daily nutritional needs (Recommended Dietary Allowances).

Key words: *Dialium guineense* fruit pulp, nutrient, antinutritional factors, ripe, unripe.

1. Introduction

Fruit is a very vital portion of balance diet and it is essential for normal growth. They serve as food supplement and appetizer; they provide roughage, which prevent constipation (Gakou *et al.*, 1994). They are used as artificial food flavour, and fragrance in cosmetics because of their sweet and pleasant smell. Wild fruits constitute source of nutrients to the rural populace, and can be a source of micronutrients. Hence, knowledge about their composition and nutrient potentials is imperative.

Dialium guineense Willd, known as black velvet, velvet tamarind in English, 'Awin' or 'Amoyin' in Yoruba and icheku in Igbo is a wild tree of the tropical region of the Fabaceae – Caesalpinioideae family. It grows in dense savannah forests, shadowy canyons and gallery forests. It is found from Senegal to Sudan along the southern border of the Sahel. This is the most common and widespread Dialium in Nigeria (Keay, 1989).

The tree grows to 30 m high, with a densely leafy crown, but often shrubby. Its flowers are usually whitish, in large terminal, or occasionally axillary, panicles up to 30 cm long; and fruits are usually abundant, more or less circular and flattened, but sometimes almost globose, up to 2.5 cm in diameter, densely velvety, black; with a brittle shell enclosing one seed embedded in a dry, brownish, sweetly acidic, edible pulp (Keay, 1989). The pulp is red, with a sweet-sour, astringent flavour similar to baobab, but sweeter. It is peeled and eaten raw; but the thirst quenching, refreshing fruit pulp can also be soaked in water and drunk as a beverage.

The edible part (pulp) of ripe *Dialium guineense* fruit is sweet but acidic (pH 3.3) and relatively poor in protein (61.3 g kg^{-1}) and oil (70.0 g kg^{-1}), and fairly low levels of ascorbic acid and tannin (Arogba *et al.*, 1994). Achoba *et al.*, (1992) studied the fruit pulp of black (African) velvet tamarind (*Dialium guineense* Willd) proximate composition, selected inorganic ions and vitamin C content and reported the pulp to contain 4.9 g moisture, 95.1 g dry matter, 4.2 g crude protein, 2.6 g crude fat, 1.8 g ash, 2.2 g crude fiber and 86.6 g per 100 g total carbohydrate; and that the black velvet tamarind is potentially a good source of nutrients for human food and animal feed. Ubbaonu *et al.*, (2005), studied some of the physical and chemical changes in velvet tamarind (*Dialium guineense* willd) fruits during development, maturation and ripening and reported significant increase in the values for percent carbohydrate, ethanol soluble sugars and total soluble solids throughout the period of 17 weeks of the study; and the sugars identified were glucose, fructose, maltose and sucrose.

Antinutritional factors have been known to inhibit protein and some mineral digestibility and utilization

+ *corresponding author* (email: tholadejo@yahoo.com)

* Presented in part at the First Faculty of Science Conference, Obafemi Awolowo University, Ile-Ife, July 3-5, 2007.

(Taylor, 1982; Makkar & Becker, 1996; Annongu et al., 1996). Literature information is scanty on the nutrient composition and antinutritional factors of *Dialium guineense* ripe and unripe fruit pulp. There is search for good sources of protein and micronutrients as a means of combating household food insecurity, as well as promotion of indigenous traditional foods and diets as a means of dietary diversification. Fruits and pulps are good sources of micronutrients especially minerals and vitamins; it is therefore the aim of this study to investigate the nutrient composition and antinutritional factors of *Dialium guineense* fruit pulp as a possible means of combating some micronutrient deficiencies.

2. Materials and Methods

Ripe and unripe *Dialium guineense* fruits were plucked around university of Ibadan community. The fruits were subjected to preliminary treatment through sorting, grading and sizing to separate the bad from the good ones. The shell of the ripe (dry) and unripe (wet) good fruits was removed and the dry pulp obtained was prepared into composite sample by grinding to powder form while the wet pulp was used as composite sample of the unripe fruits. The composite samples were then analysed for moisture, crude protein, lipid, and fibre, ash, minerals, and anti-nutritional factors using standard methods of AOAC (1995) as follows.

