

## Mineral Content, Proximate Composition and the Antioxidant Properties of the Ethanol Extract of *Hyphaene thebaica* L. from Gezawa Town, Kano State, Nigeria

Y. Datti<sup>1\*</sup>, M. Ibrahim<sup>1</sup>, I. Salihu<sup>1</sup>, M. Abdulhadi<sup>1</sup>, S. M. Muhammad<sup>1</sup>,  
S. A. Abubakar<sup>1</sup>, S. Halima<sup>1</sup>, U. U. Ahmad<sup>2</sup> and T. Nura<sup>3</sup>

<sup>1</sup>Department of Chemistry, Yusuf Maitama Sule University, Kano, Nigeria.

<sup>2</sup>Department of Science Laboratory Technology, School of Technology Kano, Nigeria.

<sup>3</sup>Department of Chemistry, School of Science Education, FCE (T) Bichi, Nigeria.

### Authors' contributions

This work was carried out in collaboration among all authors. Author YD designed and coordinated the research. Author UUA financed the research. Authors MI and IS developed the manuscript. Authors MA, SMM, SAA supplied all the materials required. While authors TN and SH were in-charge of the laboratory and its safety. All authors read and approved the final manuscript.

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### ABSTRACT

The fruits of the doum palm tree, *Hyphaene thebaica* are one of the oldest relish fruit. This study analyzed the chemical composition (both proximate and the mineral contents) of this plant, as well as its antioxidant property. The mineral content was determined by atomic absorption spectrophotometry, while the proximate and phytochemical analyses were carried out using standard procedures at Bayero University, Kano. The fruit were found to contain some minerals including K (3366.21 mg/100 g), Ca (292.04 mg/100 g), Na (212.27 mg/100 g), Mg (177.14 mg/100 g), Fe (4.86 mg/100 g), Mn (0.83 mg/100 g), Zn (0.68 mg/100 g), Cu (0.40 mg/100 g), Ni (0.32

\*Corresponding author: Email: [yaudatti@gmail.com](mailto:yaudatti@gmail.com);

mg/100 g) and Co (0.12 mg/100 g). The proximate composition of the doum palm fruit pulp reveals protein (2.86%), lipid (0.92%), ash content (6.24%), crude fiber (12.87%), moisture content (8.64%) and carbohydrate 68.47%. The DPPH radical scavenging efficacy of the ethanol extract of the fruit of the doum palm tree was analyzed at different concentrations of the extract. At concentration 0.0625 mg/mL, 0.125 mg/mL, 0.250 mg/mL and 0.500 mg/mL the extract showed inhibitory activity of 31%, 61%, 72% and 81% respectively. Thus the doum palm fruit pulp extract possess potential antioxidant properties.

**Keywords:** *Hyphaene thebaica*; antioxidant; DPPH; proximate analysis; mineral content.

## 1. INTRODUCTION

The therapeutic properties of various medicinal plants have been used to treat many human diseases. As estimated, between 60-90% of the population of developing countries use traditional herbal medicines considering them to be a normal part of primary healthcare. The demand of herbal medicine has been increasing day by day by consumers as they perceive these forms of healing as safe and effective than the synthetic drugs. This trend of using alternative and complimentary healthcare has prompted scientists to investigate the various biological activities of medicinal plants [1]. These plant-derived products contain a great diversity of phytochemicals such as phenols, flavonoids, tannins and other phytoconstituents that possess numerous health related effects such as antibacterial, antidiabetic and anticarcinogenic properties. One important plant that possesses such properties is the doum palm tree (*Hyphaene thebaica* L.) [2].

Originally native of the Nile valley but grows well in the Northern part of Nigeria, doum palm (*Hyphaene thebaica*) is a desert palm tree with edible oval fruit. It is a member of the palm family, Arecaceae and it is dichotomous and arborescent in nature. Doum palm is listed as one of the useful plants of the world [3]. Its fiber and leaflets are used by people along the Nile to weave baskets. The doum palm fruit has a brown outer fibrous flesh which is normally chewed and spewed out. Doum palm kernel is edible when it is unripe but hard when it is ripe. Moreover, doum palm is also used for local craft, for construction and the root is also medicinal. The foliage is used to make mats, ropes, baskets, and hats while the stem with the leaves are used for construction purpose [4]. Roots of doum palm are used for treatment of bilharzias while the fruit is often chewed to control hypertension [5].

