International Journal of Environment, Agriculture and Biotechnology
Vol-7, Issue-5; Sep-Oct, 2022

Journal Home Page Available: https://ijeab.com/
Journal DOI: 10.22161/ijeab

Peer Reviewed

Evaluation of Nutritional Composition of Ripe Date Fruit (*Phoenix Dactylifera L.*) pulp and Seed grown in Nigeria

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Received: 27 Sep 2022; Received in revised form: 11 Oct 2022; Accepted: 15 Oct 2022; Available online: 20 Oct 2022
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Abstract— *Date fruit (Phoenix dactylifera L.) is rich in both macro and micronutrients, including vitamins. Several researches have been carried out to determine the nutritional properties of various varieties of date fruit, however, there is currently no study that compares the nutritional composition, total phenolic content and sugar content of ripe red and yellow date. Proximate composition of ripened red and yellow dates was analyzed, the total phenolic content, Vitamin C and sugar contents were also determined. The moisture content in the date samples were 4.87 % and 5.76 %; ash content 1.05 % and 1.08 %; protein content to be 3.11 % and 1.37 %; carbohydrate content to be 60.6 % and 61.02 %; fat content to be 18.02 % and 17.4 % and crude fibre content in the two date samples was determined to be 12.3 % and 13.2 % for Red and Yellow variety respectively. Carbohydrate content of the red date was significantly higher than that of yellow date fruit with both having 14.87% and 9.10% respectively Vitamin C content of red and yellow date was 1.71 mg/100g and 1.46 mg/100g respectively. Vitamin C content of the varieties were fairly low; however, phenolic content was high. The total phenolic content of the red and yellow date was 37.91 mg/100g and 43.55 mg/100g respectively. The finding of this research helps in understanding the nutritional composition of two different varieties of the Nigerian date fruits which can be a basis for developing value-added supplements and nutritious food in the food industry.*

Keywords— ***Date Fruit, Nutritional Composition, fibre.***

I. INTRODUCTION

Date fruit (Phoenix dactylifera L.) is known to be one of the oldest fruit trees in the world (Marzouk and Kassem 2011). They are important subsistence crop grown in hot arid regions but marketed across the world because of its high nutritional and confectionery value (Sanusi *et al.*, 2016). Date tree can tolerate extremely high temperatures and does not wither when cultivated in direct sunlight, thus, it thrives even when grown in the desert (Dada *et al.*, 2012). Date fruits are rich in both macro and micronutrients, including vitamins, consequently, their production and consumption have increased all over the world as a major dietary fruit (Kuras *et al.*, 2020).

In Nigeria, date palm is grown in all the states across the federation, however, it produces and thrives better in the Sudan savanna and guinea vegetation (Sanusi *et al.*, 2016). Thus, production in Northern Nigeria far exceeds production and cultivation in other regions of the nation because of suitable climatic conditions. Its fruit serve as a major food, particularly for breaking Muslim fast, and also serve as an ingredient for making juice, snack and syrups. All parts of the date palm are useful, consequently, they are employed for providing shelter, making timber products and products such as brooms, baskets, mats and ropes (Sanusi *et al.*, 2017).

The fruit's pleasant odour and flavour makes them desirable as food, in addition to their utilization in the beverage and food flavour industry. They are generally known to possess high carbohydrate such as fructose, glucose and sucrose (El-Sohaimy, 2010). Furthermore, they are great sources of dietary fibre and minerals like iron, calcium, potassium and vitamins, but they have low protein and fat content (Agboola and Adejumo, 2013). The flesh of dates contains between 60-65 % sugar, 2 % protein, about 2.5 % fibre, and less than 2 % each of

minerals, fat, and pectin substances (Zaid *et al.*, 2002). Its sugar content is essential for individuals who cannot tolerate sucrose.

Dates contain numerous phytochemicals such as carotenoids and phenolics, which contribute to the fruit's antioxidant activity. Therefore, they possess good, antiviral, antimutagenic and anticancer activities (Assirey, 2015). The concentration of the phytochemicals decreases as ripening or maturity occurs. Its rich hydroxyl pope folic acid makes it fit for increasing the body's immunity and resistance to cancers (Ali *et al.*, 2012). All these properties sum up to make date fruit essential in providing strength, boosting immunity and fitness, providing relief during pain and protection against diseases such as cancer and other heart related diseases.

Date fruit is considered an ideal food because of its broad spectrum of usefulness. However, a large percentage of the Nigerian populace, including the date palm industry are still oblivious of its benefit despite its tremendous nutritional and medicinal potential. Therefore, the objective of the research was to determine the nutritional composition of two varieties of date fruit cultivated in Nigeria with respect to the proximate, vitamins and antioxidant composition. The research will also help to provide data of the fruit useful for food reformulation and developing value-added supplements and food in the food industry.

