



# Chemical Composition and Nutraceutical Potential of Velvet Tamarind (*Dialium guineense* wild) Fruit Pulp

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## Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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## ABSTRACT

**Background:** Fruits are known as excellent source of mineral and vitamins and may be used to increase rural population food quality. Consuming fruits and vegetables may usually aid in the prevention of chronic and degenerative diseases.

**Aim:** This study was designed to evaluate the chemical composition of velvet tamarind (*D. guineense* wild) fruit and its nutraceutical potential.

**Methodology:** The fruit of velvet tamarind was purchased from "Oja-Oba" market in Ibadan, Nigeria. The fruits were sun-dried, the coat and seed were removed by mechanical means. The pulp was ground using a pestle and mortar, and were transferred into an electric blender (Moulinex) for

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further grinding. After grinding, the powder was sieved into a finer particle and was used to determine the proximate, phytochemical, vitamin and mineral compositions of velvet tamarind fruit.

**Results:** Velvet tamarind fruit contains high concentration of carbohydrate (79.78%) but very low concentration of fat (0.43%). The phytochemical composition of the fruit has flavonoid (33.78 mg) and phytate (0.07mg) as the highest and lowest phytochemicals respectively. Velvet tamarind pulp was observed to be rich in vitamins with vitamin C (28.82 mg/100g) and vitamin B<sub>1</sub> (0.84) having the highest and lowest concentrations respectively. Velvet tamarind pulp contained 5.85 mg/100g of potassium and 0.38 mg/100g of phosphorus as the highest and lowest minerals respectively.

**Conclusion:** The composition of velvet tamarind fruit obtained in this study revealed that it is a good source of nutrient, phytochemicals, vitamins and minerals. It should be incorporated as food supplement to reduce malnutrition. It is a fruit with promising nutraceutical potential, thus it is a useful tool for further drug development from the natural plant products.

*Keywords: Minerals; nutrient; phytochemicals; velvet tamarind fruit; vitamins.*

## 1. INTRODUCTION

Velvet tamarind is an important multipurpose agroforestry crop [1]. It is made up of two species (*Dialium indium* or *Dialium cochichinense* and *D. guineense* wild) [2]. *D. guineense* commonly known as African black velvet tamarind, is a large tree found in many parts of Africa, such as West Africa, Central African Republic and the Chad. The tree belongs to the family *Fabaceae*, it is 30 m high, with a densely leafy crown, but often shrubby. The leaves are finely hairy, broadly elliptic, blunt at the apex, leathery and

are a sunken midrib. Its flowers appear whitish and the branches are horizontally spread [3].

The fruits are usually circular and flattened, black in colour with stalk 6 mm long, a little collar is seen near the apex and a bristle shell encloses one or two seeds embedded in a dry, brownish edible pulp [4]. Wild fruits are dietary supplement for rural dwellers in Nigeria during the dry season when fruits are scarce. The fruits are used as source of vitamin C, as flavour in snacks and non-alcoholic beverages [5].



**Fig. 1. Image of velvet tamarind fruit**

Fruit pulps supplies high amount of micronutrients like sodium, magnesium and potassium. Bark and leaves are used against several diseases such as malaria [6]. Velvet tamarind is a tall, tropical, fruit bearing tree which belongs to the *Fabaceae* 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 [7]. The fruit is used as a candy-like snack food in Thailand, often dried, sugar coated and spiced with chilies. It has an orange coloured pulp which has a sweet and sour taste and a dry powdery texture. In Nigeria, the fruit is called 'Icheku' by the Igbos, 'Tsamiyarkurm' by the Hausas, 'Awin' by the Yorubas and 'Ugen' among Owan people of Edo State. The pulp is believed to improve appetite and is used as a gargle for sore throats, dressing of wounds and is said to aid the restoration of sensation in cases of paralysis. The unique sweet/sour flavor of the pulp makes it popular in domestic cooking and flavorings. The thirst quenching, refreshing fruit pulp can also be soaked in water and drank as a beverage and also provides chewing sticks, jams and jellies [8]. This study is aimed at determining the proximate, phytochemical, vitamin and mineral compositions of velvet tamarind pulp.

