



Nutraceutical Potential of Two Wild Edible Fruits Growing in Sub-Sahara Region of Nigeria

Salisu Abubakar^{1,*}, Veronica Archibong Etim¹, Abubakar Bello Usman¹, Abubakar Isyaku¹, Babura Bashir Sabo²

¹Biotechnology Advanced Research Centre, Sheda Science and Technology Complex, Abuja, Nigeria

²Natural Resources Management and Climate Change, Agricultural Research Institute, Jigawa, Nigeria

Email address:

salisuabubakar99@yahoo.com (S. Abubakar)

*Corresponding author

To cite this article:

Salisu Abubakar, Veronica Archibong Etim, Abubakar Bello Usman, Abubakar Isyaku, Babura Bashir Sabo. Nutraceutical Potential of Two Wild Edible Fruits Growing in Sub-Sahara Region of Nigeria. *American Journal of Environmental Science and Engineering*.

Vol. 1, No. 2, 2017, pp. 52-58. doi: 10.11648/j.ajese.20170102.14

Received: March 10, 2017; Accepted: April 5, 2017; Published: May 15, 2017

Abstract: This work was carried out to assess nutraceutical values of two prominent wild edible fruit, *Hyphaene thebaica* (L.) Mart. and *Borassus aethiopum* Mart. from family *Arecaceae*. Determination of phytochemical, proximate, minerals and antioxidant potentials were carried out. The proximate analysis of the moisture, ash content and crude fat reveals (6.74%, 6.88%, 7.29%, 6.53% and 7.10%, 7.23%) for *H. thebaica* and *B. aethiopum* respectively. The *B. aethiopum* ranked highest in crude fibre (32.15%), while the highest carbohydrate content was determined in *H. thebaica* (65.90%), the protein content of both fruits were observed to be low (8.33±1.4%) and (3.34%) for *H. thebaica* and *B. aethiopum*, respectively. The mineral analysis revealed that in both samples sodium (Na) was highest 14.06mg/g in *B. aethiopum* and 14.54mg/g, in *H. thebaica*, Calcium (Ca) 6.20mg/g in *B. aethiopum* and *H. thebaica* 5.00±0.06, Potassium (K), 4.57mg/g in *B. aethiopum* and *H. thebaica* 5.60mg/g, Magnesium (Mg) 2.03mg/g, in *B. aethiopum* and *H. thebaica* 1.53mg/g. The antioxidant activity of the aqueous extracts were determined and compared with the standard vitamin C, using stable 2, 2-diphenyl-1-picryl-hydrazyl (DPPH) and ascertained by measuring reducing power, the extracts showed promising antioxidant activity at 0.5mg/ml, and the IC₅₀ values were calculated using linear regressions (0.86, 0.98, and 1) for vitamin C, *B. aethiopum* and *H. thebaica*, respectively. The results indicated that *B. aethiopum* and *H. thebaica* fruits possessed nutraceuticals values very much comparable with the commercial fruits reported earlier such as *Magnifera indica*, *Anarcadium occidentale*, and *Psidium guajava* just to mention but few.

Keywords: Antioxidants, *Borassus Aethiopum*, *Hyphaene Thebaica*, Minerals, Proximate, Wild Fruits

1. Introduction

The term nutraceutical refers to any type of food that provides health benefits including prevention and treatment of disease in addition to its basic nutritional value. Fruits are a very vital portion of an adequate diet and they serve as a food supplement, and an appetizer [1]. They are known to be an excellent source of nutrients, such as minerals and vitamins, and also contain carbohydrates in the form of soluble sugars, cellulose and starch [2]. In most developing countries of the world, wild fruits are commonly consumed by both rural and urban dwellers especially during the dry season when most cultivated fruits are out of season. The

high level of consumption is more pronounced in rural than urban communities. Wild and semi-wild food resources are frequently consumed as the dominant source of fruits especially in rural communities [3]. In Nigeria like any other developing country, fruits are among the major constituents of traditional medicine and they also provide the cheapest supplies of carbohydrates, fat, and minerals [4].

Plant extracts have been used by humans for protection against several diseases and also to improve health and lifestyle for many centuries. Certain non-nutritive chemicals in plants, such as terpenoids and flavonoids, were earlier

thought to be of no importance to human diet. However, with the development of recent techniques and research, they have been found to possess antioxidant properties [5]. Epidemiological studies have shown that increased consumption of fruits and vegetables is associated with protection against cancer, chronic diseases, such as neoplasm, cardiovascular diseases, inflammation, diabetes, neurodegenerative pathologies, and cataracts, as well as slowing down the ageing process [6]. Fruits and vegetables are major sources of dietary antioxidant vitamins, such as vitamin C (ascorbic acid), vitamin E (tocopherol), precursor of vitamin A (beta-carotene), phenolic compounds, which are also antioxidants and are widely distributed in the plant kingdom [7].

