Analytical and Nutritional Evaluation of Velvet Tamarind *(Dialium guineense)* pulps

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Author's contribution

This whole work was designed by the OHN

Original Research Article

ABSTRACT

The ash contents, minerals, anti nutritional factors, calorific value and vitamin C of velvet tamarind pulps were investigated. The results showed total ash (1.47%), water soluble ash content (0.40%), acid insoluble ash (2.31%) and sulphated ash (1.95%). This indicates that the velvet tamarind would provide essential valuable minerals needed for good body development. The minerals in the sample included; sodium, potassium, phosphorus, calcium, magnesium, iron and zinc. Potassium was the highest with the value of 124mg/g, while zinc was the lowest with the value of 11.8mg/g. The analysis of anti nutritional factors showed that velvet tamarind fruit contained: oxalate (2.251mg/g), tannin (0.0076%), phytate (112.82mg/g) and cyanide (0.338%). The value of vitamin C in the sample was 33.33mg/100g while the energy value was 761.4kJ/100g.

Keywords: Minerals, Vitamin C, Calorific value, Anti nutritional, Velvet, pulps

1. INTRODUCTION

Foods are generally analyzed based on the amount of energy, protein, vitamins and other nutrients. The major factors that initially influenced food production were availability, acceptability, assurance of yield, easy storage and transportation. Legumes are conceptually used to alleviate protein malnutrition and food imbroglio in developing countries. Food that contain correct and appropriate amount of minerals, vitamins, and essentials amino acids have potentials to subjugate under nutrition in various categories of people in both developed and underdeveloped countries. Malnutrition is still prevalent in developing countries and continues to be a primary cause of poor health [1, 2]. Protein malnutrition is one of the serious predicament in Africa continent especially Nigeria. The main reasons for these problems are: scarcity and high prices of foods, low income, poor environmental factors and dearth of knowledge about the underutilized farm products. There is need therefore to educate urban and rural dwellers to exploit the utilization of the farm produce domestically and industrially. Emphases should be laid on how to turn correct farm produce to nutritionally adequate products [3]. Velvet tamarind is a tall, tropical, fruit bearing tree which belongs to the leguminosae family that has small and grape-sized edible fruits with brown hard inedible shells. It grows in savanna regions of West Africa and widely spread in Nigeria [4]. It is a hard wood that is economically valuable for furniture and creative works. Its existence is threatened by human activities especially deforestation, logging and building constructions. The fruit is used as a candy-like snack food in Thailand, often dried, sugar coated and spiced with chilies. The purpose of the study is to evaluate the nutritional potentials of velvet tamarind with respect to ash analysis, minerals, anti nutritional factors, calorific value and vitamin C.

2. MATERIALS AND METHODS

The velvet tamarind fruits used for the present work were plucked from its tree grown in Ikere - Ekiti, Ekiti State Nigeria in Africa continent. The pulp was separated from the shell and the seed. The pulp was then dried and grinded into a flour packaged and stored in freezer (-4^{0}C) until used for the analyses.

2.1 Ash analysis

2.2 Determination of total ash

The total ash content was determined as described [5]. The crucible for the ashing was washed, dried in the air oven and allowed to cool in a desiccator. The crucible was weighed and 2.0g of the sample flour was added and weight determined. The crucible with its content was transferred into a muffle furnace and its temperature was maintained between 500^{o}C and 600^{o}C for 6 hours. The process was completed when there was no black speck in the ash. The percentage ash content on wet evaluated as

$$\% \text{ Ash} = \frac{\text{Weight of ash (g)}}{\text{Weight of sample flour (g)}} \times 100$$

The experiment was done in triplicate.

2.3 Determination of water soluble ash

The procedure for the determination of the total ash was followed. The ash obtained was boiled with 25mL distilled water and the liquid filtered through an ashless filter paper was then ignited in the weighed [5].

Calculation:

Water-soluble ash (%) = total ash (%) - water insoluble ash (%)

2.4 Determination acid-insoluble ash

The procedure for the determination of total ash was followed [5]. The ash was boiled with 25mL of dilute hydrochloric acid *(*10% v/v*)* for 5 minutes, then the liquid was filtered through an ashless filter paper and thoroughly washed with hot water. The filter paper was then ignited in the original crucible, cooled and weighed.

