



## Proximate Analysis and Elemental Composition of *Terminalia Catappa* Fruit

Idris M. Omenesa<sup>1\*</sup> Suleiman A. Itopa<sup>2</sup>, Jwan'an L. Emmanuel<sup>3</sup>  
Abdulsalaam O. Abdulazeez<sup>1</sup> and Sambo Ponfa<sup>3</sup>

<sup>1</sup>Department of Chemistry, Kogi State University Anyigba, Nigeria.

<sup>2</sup>Department of Biochemistry, Kogi State University Anyigba, Nigeria.

<sup>3</sup>Department of Biochemistry, Bayero University Kano, Kano state, Nigeria.

### Authors' contributions

This work was carried out in collaboration among all authors. Author IMO designed the study, carried out the investigation and prepared the original draft; author SAI carried out analysis of the data, author JLE managed the literature searches and prepare the manuscript, authors AOA and SP participated in the investigation and wrote the protocol. All authors review the manuscript, read and approved the final manuscript.

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### ABSTRACT

**Introduction:** *Terminalia catappa* is a large tropical tree in the lead wood tree family, *combretacea*. This plant is regarded as a medicinal plant and can be used in the treatment of cough, syphilis, hydropsy, rheumatism, and other infections.

**Aim:** This study assessed the nutritional value of *Terminalia catappa* and the composition of elements present in the plant fruit.

**Methods:** Proximate analysis was carried out according to food chemistry analytical methods and elements were estimated by atomic absorption and flame spectroscopy respectively.

**Results:** Proximate analysis showed that the fruits contained 81.96% moisture content, 1.47% ash, 0.04% crude fat, 1.11% crude protein, 14.05% carbohydrate, and 1.41% crude fibre. The fruits were found to be good sources of minerals. Sodium ( $2.1 \pm 0.01$  mg/100 g), potassium ( $72.5 \pm 1.03$  mg/100 g), calcium ( $320 \pm 2.00$  mg/100g), magnesium ( $20 \pm 2.65$  mg/100 g), iron ( $20 \pm 3.0$  mg/100 g), manganese ( $2 \pm 0.36$  mg/100 g), and zinc ( $8 \pm 1.25$  mg/100 g).

\*Corresponding author: E-mail: idris.mo@ksu.edu.ng;

**Conclusion:** The results revealed the presence of nutrients such as proteins, carbohydrates, crude fats, crude fibre, moisture, and ash in small amounts. And elements analysis shows that sodium, potassium, calcium, magnesium, iron, manganese, and zinc are in appreciable amount. These constituents are therefore responsible for the biochemical values of *Terminalia catappa* fruits.

*Keywords: Terminalia catappa; proximate analysis; elemental compositions.*

## 1. INTRODUCTION

*Terminalia catappa* is a large tropical tree in the lead wood tree family, *combretaceae* [1]. *Terminalia catappa* as a medicinal plant can be used in the treatment of cough, syphilis, hydrophy, rheumatism, and other infection [2]. *Terminalia catappa* is widely grown in tropical regions of the world as an ornamental tree grown for the deep shade its large leaves provide. The fruit is edible, tasting slightly acidic. The wood is red, solid and has high water resistance. It has been utilized in polynesian for making canoes. One of this chemical richness, is that the fruit and also the bark are used in different traditional medicines for treatment of liver disease [3]. In India a tea made from the fruit is prescribed against dysentery and diarrhea. It is also thought that the fruit contains agents for prevention of cancers, although the anticarcinogenic properties have not been demonstrated and so also the antioxidant as well as anticholesterogenic characteristics [4]. Keeping the fruit in an aganidium is said to lower the pH and heavy metal content of water [5]. It has been utilized in this way by national institute for pharmaceutical research and development for many years to conduct various researches. It is believed to help prevent fungi forming on the egg of the fish. However, new research suggests that eating almond can help the body be right off viral infections such as the common cold and flu [6]. The species has traditionally been very important for coastal communities, providing a wide range of non-wood products and services. It has a spreading fibrous root system and plays a vital role in coastal stabilization. It is widely planted throughout the tropics, especially along sandy seashores, for shade, ornamental purpose and edible nuts. The timbers make a useful and decorative general purpose hardwood and are well suited for conversion into furniture and interior building timbers. Fruits are produced from about 3 years of age, and the nutritious, tasty seed kernel may be eaten immediately after extraction. Tropical almond is easily propagated from seed and is fast growing and flourishes with minimal maintenance in suitable environment selected cultivars of the species warrant wider

commercial planting for joint production of timber and nuts [7].

## 2. MATERIALS AND METHODS

### 2.1 Sample Collection

*Terminalia catappa* fruits used in this research were obtained from the National Institute for Pharmaceutical Research and Development, Idu-Industrial Area of Abuja and was identified in the Department of Plant Science and Biotechnology, Kogi State University Anyigba, Nigeria, with the identification number IM/AA/21/33. *Terminalia catappa* fruit were separated from their seeds and dried for weeks. After drying, the *Terminalia catappa* fruits were pulverized to powdered form, which served as the sample used throughout the research work.