The powder of the fruit pulp of doum palm was used in making some alcoholic drinks, as well as

in the treatment of bilharzias, bleeding especially after child birth and also as haematinic agent [6,7]. The anti-cancer, antioxidant and antimicrobial activities of the fruit pulp of the doum palm have also been well documented [8,9,10]. The fruit pulp of *H. thebaica* has been shown to contain nutritional trace minerals, proteins and fatty acids, in particular the nutritionally essential linoleic acid [11] and many other beneficial nutrients [12]. In a study by Shehu et al. [13] it is reported that the extract of the fruit of *H. thebaica* (L) Mart reduces fasting hyperglycaemia. Various studies have revealed that doum palm fruit contains high levels of phenols and flavonoids, and these are known to possess significant antioxidant and antibacterial activities [9,12].

The aim of this study is to investigate the mineral content, proximate composition and the antioxidant properties of the ethanol extract of the fruit pulp of doum palm (*Hyphaene thebaica*) available in Gezawa Town, Kano State, Nigeria.

## 2. MATERIALS AND METHODS

### 2.1 Sample Collection and Preparation

Mature fruits of doum palm were obtained from Gezawa Local Government of Kano State, Nigeria, brought to the department of Biological Sciences, Yusuf Maitama Sule University, Kano, and was identified by a plant taxonomist. The plant was identified and authenticated an issued a voucher specimen number YUHAN 0047.

The fruits were crushed using mortar and pestle to separate the pulp from the kernel. The pulp sample (the doum palm pulp) was then ground into fine particles using pestle and mortar [14] and then packed in an air tight container and stored in a desiccator (containing silica gel) ready for further analysis.

All the chemicals used were of analytical grade.

## 2.2 Extraction

Fifty grams (50 g) of the powdered sample was soaked in 300 ml of absolute ethanol for forty eight hours (48 hrs) and stored away from direct light. The supernatant was decanted and filtered using filter paper. The filtrate was evaporated to dryness, and stored in sample bottles at room temperature [15].

## 2.3 Determination of Mineral Content

Mineral analysis was carried out using 10 g of the ground doum palm fruit pulp, where the pulp was subjected to dry ashing for 5 hr in well cleaned porcelain crucibles at 550°C. The residue ash was dissolved in 5 ml of HNO<sub>3</sub>/HCl (1:2) and heated gently on a hot plate until brown fumes disappeared and white coloration was formed. The solution on each crucible was filtered into 100 ml volumetric flask and the volume made up to 100 ml with deionized water [16].

The cations (K, Ca, Na, Mg, Fe, Mn, Zn, Cu, Ni and Co) were determined using flame atomic absorption spectrophotometer (model VGP 210, Buck Scientific, USA) [16].

## 2.4 Determination of Proximate Composition

The proximate compositions of the ground doum palm pulp were determined using standard analytical methods [17,18,19].

All measurements were done in triplicates and values presented in percentage.

### 2.4.1 Moisture content

Two grams of the ground doum palm pulp was oven-dried in a crucible at 105°C for 5 hrs. The dried sample was then cooled in desiccator for 1 hr and weighed to a constant weight and the percentage loss in weight was expressed as percentage moisture content [17].

### 2.4.2 Ash content

The residue remaining was weighed after the ashing of 2 g ground doum palm pulp in a crucible. The ashing was done in a muffle furnace of temperature 550°C for 6 hr. The ashed sample was cooled in a desiccator and weighed. The percentage residual weighed was expressed as ash content [17].

### 2.4.3 Crude lipid content

Continuous extraction of lipid was done for 5 hr with petroleum ether in a soxhlet extractor with 2.00 g of the ground doum palm pulp used to determine the crude lipid content [20].

### 2.4.4 Crude protein content

Kjeldahl method was used to determined total protein. Here 1 g of the ground doum palm pulp was transferred into a filter paper and put into a Kjeldahl flask, 10 cm<sup>3</sup> of concentrated H<sub>2</sub>SO<sub>4</sub> were added and digested in a fume cupboard until the solution becomes colorless. The distillation was carried out with 15 mL of 50% of NaOH. The tip of the condenser was dipped into a conical flask containing 6 cm<sup>3</sup> of 4% boric acid in a mixed indicator until a green coloration was observed. Titration was done in the receiver flask with 0.01 M HCl until the solution turned red [21].

### 2.4.5 Crude fiber content

Estimation of the crude fiber was done by acid and alkaline digestion methods 2.00 g of the ground doum palm pulp were used with 20% H<sub>2</sub>SO<sub>4</sub> and NaOH solution [21].