Moisture content of the samples was determined by air oven (Gallenkamp) method. The crude protein of the pulps was determined using micro- Kjeldhal method by digesting 5g of the dry pulp with conc. H_2SO_4 and Kjeldhal catalyst in Kjeldhal flask for 4 hours. 5 ml portion of the digest made up to 100 ml was then pipetted to Kjeldhal apparatus and 5 ml of 40% (w/v) NaOH added. The mixture was steam distilled, and the liberated ammonia collected in 10 ml of 2% Boric acid, and titrated against 0.01 M HCl solution. The amount of crude protein was then calculated by multiplying percentage nitrogen in the digest by 6.25. Crude lipid was determined by weighing 5 g of dried fruit pulp into fat free extraction thimble and plug lightly with cotton wool. The thimble was placed in the soxhlet extractor fitted up with reflux condenser. The dried pulp was then extracted with petroleum ether and the crude lipid estimated as g per 100 g dry weight of pulp, and then converted to g per 100 g fresh pulp weight.

The ash content was determined by weighing 5 g of sample in triplicate and heated in a muffle furnace at 550 °C for 4 hours, cooled to about 100 °C in the furnace and then transferred into a dessicator to cool to room temperature and weighed. The ash was calculated as g per 100 g fresh pulp. Crude fibre was determined by refluxing 2 g of the pulp with 100 ml of 0.30 N H_2SO_4 for 1 hour. The hot mixture was filtered through a fibre sieve cloth. The residue obtained was returned to the flask and refluxed for another 1 hour with 100 ml of 0.3 N NaOH solution. The mixture was filtered through a sieve cloth and 10 ml of acetone. The residue was washed with 50 ml hot water twice on the sieve cloth before it was finally transferred into the crucible. The crucible and the residue was oven dried at 105 °C overnight, and weighed. The crucible and its content was then transferred into a muffle furnace set at 550 °C for 4 hours, cooled and re-weighed. The weight of crude fibre was then calculated as g per 100 g fresh pulp. The carbohydrate content was obtained by difference. Gross energy of the pulp was determined using Gallenkamp ballistic bomb calorimeter.

Mineral analysis:

Potassium and sodium were determined by digesting the ash of the pulp with perchloric acid and nitric acid, and then taking the readings on Jenway digital flame photometer / spectronic20 (Bonire *et al.*, (1990). Phosphorus was determined by vanado-molybdate colorimetric method. Calcium, magnesium, iron, zinc, manganese and copper were determined spectrophotometrically by using Buck 200 atomic absorption spectrophotometer (Buck Scientific, Norwalk) (Essien *et al.*, 1992) and compared with absorption of standards of these minerals.

Determination of antinutritional factors:

Oxalate in the fruit pulp was determined by weighing 1 g of the dried sample into a 250 ml conical flask soaked with 100 ml distilled water and allowed to stand for 3 hours, followed by filteration through a double layer of filter paper. 10 ppm, 20 ppm, 30 ppm, 40 ppm and 50 ppm standard solutions of oxalic acid were then prepared and the absorbance read on the spectrophotometer (Spectronic20) at 420 nm. The absorbance of filterate of the sample was also read and percentage oxalate calculated. Phytate was determined by soaking 2 g of pulp with 100 ml of 2% concentrated hydrochloric acid for 3 hours, followed by filteration through a double layer of hardened filter paper. 50 ml of the filterate was diluted to trice its volume with distilled water and 10 ml of 0.3% ammonium thiocyanate solution added as indicator. The resulting solution was titrated with standard Iron (III) chloride solution containing 0.00195 g iron per ml (Sudarmadji and Markakis 1977) and the percentage phytic acid calculated.

Trypsin inhibitors were determined by weighing 0.2 g of sample into a screw cap centrifuge tube. 10 ml of 0.1 M Phosphate buffer and the content was shaken at room temperature for 1 hour on a UDY shaker. The suspension obtained was centrifuged at 5000 rpm for 5 minutes and filtered through Whatman No. 42 filter paper. The volume was then adjusted to 20 ml with phosphate buffer. The test tube was placed in a water bath, maintained at 37 °C. 6 ml of 5% tetrchloroacetic acid (TCA) solution was added

to one test tube to serve as a blank. 2 ml of 0.1 M casein solution was added to the tubes which was previously kept at 37 °C and then incubated for 20 minutes. The reaction was allowed to proceed for 1 hour at room temperature and the mixture filtered through whatman No. 42 filter paper. Absorbance of the filterate of the pulp, and trypsin standard solutions were read at 280 nm. The trypsin inhibitor in mg per g sample was then calculated. This is the modified method of Makkar and Becker (1996).