H. thebaica is a dioecious palm 10-17 m high. The trunk is Y-shaped, with a girth of 90 cm and the tree is easily recognizable by the dichotomy of its stem forming up to 16 crowns [8]. The various ethnic groups in Northern Nigeria identify *H. thebaica* by different names: Hausa, 'Goriba', Fulfulde, 'Gellechi', Kanuri, 'Kirsim'.

The fruits are glubose-quadrangular about 6 x 5 cm with a shiny orange-brown to deep chestnut skin (epicarp). The mesocarp is edible and very palatable, highly aromatic and sweet with a taste like gingerbread from where its English name is derived. It serves as a vermifuge and parasite expellant [9]. The aqueous extract of *H. thebaica* is used in the treatment of bilharziasis, haematuria, bleeding especially after childbirth and as haematinic agent. It is also good as a hypocholesterolemic, hypolipidemic and heamatinic suspension [9 - 12]. The young leaves are readily eaten by livestock, while old leaves are bitter and unpalatable, the activities of both ethyl acetate, methanol and hexane extracts against various human pathogenic bacteria and fungi are reported by [13]. Many herbalists use the fruit of the *H. thebaica* palm to treat hypertension, diabetes, and other health problems. In early 2010, researchers at Egypt's Mansoura University studied the effects of extracts from the palm. They found that it lowered high blood pressure, lowered bad cholesterol, and raised good cholesterol. Dietary supplementation with *H. thebaica* exerts hypotensive and hypolipidemic effects [11]. A different fraction of the fruit extracts of *H. thebaica* was also evaluated and proven to be hypocholesterolemic in female Sprague-Dawley rats [14, 15]. The constituents of the *H. thebaica* exhibited significant decrease in serum total cholesterol and non-HDL cholesterol in rat, which can reduce the risk of atherosclerosis and subsequent cardiovascular diseases [15].

The plant, *B. aethiopum* is a palm tree with huge fan shaped leaves; it can reach 30m in height, but is typically 7-20m. The straight trunk is dark grey, 40-50 cm in diameter; with a bulge up to 80 cm across above the middle. The leaf bases place down a scar on the surface of the trunk. The leaves are dark bluish-green [16]. The fruits are 8-18 by 6-16 cm, and each weigh 1-1.5 kg. They are smooth, and have persistent outer petals surrounding the base. They are often ovoid to slightly triangular; however, the shape depends on the number of seeds developed. A persistent, protective calyx

covers approximately a quarter of the fruit. The fruits turn a dull orange-brown colour when ripe. The fibrous fruit pulp is yellow to white and slightly oily. Each fruit contains up to 3 ovoid compressed pyrenes.

The various ethnic groups in Nigeria identify *B. aethiopum* by different names. In Hausa language 'Giginya', in Yoruba 'Agbon Oludu', in Ibos 'Ubiri' and in Kanuris 'Kemelutu'. The root, shoot and fruit of the plant in traditional medicine are used for the treatment of various ailments and as an aphrodisiac, the profitability of the plant has also been studied [17].

The fruits are widely used for 'Dalang' preparation in northeastern Nigeria. Dalang is a local name for the evaporated extract of plant ashes or animal dung, traditionally used as a flavouring agent in foods and in the treatment of diarrhoea, minor injuries and as the mouthwash in Northern Nigeria. Traditionally, the people apply a small amount of powdered Dalang to dress open wounds while an aqueous solution of the extract is used as a mouthwash in the treatment of mouth infections. A glassful of the aqueous solution of extract is taken three times daily to cure diarrhea [18].

The present work was aimed at examining the phytochemicals, proximate, minerals and antioxidant potentials of *H. thebaica* and *B. aethiopum*, which are the two prominent wild edible tree fruits grown in Jigawa state of Nigeria, with a view to provide useful information towards the effective usage of these fruits as a good source of nutraceuticals.

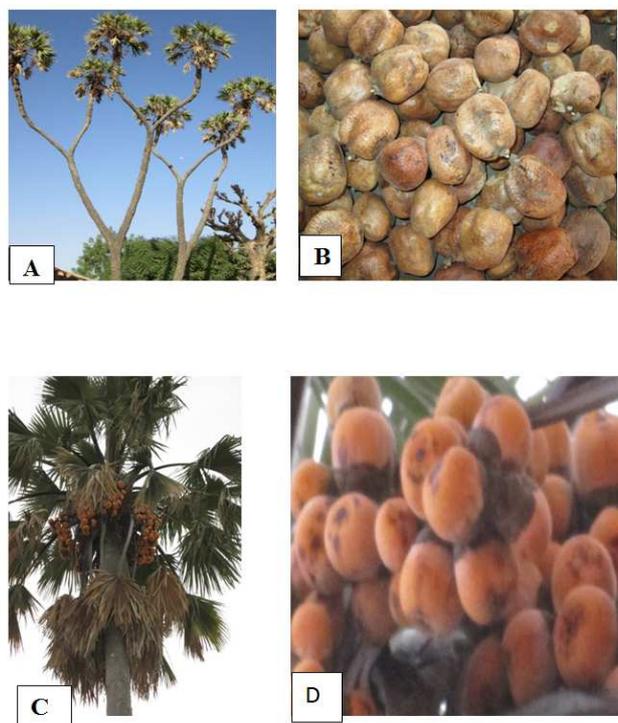


Figure 1. {A} *H. Thebaica* tree {B} *H. Thebaica* Fruits {C} *B. aethiopum* tree {D} *B. aethiopum* fruits.

