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Nutritional Composition of Date Fruits (*Phoenix dactylifera* L.) from Markets in Jos North, Plateau State, Nigeria

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Abstract

Date fruits (Phoenix dactylifera L.) are widely consumed as natural energy sources, yet information on their nutritional quality in Nigerian markets remains limited. This study evaluated the proximate composition, mineral content, and energy value of date fruits obtained from three major markets in Jos North Local Government Area, Plateau State, Nigeria. Samples were analyzed using standard AOAC methods for proximate and mineral composition, while energy value was estimated using Atwater factors. Results showed that carbohydrates were the predominant component (85.96%), followed by crude fat (5.91%), crude protein (2.11%), ash (1.60%), and crude fibre (0.83%). Mineral analysis revealed the presence of magnesium, calcium, sodium, phosphorus, iron, and potassium, though all occurred below WHO recommended daily intake levels. The energy value of date fruits (405.47 kcal/100 g) was slightly higher than that of refined cane sugar (395.00 kcal/100 g), with the added benefit of fibre, protein, and minerals. The findings highlight the nutritional relevance of date fruits as natural energy sources and healthier alternatives to refined sugar.

Keywords: Date fruit, proximate composition, mineral content, energy value, nutrition.

Composition nutritionnelle des fruits de datte (*Phoenix dactylifera* L.) provenant des marchés de Jos North, État du Plateau, Nigéria

Résumé

Les fruits de datte (Phoenix dactylifera L.) sont largement consommés comme sources d'énergie naturelle, mais les informations sur leur qualité nutritionnelle sur les marchés nigérians restent limitées. Cette étude a évalué la composition proximale, la teneur en minéraux et la valeur énergétique des fruits de datte obtenus dans trois marchés principaux de la zone de gouvernement local de Jos North, dans l'État du Plateau, au Nigeria. Les échantillons ont été analysés à l'aide des méthodes standard de l'AOAC pour la composition proximale et minérale, *tandis que la valeur énergétique a été estimée à l'aide des facteurs d'Atwater. Les résultats ont montré que les glucides étaient le composant prédominant (85,96 %), suivis des matières grasses brutes (5,91 %), des protéines brutes (2,11 %), des cendres (1,60 %) et des fibres brutes (0,83 %). L'analyse minérale a révélé la présence de magnésium, calcium, sodium, phosphore, fer et potassium, bien que tous soient présents à des niveaux inférieurs aux apports journaliers recommandés par l'OMS. La valeur énergétique des fruits de datte (405,47 kcal/100 g) était légèrement supérieure à celle du sucre de canne raffiné (395,00 kcal/100 g), avec l'avantage supplémentaire de fournir des fibres, des protéines et des minéraux. Les résultats mettent en évidence l'importance nutritionnelle des fruits de datte comme sources d'énergie naturelle et alternatives plus saines au sucre raffiné.*

Mots-clés : Fruit de datte, composition proximale, teneur en minéraux, valeur énergétique, nutrition.

تُستهلك ثمار التمر (Phoenix dactylifera L.) على نطاق واسع بوصفها مصدرًا طبيعيًا للطاقة، غير أن المعلومات المتعلقة بجودتها الغذائية في الأسواق النيجيرية ما تزال محدودة. هدفت هذه الدراسة إلى تقييم التركيب التقريبي، والمحتوى المعدني، والقيمة الطاقية لثمار التمر التي جُمِعت من ثلاثة أسواق رئيسية في منطقة الحكم المحلي جوس الشمالية بولاية بلاتو، نيجيريا. وقد جرى تحليل العينات باستخدام الطرائق القياسية لجمعية الكيميائيين التحليليين الرسميين (AOAC) لتحديد التركيب التقريبي والمعدني، في حين قُدِّرت القيمة الطاقية باستخدام عوامل أتواتر.(Atwater) أظهرت النتائج أن الكربوهيدرات كانت المكوّن السائد بنسبة (85.96%)، تلتها الدهون الخام (5.91%)، ثم البروتين الخام (2.11%)، فالرماد (1.60%)، والألياف الخام (0.83%). وكشف التحليل المعدني عن وجود المغنيسيوم، والكالسيوم، والصوديوم، والفوسفور، والحديد، والبوتاسيوم، إلا أن جميعها كانت دون مستويات المدخول اليومي الموصى بها من قبل منظمة الصحة العالمية. وبلغت القيمة الطاقية لثمار التمر (405.47كيلوحريرة/100 غرام)، وهي أعلى قليلًا من قيمة سكر القصب المكرر (395.00كيلوحريرة/100 غرام)، مع ميزة إضافية تتمثل في احتوائها على الألياف والبروتين والمعادن.