Tannin was extracted by soaking 1 g of sample with acetone-glacial acetic acid mixture (4:1) for 5 hours. The resultant solution was filtered through a double layer filter paper and standard solutions of tannic acid (10 to 50 ppm) were prepared and their absorbance read at 500 nm on a spectronic20 (Griffiths and Jones, 1977). The absorbance of the filterate was also read at this wavelength and the mg per 100 g tannin calculated. 2 g of sample was extracted with 100 ml of isobutyl alcohol (octanol) for 5 hours on a UDY shaker. The mixture was then filtered through a Whatman No. 1 filter paper. The filterate was saturated with magnesium carbonate solution and filtered. The absorbance was read on the spectrophotometer at 380 nm. Standard saponin solutions (0-10 ppm) were prepared and saturated with magnesium carbonate as above, and filtered. The absorbance of the filtered standard saponin solutions was then read at 380 nm to obtain the gradient of a standard curve (Makkar and Becker, 1996). Nitrates and nitrites were determined by using EDTA, and sulphanilamide / N-1-nathylethelene diamine dihydrochloride solutions respectively, and absorbance measured at 538 nm (Mottran *et al.*, 1977).

3. Results and Discussion

The result of proximate chemical composition of *Dialium guineense* fruit pulp is as shown in Table 1. The values obtained were comparable with the values in the literature. The pulp was very low in moisture content for both dry and wet samples. These values were in perfect agreement with the one in the literature (Achoba *et al.*, 1992). The moisture content values obtained were very low compared with the values reported in the literature for some fresh fruitpulps such as shea butter and pumpkin (Adepoju

Table 1: Proximate Chemical Composition of *Dialium guineense* (g /100 g)

	Ripe	Unripe
Moisture	4.0 ± 0.10	8.0 ± 0.04
Dry Matter	96.0 ± 0.10	92.0 ± 0.04
Crude Protein	8.3 ± 0.10	3.3 ± 0.01
Crude Lipid	4.9 ± 0.03	2.1 ± 0.01
Ash	3.2 ± 0.01	1.2 ± 0.01
Crude Fibre	0.6 ± 0.01	0.3 ± 0.02
Carbohydrates	79.6 ± 0.01	87.3 ± 0.10
Gross Energy (kcal/100 g)	289.0 ± 0.40	257.0 ± 0.30

Table 2: Mineral And Some Vitamin Composition of *Dialium guineense* Fruit pulp (mg /100 g)

	Ripe	Unripe
Potassium	260 ± 14.14	260.0 ± 14.14
Sodium	390 ± 42.43	276.5 ± 22.98
Calcium	47.0 ± 0.40	35.0 ± 0.30
Magnesium	300 ± 14.14	250.9 ± 34.10
Iron	4.1 ± 0.40	2.0 ± 0.14
Phosphorus	4.1 ± 0.40	2.0 ± 0.14
Zinc	0.7 ± 0.14	3.5 ± 0.21
Manganese	2.5 ± 0.14	2.9 ± 0.10
Copper	1.0 ± 0.14	0.0 ± 0.00
β-Carotene (µg/100 g)	3.6 ± 0.14	0.1 ± 0.10
Niacin	0.01 ± 0.01	0.0 ± 0.00
Ascorbic acid	0.10 ± 0.00	0.1 ± 0.10
Riboflavin	0.00 ± 0.00	0.0 ± 0.00

Table 3: Antinutritional Factors of *Dialium guineense* (mg/100 g)

	Ripe	Unripe
Phytates	1.30 ± 0.03	1.20 ± 0.01
Oxalates	0.90 ± 0.04	0.70 ± 0.01
Tannins	0.60 ± 0.04	0.30 ± 0.03
Saponins	0.20 ± 0.02	0.10 ± 0.01
Trypsin Inhibitors	16.40 ± 0.04	13.30 ± 0.01
Nitrates (µg/100 g)	0.81 ± 0.02	0.60 ± 0.01
Nitrites (µg/100 g)	0.31 ± 0.02	0.14 ± 0.01

and Ketiku, 2003; Essien *et al.*, 1992), but closely related to that of *Adansonia digitata* (Murray *et al.*, 2001). The low moisture content of the pulp is suggestive of its high dry matter content, and possible high resistance to microbial spoilage and aerobic fermentation characteristic of high moisture content fruit pulps.