2. Materials and Methods

2.1. Study Area

Jigawa State is one of thirty-six states that constitute the Federal Republic of Nigeria. It is situated in the north-western sub-sahara region of the country between latitudes 11.00°N to 13.00°N and longitudes 8.00°E to 10.15°E. Kano State and Katsina State border Jigawa to the west, Bauchi State to the east and Yobe State to the northeast. To the north, Jigawa shares an international border with Zinder Region in the Republic of Niger. Most parts of Jigawa vegetation lie within the Sudan Savannah with elements of Guinea Savannah in the southern part. Total forest cover in the State is very much below the national average of 14.8% [19]. Due to both natural and human factors, forest cover is being depleted, making the northern part of the State highly vulnerable to desert encroachment. The soils are generally sandy at the top and compact at depth with often hard pans. Only a few species of flora are thriving, among which *H. thebaica* and *B. aethiopicum* are pronounced.

2.2. Sample Collection and Identification

The fruits were collected from cultivated land in the Taura Local Government Area of Jigawa state, in a clean polyethene bag and brought to the botanical garden of Bayero University Kano, Department of Botany for proper identification and drying at temperature of 36.9°C after washing, where the voucher specimens were deposited.

2.3. Sample Processing

The dried fruits were ground using mortar and pestle to obtain a fine powder for proximate and minerals analysis, 20g of the powder was also soaked in water for 24hours with vigorous shaking in Annova 44 incubator shaker series (USA), then filtered, dried and stored in a clean sample container inside the refrigerator for phytochemical and antioxidant analysis.

2.4. Phytochemical Screening

The phytochemical test was carried out on the fruit aqueous extracts, using procedures described by [20 - 22].

a) Test for alkaloids

To each, fruit pulp extracts were added to 1% aqueous HCl over water bath and filtered. The filtrate was treated with (2g of Iodine in 6g of Potassium iodide in 100 ml of distilled water). Formation of brown or reddish brown precipitate indicated presence of alkaloids.

b) Test for saponins

1g of each extract was boiled with 5ml distilled water and filtered. 3ml distilled water was added to the filtrate and shaken vigorously for 5 minutes. Persistent frothing on warming indicates the presence of Saponins.

c) Test for Steroids

Into each fruit pulp extracts 2ml of acetic anhydride and 2ml of H₂SO₄ was added. Color change from violet to blue or green indicates the presence of steroids.

d) Test for flavonoids

5ml of Ammonium solution was added to the aqueous fruits pulp filtrate of each extract and then a few drops of concentrated H₂SO₄. Yellow coloration indicates the presence of Flavonoids.

e) Test for terpenoids

0.5ml of acetic anhydride was mixed with 1ml of each fruits pulp extracts and a few drops of concentrated H₂SO₄ was added to each. A bluish green precipitate indicates the presence of terpenoids.

f) Test for glycosides

5ml of H₂SO₄ was added to each of the fruits pulp extract in a boiling tube. The mixture was heated in boiling water for 15minutes. Fehling's solution A and B was added and the resulting mixture was heated to boiling. A brick red ppt indicate the presence of glycosides.

g) Test for tannins

Each fruit pulp Extract was boiled in 20ml water and filtered. A few drops of 0.1% Ferric Chloride solution were added. Brownish green or blue-black color indicates the presence of Tannins.

h) Test for phenols

Equal volumes of each fruit pulp extract and ferric chloride solution (which is prepared by dissolving 135.2g of FeCl₃.6H₂O in distilled water containing 20 ml of concentrated HCl dilute to 1 liter) are added together. A deep bluish green precipitate indicates the presence of phenol.

i) Test for cardiac glycosides

The fruit pulp extracts was treated with 2ml glacial acetic acid with a drop of Ferric Chloride solution and underplayed with 1ml H₂SO₄. A browning at the interface indicates the presence of cardiac glycosides.

j) Test for reducing sugar.

Each aqueous fruit pulp extracts were dissolved individually in 5ml distilled water and filtered. The filtrates were used to test for the presence of reducing sugars using Benedict's reagent, equal volume of the filtrates and that of Benedict's reagent was vortexed and the mixture was left in a boiling water bath for 5 minutes. Orange red precipitate indicates the presence of reducing sugars.

k) Test for phlobatannins

3 drops of 1% HCl were added to 1ml of test fruit pulp extracts and boiled. A reddish precipitates indicate the presence of phlobatannins.

l) Test for carotenoids:

1g of each of the fruit pulp extracts were extracted with 10ml of chloroform in a test tube with vigorous shaking. The resulting mixture was filtered and 85% sulphuric acid was added. A blue colour at the interface showed the presence of carotenoids.