Calculation:

$$\text{Acid insoluble ash (\%)} = \frac{\text{Wieght of acid insoluble ash (g)}}{\text{Weight of sample (g)}} \times 100$$

2.5 Determination of sulphated ash

The procedure for the determination of total ash was used [5]. The ash obtained was moistened with concentrated H_2S0_4 and ignited gently to constant weight.

$$\text{Sulphated ash (\%)} = \frac{\text{weight of sulphated ash (g)}}{\text{weight of sample (g)}} \times 100$$

2.6 Mineral Analysis

The minerals were analyzed by dry ashing the sample at 550ºC to constant weight and dissolving the ash in 100 mL standard flask using distilled deionized water with 3 mL of 3M HCl. Sodium and potassium were determined by using a flame photometer (model 405, corning, U.K). All other minerals were determined by Atomic Absorption Spectrophotometer (Perkin & Elmer model 403, USA) [5].

2.7 Determination of Anti nutrients

Cyanide: A simple picrate method described by Nwokoro et. al. [6] was used to determine the cyanide content. The cyanide in the sample reacted with hot 20% HCl solution to produce hydrogen cyanide vapour which then reacted with alkaline picrate test strips to form red colour complex on the test strips. The red coloured complex on the strips was extracted with 50% ethanol solution and the absorbance of the extract was measured at 510 nm using a UV- Visible Spectrophotometer.

Oxalate: A 1g of the sample was taken into 100mL conical flask, 75mL of 1.5M H_2SO_4 was added and the mixture was stirred for 1 hour and then filtered. 25mL of sample filtrate was titrated against 0.1M$KMnO_4$ solution until faint color persisted for 30 seconds [7].

Tannins: A 200mg of the sample was added to 10mL of 70% aqueous acetone and properly covered. The mixture was put in an ice bath and shaken for 2hours at 30^0C. The mixture was later centrifuged at 3,600rpm; 0.2mL of the mixture was pipetted into test tubes and 0.8mL of distilled water was added. Standard tannic acid solutions were prepared from a 0.5mg/mL stock and the solution made up to 1ml with distilled water. 0.5mL Folin reagent was added to both sample and standard solution and then followed by the addition of 2.5mL of 20% Na_2CO_3. The solutions were mixed and allowed to incubate for 40minutes at room temperature after which absorbance was measured at 725nm [7].

Phytate was determined on Spectronic 20 colorimeter (Gallenkamp,UK) using the method described [8,9]. The amount of phytate in the sample was estimated as hexaphosphate equivalent.

2.8 Determination of calorific value

Five grams of each sample was ignited electrically in Ballistic bomb calorimeter (Gallenkamp CBB-330-030F) and burned in the excess of oxygen (with recommended oxygen pressure of 25 atmospheres) in the bomb calorimeter. The maximum temperature rise of the bomb calorimeter was measured with the thermocouple and galvanometer system. The rise in temperature obtained was compared with that of benzoic acid to determine the calorific/energy value of the sample.

2.9 Determination of vitamin C

The non-spectrophotometric method described [10, 11] was used for the determination of vitamin C. Sample flour (100g) was blended using Marlex Mixer with 50 mL distilled water. The mixture was strained after blending through white cloth and then washed with 10mL portion of distilled water. The extracted solution was made up to the mark with 100 mL distilled water in a volumetric flask. A 20 mL of aliquot sample solution was pipetted into a 250mL conical flask. Then, 150 mL distilled water and 1 mL starch indicator were added. The resulting mixture was titrated with 0.005M iodine solution. The end point of the titration was identified as the appearance of first permanent dark blue – black colouration due to the starch – iodine complex.

3. RESULTS AND DISCUSSION

Table 1: Ash contents of velvet tamarind pulps (dry basis)

PARAMETER	%
Total ash	1.47
Water soluble ash	0.40
Acid insoluble ash	2.31
Sulphate ash	1.95

The results of the ash analysis are presented in Table 1. The total ash was found to be lower than those of African yam bean (AYB) (2.06-2.30%) [12], *Adenopus breviflorus benth* protein concentrate (2.06%) [13], lima bean flour (3.1%-3.6%) [14], pigeon pea flour (5.76%) [15], *Leucaena leucocephala* (3.40%) and *Prosopis africana* (4.16%) [16], but higher than that of the total ash reported for 100% whole wheat flour

(1.43%) [17], but comparable with that of fortified weaning food (1.47%) [17]. Ash value has been regarded as an indicator for food quality evaluation. The water – soluble ash of the sample was lower than that of gourd seed (5.25%) [18], while the acid – soluble ash was higher than that of yellow melon (1.80%) [18]. Sulphated ash was lower than the range reported for some edible seeds (2.80 – 3.95%) [18]. Egan et. al. [19] observed that the sulphated ash gives a more reliable ash figure for food containing varying amounts of volatile compounds which may be lost at ignition temperature used. The ash obtained during the analysis has not exactly the same composition as the mineral matter, as there may have been losses due to volatilization interaction between constituents. The ash composition can be regarded as an index to measure the quality of food.