II. MATERIALS AND METHODS

2.1 Sample preparation

Two ripe varieties of date fruit (Red and Yellow) in the research were procured from the main market, Zaria, Kaduna state, Nigeria. The samples were cleaned and washed before any experiment was done.

2.2 Chemical analysis

All the samples were analyzed chemically using the official methods described by the Association of Official Analytical Chemist (AOAC, 2010). Moisture content of each samples used in the experiment was determined by taking measurement of the sample before and after water was removed by the process of evaporation. The samples were placed in the oven and dried for 8hrs at 105℃. The gravimetric method described by AOAC (2010) was adopted in determining the percentage of ash in the samples. The fat content was determined using the Soxhlet type of the direct solvent extraction method. Micro-kjedhal method was used in determined the protein content of the samples.

2.3 Determination of Carbohydrate content

The total carbohydrate content of each sample was estimanted by "difference". The sum of the percentage concentrations of each parameter of the other proximate compositions were subtracted from 100. The total carbohydrate content was calculated as equation 1 by Olabinjo (2020; 2022);

Total carbohydrate = 100 - (% moisture + % ash + % fat + % protein + % crude fibre) …… (1)

2.4 Determination of Total Phenolic Content

The total phenol content of the sample was determined by the method of (L. Fu, (2010). 0.20 ml of the plant extract was mixed with 2.5 ml of 10% Folin ciocalteau's reagent and 2.0 ml of 7.50 % sodium carbonate solution. The reaction was mixture was subsequently incubated at 45 ℃ for 40mins and the absorbance of the coloured mixture was read at 700nm using UV visible spectrophotometer. Garlic acid was used as standard phenol.

2.5 Determination of Vitamin C Content

The vitamin C content was determined using the ascorbic acid as the reference compound. 200 ul of the extract was pipetted and mixed with 300 ul of 13.30 % of TCA and 75ul of DNPH. The mixture was incubated at 37 ℃ for 3hours and 500 ul of 65 % H_2SO4 was added. The absorbance was then read at 520nm (AOAC, 2006).

2.6 Statistical Analysis

The data obtained from the experiment were analyzed using the statistical package for social science software (SPSS version 16.0). Analysis of variance (ANOVA) test was used in determining the mean ± standard error, while Duncan's multiple range test was used in separating the means at significant level of p = 0.05.

Fig.1; Bulk of the two ripe varieties of date fruit (Red date fruit and Yellow date fruit)

III. RESULTS AND DISCUSSION

3.1 Proximate composition of the banana varieties

Proximate composition of the ripe date fruit pulp and seeds were investigated to understand the nutrient profile of the fruit and its quantity in terms percentage. The proximate analysis revealed the presence of ash, moisture, fat, carbohydrates, fibre and protein in the two varieties of date fruit (*Phoenix dactylifera*) pulp and seed. Table 1 shows the mean proximate composition of the ripe varieties of Date fruit (red and yellow) pulp and seed used for the study. The result indicated that the amount of nutrients in each of the samples varied.

Table 1: Table showing the mean proximate composition of ripe red and yellow date fruit pulp/seed (g/100 g).

Sample	Ash	Moisture	Fat	Fibre	Protein	CHO
A	1.23 ± 0.004^{a}	59.70 ± 0.09^{e}	2.24 ± 0.04^{b}	19.80 ± 0.12^{d}	2.17 ± 0.01^{b}	14.87 ± 0.05^{c}
B	0.64 ± 0.003^{a}	67.11 ± 0.04^{f}	4.17 ± 0.12^{c}	16.77 ± 0.05^{e}	2.23 ± 0.03^{d}	9.10 ± 0.11^{b}
C	1.05 ± 0.004^{a}	4.87 ± 0.06^{e}	18.02 ± 0.06^{b}	12.30 ± 0.12^{d}	3.11 ± 0.01^{b}	60.63 ± 0.05^{c}
D	1.09 ± 0.003^{a}	5.77 ± 0.04^{f}	17.48 ± 0.12^{c}	13.27 ± 0.05^{e}	1.38 ± 0.03^{d}	61.02 ± 0.11^{b}

Notes: A: Ripe Red Date Fruit pulp, B: Ripe yellow date fruit pulp; C: Ripe Red Date Fruit seed, D: Ripe yellow date fruit pulp. Results in the table above are presented as mean ± standard deviation.