2.5. Proximate Analysis

The proximate analyses were carried out in triplicate using a standard procedure described by [23].

a. Moisture content: was determined by heating 2g of each fresh sample to a constant weigh in a crucible and placed in an oven maintained at 105 E°C till constant weigh observed.

b. Crude protein. The Crude protein was determined using micro Kjeldahl method. The Total protein was calculated by multiplying the evaluated nitrogen by 6.25.

c. Crude fat was determined by exhaustively extracting 5g of each sample in a Soxhlet apparatus using petroleum ether (boiling point range 40-60°C) as the extractant.

d. Total ash was determined by the incineration of 10g samples placed in a muffle furnace maintained at 550°C for 5h.

e. Crude fibre was determined by digesting 2g of sample with H₂SO₄ and NaOH and incinerating the residue in a muffle furnace maintained at 550°C for 5h.

f. Carbohydrate was given by (percentage of ash + percentage of Fat + percentage of Protein + percentage of crude fibre). Each analysis was carried out in triplicate.

2.6. Elemental Analysis

Two (2g) grams of each sample of fruits were dried and ashed at 550°C for 5hr. The ash was dissolved in 3ml of HCL to 1ml of HNO₃ until a clear solution was observed; the suspension was then filtered into a 100ml volumetric flask and made it up to the mark (100ml) using deionized water. Ca, Cu, Fe, Mg, Mn, Cr, Pb, Zn, Na, and K contents were determined using Atomic Absorption Spectrophotometer (AAS Shimadzu AA 6800 model).

2.7. Antioxidant

The in vitro antioxidant properties of the two wild edible fruits were performed by 2, 2-diphenyl-1-picryl-hydrazyl (DPPH) radical scavenging assay, using DPPH stable free radical method which is an easy, rapid and sensitive way to survey the antioxidant activity of a specific compound of the fruits extracts [24].

About 0.1mM of DPPH in methanol was prepared and 1ml of this solution was added to 3.0ml of extract solution in ethanol at different concentrations (0.5, 0.25, 0.125, 0.0625, 0.03125 mg/ml). Thirty minutes later, the absorbance was measured at 517 nm. Lower absorbance of the reaction mixture indicated higher free radical scavenging activity. The same experiment was carried out on Ascorbic acid, which are known antioxidant. All tests and analyses were run in triplicate and the results obtained were averaged. Radical scavenging activity was expressed as the inhibition percentage of free radical by the sample and was calculated using the following formula:

$$\text{Percentage (\% Inhibition)} = \frac{(Ab - Aa)}{Ab} \times 100$$

Where Ab was the absorbance of the control (blank, without extract) and Aa was the absorbance in the presence of the extract. All these tests were performed in triplicate and the barchart was plotted with the mean values.

3. Results

The aqueous fruit extracts were analyzed for the presence

of alkaloids, reducing compound, free anthraquinone, flavonoids, terpenoid, saponin, tannin, phenol, anthracene, phlobotannin, carotenoid, glycoside and cardiac glycoside using generally standard laboratory technique for qualitative determinations. It was revealed that alkaloids, reducing sugar, free anthraquinone, flavonoids, terpenoid, and saponin are all present in the two fruit samples. Tannins, and phenols were present in *H. thebaica* and absent in *B. aethiopicum*.

Table 1. Phytochemical screening of powdered extracts.

Phytochemical test	Plants	
	<i>H. thebaica</i>	<i>B. aethiopicum</i>
Alkaloid	+	+
Saponins	+	+
Steroids	+	-
Flavonoids	+	+
Terpenoids	+	+
Glycoside	-	-
Tannins	+	-
Phenol	+	-
Cardiac Glycosides	-	-
Reducing Sugar	+	+
Phlobatannins	-	-
Carotenoids	-	-

+, indicates present. -, Not detected.

The proximate analysis in table 2, revealed the moisture content of *H. thebaica* and *B. aethiopicum* were 6.74±0.14 and 6.88±0.50%, ash content 7.29±0.20 and 6.53±0.10%, crude fat 7.10±0.15 and 7.73±0.80%, carbohydrate content 65.90±0.18 and 38.15±0.90%, protein content 3.34±0.14% and 8.33±1.40% and crude fibre 9.63±0.20 and 32.56±0.60% respectively. The *B. aethiopicum* had the highest values in crude fibre (32.56±0.60%), while the highest carbohydrate content was noted in *H. thebaica* (65.90±0.2%). The protein content for both fruits were observed to be low (8.33±1.4% and 3.34±0.1%) for *H. thebaica* and *B. aethiopicum* respectively.

Table 2. Proximate composition of *H. thebaica* and *B. aethiopicum* Fruit.

