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Nutritional and Phytochemical Profile of Niger Cultivated Date Palm (*Phoenix Dactilyfera L*)

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Abstract: The chemical constituents available in plants have been reported to vary with the geographical location of the plants. This investigation assessed the nutritional and phytochemical profile of Niger date palm (Khaokhara) fruit and sought to determine any uniqueness of Niger cultivate Date palm relative to Date palms cultivated in other regions. Standard procedures as described by AOAC were employed in the analyses. The moisture, crude protein and fat contents were determined to be 13.40, 2.67 and 0.70 g/100g respectively while the dietary fibre, ash, and carbohydrate values were respectively estimated as 2.13, 3.29 and 76.95 g/100g. The antioxidant vitamins present in the fruit were also evaluated; ascorbic acid (0.5mg/100g), carotenoid (15.5µg/100g) and Tocopherol (0.00mg/100g). Phytochemical screening of the fruit showed that it contained alkaloids (1.59g/100g), anthraxquinones (0.17g/100g), flavonoids (3.36g/100g), tannins (0.69g/100g), saponins (1.37 x 10^{-3}g/100g) and terpenoids (1.97 x 10^{-3} g/100g). Other phytochemicals that were detected but not quantified are phlobatanins and steroids. This fruit is very rich in potassium (360.79 mg/100g) and contains appreciable amount of calcium and phosphorus (37.45 and 27.30 g/100g respectively). Overall, the data obtained from this investigation did not show much difference between Niger Date palm fruit and other previously studied cultivars vis-a-vis phytochemical and nutritional compositions.

Keywords: Niger, Date Palm, Proximate Analysis, Phytochemical Analysis, Minerals

1. Introduction

Date palm (Phoenix dactilifera L.) belongs to the Palmae (Arecaceae) family. They are extensively cultivated in the Middle-East and Northern-African countries including Niger Republic. Date palm fruits are considered as staple fruits and important component of diet in most arid and semi-arid regions of the world [1,2]. They are berries rich in carbohydrates with abundant simple sugars like glucose and fructose, but low in fats and entirely lack starch [1, 3, 4]. They are a good source of fibre and are also rich in vitamins like riboflavin, biotin, thiamine, ascorbic and folic acid that are essential to the body. Date palms are used for flavouring foods and beverages. Due to its longevity, nutritional value and great yields, date palm is often regarded as 'tree of life' [5]. Different cultivars of date palm fruits have been reported to be rich in calcium, iron, copper, cobalt, magnesium, fluorine, manganese, phosphorus, potassium, sodium, boron, sulfur, zinc and selenium [3, 6]. Many studies around the world have established the richness of date palms fruits in bioactive compounds such as sterols, saponins, terpenoids, flavonoids, and anthocyanins However, results on nutritional and phytochemical components of different cultivars of date palms varies with the locations from which they were harvested. In this study, we accessed the phytochemical profile and nutritional value of Niger cultivated date palm fruits and sought to determine any uniqueness of Niger cultivate Date palm fruits relative to Date palm fruits cultivated in other regions.

2. Methods and Materials

Fresh date palm fruits were procured from date farm in Niger republic and were transported at room temperature to laboratory of the department of Biochemistry, Lead City University, Ibadan, Nigeria. The fruits were dried at room temperature, deseeded and blended into paste using Nakkai

blender MX-3180. Chemicals and reagent used in this study were purchased from sigma company USA.

3. Proximate Analysis

Standard methods by AOAC were used to determine the carbohydrate content, crude fats, crude fibres, protein, ash and moisture content of the sample [7]. Ascorbic acid was estimated using titration method developed by Harris and Ray [8]. Vitamin A (Carotenoid) was evaluated following standard method of Arnon [9].

4. Gross Energy

The formula used for gross energy is as follows:

GE (Kcal/g) = 5.72 x (protein) + 9.5 (fat) + 4.79 (fibre) + 4.03 (carbohydrate) Garrett and Johnson [10].

5. Elemental Analysis

100 ppm stock solution of the K, Mg, Ca, Na, Fe, Zn, Pb, were prepared by dissolving required amount of salts in distilled water for elemental analysis of the sample. The sample was digested according to perchloric-acid digestion method [11]. 0.25 g of the sample was taken into 50 mL flask, 6.5 mL of mixed acids solution (Nitric acid, Sulfuric acid, perchloric acid in ratio 5:1:0.1) was added to it and boiled in a fume hood on hot plate till the digestion was completed which was indicated by white fumes coming out from the flasks. Digested sample was allowed to cool and then transferred into 50 mL volumetric flask, by rinsing volume with distilled water. The digested sample was filtered through Whatmann filter paper (No 42). The elemental concentrations in the sample (filterate) were determined using Shimadzu AA-670 Atomic Absorption Spectrophotometer as follows:

Nutrient Cation = (Extract - Blank) x A/W x Dilution Factor (Ppm)

A=Total volume of extract (mL), W=Weight of dry plant

6. Phytochemical Screening

Chemical tests were carried for preliminary Phytochemical screening of date palm fruit using standard procedure by Sofowora [12], Trease and Evans [13] and Harbone [14]. The fruit extract was screened for the presence of tannins, phlobatinins, saponins, flavonoids, terpenoids, anthraquinones, cardiac glycosides, coumarine and alkaloids.