## 2. MATERIALS AND METHODS

### 2.1 Collection of Velvet Tamarind Fruit

The fruit of velvet tamarind was purchased from "Oja-Oba" market in Ibadan, Nigeria and was identified by a botanist, Mr. A. O. Adekale of the University of Ibadan. The fruits were sun-dried, the coat and seed were removed by mechanical means. The pulp was ground using a pestle and mortar, and were transferred into an electric blender (Moulinex) for further grinding. After grinding, the powder was sieved into a finer particle and preserved for further analysis.

### 2.2 Determination of Proximate and Energy Composition of Velvet Tamarind Pulp

The proximate compositions of the sample were determined using Association of Official Analytical Chemists (AOAC) [9] methods. Moisture content of the pulp was determined gravimetrically. The protein content was determined by micro Kjeldahl method, using 6.25 as the nitrogen conversion factor. The fat content was determined by Soxhlet extraction method using petroleum ether. Acid-base method was

used to determine the crude fibre content. The ash content was determined by incinerating the samples at 600°C in a muffle furnace. Carbohydrate concentration was obtained by difference, while gross energy (KJ and Kcal per 100 g) was calculated based on the formula of Eknayake et al. [10]. The percentage calories was calculated by multiplying the percentage of crude protein and carbohydrate with 4 and crude fat by 9. The value was then converted to calories per 100 grams of each sample [9].

$$\text{Energy} = (\text{carbohydrate } 4) + (\text{crude protein } 4) + (\text{crude fat } 9)$$

### 2.3 Quantitative determination of Phytochemical Composition of Velvet Tamarind Pulp

Phytochemical composition of velvet tamarind pulp was determined according to the methods described by AOAC [9].

### 2.4 Determination of Vitamin Composition of Velvet Tamarind Pulp

Vitamin composition of velvet tamarind pulp was determined according to the methods described by AOAC [9].

### 2.5 Determination of Mineral Composition of Velvet Tamarind Pulp

Mineral elements were determined using wet-acid digestion method for multiple nutrients determination as described by the AOAC [9]. About 0.2 g of the sample material was weighed into a 150 ml Pyrex conical flask. 5 ml of the extracting mixture (H<sub>2</sub>SO<sub>4</sub> – Sodium salicylic acid) was added to the sample. The mixture was allowed to stand for 16 h. The mixture was then placed on a hot plate set at 30°C and allowed to heat for about 2 h. 5 ml of concentrated perchloric acid was introduced to the sample and heated vigorously until the sample was digested to a clear solution. 20 ml of distilled H<sub>2</sub>O was added and heated to mix thoroughly for about a minute. The digest was allowed to cool and was transferred into a 50 ml volumetric flask and made up to the mark with distilled water. The digest was used for the determinations of calcium (Ca) and magnesium (Mg) by the ethylenediamine tetracetic acid Versenate Complexiometric titration method. AOAC [9] method was used to determine sodium (Na) and potassium (K) by using a flame photometer (model PFP7 Digital, Jenway, UK). All other

minerals were determined by atomic absorption spectrophotometer (model 3030, Perkin Elmer, Norwalk USA).

## 2.6 Statistical Analysis

Microsoft Excel (2013) software was used to calculate the results. Data were presented as means  $\pm$  standard deviation (SD) of triplicate analysis ( $n = 3$ ).

## 3. RESULTS

The results of this study are presented in mean  $\pm$  standard deviation with  $n = 3$ . The proximate composition of velvet tamarind pulp is presented in Table 1. It contains high concentration of carbohydrate (79.78%) but very low concentration of fat (0.43%). The phytochemical composition of the pulp is presented in Table 2 with flavonoid (33.78 mg) and phytate (0.07mg) having the highest and lowest concentrations respectively. Velvet tamarind pulp was observed to be rich in vitamins as presented in Table 3, with vitamin C (28.82 mg/100g) and vitamin B<sub>1</sub> (0.84) having the highest and lowest concentrations respectively. Velvet tamarind pulp contained 5.85 mg/100g of potassium and 0.38 mg/100g of phosphorus as the highest and lowest minerals respectively as presented in Table 4.