وتُبرز هذه النتائج الأهمية الغذائية لثمار التمر بوصفها مصدرًا طبيعيًا للطاقة وبديلًا صحيًا أفضل للسكر المكرر.

الكلمات المفتاحية :ثمار التمر، التركيب التقريبي، المحتوى المعدني، القيمة الطاقية، التغذية.

Introduction

The date palm (*Phoenix dactylifera* L.) is one of the oldest cultivated fruit crops, widely grown in arid and semi-arid regions and valued for its nutritional, economic, and cultural significance. Date fruits are rich in carbohydrates, primarily glucose and fructose, which provide a rapid source of dietary energy (Baliga et al., 2011). In addition, they contain modest amounts of protein, fat, dietary fibre, and minerals that contribute to their functional and health-promoting properties (Al-Alawi *et al.,* 2017).

Globally, the consumption of dates has expanded beyond the Middle East and North Africa to Sub-Saharan Africa, where they are widely sold in Nigerian markets, particularly during festive and religious seasons. Despite their increasing consumption, limited scientific information exists on the nutritional quality of dates consumed in Nigeria, and available reports indicate variations associated with cultivar type, origin, and post-harvest handling (Oyebola et al., 2022; Sunmonu *et al.,* 2022).

Nutritional profiling of dates sold in local markets is essential to assess their contribution to human diets, especially in regions where food insecurity and micronutrient deficiencies remain prevalent. Proximate and mineral composition analyses provide insight into the dietary value and potential health implications of date fruit consumption. Furthermore, comparison of the energy value of dates with refined sugar is important in promoting healthier dietary alternatives.

This study aimed to determine the proximate composition, mineral content, and energy value of date fruits sold in Jos North Local Government Area, Plateau State, Nigeria.

Materials and Methods

Date fruit samples were purchased from three major markets in Jos North L.G.A., Plateau State: Terminus Market, Katako Market, and Farin Gada Market. Equal quantities of fruits were collected, cleaned, and homogenized for analysis. Data were analyzed using descriptive statistics, and results were expressed as mean ± standard deviation

Figure I: Date Fruits Sampled from Jos North Markets

Proximate Analysis

Proximate composition, including moisture, ash, crude fibre, crude protein, crude fat, and carbohydrate contents, was determined using the standard methods of the Association of Official Analytical Chemists (AOAC, 2016). Each analysis was performed in triplicate, and results expressed as mean ± standard deviation (SD).

Moisture Content Determination

Moisture content of the date fruit samples was determined using the oven-drying method as described by AOAC (2016). Approximately 5 g of the homogenized sample was weighed into a pre-dried and weighed moisture dish and dried in a hot air oven at 105 °C until constant weight was achieved. The loss in weight after drying was recorded as moisture content and expressed as percentage on a wet weight basis.

$$\text{Moisture content (\%)} = \frac{(W2 - W3)}{W2 - W1} \times 100 \qquad \text{i}$$

Where:

W1 weight of empty moisture dish (g)

W 2= weight of dish + sample before drying (g)

W 3= weight of dish + sample after drying (g)