7. Determination of Alkaloid in Sample

Five hundred milligram (500mg) sample was weighed into a 250 mL beaker and 200 mL of 10% acetic acid in ethanol was added to it, covered and allowed to stand for 4 h. This was then filtered and the extract was concentrated on a water bath to one-quarter of the original volume. Concentrated ammonium hydroxide was added drop wise to the extract until the precipitation was completed. The whole solution was allowed to settle and the precipitate was collected and washed with dilute ammonium hydroxide solution and then filtered, dried and weighed [14].

8. Determination of Saponin Sample

Fifty milligram (50 mg) of the sample was weighed into a conical flask and 100 cm^3 of 20% aqueous ethanol was added to the sample. The sample was heated over a hot water bath for 4 h with continuous stirring at about 55^0C. The mixture was filtered and the residue re-extracted with another 200 mL 20% ethanol. The combined extracts were reduced to 40 mL over water bath at about 90^0C. The concentrated filtrate was transferred into a 250 mL separating funnel and 20 mL of diethyl ether was added and shaken vigorously. The aqueous layer was recovered while the ether layer was discarded. The purification process was repeated. 60 mL of n-butanol was added. The combined n-butanol extracts were washed twice with 10 mL of 5% aqueous sodium chloride. The resultant solution was heated in a water bath. After evaporation the samples were dried in the oven to a constant weight the weight of saponin were determined in the samples [15].

9. Determination of Flavonoid in Sample

Fifty milligram (50 mg) of the sample was extracted repeatedly with 100 mL of 80% aqueous methanol at room temperature. The solution was filtered through Whatmann filter paper No 42 (125 mm). The filtrate was later transferred into a crucible and evaporated into dryness over a water bath and weighed to a constant weight [16].

10. Determination of Anthraquinone in Sample

Fifty milligram (50 mg) of the sample was soaked in 50 mL of distilled water for 16 hours. The suspensions of the samples were heated in water bath at 70^oC for one hour. After the suspensions were cooled, 50mL of 50% methanol was added to the sample, followed by filtration. The spectrophotometric value of the filtrate was read at a wavelength of 450nm and compared with those of standard solutions containing 1mg/100mL of alizarin and purpurinrespectively [17].

11. Determination of Tannins in Sample

Fifty milligram (50mg) of the sample was weighed into a 250 mL beaker. 50 mL of distilled water was added and stirred for 1 h on a mechanical shaker. The sample was filtered into a 50 mL volumetric flask and made up to the meniscus mark. 5 mL of the filtered sample was measured into test tube containing 2 mL of 0.1 M $FeCl_3$ in 0.1 M HCl

and 0.008 M $K_3Fe(CN)_6$ (1:1). The absorbance was measured with a spectrophotometer at 120 nm wavelength within 10 min [18].

12. Determination of Terpenoids in Sample

One gram (1g) of the sample was added to 10 mL of petroleum ether and allowed to extract for 15mins. The solution was filtered and read at an absorbance of 420nm [19].

13. Statistical Analysis

All determinations were conducted in triplicate and statistical analysis was performed using SPSS software 16.0 (SPSS Inc., Chicago, IL). Results were recorded as Mean ± SD

14. Results

The proximate composition of date palm fruit is shown in Table 1. The fruit contains high level of carbohydrate (76.95g/100g).

Table 1. *Proximate composition of Niger Date palm fruit.*

Nutritional components	Fruit(g/100g)
Moisture Content	13.40±0.10
Crude Protein	2.67±0.08
Crude Fat	0.70±0.01
Crude Fibre	2.13±0.01
Total Ash	3.29±0.02
Carbohydrate	76.95±0.95

Results are means of triplicate determinations ± standard deviation

Table 2. *Antioxidant vitamins in Niger Date palm fruit.*

Nutritional components	Fruit(mg/100g)
Ascorbic acid	0.5 ± 0.00
Carotenoid	1.55 x 10^{-2}± 0.00
Tocopherol	0.0± 0.00

Results are means of triplicate determinations ± standard deviation

Niger Date palm fruit was found to contain ascorbic acid and carotenoid but lack tocopherol as shown in Table 2.

Table 3. *Mineral compositions of Niger date palm fruit.*

Minerals	Fruit (mg/100g)
Sodium	0.73±0.01
Potassium	360.79±39.21
Calcium	37.45±0.25
Magnesium	0.45±0.00
Iron	2.32±0.00
Phosphorus	27.30±0.00
Zinc	0.69±0.25

The values of mineral elements present in Niger Date palm fruit are shown in Table 3. Potassium was observed to be outstandingly high in Niger date palm fruit (360.79mg/100g) when compared to other mineral elements detected in the fruit. Calcium and phosphorous in the fruit were also of reasonable amounts when compared to other minerals like sodium, zinc and magnesium.