## 4. DISCUSSION

### 4.1 Proximate Composition of Velvet Tamarind Fruit Pulp

The proximate analysis of this study showed that velvet tamarind fruit contains high amount of nutrient (Table 1). The concentration of crude protein was low (6.66%). According to Essien et al. [11], velvet tamarind pulps are generally not considered as excellent sources of proteins. The result obtained for crude protein in this study is

similar to the 6.43% reported by Gnansounou et al., [12]. However, it is lower than the 9.2% and 9.38% reported by FAO [13] and Asoiro et al., [14] respectively. Furthermore, the concentration of crude protein observed in this study is higher than the 3.94% and 2.3% reported by Osanaiye et al., [15] and Okudu et al., [16] respectively. In spite of the relatively weak value of crud proteins contained in the fruit pulp (6.66%), the fruits of velvet tamarind are richer in proteins than the wild berries from British Colombia [17], orange, strawberry and melon [18]. Therefore, this fruit wear a particular aspect because fruits are generally not considered like sources of proteins. Protein has been identified as one of the deficit nutrient in the developing countries; this implies that consuming velvet fruit along with other protein food sources will increase protein intake. Protein malnutrition is one of the serious challenges in Africa continent especially Nigeria [16].

The concentration of crude fat (0.43%) obtained from this study is similar to the 0.47% reported by Okudu et al., [16] but is significantly lower than the 5.34% and 9.21% reported by Osanaiye et al., [15] and Gnansounou et al., [12] respectively. Substances with low fat content will not undergo rancidity during storage [19]. This is suggestive that velvet tamarind fruit could be stored for longer period without any discolouration or development of off-odour.

Fibre has been reported to enhance digestion [19]. Thus, velvet tamarind pulp might be play a vital role in food digestion and eliminates the possibility of constipation in consumers. The concentration of crude fibre in this study is similar to the 1.05% reported by Osanaiye et al., [15] but higher than the 0.66% reported by Okudu et al., [16]. However, it is lower than the 3.12% and 4.57% reported by Adamu et al., [20] and Asoiro et al., [14] respectively.

**Table 1. Proximate and energy composition of velvet tamarind pulp**

Parameters	Concentration
Protein (%)	6.66 $\pm$ 0.51
Crude Fat (%)	0.43 $\pm$ 0.02
Crude Fibre (%)	1.21 $\pm$ 0.06
Ash (%)	2.65 $\pm$ 0.22
Moisture (%)	9.26 $\pm$ 0.47
Carbohydrate (%)	79.78 $\pm$ 4.85
Energy (KJ/100g)	349.61 $\pm$ 11.82

*Results are presented as means  $\pm$  standard deviation (SD) of triplicate analysis ( $n = 3$ )*

**Table 2. Phytochemical composition of velvet tamarind pulp**

Phytochemical	Concentration (mg)
Alkaloid	21.08±2.34
Flavonoid	33.78±4.21
Saponin	0.14±0.00
Tannin	1.35±0.02
Phytate	0.07±0.00
Phenol	14.04±2.39

Results are presented as means ± standard deviation (SD) of triplicate analysis (n = 3)

**Table 3. Vitamin composition of velvet tamarind pulp**

Vitamin	Concentration (mg/100g)
Vitamin A (Retinol)	3.60±0.11
Vitamin B <sub>1</sub> (Thiamine)	0.84±0.01
Vitamin B <sub>2</sub> (Riboflavin)	5.43±0.12
Vitamin B <sub>3</sub> (Niacin)	1.62±0.01
Vitamin B <sub>12</sub> (Cobalamin)	2.61±0.06
Vitamin C (Ascorbic Acid)	28.82±6.29
Vitamin E (Tocopherol)	2.58±0.02