Ash Content Determination

Ash content was determined using the dry ashing method according to AOAC (2016). A known weight (5 g) of the dried sample was placed in a pre-weighed crucible, gently charred to remove organic matter, and then incinerated in a muffle furnace at 550 °C until a light grey ash was obtained. The crucible was cooled in a desiccator and weighed, and ash content was calculated as the percentage residue relative to the original sample weight.

$$\text{Ash content (\%)} = \frac{(W2 - W1)}{W2 - W1} \times 100 \qquad \text{ii}$$

Where: W_1 = weight of empty crucible (g)

W_2 = weight of crucible + sample before ashing (g)

W_3= weight of crucible + ash (g)

Crude Protein Determination

Crude protein content of the date fruit samples was determined by the Kjeldahl method according to AOAC (2016). The samples were digested to convert organic nitrogen to ammonium sulphate, followed by distillation and titration. Nitrogen content was calculated and multiplied by a conversion factor of 6.25 to obtain crude protein content, which was expressed as percentage.

Crude Protein (%)

Crude protein was calculated from nitrogen content determined by the Kjeldahl method:

Nitrogen (%) = $\frac{(Va - Vb \times N \times 14.01}{W} \times 100$ iii

Crude protein (%) =Nitrogen (%) ×6.25

Where:

Vs = volume of acid used for sample titration (mL)

b = volume of acid used for blank titration (mL)

N = normality of the acid

14.01 = atomic weight of nitrogen

W = weight of sample (g)

6.25 = nitrogen-to-protein conversion factor

Crude Fat Determination

Crude fat content was determined using the Soxhlet extraction method as described by AOAC (2016). A known weight of the dried sample was extracted continuously with petroleum ether as solvent. After extraction, the solvent was evaporated and the residue weighed. Crude fat content was calculated as the percentage of extracted lipid relative to the original sample weight.

Crude fat (%) = $\frac{(W2 - W1)}{W} \times 100$ iv

Where: W_1 = weight of empty extraction flask (g)

W_2 = weight of flask + extracted fat (g)

W = weight of sample (g)

Crude Fibre Determination

Crude fibre content was determined following the acid–alkali digestion method outlined by AOAC (2016). The defatted sample was sequentially digested with dilute acid and alkali solutions, filtered, dried, and incinerated. The loss in weight after ashing was recorded as crude fibre content and expressed as percentage.

Crude fibre (%) = $\frac{(W2 - W3)}{W} \times 100$ v

Where: W = weight of sample (g)

W_2 = weight after acid–alkali digestion and drying (g)

W_3= weight after ashing (g)

Carbohydrate Determination

Carbohydrate content was calculated by difference, according to AOAC (2016). The percentage carbohydrate was obtained by subtracting the sum of moisture, ash, crude protein, crude fat, and crude fibre contents from 100.

Carbohydrate (%)=100−(%Moisture+%Ash+%Crude protein+%Crude fat+%Crude

Mineral Analysis

Mineral contents (magnesium, calcium, sodium, phosphorus, iron, and potassium) were determined using Atomic Absorption Spectrophotometry (AAS) following wet digestion of the samples, as described in AOAC (2016). Results were compared with WHO daily dietary requirements.

Energy Analysis

The energy value of the date fruit samples was estimated using Atwater conversion factors as described by FAO (2003). Carbohydrate and crude protein contents were multiplied by 4 kcal/g, while crude fat content was multiplied by 9 kcal/g. The total metabolizable energy was calculated as the sum of the individual contributions and expressed as kilocalories per 100 g of sample. The energy value of date fruits was compared with that of refined cane sugar.

Energy (kcal/100 g) =(4×%Carbohydrate) +(4×%Protein) +(9×%Fat)

Results

3.1 Proximate Composition

Table I presents the proximate composition of date fruits obtained from three major markets in Jos North L.G.A. Slight variations were observed among the markets for all proximate parameters. Moisture content ranged from 2.67% to 4.81%, with the lowest value recorded in Market 1 and the highest in Market 3. The generally low moisture content across all samples suggests good keeping quality and reduced susceptibility to microbial spoilage.