### 2.2 Proximate Analysis of *Terminalia catappa* Fruits

Total ash content, moisture content, and crude fat were determined [8]. Total carbohydrate was determined [9]. The determination of crude protein was based on Kjeldahl procedure; the digest having been made alkaline was 3 trapped in a standard acid and filtered [10]. Crude fiber was calculated by the relation 100- (% ash content + % moisture content + % crude fat + % carbohydrate + % crude protein).

#### 2.2.1 Determination of moisture

The moisture content of the sample was determined by oven drying method, 1.5g of well mixed sample was accurately weighed in a clean crucible as (w1). The crucible was then allowed in an oven at 100°C for 8-12hrs until a constant weight was obtained. The crucible was placed in a desiccator for 30mins to cool and was weighed as (w2). The percentage moisture was calculated by the formula.

$$\% \text{Moisture} = \frac{w1 - w2}{\text{wt. of sample}} \times 100$$

Where W1 = initial weight of crucible + sample

$W_2$  = final weight of crucible + sample

### 2.2.2 Determination of ash

Empty crucible was cleaned and placed in a muffle furnace at 600°C for 1hr it was then cooled in desiccators and weighed as ( $w_1$ ). After which 1g of the sample was taken in the crucible as ( $w_2$ ). The sample was ignited over a burner with the help of blowpipe until it is charred. Then crucible was placed in a muffle furnace again at 550°C for 2-4hrs, the appearance of grey white ash indicate complete oxidation of all organic matter in the sample. After ashing, the furnace was switched off and the crucible was cooled and weighed as ( $w_3$ ) percent ash was calculated by the formula

$$\% \text{Ash} = \frac{(W_3 - W_1) \text{weight of ash}}{\text{weight of sample}} \times 100$$

### 2.2.3 Determination of crude protein

These procedure was carried out according to Kjeldal method. The sample was digested by heating with concentrated  $H_2SO_4$  in the presence of digestion mixture, the mixture was then made alkaline and an ammonium sulfate is formed. The released ammonia was collected in 2% boric acid solution and titrated against standard HCl. Total protein was calculated by multiplying the amount of nitrogen with appropriate factor (6.25) and the amount of protein was calculated as

$$\% N = \frac{(S - B) \times N \times 0.014 \times D \times 100}{\text{wt. of sample} \times V}$$

% Crude protein = 6.25 x % N (correctional factor)

Where S = sample titre reading

B = blank titre reading

N = Normality of HCl

D = dilution of sample after digestion.

V= Volume for dilution

0.014 = Milli equivalent weight of nitrogen

### 2.2.4 Determination of crude fibre

Moisture free ether extract of the sample was digested with dilute  $H_2SO_4$  followed by addition of KOH solution. After digestion, residue was collected and was ignited to weight loss and weight was taken as ( $w_1$ ). After which the sample

in the crucible was kept in a muffle furnace at 55°C and was cooled in a desiccator, the weight was taken as ( $w_2$ ). The crude fiber was calculated by the formula.

$$\% \text{ Crude fibre} = \frac{(W_1 - W_2)}{\text{weight of sample}} \times 100$$

### 2.2.6 Determination of carbohydrate

The total carbohydrate analysis of *Terminalia catappan fruit* was carried out using the phenol sulfuric acid method as described by [11,12] 100mg of the fruit extract of *Terminalia catappa* was weight in a boiling tube and was hydrolyzed by keeping it boiling water for 3hrs, and 5ml of 2.5 N-HCl was added and was allowed to cool at room temperature. After cooling, the mixture was neutralized with solid sodium carbonate until the effervescence disappears and was made to 100mls followed by centrifugation. 0.1 and 0.2mls of the extract was measured a separate tubes, and make to 1ml with distilled water, phenol solution and 5ml of 95% $H_2SO_4$  was added to each tube serially and was shaken thoroughly and allowed to stand for 10mins. The mixture was placed in a water bath at 25-30oc for 20mins. The same procedure was carried out for the standard at various concentrations 0.2, 0.4, 0.6, 0.8, and 0.1mls respectively. The absorbance of the sample and the standard was taken at 490nm against the blank (distilled water). Total carbohydrate was calculated using the formula below

Absorbance corresponds to 0.1ml of the test = Xmg of glucose

100ml of the sample solution contains?

$$\% \text{ Carbohydrate} = (X \div 0.1) \times 100 \text{mg of glucose}$$

### 2.2.7 Determination of crude fat

This was carried out by the dried extraction method. The dry sample was extracted with ether using soxhlet extraction; approximately 1g of moisture free sample was wrapped in filter paper placed in the fat free thimble and then introduced in the extraction tube. After evaporating the solvent, the extract was transferred into a clean glass dish with ether washing and then evaporated in a water bath. After which the dish was placed in an oven at 105°C for 2hrs and was

cooled in a desiccators. The percent crude fat was determined by using the formula.

$$\% \text{ Crude fat} = \frac{\text{wt of ether extract}}{\text{weight of sample}} \times 100$$

### 2.3 Atomic Absorption spectroscopy and Flame Photometer for determination of iron (Fe), Zinc (Zn), Calcium (Ca), Manganese (Mn) and Potassium (K) and Sodium (Na) Respectively