Results are presented as means ± standard deviation (SD) of triplicate analysis (n = 3)

**Table 4. Mineral composition of velvet tamarind pulp**

Mineral	Concentration (mg/100g)
Potassium (K)	5.85±0.28
Magnesium (Mg)	3.02±0.14
Calcium (Ca)	0.89±0.02
Phosphorus (P)	0.38±0.01
Iron (Fe)	1.40±0.07
Sodium (Na)	2.92±0.16
Na/K	0.49±0.02
Ca/P	2.34±0.13

Results are presented as means ± standard deviation (SD) of triplicate analysis (n = 3)

Ash value has been regarded as an indicator for food quality evaluation [16]. Airaodion et al., [19] has explained that ash content is a measure of the total minerals present within a food when they reported the nutritional and anti-nutritional evaluation of garri processed by traditional and instant mechanical methods. The ash content of velvet tamarind fruit used in this present study was observed to be 2.65% which is similar to the 2.0% and 2.45% respectively reported by Adamu et al., [20] and Asoiro et al., [14] but significantly lower than the 12.52% reported by Osanaiye et al., [15]. It is however, higher than the 1.70% and 0.85% observed by Gnansounou et al., [12] and Okudu et al., [16] respectively.

Moisture content estimates directly the water content and indirectly the dry matter content of the sample. It is also an index of storage stability of the flour samples. Substances with moisture

content less than 14% can resist microbial growth and thus have better storability [19]. Interestingly, the result of moisture content of velvet tamarind fruit pulp observed in this study falls within this range thus can resist microbial growth and have better storability. This result is in line with the 9.36% and 10.53% respectively reported by Gnansounou et al., [12] and Osanaiye et al. [15] but lower than the 19.04 and 30.00% respectively reported by Asoiro et al. [14] and Adamu et al. [20] for moisture content of velvet tamarind pulp in their respective studies.

The carbohydrate and energy obtained for velvet tamarind pulp were 79.78% and 349.61 KJ/100g respectively. 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 to 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 [16]. The energy that the body derived from food is lower than the amount of energy produced when food is burnt or completely oxidized in a bomb calorimeter. This is due to calorie producing nutrients, which are mainly protein, fats and carbohydrates that are not completely digested, absorbed or oxidized to yield energy in the body [21]. The concentration of carbohydrate in this study corresponds to the 75.03% and 80.00% reported by Asoiro et al., [14] and Gnansounou et al., [12] respectively but higher than the 58.65% and 57.04% reported by Osanaiye et al., [15] and Adamu et al., [20] respectively. Similarly, the energy observed in this study is higher than the 263.27KJ/100g but lower than the 499KJ/100g reported by Adamu et al., [20] and Okudu et al., [16] respectively. Based on the required amount per day recommended (1,500 - 2,000 Kcal per day) [22], velvet tamarind may only supply a part of energy required per day when consumed but would contribute greatly to meet the energy requirement per day.

Variations in the reported values of proximate composition of velvet tamarind fruit pulp in comparison with some previous studies may be due to differences in the soil, climatic conditions, geographical condition and relative humidity of the surrounding atmosphere as well as cultural practices [14].

#### 4.2 Phytochemical Composition of Velvet Tamarind Pulp

Phytochemicals are chemical compounds produced by plants, generally to help thrive or thwart competitors, predators or pathogens. The phytochemical category includes compounds recognized as essential nutrients, which are naturally contained in plants and are required for normal physiological functions and must be obtained from diet by humans [23]. Phytochemicals are bioactive compounds found in vegetables, fruits, cereal grains, and plant based beverages such as tea and wine. They are chemicals produced by plants through primary or secondary metabolism. They have been used as poison and in tradition medicine [24]. The results of the phytochemical composition of the velvet tamarind pulp are shown in Table 2. The result showed that the pulp contained 21.08mg of alkaloid. Alkaloids have many pharmacological

activities including antihypertensive effects (many indole alkaloids), antiarrhythmic effect (quinidine, sparteine), antimalarial activity (quinine), and anticancer actions (dimeric indoles, vincristine, vinblastine) [25]. Some alkaloids have stimulant properties such as caffeine, nicotine and morphine and are used as analgesic [26]. Thus, velvet tamarind pulp will be a potent pharmaceutical agent.