The fruit pulp was low in crude protein. However, the value obtained for the ripe pulp in this study was significantly higher than the ones in the literature (Arogba *et al.*, 1994; Achoba *et al.*, 1992), and comparable with the value obtained for shea butter (Adepoju and Ketiku, 2003). Fruits are generally poor sources of protein (Adepoju and Karim, 2004).

The fruit pulp was also low in crude lipid, especially the wet sample. This confirmed the findings of Arogba *et al.*, (1994) and Achoba *et al.*, (1992). However, the crude lipid values obtained for ripe and unripe fruit pulps here were lower than the value quoted for ripe fruit pulp by Arogba *et al.*, 1994; but higher than that of Achoba *et al.*, (1992). This observed variation might be due to geographic and climatic variation. The low value of the crude lipid is suggestive that the pulp may not possibly be a good source of oil soluble vitamins such as vitamins A, D, E, and K.

The ash values of the pulps were also low, especially for the unripe sample. However, these values were higher than those recorded for pumpkin and shea butter pulps (Essien *et al.*, 1992; Adepoju and Ketiku, 2003). Also, the crude fibre values of the pulps were very low; and this points to the fact that the pulp may not be a good source of dietary fibre.

The carbohydrate content of the pulp was very high, and this might be greatly responsible for its moderately high gross energy value. The high carbohydrate content may partly be responsible for the sweet taste of the ripe pulp since glucose, fructose, maltose and sucrose were identified to be present in the pulp (Ubbaonu *et al.*, 2005). Except in carbohydrate content in which the value for unripe sample was higher than that of ripe sample, all the other nutrients analysed were higher in the ripe sample.

The result of mineral composition of *Dialium guineense* fruit pulp is as shown in Table 2. The fruit pulps were low in calcium, phosphorus, zinc, copper and manganese. However, their values for sodium, potassium, magnesium and iron were moderately high. The pulp can be a source of meeting part of daily requirement of iron when in season. Except for manganese and zinc, the ripe sample had higher mineral value than the unripe sample. This might be the underlying reason why the unripe fruit pulp is not consumed.

The pulps of both ripe and unripe samples were very poor in â-carotene. This was an indication that the velvet colour of the ripe pulp, and the creamy colour of unripe pulp were not due to the presence of â-carotene. The pulps were also very low in niacin, ascorbic acid and riboflavin. This was indicative that the pulp was not a good source of these vitamins.

Table 3 shows the antinutritional factors of *Dialium guineense* pulp. Both the ripe and unripe pulps were very low in antinutritional factors. However, the level of trypsin inhibitors seemed to be slightly on the high side when compared with other antinutritional factors. When consumed in very large quantity, the trypsin inhibitor level of the pulp may tend to have a negative effect on bio-availability of other nutrients such as protein, as trypsin inhibitors are known to hinder availability of dietary protein as well as its absorption in the body (Li *et al.*, 1998).

The low level of antinutritional factors and toxicants in the pulp makes it safe for consumption at a high level without any serious side effects; and this might be the underlying reason why there had not been literature report of any case of toxicity or fatality after consumption of the pulp.

4. Conclusion

Dialium guineense fruit pulp was found to be very low in vitamins, low in crude protein, crude lipid, crude fibre, calcium, and phosphorus, but moderately high in sodium, magnesium, potassium, and iron. It is also high in carbohydrates and gross energy; hence it can be taken as a food supplement or snack. The ripe pulp can be a good source of iron which is believed to be bioavailable due to low content of its phytates. However, its high sodium content might disqualify it as a good food supplement or snack for the hypertension patients.

The pulp was also found to be low in antinutritional factors as well as toxicants, hence its consumption may not have any serious effect on digestion and absorption of nutrients from other food source(s). Since the fruit pulp is low in crude lipid and antinutritional factors, moderate in macrominerals and energy, it can serve as a food supplement in meeting some of the recommended dietary allowances of the consumers. It can also serve as a good snack for the obese and diabetic patients since fruit carbohydrates are easily digestible and assimilated in the human body. However, processing the fruit pulp into juice through heating can lead to remarkable reduction in its trypsin inhibitors content.