*Values followed by different letters in each column are statistically different at $p < 0.05$.

i. Ash content: - From table 1, the yellow date fruit variety had an ash content of 0.64 %, while the ash content of the red variety was 1.23 % and the ash content of the Red date seed variety is 1.05 % and 1.08 % for Yellow variety. The red Date fruit pulp had more ash content than the yellow pulp variety while reverse was the result for the date fruit seed. This value was lower than those obtained by Habib and Ibrahim, (2011) and Abdulrahman *et al.*, (2020). The ash content in the study showed the percentage of inorganic mineral elements present in both varieties date fruits. Generally, ash content is considered as an index of mineral present in a food or index to the nutritive value of foods (Agboola and Adejumo, 2013). Thus, the moderate level of ash content shows a moderate level of minerals present in the date fruits. This result review that the samples have low ash content when compare to 3.27 % by Ogungbenle (2011). This result of both varieties is lower than 1.6% of kimri as reported by Gamal et al. (2012). This result is in agreement with the result obtained from the analysis of different varieties of date palm fruits (1.3 for Dora), (1.7 Dhaki) and (1.5 Karbaline) respectively (Faqir et al., 2012).

ii. Moisture content: - The Ripe red date pulp had a moisture content of 59.70 %. while that of ripe yellow date was 67.11 %. The moisture content of both pulp variety was higher than those reported by Assirey (2015) and Abdulrahman *et al.*, (2020), whose result showed that moisture content of a selected number of date fruits ranged between (10.5 - 29.5 g/100 g dry weight) and (2.25 – 7.65 %) respectively. The moisture content recorded for the seed were lower in value compared to the pulp. This variation can be attributed to differences in variety, stage of maturation, environmental conditions (Biglari, 2009). High moisture content in dates fosters spoilage, while low moisture content will make the fruit not unacceptable to consumers. The result revealed that the moisture content in the two date seeds were 4.87 % for Red variety and 5.76 for Yellow variety. This result shows that the moisture content of Yellow variety is higher than that of the Red date variety. The moisture content value recorded in this research were lower compared to different varieties of date palm seeds, (7.81 % Dora), (9.90 for Dhaki), (6.3 for Karbaline) respectively as reported by Faqir *et al*., (2012).

iii. Fat content: - The fat contents for red and yellow date fruit pulps were 2.24 and 4.17 % respectively. The date seed containing a significant amount of fat ranged between 17.4 % for Yellow variety and 18.02 % for Red variety, showing that the red date seeds had more fat content than the yellow variety. The low-fat content of red and yellow dates pulp indicates that they are safe for high blood pressure patients as they contain low levels of cholesterol and fatty acids. This was within range of that reported by Abdulrahman *et al.,* (2020). However, the fat content is higher in values as reported by Assirey (2015), (Habib and Ibrahim, 2011) for Saudi Arabian, Iranian, and United Arab Emirates varieties, which ranged between (0.12-0.72%), (0.4–0.9%), and (0.10-0.21 %) respectively. The results reported in this work were more than those reported by El-Rahman (2017), who found that date seeds contained high levels of crude oil, being 5.95 and 6.4 times as high as that in date fruits of palm shell, respectively. This percentage favors the extraction of seed oil, which has many benefits. The study of two Tunisian cultivars by Besbes *et al.* (2004) showed that date seed oils contain high relative percentages of oleic acid. They are also more yellow-colored than other vegetable oils and they can protect against UV light responsible for much cellular damage. Date seed oils could easily be conserved due to their high oxidative stability. Regarding these specifics, the value of this by-product in the cosmetic and food industries may be justified. However, the antioxidant composition of date seed oil must be tested in order to more valorize this byproduct.

iv. Fibre content: - Fibre content of the red date pulp was 19.80 %, while that of the yellow date was 16.7 7%. The crude fibre content of seeds were 13.2 % for Yellow variety and 12.3 % for Red variety as presented in Table 1. Dates are excellent sources of dietary fibre, which has tremendous health benefits. It is consumed to prevent the incidence of heart disease, colon cancer, diabetes and other disorders (Habib and Ibrahim, 2011). Furthermore, the moderate quantity of fibre in the date fruits makes them suitable for aiding absorption and digestion process when consumed. Fibre content of foods helps in digestion process and prevention of cancer (Saldanha, 1995; UICC/WHO, 2005). Crude fiber decreases the absorption of cholesterol from the gut in addition to delaying the digestion and conversion of starch to simple sugars, an important factor in the management of diabetes (Cust et al., 2009). Dietary fiber serves as a useful tool in the control of oxidative processes in food products and as functional food ingredient (Mandalari et al., 2010).

v. Protein content: - Red date fruit pulp had a protein content of 2.17 %, which was slightly lower than that of yellow date fruit pulp. The yellow date seeds variety had a protein content of about 1.37 % while the red date seeds variety had protein content of about 3.11 % (Table 1). Dates generally have been reported to have low protein content; thus, they are not a good source of protein (Sirisena *et al.,* 2015). These results were lower than those of Saudi date variety (3.12 %) as reported by El-Rahman and Al-Mulhemsi (2017). The results also showed that the red date seeds had more protein content than the yellow date seeds variety.