Flavonoid was the highest phytochemical obtained in this study with 33.78 mg. this is similar to the 35.44 mg observed by Oluwole-Banjo [27]. Flavonoids have been reported to exert multiple biological properties such as antimicrobial, cytotoxicity, anti-inflammatory as well as antitumor activities but the best-described property of almost every group of flavonoids is their capacity to act as antioxidants which can protect the human body from free radicals. The capacity of flavonoids to act as antioxidants depends upon their molecular structure. The position of hydroxyl groups and other features in the chemical structure of flavonoids are important for their antioxidant and free radical scavenging activities [28]. Flavonoids have been stated to possess many useful properties, containing anti-inflammatory activity, enzyme inhibition, antimicrobial activity, oestrogenic activity, anti-allergic activity, antioxidant activity, vascular activity and cytotoxic antitumor activity [29]. Flavonoids are a class of secondary plant metabolites that exert beneficial health effects through their antioxidant activity [25]. Flavonoids constitute a wide range of substances that play important role in protecting biological systems against the harmful effects of oxidative processes on macromolecules, such as carbohydrates, proteins, lipids and DNA [22]. Several studies have reported the potential of some plants extracts to prevent peptic ulcer due to the presence of flavonoid [31,32,33].

In this study, velvet tamarind fruit was observed to contain 0.14mg of saponin, a concentration higher than the 0.04mg reported by Okudu et al., [16]. In another study, Oluwole-Banjo [27] reported that saponin was not detected in velvet tamarind pulp. It has been reported that saponin has a range of biological activities and potential health benefits such as hypocholesterolemic, anti-coagulant, anti-carcinogenic, hepatoprotective, hypoglycemic, immunomodulatory, neuroprotective, anti-inflammatory, anti-oxidant activity, inhibition of dental caries and platelet aggregation [34]. They might also be used in the treatment of hypercalciuria and have also been found to

significantly affect growth positively, feed intake and reproduction in animals. Saponins have also been observed to kill protozoans and molluscs and act as antifungal and antiviral agents [35].

In this study, velvet tamarind pulp was observed to contain 1.35mg of tannin, a concentration higher than the 0.55mg reported by Okudu et al., [16]. Tannin-containing plant extracts are used as astringents, against diarrhoea, as diuretics, against stomach and duodenal tumors, and as anti-inflammatory, antiseptic, antioxidant and hemostatic pharmaceuticals [36]. The presence of tannin in velvet tamarind pulp used in this study implies that it might have high potential in natural healing and prevention of inflammation.

Knowledge of phytate levels in food is necessary because a high content can cause harmful effects on digestibility [37]. Phytate has been recognized as an anti-nutrient due to its adverse effects. It reduced the bioavailability of minerals and caused growth inhibition. Phytate is capable of chelating divalent cationic minerals like calcium, iron, magnesium and zinc thereby inducing dietary deficiency [38,39]. Wise [40] suggested that the solubility of phytate and proportion of minerals bound to the complex depend on dietary calcium levels. The phytate concentration of velvet tamarind pulp used in this study is 0.07mg which is similar to the 0.06mg recorded by Okudu et al., [16]. The low level of phytate in velvet tamarind pulp reduces its adverse effect on the health of its consumers.