### 2.4.6 Carbohydrate content

The carbohydrate content of the test sample was determined by estimation using the arithmetic difference method [22,23].

$$\% \text{ Carbohydrate} = 100 - (\% \text{ Moisture} + \% \text{ Fat} + \% \text{ Ash} + \% \text{ Fiber} + \% \text{ Protein})$$

## 2.5 Determination of Antioxidant Properties of Doum Palm Fruits Pulp Extract

Evaluation of DPPH radical scavenging method was adopted as reported by Chandra and Goyal [24]. Free radical scavenging activity of the extract was measured by 1,1-diphenyl-2-picrylhydrazyl (DPPH). Here 0.1 mM solution of DPPH in ethanol was prepared and added to 3 ml of the extracts at different concentration of 50, 25, 12.5 and 6.25 mg/mL respectively. The mixture was then shaken vigorously and allowed to stand at room temperature for 30 min. The absorbance was then measured at 517 nm using spectrophotometer. Reference standard compound being used was ascorbic acid and the procedure was done in triplicate. Lower absorbance of the reaction mixture indicated

higher free radical activity. The percentage DPPH scavenging effect was calculated by using following equation:

$$\text{Percentage Inhibiton (\%)} = \frac{A_0 - A_1}{A_0} \times 100$$

Where,

A0 was the Absorbance of control reaction

A1 was the Absorbance in presence of test or standard sample

The IC<sub>50</sub> values were calculated using linear regression analysis and used to indicate antioxidant capacity.

### 3. RESULTS AND DISCUSSION

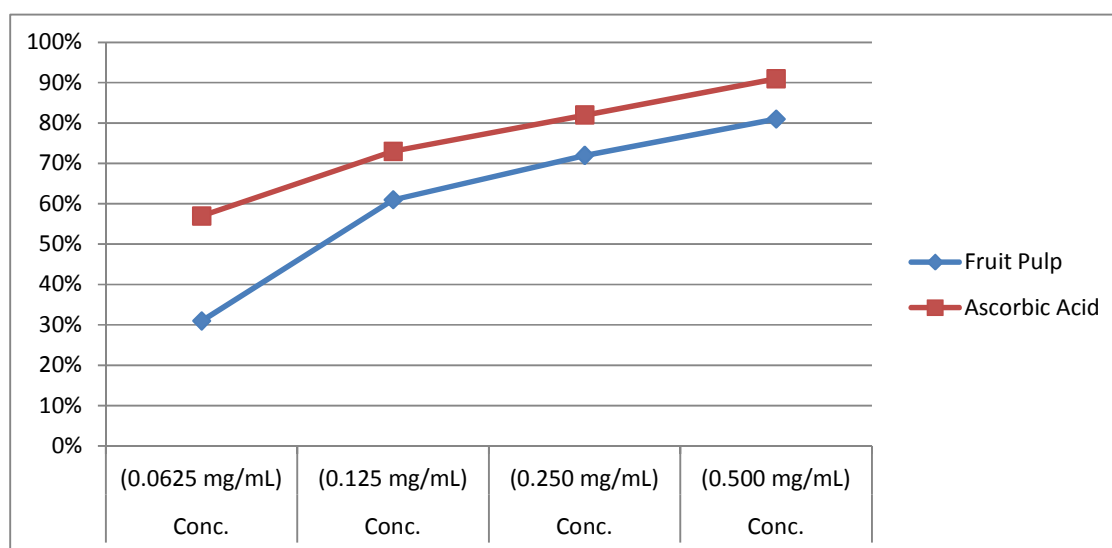
The mineral contents of the doum fruit pulp is presented in Table 1, while the proximate composition of the fruit pulp is presented in Table 2 and the and DPPH radical scavenging activity of the fruit is presented in Fig. 1.