vi. Carbohydrate content: - Carbohydrate content of the red date fruit pulp was significantly higher than that of yellow date fruit pulp with both having 14.87 % and 9.10 % respectively. Dates are generally good sources of carbohydrates and fibre. This result indicates that the ripe red and yellow date fruit pulp and seeds are great energy sources because of their high carbohydrate and fibre content. More so, it shows that the ripe red variety is suitable for confectionary products. The results presented in table 1 shows that the yellow date seeds had more carbohydrate content than the Red variety. The value of carbohydrate present in the two varieties are 60.6 % for Red variety, and 61.02 % for Yellow variety. This value is lower than 80.67 % (Dhaki) as obtained Ogungbenle (2011).

3.2 Total phenolic contents of the Date fruit varieties

Total phenolic content, which is an antioxidant compounds in plants, plays a great role in fighting diseases in humans and promoting healthy living. They are known to possess antibacterial, antiviral and anti-inflammatory diseases.

Date fruit analysis show that the content of antioxidant compounds is dependent on the variety and place of cultivation. (Kuras *et al.*, 2020). Phenolic content was considered an effective antioxidant because they act as free radical captors or scavengers. Several research groups have reported that dates are rich in phenolic acids (Benmeddour Z. *et al.*,2013; El Sohaimy S. *et al.*, 2015). The total phenolic content of the red and yellow date pulp recorded in the study were 37.91 mg/100g and 43.55 mg/100g respectively (Table 2). This shows that yellow date fruit pulp has more phenolic content than red date fruit pulp. Red variety of date seed contained the highest total phenolic content (31.4 mg/g), whereas Yellow variety had the lowest total phenolic (31.2 mg/g). The variation in the phenolic content can be attributed to the heterogeneous nature of Date fruit in terms of variety, place of cultivation, growing condition, maturity, season, geographic origin, fertilizer, soil type, storage condition, and amount of sunlight received (Kuras *et al.*, 2020). Both varieties fruit are recommended as a major diet for treating gastric disease conditions and other therapeutic purposes because of their high phenolic content. The results of phenolic contents were higher than those reported by El-Rahman and Al-Mulhemsi (2017), who found 10.3mg/ g in varieties grown in Oman. Seeds may be considered a rich source of phenolic compounds based on high phenolic content. Date seeds could be used in functional foods, food additives, pharmaceuticals, and cosmetic industries.

Table 2: Table showing the Total phenolic content, vitamin C and sugar content of the ripe Date fruit pulp and seed for the yellow and red varieties.

Sample	A	B	C	D	
Phenolic content (mg/100g)	37.91	43.55	31.41	31.29	
Vitamin C (mg/100g)	1.79	1.46	NA	NA	
Sugar content (mg/100g)	0.24	0.23	NA	NA	

3.3 Vitamin C contents of the Date fruit varieties

Date fruits provides a broad range of essential nutrients; hence, they possess potential health benefits upon consumption. The results from table 3 showed that both variety of dates were in the same range of Vitamin C content with red date having 1.71 mg/100g and yellow date having 1.46 mg/100g. Vitamins present in the fruits show that they can aid multiple biochemical reactions in organisms when digested.

3.4 Sugar contents of the Date fruit varieties

The result also showed that both varieties have similar sugar content; 0.24 and 0.23 mg/100g respectively for red and yellow dates. Glucose, fructose and sucrose are some of the sugars found in dates. Although analysis of these individual constituents was not carried out, the result as tabulated on table 2 shows that both ripe red and ripe yellow date fruits have low sugar contents. Sugars are one of the most important constituents of dates, the low sugar content of the two varieties show that they can be consumed by diabetic and high-blood pressure patients.

IV. CONCLUSION

This study shows the nutritional composition of two ripe varieties of date fruit (Phoenix dactylifera l.) cultivated in Nigeria with respect to the proximate, vitamins and antioxidant composition. The varieties used for this experiment (red and yellow variety) contained substantial nutrient levels which varied in both the ripe varieties. The study also shows the heterogeneous nature of date fruit with respect to variety, and place of cultivation. Both varieties of the dates are excellent sources of carbohydrate. The rich fibre content of the varieties makes them suitable for aiding absorption and digestion process when consumed. Vitamin content of the varieties were fairly low; however, phenolic content was high. Sugars are one of the most important constituents of dates, however, the low sugar content of the two varieties show that they can be consumed by diabetic and high-blood pressure patients. Further researches can be done to determine the mineral, and antinutrient properties of different varieties of Nigerian date fruit.

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