Varied biological activities of phenols have been reported [34,41,42]. Increase in bile secretion, reduction in blood cholesterol and lipid levels and antimicrobial activity against some strains of bacteria such as staphylococcus aureus are some of biological activities of phenol. Phenolics possess diverse biological activities, such as antiulcer, anti-inflammatory, antioxidant [41], cytotoxic and antitumor, antispasmodic, and antidepressant activities [42]. In this study, velvet tamarind pulp was observed to contain 14.04mg of tannin, a concentration which corresponds to the 13.43 reported by Oluwole-Banjo [27]

### 4.3 Vitamin Composition of Velvet Tamarind Pulp

Vitamins are usually required in very small quantities. They are usually grouped into two as fat-soluble vitamins (A, D, E and K) and water-soluble vitamins (B and C). The fat-soluble vitamins can be found in the liver and the adipose tissues, while the water-soluble are

usually eliminated out of the body. Vitamin C possesses an antioxidant character and has the potential for maintaining the connective tissues, facilitates the absorption of dietary iron from the intestine and wound healing [43]. Vitamin A and C content are adequate to supplement other dietary sources. Vitamin A helps in the treatment of eye problem while lack of vitamin C causes scurvy and gingivitis. Vitamin E and C are important antioxidants which protect the outer membranes from oxidative stress/damage [44]. The recommended dietary allowance of vitamin C for adults is 45 mg/day [45]. Vitamin C is one of the major components of the fruit pulp of velvet tamarind. In this study, the fruit pulp of velvet tamarind contain ascorbic acid (Vitamin C), tocopherol (vitamin E), retinol (vitamin A), thiamine (Vitamin B<sub>1</sub>), riboflavin (vitamin B<sub>2</sub>), niacin (vitamin B<sub>3</sub>) and cyanocobalamin (vitamin B<sub>12</sub>) which recommends them as good dietary supplements, antioxidants, and also essential for clear vision.

Vitamins are also important nutrients. Vitamin A is important for normal vision, gene expression, growth and immune function by its maintenance of epithelial cell functions [46]. The vitamin A concentration (3.60 mg/100g) obtained in this study corresponds with the 3.8 mg/100g obtained by Awotedu et al., [47] in velvet tamarind fruit pulp harvested in Oyo State. It is however lower than the 6.2 mg/100g obtained for velvet tamarind pulp harvested from Abuja but higher than the 1.1 mg/100g and 2.4 mg/100g obtained for velvet tamarind pulp harvested from Abia and Edo States respectively by Awotedu et al., [47]. The recommended dietary allowance and the daily dose of vitamin A for adults is 0.8-10 mg/day [48]. Thus, consumption of velvet tamarind fruit will meet the daily requirement for vitamin A in human.

The B-vitamins determined in velvet tamarind fruit are thiamin (0.84 mg/100 g), riboflavin (5.43 mg/100 g), niacin (1.62 mg/100 g) and cyanocobalamin (2.61 mg/100 g). The B-vitamins are known for their roles in energy metabolism *in vivo* [16]. The niacin concentration in this study is similar to the 1.5 mg/100g but thiamine and riboflavin are higher than the 0.10 and 2.01 respectively reported by Okudu et al., [16]. The cyanocobalamin concentration in this study is similar to the 2.67 and 2.59 mg/100g reported by Awotedu et al., [47] for velvet tamarind fruit harvested from Oyo state and Abuja respectively. Vitamin B<sub>12</sub> plays an important role in promoting carbohydrate, protein and normal fat metabolism,

it is essential in the formation of red blood cells, the normal functioning of the nervous system and on the translocation of the methyl group in DNA synthesis.

Ascorbic acid (vitamin C) is an effective quencher of singlet oxygen and other radicals. It has a vitamin E sparing antioxidant action, coupling lipophilic and hydrophilic reactions [49]. It reacts with superoxide and a proton to yield hydrogen peroxide or with the hydroxyl radical to yield water [50]. It is also indispensable for iron absorption, clothes repair and blood vessels formation via collagen synthesis. Any food poor in vitamin C is associated with fatigue [51] and immunodeficiency [52]. The deficiency in human may cause scurvy. In this study, the concentration of vitamin C was determined as 28.82 mg/100g which corresponds to the 27.7 mg/100g reported by Okudu et al., [16]. The high value of ascorbic acid in velvet tamarind pulp makes it useful in the prevention of scurvy, bleeding gums, limbs pain and blindness. The daily dietary allowance for vitamin C is 45 mg/day as reported by NAS [53]. The vitamin C content in velvet tamarind will meet the recommended daily requirements [53] when consumed.