The ash obtained from ash determination was transferred to a desiccator to cool, And concentrated HNO<sub>3</sub> (5cm<sup>3</sup>) acid solution was added. The sample was evaporated to dryness on a hot plate and returned to the muffle furnace and heated again at 400°C for 20minutes until perfectly grayish-white color was observed. The sample was allowed to cool by addition of concentrated HCl acid (5cm<sup>3</sup>) to dissolve the ash. The solution was filtered in a 100cm<sup>3</sup> volumetric flask which was made up to the mark with distilled water. Atomic Absorption Spectrophotometer (AAS) and Flame Photometer were used to analyze the absorbance of each element present in the solution. The concentration of minerals recorded in terms of PPM were converted to milligram (mg) of the mineral by multiplying the ppm with dilution factor and divided by 1000 as follows

$$MW = \frac{\text{absorbancy(ppm)} \times \text{dry wt.} \times D}{\text{wt of sample} \times 1000} \times 100$$

### 3. RESULTS/DISCUSSION

The result of proximate analysis of *Terminalia catappa* shows that the fruit contains many nutrients that are required as essential nutrient needed for the well being of life. Table 1 shows the percentage of nutrient contained in *Terminalia catappa* fruits which include moisture content (81.96%), ash (1.47%), crude fat (0.04%), carbohydrate (14.05%), crude fibres (1.41%), and protein (1.11%). This revealed that, there is a high percentage of moisture content followed by carbohydrate, while protein recorded the lowest percentage composition. The recent research by the National Research Council [13] on *Terminalia catappa* seed revealed a higher percentage composition of 51.80% fat followed

by 23.78% crude protein while 4.13% moisture was recorded as the lowest. This indicated that *Terminalia catappa* fruits have a high moisture and carbohydrate content than its seed. And because of high moisture content, *Terminalia catappa* fruit is subject to spoilage by bacterial action and cannot be preserved [14]. The fruits have low fats as reported by [15] that fruits and vegetables are not good source of fats and oils and reduces the level of cholesterol and obesity [16] Carbohydrates are the major source of energy for living cells and serve as natural laxatives for human beings [17]. Also carbohydrates are the first cellular constituents, synthesized by green plant during photosynthesis from carbon dioxide and water, on absorption of light. Thus, light is the ultimate source of energy for all biological processes [18]. This shows the nutritional value of *Terminalia catappa* fruits and its use as a medicinal plant.

The elemental composition of *Terminalia catappa* fruits in different concentrations are sodium (2.1±0.01 mg/100 g), potassium (72.5±1.03 mg/100 g), calcium (320±2.0 mg/100 g), magnesium (20±2.65 mg/100 g), iron (20±3.00 mg/100 g), manganese (2±0.36 mg/100 g), and zinc (8±1.25 mg/100 g). The principal minerals studied are sodium, potassium, magnesium, and calcium while the essential trace element includes iron, zinc, and manganese with calcium having the highest concentration followed by potassium while manganese has the lowest concentration. The recent research by the National Research Council, (2000) on *Terminalia catappa* seed revealed a high concentration of 9280±0.14 mg/100 g potassium followed by 827.2±2.18mg/100gcalcium and 27.89±0.42 mg/100 gcalcium as the lowest. This shows that *Terminalia catappa* fruits have considerable biochemical functions in the body, the various functions of these elements in combination with its proximate composition perhaps makes it possible for the stated functions. Calcium which is present in high concentration plays a vital role in blood clotting and development of bones and teeth. Calcium is needed for the direct activation of enzymes such as lipase, ATPase and succinate dehydrogenase. Calmodulin is a calcium binding regulatory protein which activate certain enzymes e.g. adenylate cyclase, a calcium dependent protein kinases [18].

**Table 1. Results showing the Percentage composition of various nutrients present in *Terminalia catappa* fruits**

NUTRIENT	% COMPOSITION
Moisture	81.96
Ash	1.47
Crude protein	1.11
Crude fibre	1.41
Carbohydrate	14.05
Crude Fat	0.04

**Table 2. Results showing the concentrations in (mg/g) of various Element in *Terminalia catappa* fruits**

Elements	Concentration (mg/100g)
Sodium (Na)	2.1±0.01
Potassium (K)	72.5±1.03
Calcium (Ca)	320±2.00
Magnesium (Mg)	20±2.65
Iron (Fe)	20±3.00
Manganese (Mn)	2±0.36
Zinc (Zn)	8±1.25

Results are expressed as Mean ± SD of triplicate data

#### 4. CONCLUSION

Proximate analysis of *Terminalia catappa* fruits revealed the presence of proteins, carbohydrates, crude fats, crude fibre, moisture, and ash in small amounts. The elemental analysis revealed the presence of sodium, potassium, calcium, magnesium, iron, manganese, and zinc in appreciable amount. These constituents are therefore responsible for the biochemical values of *Terminalia catappa* fruits. Further research could be carried out on *Terminalia catappa* fruits to characterize the fruit sample, evaluate its anti-microbial activities and elucidate structures of the active components.

#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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