Constituents	<i>Hyphaena thebaica</i> Fruit (n=3) in percentage.	<i>Borassus aethiopicum</i> Fruit (n=3) in percentage.
Moisture content	6.74±0.14	6.88±0.50
Ash content	7.29±0.20	6.53±0.10
Crude fat	7.10±0.15	7.73±0.80
Crude fibre	9.63±0.20	32.56±0.60
Carbohydrate	65.90±0.18	38.15±0.90
Crude protein	3.34±0.14	8.33±1.40

The values ± are means standard deviation of triplicates.

The minerals analysis in Table 3 showed that the concentration of Calcium (Ca) and Sodium (Na) present in both the two fruit pulp were very comparable (5.00±0.06, 6.20±0.01 and 14.54±0.08, 14.06±0.00) for *H. thebaica* and *B. aethiopicum* respectively, Potassium (K) is present in higher concentration in *H. thebaica* (5.60±0.05) than *B. aethiopicum* (4.57±0.00), While Magnesium (Mg) is higher in *B. aethiopicum* (2.03±0.00) than *H. thebaica* (1.32±0.01),

Chromium (Cr) was present in *H. thebaica* (0.035 ± 0.01) but below detectible limit in *B. aethiopicum*. Lead (Pb) was completely absent in both the fruits pulp, other minerals such as magnesium, iron, copper, manganese and zinc were all present within safety limits. (Table 3).

Table 3. Minerals analysis of *H. thebaica* and *B. aethiopicum* Fruits.

Test Elements	<i>H. thebaica</i> Fruit Concentrations in Mg/g.	<i>B. aethiopicum</i> Fruit Concentrations in Mg/g.
Ca	5.00 ± 0.06	6.20 ± 0.01
Cu	0.035 ± 0.01	0.541 ± 0.00
Fe	0.244 ± 0.05	0.218 ± 0.05
Mg	1.32 ± 0.01	2.029 ± 0.00
Mn	0.041 ± 0.01	0.065 ± 0.00
Cr	0.035 ± 0.01	BDL
Pb	ND	ND
Zn	0.046 ± 0.01	0.322 ± 0.00
Na	14.54 ± 0.08	14.06 ± 0.00
K	5.60 ± 0.05	4.574 ± 0.00

The values \pm standard deviation of triplicate, BDL = Below Detection Limit. ND= Not Detected

The antioxidant results of *H. thebaica* and *B. aethiopicum* fruits exhibited a strong scavenging activity at 0.5mg/ml and low activity at 0.3125mg/ml, which proves the fruit extracts were concentration dependent. However, from the result, the extracts showed a weak activity in comparison with standard antioxidant vitamin C, shown in Figure 2.

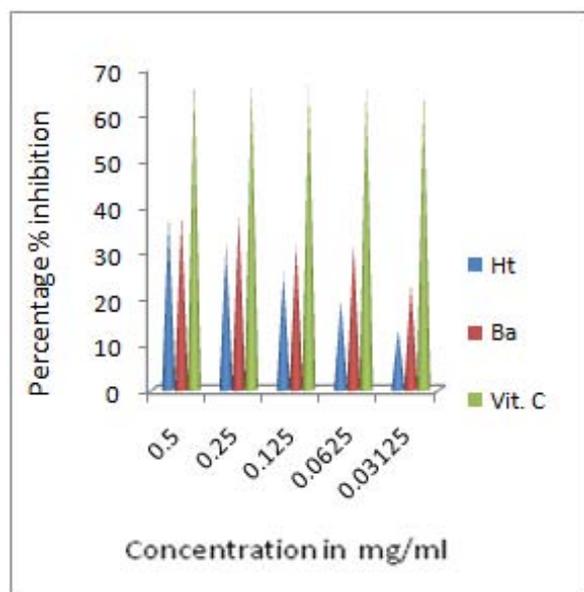


Figure 2. Antioxidant activity of *H. thebaica* and *B. aethiopicum* compared with standard antioxidant vitamin C.

4. Discussion

Most phytochemicals are known to possess many properties that make them vital to both plants and animals. Alkaloids are a heterogeneous group of naturally occurring compounds found in the leaves, bark, roots, fruits and seeds of plants [25]. Both the fruit powder extracts revealed the presence of alkaloids, which may stimulate the nervous

system, cause paralysis, elevate or lower blood pressure. Certain alkaloids act as pain relievers or tranquilizers [25]. Furthermore, it was observed that flavonoids are also detected in both *H. thebaica* and *B. aethiopicum*. Flavonoids are generally found in a variety of fruits [26]. Some flavonoids have been reported to possess a variety of biological activities, including antiallergic, anti-inflammatory, antiproliferative, and anti-carcinogenic activities, in addition to having effects on mammalian metabolism [27]. Flavonoids have received considerable attention because of their beneficial effects as antioxidants in the prevention of human diseases, such as cancer and cardiovascular diseases, and some pathological disorders of gastric and duodenal ulcers, antidiabetic, hepato-protective, vascular fragility, and viral and bacterial infections. Overall, flavonoids exhibit a wide spectrum of pharmacological properties and biological properties that may account for cancer chemoprevention [28 -30].