Results from qualitative phytochemical screening revealed the presence of alkaloids, anthraquinones, phenolic compounds, phlobatinins, saponins, steroids, tannins and terpenoids, Quantitative estimation of the phytochemicals showed relatively large amounts of flavonoids and alkaloids in Niger date fruit (Table 4).

Table 4. *Phytochemical component of Niger Date palm fruit.*

Phytochemicals	Fruit (mg/100g)
Alkaloids	1591.0±15.39
Flavonoids	3360±0.00
Anthraquinone	169.2±15.21
Saponin	1.37±0.10
Terpenoids	1.97.0 ±0.12
Tannin	685.0 ±0.00

15. Discussion

Date fruits are considered as staple fruits in Arabian Peninsula and they are widely cultivated in semi-arid regions including Niger republic. Phytochemical and nutritional compositions of Date palm fruits reported by different studies vary [2, 4, 20] and difference in the region of cultivation has been implicated [3, 21, 22]. Our study focused on the nutritional and phytochemical profile of Niger cultivated date palm fruit. The result of our study was a bit related to studies conducted on date palm fruit harvested from Oman, Nigeria and Saudi Arabia [1, 2, 4, 22].

The date fruit examined in this study showed high carbohydrate content hence can be considered a good source of energy. Carbohydrate contributes the greatest amount of energy required by man and animals. This probably explains why this fruit is considered a staple fruit in semi-arid region of the world. Generally, the carbohydrate content of date palms has been reported to largely compose of fructose and glucose [1, 3] which are readily metabolized in cell energy production pathways. The carbohydrate content (76.96 g/100g) recorded in this study is similar to the value (75.85 g/100g) reported on Nigerian date fruit (dabino) [2].and also to values (74.3 to 78.4 g/100g) reported for different Date varieties in medinah Al-munawarrah [21] but in variance with another study on Nigerian cultivar [23].

The low moisture content observed in Niger Date fruit in this study accounts for long shelf life generally associated with Date fruits. Fruits or vegetable with high moisture contents are susceptible to spoilage and microbial invasion. Conversely, fruits or vegetable with low moisture contents have low susceptibility to microbial degradation and consequently, high durability. The low moisture content (13.4 g/100g) observed in the examined date fruit is in consonant

with values reported by previous studies on different varieties [3, 20, 21, 24]c . It however differs from that obtained by Agboola and Adejumo [23].

The Niger cultivated date palms, like cultivars from some other countries has low fat content [3, 20, 21, 24]. In light of this, Date fruit cannot be considered as source of oil for industry but more importantly, it can be recommended as part of diet for patients with cardiovascular disease. The health recommendations and reports on diets call for the replacement of high fatty food with increase fruit intake in healthy or in some disease condition such as cardiovascular disease and digestive disorders.

Vitamin C, E and A play key role in non enzymatic, endogenous antioxidants defence mechanism against oxidative stress [25, 26]. The amounts of vitamins C and A determined in Niger date fruit are quite small and not sufficient for the fruit to possibly function as a source of these vitamins to the body.

Mineral analysis of Niger date fruit showed high content of potassium (360.79 mg/100g), calcium (37.45mg/100g) and phosphorus (27.30 mg/100g).The values of K^+ and Ca^{2+} obtained in this study are similar to those reported on different cultivars of Date palm fruits [21].

Potassium plays significant role in a number of metabolic and physiological processes. Intake of diet rich in potassium and low in sodiumlike Niger date fruit may offer remarkable antihypertensive effect among other health benefits. The role of calcium and phosphorus in bone formation and development is well established. Their substantial amounts in Niger date fruitmake the fruit a natural means of preventing bone disorders like osteoporosis and osteomalacia.

The phytochemicals present in plants are majorly responsible for the pharmacological and biological activities they elicit. The pytochemical profile of Niger date fruit (phoenix dactyliferaL) showed high amount of flavonoids, alkaloids anthraquinone and tannins but relatively low saponin and terpenoid contents. The presence of these phytochemicals in Niger date fruit may suggest some medicinal properties which are yet to be exploited.

Flavonoids have been shown to have antibacterial, anti-inflammatory, anti-allergic, anti-viral and antineoplastic properties. The high alkaloid content of Niger date fruit could be contributory to the longevity and pharmacological properties of the fruit. Tannin found in date palm fruit might be of pharmacologically useful as astringents. The anstringent property of tannin had been reported to have protective role on underlying tissues thereby improving wounds healing [27]. Tannins may as well help against microbial degradation of dietary proteins in the rumen. Saponins have been shown to have tumor inhibitory property on experimental animals. Plant Terpenoids are of important in pharmacy because of its wide use as anti-malaria.

16. Conclusion

Niger cultivated date palm is a good source of carbohydrate and essential elements (potassium, calcium and phosphorus). Health promoting compounds like flavanoids and alkakoids are also abundant in the fruit. Overall, the data obtained from this investigation did not show much difference between Niger Date palm fruit and some other previously studied cultivars (Date palms from different countries) vis-a-vis phytochemical and nutritional compositions.

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