Table 2: Mineral content of velvet tamarind pulps (dry basis)

Minerals	mg/g
Sodium (Na)	47.1
Potassium (K)	124
Phosphorus (P)	25.9
Calcium (Ca)	44.1
Magnesium (Mg)	11.8
Iron (Fe)	19.1
Zinc (Zn)	1.18
Na/K	0.38
Ca/P	1.70

The results of mineral analysis of velvet tamarind pulps are presented in Table 2. The most concentrated mineral was potassium followed by sodium while calcium took the third position. Zinc was the least concentrated mineral. Both calcium and magnesium are mostly found in the skeleton. In addition to its structural role, magnesium is an activator of various enzymes. The calcium is an essential component in bone formation. The value of calcium was greater than those values reported for African mango seeds (0.14 mg/g) [20], African nutmeg (2.03 mg/g) [21]. This suggests that the amount of calcium present in the sample would be adequate for infant development of bones and teeth. Sodium and potassium control water equilibrium level in the body tissue and are also important in the transportation of some non-electrolyte. The Na/K ratio was 0.38. The ratio of 0.60 is recommended for intake [22]. The value reported for the sample was lower than the recommended value. This indicates that velvet tamarind would not support hypertension. Phosphorus is required for most chemical reactions in the body especially in the teeth. The Ca/P ratio of >0.5 is required for favourable calcium absorption in the intestine for bone formation [22]. The Ca/P that was greater than 0.5 obtained for the sample would enhance high absorption of calcium in the digestive system, when consumed. The imbalance of calcium and phosphorus may also lead to adult rickets called osteomalacia and deficiency of calcium may equally result to bone thinning called osteoporosis, which is common among older people [23]. This indicates that when the daily consumption of calcium is insufficient, the body utilizes the available calcium in the blood serum and bones to maintain constant body activities. Therefore, consumption of calcium should be maintained at optimal level over human life span. The value of iron was higher than those of bouillon cubes (6.83 mg/g), chicken seasoning (18.43 mg/g) [24] and benniseed (0.138 mg/g) [25]. Iron is essential for the formation of blood. Iron deficiency anaemia (IDA) is a major cause of low birth weight and maternal mortality and has been identified as an important cause of cognitive deficit in infants and young children [24, 26]. Bassa et. al. [27] reported that IDA is one of the major public health diseases in the world at large, most especially in Asia, sub-saharan African countries; Nigeria inclusive. The iron level in velvet tamarind will enhance the formation of red blood cells in the body and therefore, alleviating IDA when fortify with other human foods of low iron value. Iron element is essential for blood cell particularly haemoglobin. Zinc is an element found in virtually every cell of the human body and plays a vital role in the development and healthy growth of the body [24]. The value of Zinc was lower than that of beef seasoning (12.48mg/g) [24] but higher than date palm fruit (0.29mg/g) [21]. Zinc has been found to possess a recognized action in more than 300 enzymes by participating in the structure or in their catalytic and regulatory action [24]. Zinc rich foods are known to be very expensive. Zinc fortification is very important in food industries because its daily intakes appear to be more useful physiologically than in intermittent doses clinical recommendations [28]. Zinc deficiency in body may cause loss of appetite, taste, skin and bowel irritation, difficulty in wound healing, poor growth rate, sexual maturation, fertility, immune system deterioration and elevation of blood pressure during pregnancy [29]. Akhter et. al. [30] also reported that the overload of zinc (> 100 mg/day) may be dangerous. It can depress immune, cause anemia, copper inadequacy and decrease high density lipoprotein cholesterol in blood (HDLP). The amount of zinc may not be enough per day for the consumers. Therefore, it is suggested that fortification may be necessary so as to cater for the short fall of zinc in the sample.