Saponins, which is a group of two expectorant elements that induce hormonal activity (including triterpenoid and steroidal), were present and are similar to naturally occurring hormones found in the human body. Others have also been noted to contain antimicrobial properties. Tannin and phenol were present in *H. thebaica* and absent in *B. aethiopicum*, Tannins serve as a natural defense mechanism against microbial infections, and exert other physiological effects, such as accelerating blood clotting, reducing blood pressure, decreasing the serum lipid level, modulate liver necrosis and immunoresponses [31]. Phenols were also determined in *H. thebaica* and *B. aethiopicum*. Phenols are widely used in the manufacture of resins, plastics, insecticides, explosives, dyes and detergents and as raw materials for the productions of medicinal drugs such as aspirin [32]. Anthracene, phlobotannin, carotenoid, glycoside and cardiac glycoside were absent in both extracts.

The fruits were good sources of dietary fibre, which helps to prevent constipation, bowel problems and piles [33]. The highest carbohydrate content was determined in *H. thebaica*, the protein content for both the fruits was low. Most of the values reported in this work differ from those reported in the past. [34] reported the percentage of *H. thebaica* Carbohydrate, 72.50 ± 0.50 , Protein 2.17 ± 0.14 and Fibre $12.37\pm 0.09\%$ while [35] reported $72.93(0.26)$, $1.17(0.02)$ and $1.39(0.04\%)$ for *B. aethiopicum* and this observed variation might have resulted from geographic, climatic and seasonal variations.

The mineral analysis revealed that in both the samples, Sodium (Na) level of both the fruits under investigation were high compared to commercial fruit like *Psidium guajava* $0.19\pm 0.00\text{mg/g}$, *Carica papaya* $0.22\pm 0.00\text{mg/g}$, *Citrus sinensis* $0.21\pm 0.00\text{mg/g}$ and *Dacryodes edulis* $0.46\pm 0.00\text{mg/g}$ [36]. The level of calcium (Ca) ($6.20\pm 0.01\text{mg/g}$) in *B. aethiopicum* and *H. thebaica* ($5.00\pm 0.06\text{mg/g}$), is higher than that of *Adansonia digitata pulp* ($3.2\pm 0.00\text{mg/g}$) [37]. Potassium (K) was quite low compared with the level of other commercial fruits such as *Ananas comosus* $19.8\pm 0.02\text{mg/g}$, *Dacryodes edulis*

(8.39 ± 0.01 mg/g) and *Carica papaya* (11.3 ± 0.001 mg/g). Magnesium (Mg) level (2.03 ± 0.00 mg/g) in *B. aethiopicum* and *H. thebaica* (1.53 ± 0.01 mg/g), is also high compared to that of some commercial fruits such as *Psidium guajava* (0.18 ± 0.00 mg/g), *Citrus sinensis* (0.43 ± 0.00 mg/g), *Dacryodes edulis* (0.38 ± 0.00 mg/g) and *Ananas comosus* (1.01 ± 0.01 mg/g) and also high compared to that of *Adansonia digitata* pulp 46.27 ppm [36, 37]. These elements support human biochemical processes by serving structural and functional roles as electrolytes [38]. Sodium and Potassium are necessary to maintain osmotic balance in the body as well as the pH. Calcium (2200 ppm), is needed for the formation of bones and it supports the synthesis and function of blood cells. Iron is present in considerable amount (0.244 ± 0.05 mg/g, 0.218 ± 0.05 mg/g) for *H. thebaica* and *B. aethiopicum* respectively and it is necessary in formation of haemoglobin and normal functioning of the central nervous system. The other micro minerals like Manganese, Copper and Zinc are also present which are known to play important roles in metabolic activities. *H. thebaica* and *B. aethiopicum* can serve as organic source of our body micro minerals. All the micro elements analysed in this research work are within safety limits while compared with the daily recommended intake of minerals by World Health Organization [39].

The antioxidant effect is proportional to the disappearance of the purple colour of DPPH in test samples. Thus antioxidant molecules can quench DPPH free radicals by providing hydrogen atom or by electron donation and a colorless stable molecule 2, 2-diphenyl-1-hydrazine is formed as a result of which the absorbance (at 517 nm) of the solution was decreased [40]. Hence the more potent antioxidant, more decrease in absorbance is seen and consequently the IC_{50} value will be minimum. The 50% inhibition of DPPH radical (IC_{50}) by the fruit extracts (*H. thebaica* and *B. aethiopicum*) was calculated using linear regression, a lower value would reflect greater antioxidant activity of the fruits extracts, the radical scavenging activities were (0.86 ± 0.01 , 0.98 ± 0.05 , and 1 ± 0.00) for Vitamin C, *B. aethiopicum* and *H. thebaica* respectively. The fruit extracts are concentration dependent, shown high antioxidant potentials at 0.5 mg/ml. (Figure 2). From the past, wild edible fruits have played a very vital part in supplementing the diet of the people. The dependence on these fruits has gradually decline as more exotic fruits have been introduced. But many people in tribal areas still use them as a supplement of their basic need of food. Some of them are preserved for use in dry period or sold in rural market. But the popularity of these wild forms has recently decreased.