Carbohydrate content was consistently high across the three markets, ranging from 84.55% to 86.71%, confirming carbohydrates as the dominant macronutrient in the date fruits. Crude fat content showed minor variation (5.62–6.19%), while crude protein ranged from 1.84% to 2.39%. Ash and crude fibre contents showed minimal variation across the markets, indicating relatively uniform mineral and fibre distribution in the sampled fruits. The low standard deviation values recorded for most parameters indicate minimal variability among the samples, suggesting comparable nutritional composition of date fruits sold across the different markets.

3.2 Mineral Content

The mineral composition of date fruits sold in Jos North is summarized in Table II. Magnesium recorded the highest concentration among the analyzed minerals (1.103 mg/L), followed by calcium, sodium, and phosphorus, while potassium showed the lowest concentration (0.149 mg/L). The relatively narrow range of values observed suggests limited variation in mineral content across the markets. Although the concentrations of the analyzed minerals were below WHO recommended daily intake levels, their presence confirms that date fruits contribute measurable amounts of essential minerals to the diet. The low variability observed among samples further indicates consistency in mineral composition irrespective of market source.

Table II: Mineral concentrations of date fruits and WHO recommended daily intake values (for contextual comparison only)

Mineral	**Concentration (mg/L)**	**WHO Daily Limit (mg/day)**
Magnesium (Mg)	1.103	420
Calcium (Ca)	0.760	1000
Sodium (Na)	0.755	1500
Phosphorus (P)	0.753	700
Iron (Fe)	0.430	8–11
Potassium (K)	0.149	3000–3400

3.3 Energy Composition

The energy values of date fruits and refined cane sugar are presented in Table III. Date fruits exhibited a higher energy value (405.47 kcal/100 g) compared with refined cane sugar (395.00 kcal/100 g). The high energy content of date fruits reflects their substantial carbohydrate levels and contribution from crude fat. Unlike refined sugar, date fruits also contain fibre, protein, and minerals, which enhance their overall nutritional value.

Table III: Energy value of date fruits compared with refined cane sugar

Sample	Energy value (kcal/100g)
Date fruit	**405.47**
Refined cane sugar	**395.00**

Discussion

The findings of this study provide baseline information on the proximate, mineral, and energy composition of date fruits sold in Jos North L.G.A., Nigeria. The predominance of carbohydrates (>85%) confirms that dates are energy-dense foods, consistent with earlier reports describing dates as concentrated sources of natural sugars, mainly glucose and fructose (Baliga *et al.,* 2011; Abubakar and Babandi, 2023).

The relatively low protein and fat contents observed in this study agree with previous findings indicating that dates contribute modestly to dietary protein and lipid intake (Sunmonu et al., 2022). Nevertheless, the presence of dietary fibre, although low, remains nutritionally relevant due to its role in gastrointestinal health and disease prevention (Elleuch et al., 2022).

Mineral analysis revealed measurable levels of magnesium, calcium, sodium, phosphorus, iron, and potassium, although all were below WHO recommended daily intake values. This supports earlier observations that dates serve as supplementary rather than primary sources of essential minerals (Abubakar and Babandi, 2023). Variations in mineral content may be attributed to cultivar differences, soil composition, and handling practices.

The higher energy value of date fruits compared with refined cane sugar highlights their potential as healthier natural sweeteners. Unlike refined sugar, which provides empty calories, dates supply additional nutrients that contribute to dietary quality. These findings support recommendations encouraging the substitution of refined sugar with natural fruit-based sweeteners where possible.

Conclusion

This study demonstrated that date fruits sold in Jos North are rich in carbohydrates and provide high energy with additional fibre and minerals. Although mineral levels were below WHO recommendations, dates offer nutritional advantages over refined sugar. These findings support the promotion of date fruits as healthier natural energy sources.

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