**Table 1. Mineral contents of the Doum fruit pulp (mg/100 g)**

S/No	Mineral	Mean value (mg/100 g)
1	Potassium (K)	3366.21
2	Calcium (Ca)	292.04
3	Sodium (Na)	212.27
4	Magnesium (Mg)	177.14
5	Iron (Fe)	4.86
6	Manganese (Mn)	0.83
7	Zinc (Zn)	0.68
8	Copper (Cu)	0.40
9	Nickel (Ni)	0.32
10	Cobalt (Co)	0.12

**Table 2. Proximate composition of the Doum palm fruit pulp**

S/NO	Parameters	Fruits (%)
1	Protein	2.86
2	Lipid	0.92
3	Ash Content	6.24
4	Crude Fiber	12.87
5	Moisture Content	8.64
6	Carbohydrate	68.47



**Fig. 1. DPPH radical scavenging activity in Doum palm fruit**

The major minerals, potassium, calcium, sodium and magnesium were found in high amounts, while iron, manganese, zinc, copper, nickel and cobalt were found in lower amounts. All these elements, potassium (3366.21 mg/100 g), calcium (292.04 mg/100 g) and sodium (212.27 mg/100 g), magnesium (177.14 mg/100 g), iron (4.86 mg/100 g), manganese (0.83 mg/100 g), zinc (0.68 mg/100 g), copper (0.40 mg/100 g), nickel (0.32 mg/100 g) and cobalt (0.12 mg/100 g) were found to be in agreement with similar findings reported by Babiker and Makki [25]; Aboshora et al. [12] and Reda [26]. However, the result is higher than some the values reported by Bonde et al. [27]. It is evident from the results that these essential mineral elements are present in large amount in the fruit of doum palm plant, and this means that the fruit can be used as an excellent source of these elements especially during deficiency condition where they may be used to keep the balances and ratios between those in need [12].

The results for the proximate composition of the doum palm fruit pulp studied revealed the presence of some amounts of protein (2.86%), lipid (0.92%), ash (6.24%), crude fiber (12.87%), moisture content (8.64%) and carbohydrate (68.47%). These results were found to be very close to that reported by Hussein et al. [28]; Babiker and Makki [25]; Aboshora et al. [12] and Reda [26]. However, some researchers have reported much higher parameters in some instances. For example, Bonde et al. [27] has reported a much higher protein content of 9.26%, while Hussein et al. [28] reported 6.41%. Similarly, the value of the crude fiber (12.87) is found to be higher than that reported by Nwosu et al. [29] who reported 8.1%, Aboshora et al. [12] who reported (6.64%) and Abdel-Rahman et al. [30] who reported (7.17%). Foods rich in dietary fiber have other numerous health benefits including reduction in the risk of coronary heart disease, obesity, diabetes, reduction of hypertension and hyperlipidemia. They also contribute to gastrointestinal health, decrease cholesterol and fat contents, as well as some forms of cancer [31,32,33]. The moisture content reported in this research work (8.64%) is also found to be higher than that reported by FAO [34] (4.00%), Abdel-Rahman et al. [30] (5.47%) and Aboshora et al. [12] (5.50%). The carbohydrate content of this research work was found to be as high as 68.47% and this result is in agreement with those obtained by Tunland and Meyer [35]; Venn and Mann [36]; Hussein et al. [28]; Babiker and Makki [25]; Aboshora et al. [12]; Reda [26].

Variations in some proximate compositions like the moisture, fibre and protein contents in this study, with some reported literatures could be due to the species and the time/season when the plant was harvested [37,38]. It could also be due the climatic and environmental conditions, as well as storage condition [38,39]. There may also be more other factors that can influence the moisture of the seeds, like the size of the seed, the ratio of seed volume to surface area, the relative attractions of fat, protein and starch for water in the seed [38,40].

Different researchers have reported antioxidant activity in both the leaves and the fruit pulp of the doum palm plant [9,10,41,42,43,44,45]. In this study, the doum palm fruit pulp extract exhibited a comparable antioxidant activity with that of the standard (ascorbic acid) at varying concentrations analyzed (0.0625, 0.125, 0.250 and 0.500 mg/mL). There was a concentration-dependent increase in the percentage antioxidant activity for all concentrations tested. Ascorbic acid was used as the standard for the DPPH antioxidant activity testing. At varying concentration of the ascorbic acid there was also increasing percentage inhibition ranging from 57% to 91%. While at the same varied concentrations the extract recorded percentage inhibition ranges of 31% to 81%.

#### 4. CONCLUSION

*Hyphaene thebaica*, the doum palm tree is a desert tree that is widely used in medicine for the treatment of several disease conditions. This research aimed at investigating the mineral content, proximate composition and the antioxidant properties of the ethanol extract of the fruit pulp of doum palm (*Hyphaene thebaica*). The fruit was found to contain appreciable amount of some minerals and proximate constituents which can be of both nutritional and medicinal importance, as well as an excellent antioxidant.

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#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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