5. Conclusion

Both the *H. thebaica* and *B. aethiopicum* contains therapeutic phytochemical agents such as alkaloids, flavonoids and saponins. The fruits also contain macronutrients such as carbohydrate and crude fibre. Some essential elements are also present at safety limit which can

benefit human health.

Recommendation

It is however, recommended that more advanced studies should be conducted to elucidate the specific concentrations in the different phytochemical and proximate composition, as well as the minerals present in both fruits. This could provide important information on the health benefits of consuming these fruits to the indigenous people of Nigeria. Furthermore, quantitative analysis may provide information on toxicity levels of the different chemical compositions under survey.

References

- [1] Adepoju, T. O., (2009). Proximate composition and micronutrient potentials of three locally available wild fruit Nigeria. *Afr. J. of Agric. Research*, 9: 887-892.
- [2] Nahar, N., Rahman S. and M. Mosiuhuzzaman, 1990. Analysis of carbohydrates in seven edible fruits of Bangladesh. *J. Sci. Food Agric.* 51: 185-192.
- [3] Barminas, J. D., Charles M. and D., Emmanuel, (1998). Mineral composition of nonconventional leafy vegetables. *Plant Foods Hum. Nutr.* 53: 29-36.
- [4] Mann, A., Yahaya A. Y., and I. D. Suleiman, (2007). Physicochemical studies of some fruits of Nigerian medicinal plants used for treatment of respiratory diseases. *Chem. Class Journal.* 4:91-94.
- [5] Jyotsna Mishra, R. K., Srivastava S. V., Shukla Singleton V. L. and C. S. Raghav, 2007. Antioxidants in Aromatic and Medicinal Plants, *Science and Tech Entrepreneur*, 7: 1-16.
- [6] Tapan, S., (2011a). Nutritional composition of wild edible fruits in Meghalaya state of India and their ethnobotanical importance. *Research J. of Bot.* 2: 58-67.
- [7] Namiki, M., (1999). Antioxidant-antimutagens in foods. *Critical Reviews in Food Science and Nutrition*, 29: 273-300.
- [8] WWW.Worldagroforestry.org/treedb- (Accessed on 15 February, 2011).
- [9] Burkill, H. M., (1997). The useful plants of west tropical Africa, 2nd (Edn), Royal Botanical garden, Kew, 4: 371-373.
- [10] Adaya, A. L., Bitrus H., Fanjoji M., Eaton N. and D. Gambo (1977). Hidden harvest project in research series compiled by IED and HNNCP. 47-53.
- [11] Hetta, M. H., Hetta M. H. and N. Z. Yassin, 2006a. Comparative studies on hypocholesterolemic effect of different fractions of *Hyphaene thebaica* (Doum) in experimental animals. *Die Pharmazie- An Int. J. of Pharm. Sci.*, 61: 230-232.
- [12] Kamis, A. B., Modu S., Zauna H. and T. A., Oniyangi, 2003. Preliminary biochemical and haematological effects of aqueous suspension of pulp of *H. thebaica* (L) Mart in rats. *Biokemistri*, 13: 1-7.
- [13] Dosumu, O. O., Nwosu F. O. and C. D., Nwogu, (2006). Antimicrobial studies and Phytochemical screening of extracts *H. thebaica* (Linn) Mart fruits. *Int. J. of Trop. Med.* 186-189.