REFERENCES

Achoba, I.I, Lori, J.A. Elegbede, J.A. Kagbu J.A. 1992. Nutrient composition of black (African) velvet tamarind (Dialium guineense Wild) seed and pulp from Nigeria. *Journal of Food Biochemistry* 16 (4), 229–233.

Adepoju, O. T. and Ketiku, A. O. 2003. Chemical composition and contribution of sheabutter (*Butyrospermum paradoxum)* fruit pulp to nutrient intake of its consumers. *J. Trop. For. Res.* 19 (2); 20 – 28.

Adepoju, O. T. and Karim, S. A. (2004). Nutrient composition, anti-nutritional factors and jam preparation from

Spondias mombin (hog plum (Iyeye)) fruit pulp. *Nig. J. Nutr Sci.* 25(1), 20 – 25.

AOAC (1995): Official methods of analysis (15th edn) Association of Official Analytical Chemists. Arlington, V. A. USA

Arogba, S S, Adejoke A Ajiboro, Ifeanyi J Odukwe 1994. A physico-chemical study of Nigerian velvet tamarind (*Dialium guineense* L) fruit.

Annongu, A. A.; Meulen-U-ter, Atteh, J. O.; Chinnah, T.; Ter Meulen 1996. Biochemical and histological alterations in the liver of the broiler after ingestion of vegetable saponins and effects of dietary supplementation with adsorbents or methyl donour. *Archiv-fur-Geflugelkunde* 60, (6), 267-272.

Bonire, J. J., Jalil, N. S. N. and Lori, J. A., 1990. Sodium and potassium content of two cultivars of white yam (*Dioscorea rotundata*) and their source soils. J Sci Food Agric 53. 271-274.

Essien, A. I.; Ebana, R. U. B.; and Udo H. B. 1992: Chemical evaluation of pod and pulp of the fluted pumpkin (*Telfaira occidentalis*) fruit. Food Chem 45, 175-178.

Gakou M., Force J.E. and McLaughlin W.J. (1994). Non-timber forest Products in rural Mali: a study of villager use. *Agroforestry Systems* 28:213-226.

Griffiths, D. W. and Jones, D. I. H. 1977. Cellulase inhibition by tannins in the testa of field beans (Vicia faba). *J. Sci. Food Agric.*28 911). 938-989.

Keay RW. (1989). Trees of Nigeria. Claredon Press Oxford. Kuhnlein, H. V. 1989: Nutrient values in indigenous wild berries used by the Nuxalk people of Bella Coola, British Columbia. J. Food Comp Anal 2, 28-36.

Li, Shaoyan; Sauer, W. C.; and Caine, W. R. (1998): Response of Nutrient digestibilities to feeding diets with low and high levels of soybean trypsin inhibitors in growing pigs. *J Sci Food Agric.* 76, 357-363.

Makkar, H. P. S. & Becker, K. 1996: Nutritional value and antinutritional components of whole and ethanol extracted *Moringa oleifera* leaves. *Animal Feed Sci Technol* 63, 211-238.

Mottran, D. S.; Patterson, R. L. S.; Edwards R. A and Gough T. A., 1977. The preferential formation of volatile N-nitrosamines in the fat of fried bacon. *J Sci Food Agric* 28 (11), 1025-1029.

Murray, S. S., Schoeniger, H. T., Bunn, H. T., Pickering, T. L., and Marlett, J. A. 2001. Nutritional composition of some wild plant foods and honey used by Hadza foragers of Tanzania. J food comp and Anal 13. 1 – 11.

Sudarmadji, S. and Markakis, P., 1977. The phytate and phytase of soybean Tempeh. *J Sci Food Agric* 28 (4); 381-383.

Taylor, S. L. 1982: An overview of interactions between food borne toxicants and nutrients. *Food Tech* 32 (10) 91-95.

Ubbaonu, C. N., Onuegbu, N. C., Banigo, E. O. I. and A Uzoma 2005. Physico-chemical changes in velvet tamarind (*Dialium guineense* Wild) during fruit development and ripening. *Nigerian Food Journal* Vol. 23: 133-138.