TABLE 3: Anti nutritional factors of velvet tamarind pulps

ANTINUTRIENT	mg/g
Phytate	112.8
Oxalate	2.251
Tannin	0.076
Cyanide	0.338

Table 3 presents the phytate, oxalate, tannin and cyanide. The phytate level was higher than those of *Colocynthis citrullus* (110 mg/100g) [9], nicker bean (6.59mg/g), sorghum (5.34mg/g) and millet (4.41mg/g) [31] but lower than those of *Afzelia africana* (135.9 mg/g) [32], walnut flour (201.8 mg/g) [33], cassava (530mg/g) and white yam (694 mg/g) [34]. The Oxalate was lower than those of walnut flour (1.13 mg/g) [33], antelope meat (0.27 mg/g) [35], *Entada gigas* (3.15mg/g), sorghum (5.22mg/g) and millet (4.06 mg/g) [31]. It has been suggested that dietary phytic and oxalic acids may perturb the maximum usage of some essential minerals such as calcium, zinc and magnesium which result to formation of rickets during the consumption of some cereals and legumes [35, 36]. Tannins have been shown to contribute some degree of resistance to pre-harvest germination [37]. The tannin value of the sample was fairly lower than those of faba bean (2.6%) [38], date palm fruit (3.0%) [39] and cooked walnut (2.33%) [33], while the cyanide value (0.338%) was higher than *Afzelia africana* (2.19%) [32]. Cyanide is highly capable of binding to haemoglobin which results to cyano-haemoglobin and cause serious disorders in the blood system. It is note worthy that velvet tamarind has low level of cyanide which makes it good for consumption since it possesses little or no negative effect in the blood when consumed. The phytate which was high, this indicates that the velvet tamarind pulps may be processed chemically as a source of phytic acid while tannin which is very low makes it important medicinally and as astringent in intestinal tubules [40]. It can also be taken to counteract alcohol intoxication.

Table 4: Energy and vitamin C contents of velvet tamarind pulps

PARAMETER

Energy Value (KJ/100g)	761.4
Vitamin C (mg/100g)	33.33

Table 4 shows the energy evaluation of velvet tamarind. The calorific value of the sample was fairly high. The human body needs considerable energy when at rest. The amount required has been determined to be about 1 Kcal per kg of body weight per hour or 1,500 – 2,000 Kcal per day. This depends on the individual's metabolism. The largest part of human energy consumption via food is used for manufacturing essential life processes and body temperature [41]. The energy that the body derived from food is lower than the amount of energy produced when food is burned or completely oxidized in a bomb calorimeter. This is due to calorie producing nutrients, which are mainly protein, fats and carbohydrates are not completely digested, absorbed or oxidized to yield energy in the body [41]. The present value was lower than those of gourd seed (1265KJ/100g), *Cucumeropsis edulis* (1122KJ/100g) and bulma cotton seed (1645KJ/100g) [9] but higher than those values of ***Amaranthus hybridus L*. leaves (268.92 KJ/100g) [42] and some Nigeria vegetables (248.8-307.1 KJ/100g) [43, 44]**. The calorific value dictates the level of combustion and their rate of digestion in the body when combined with oxygen, and the energy thus released may be useful for normal mitochondria electron transport. The free energy available from oxidation is utilized in a series of steps to promote three moles of ATP from ADP and phosphate which is used in a range of ways in the cell for mechanical work, biosynthesis and transport of metabolites. Based on the required amount per day recommended (1,500 – 2,000 Kcal per day) [41]. Velvet tamarind may only supply half of energy required per day when consumed.

The value of vitamin C in velvet tamarind was fairly high. The major vitamin in the velvet tamarind is vitamin C called ascorbic acid. The deficiency in man may cause scurvy. The value currently reported for the sample was in close agreement with those values reported for paprika seed (36.52 mg/100g) [45] and mucuna seed (34.63 mg/100g) [46] but higher beach pea (1.60 mg/100g), green pea (6.50 mg/100g) [47] and *Amaranthus hybridus L.* leaves (25.40 mg/100g) [42]. The vitamin C value for velvet tamarind was also lower than that of cashew apple (203.5mg/100g) [48]. The high value of ascorbic acid in velvet tamarind pulp makes it useful in the prevention of scurvy, bleeding gums, limbs pain and blindness.

4. CONCLUSION

The results showed that velvet tamarind would provide essential valuable minerals needed for body growth, low levels of anti nutrients, high vitamin c content and energy value for body metabolism. The data suggest that the sample is nutritionally good for children, adult and also may supply some nutrition deficiencies.

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COMPETING INTERESTS

Author has declared that no competing interests exist

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