- [14] Gendy, A., El-Mileegy E., Ghyaty H., Malek A. and M., El-Hamid, (2008). The beneficial dietary hypotensive and hypolipidaemic Effects of *Hyphaene thebaica* (Doom). *The Internet J. of Alter. Med.* 7 (1).
- [15] Hetta, M. H. and N. Z. Yassin, 2006b. Effect of *Hyphaene thebaica* on sperm count and serum testosterone in mature male rats. Submitted to conference: Environmental pollution and human health in 21st century. Beni Sueif University, Egypt.
- [16] Sharaf, A., Sovour A., Gomaa N. and M. Youssaf, 1972. Some pharmaceutical studies on *H. thebaica* Mart fruit. *Plant Food for Human Nutrition*, 6: 129-199.
- [17] Akinniyi, J. A., Waziri M. and H. S. Usman, (2010). Assessment of the anabolic Effect of androgens of the edible portion of the shoot of *Giginya* plant (*Borassus aethiopum* mart). *J. Sci Res.* 2:362-338.
- [18] Waziri, M., Akinniyi J. A. and M. A., Chidi, 2011. Elemental composition of 'Dalang': A food condiment from evaporated extract of *Borassus aethiopum* fruit ash. *Am. j. of food nutri.* 1:123-125.
- [19] C-GIDD, (2008). Canback Global Income Distribution Database. Canback Dangel. Retrieved.
- [20] Adesuyi, A. O., Elumm I. K., Adaramola F. B. and A. G. M. Nwokocha, 2012. Nutritional and Phytochemical Screening of *Garcinia kola*. *Adv. J. of Food Sci. and Tech.* 1: 9-14.
- [21] Sofowora, A., 1993. Medicinal plants and Traditional Medicine in Africa. *Spectrum Books, Ibadan.*150.
- [22] Harbone, J. B., 1973. *Phytochemical Methods London. Chapman and Hall Ltd,* 49-188.
- [23] AOAC, (1990). Official Methods of Analysis (15th edn), Association of official analytical chemists. Washington D.C.USA, 85 – 89.
- [24] Blois, M. S., (1958). Antioxidant determination by the use of a stable free radical *Nature*, 1199-1200.
- [25] Ayoola, G. A., Sofidiya T., Odukoya O. and H. A. B. Coker, (2006). Phytochemical screening and free radical scavenging activity of some Nigerian medicinal plants. *J. Pharm. Sci. and Pharm. Pract.* 8: 133-136.
- [26] Middleton EJr, Kandaswani C and TC Theoharides, 2000. The effects of plant flavonoids on mammalian cells, implication for inflammation, *heart disease and cancer Pharmacology*, 52:673-751.
- [27] Ren, W., Qian Z., Wang H., Zhu L. and L., Zhang, 2003. Flavonoids: Promising anticancer agents. *Medicinal Res Rev.* 4: 519–534.
- [28] Zand R. S. R., Jenkins D. J. A., and E. P., Diamandis, 2002. Flavonoids and steroid hormone- dependent cancers. *J. Chromatogr. B.* 77: 219–232.
- [29] Yao, L. H., Jiang, YM, Shi J., TomaDatta F. A. N., Singanusong R. and S. S., Chen, 2004. Flavonoids in Food and Their Health Benefits. *Plant Foods for Human Nutrition.* 59: 113–122.
- [30] Bele, A. A., Jadhav V. M. and V. J., Kadam, (2010). Potential of Tannins: Areview. *Asian J. of plant sci.* 9: 209-214.
- [31] Michael, C. H., 2008. Western poison-Oak; *Toxicodendron diversilobum*. 1st Edn., Global Twitcher. Nicklas Stromberg, 49.
- [32] Asaolu, S. S., Adefemi O. S., Oyakilome G., Ajibulu K. E. and M. F. Asaolu, (2012). Proximate and Mineral Composition of Nigerian Leafy Vegetables. *J. of Food Res.* 3: 214-218.
- [33] Udeme, J., Ogoloma Kpobari W., Nkpaa Joyce O, Akaninwor A. and A. Uwakwe (2013). Proximate, Phytochemical and Mineral Elements Compositions of Some Edible Fruits Grown in Oil Producing Community of Rivers State, Nigeria. *IOSR. J. of Env. Sci. Tox. And Food Tech.* (IOSR-JESTFT), 5: 38-46.
- [34] Waleed, A., Zhang L., Mohammed D., Mohammed A., Gasmalla A., Abubakr M, Elshareif O, and Mallika T. (2014). Physicochemical, Nutritional and Functional Properties of the Epicarp, Flesh and Pitted Sample of Doum Fruit (*Hyphaene Thebaica*). *Journal of Food and Nutrition Research*, 2:180-186.
- [35] Adzinyo, O. A., Kpodo F. M., Asimah V. K. and Asante-Dornyinah D., (2015). Sensory and Physicochemical Characteristics of Naturally Flavoured *Borassus aethiopum* Syrups for Potential Applications in Food Products. *Food Science and Quality Management*, 45:109-113.
- [36] Adebisi, F. A., Pius I. P., Michael A. O., Olutayo O. O., Olakunle F. A. and T. F., Akanji, (2012). Chemical Composition and Anti- Oxidant Capacity of the Fruit Pulp of *Adansonia digitata* L. *Int. J. of App. Chem.* 3: 165-172.
- [37] Nelson, D. L. and M. M. Cox, 2008. *Lehninger Principles of Biochemistry.* 5th Edn., W. H. Freeman and Company. Madison Avenue, New York, 343.
- [38] Koleva II van Beek, T. A., Linssen J. P., de Groot A. and L. N., Evstatieva, 2002. Screening of Plant extracts for antioxidant activity: a comparative study on three testing methods. *Phytochem. Anal.* 13: 8-17.
- [39] World Health Organization, 1996. Trace Elements in human nutrition and health, Macmillan/Ceuterick- Geneva, 248286.
- [40] Tapan, S., (2011b). Antioxidant Activity of Some Wild Edible Fruits of Meghalaya State in India. *Advances in Biological Research.* 3: 155-160.