Vitamin E is a powerful antioxidant which helps to protect cells from damage by free radicals and it is vital to the formation and normal function of red blood cell and muscles [46]. Velvet tamarind fruit used in this study contained 2.58 mg/100g of vitamin E. This is similar to the 2.23mg/100g but lower than the 3.26 mg/100g reported by Awotedu et al., [47] for velvet tamarind fruit harvested from Oyo and Edo States respectively. The recommended dietary allowance and the daily dose of vitamin E for adults is 8-10 mg/day [48]. This implies that velvet tamarind fruit could complement the vitamin E need of the body.

#### **4.4 Mineral Composition of Velvet Tamarind Pulp**

The results of mineral profile of velvet tamarind pulp are presented in Table 4. The most concentrated mineral was potassium (5.85 mg/100g) followed by magnesium (3.02 mg/100g) while sodium (2.92 mg/100g) took the third position. According to Kadri et al. [54], these minerals are essential in numerous biological functions and are very important for health. The 5.85 mg/100g obtained for potassium in this study is higher than the 1.21 and 1.44 mg/100g reported by Osanaiye et al., [15] and Okudu et al., [16]. Similarly, the 3.02 mg/100g obtained for

magnesium in this study is higher than the 0.40 and 1.0 mg/100g reported by Osanaiye et al., [15] and Okudu et al., [16] but corresponds to the 2.90 mg/100g reported by Asoiro et al., [14]. Magnesium has been reported to cooperate with calcium for muscular contraction and blood coagulation. It is a co-factor for several enzymes [55]. The value of 0.89 mg/100g of calcium obtained in this study is similar to the 0.97 mg/100g obtained by Okudu et al., [16] but higher than the 0.51 and 0.35 respectively reported by Asoiro et al., [14] and Osanaiye et al., [15]. Calcium is needed for ossification, muscular contraction and blood coagulation [56]. This suggests that the amount of calcium present in the sample would be adequate for infant development of bones and teeth. Both calcium and magnesium are mostly found in the skeleton. In addition to its structural role, magnesium is an activator of various enzymes. Furthermore, the mean values of sodium and iron obtained in this study is similar to the 2.88 and 1.43 mg/100g respectively reported by Osanaiye et al., [15] but higher than those obtained by Okudu et al., [16]. Iron content of the fruit is a good means of preventive struggle against anemia. 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 obtained in this study is 0.49. The ratio of 0.60 is recommended for intake [57]. The value reported for the sample was lower than the recommended value. This indicates that velvet tamarind would not support hypertension. The mean value of 0.38 mg/100g obtained for phosphorus in this study corresponds to the 0.35 mg/100g reported by Okudu et al., [16] but lower than the 0.49 mg/100g reported by Asoiro et al., [14]. Phosphorus is required for most chemical reactions in the body especially in the teeth. The Ca/P ratio obtained in this study is 2.34. The Ca/P ratio greater than 0.5 is required for favourable calcium absorption in the intestine for bone formation [57]. Thus, consumption of velvet tamarind fruit will enhance calcium absorption and facilitates bone formation.

#### **5. CONCLUSION**

The composition of velvet tamarind fruit obtained in this study revealed that it is a good source of nutrient, phytochemicals, vitamins and minerals. It should be incorporated as food supplement to reduce malnutrition. It is a fruit with promising nutraceutical potential, thus it is a useful tool for further drug development from the natural plant products.



## DISCLAIMER

The products used for this research are commonly and predominantly used products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

## CONSENT

It is not applicable.

## ETHICAL APPROVAL

It is not applicable.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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