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Proximate and Mineral Analysis of *Phoenix Dactylifera* (Dates) Collected from Iyana Iba and Agbara, South West Nigeria

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Abstract

Date fruits (Phoenix Dactylifera) are increasingly gaining recognition in Nigeria as both staple and medicinal fruits due to their high nutritional and therapeutic value. This study assessed the proximate and mineral composition of dried dates obtained from two major local markets (Agbara and Iyana-iba) in Lagos State, Southwest of Nigeria, to provide scientific evidence of their dietary relevance and potentials in food and health industries. Carbohydrates were the dominant nutrient, with Iyana-iba dates (78.44%) slightly surpassing Agbara dates (77.49%). Moisture content was similar (14.05% and 14.14%), supporting good shelf stability. Agbara dates had higher protein (4.24%) and lipid (2.66%) levels, while Iyana-iba dates showed slightly higher crude fiber (0.90%) than Agbara (0.84%). Ash content was also comparable, with Agbara (0.76%) slightly exceeding Iyana-iba (0.73%). Mineral analysis revealed potassium as the most abundant element, highest in Agbara (379.94 ppm) compared to Iyana-iba (299.40 ppm). Magnesium (57.43 ppm) and calcium (12.18 ppm) were also higher in Agbara, while Iyana-iba had greater sodium (3.57 ppm), iron (4.69 ppm), and zinc (3.35 ppm). Collectively, the findings confirm that dried dates are nutrient-dense. This research contributes to the existing knowledge on indigenous food sources and supports efforts to promote food security and nutrition through locally available agricultural products.

Keywords: Date Fruits; Proximate Composition; Mineral Analysis; Nutritional Value

Introduction

Background of the Study

Dates (*Phoenix dactylifera*) are sweet fruits cultivated in arid regions and consumed worldwide. Dates are renowned for their high energy and nutritional content. They are rich in carbohydrates, dietary fibre, and essential minerals, making them a valuable food source in both traditional and modern diets [3, 14, 26]. In Nigeria, where malnutrition and micronutrient deficiencies are public health concerns, the nutritional value of locally grown dates cannot be overemphasized. A comprehensive analysis of their proximate and mineral composition provides vital information for their inclusion in food fortification, dietary planning, and industrial applications such as in the production of syrup, pastes, and natural sweeteners [1, 22, 26].

Historical Background of Dates: The date palm (*Phoenix dactylifera*) is one of the oldest cultivated fruit trees in the world, with evidence of domestication tracing back over 5,000 years. Archaeological findings suggest that date cultivation originated in the Mesopotamian region (modern-day Iraq and surrounding areas) and the Persian Gulf, from where it spread to North Africa, the Middle East, and parts of South Asia. Ancient civilizations, including the Sumerians, Babylonians, and Egyptians, documented the cultivation and use of dates for both food and medicinal purposes. Dates were not only consumed fresh but also preserved by drying, which allowed storage and long-distance trade [10, 11].

In Nigeria, date cultivation took root primarily in the northern states, including Borno, Yobe, Katsina, Sokoto, Jigawa, and Kebbi, where the hot and semi-arid climate provided suitable conditions for growth. Initially, dates were cultivated on a small scale in family farms and palace orchards, often as part of traditional systems of subsistence agriculture. Over time, their significance extended beyond nutrition, becoming associated with religion, hospitality, and commerce (Zaid & De Wet, 2019; [21]).

The religious value of dates was solidified with the spread of Islam across northern Nigeria from the 11^{th} century onward. Following Islamic tradition, dates became an essential food item during fasting. Dried dates were especially favored, since they could be stored for long periods without spoilage and were readily available for religious observances, even outside the harvest season.

From a commercial perspective, dried dates gained prominence in regional markets as they were relatively easy to transport and stored compared to fresh fruits. Northern Nigerian traders exchanged dried dates for grains, livestock, and other goods with communities further south. The fruit gradually became a staple of festive occasions, religious ceremonies, and household consumption, strengthening its place in Nigeria's food culture.

Although Nigeria is not yet a major producer of dates compared to North African and Middle Eastern countries, the dried fruit remains a vital part of the agricultural and cultural landscape. Large quantities of dried dates are still imported from Saudi Arabia, Egypt, and Algeria to meet rising demand, particularly during the fasting period of Ramadan. Nonetheless, local production in the northern states continues to contribute significantly to regional diets, and research into improving cultivation and processing is growing [11].

Thus, the historical background of dried dates in Nigeria reflects a story of trade, religion, adaptation, and continuity. From their introduction via ancient caravans to their modern-day role as a source of nutrition and economic activity, dried dates remain an enduring symbol of both cultural heritage and food security in the Nigerian context.

Health Benefits of Dried Dates: Energy booster – high natural sugar content makes them excellent for quick energy. Digestive health – high dietary fiber aids bowel movement and prevents constipation [13, 29]. Bone health – rich in calcium, magnesium, and phosphorus. Anemia prevention – contains iron which supports hemoglobin formation [20, 23]. Antioxidant properties – protects against oxidative stress and inflammation. Cardiovascular health – potassium helps regulate blood pressure and heart function. Reproductive health – traditionally believed to improve fertility and sexual health. Brain function – vitamin B-complex supports nerve function.

Aim and Objective(s)

Aim of this study is to determine the proximate and mineral composition of dried dates.

Objectives are:

- To analyze the proximate composition (moisture, ash, crude protein, lipid, crude fiber, and carbohydrate) of dried dates.

- To determine the mineral content (calcium, magnesium, potassium, sodium, iron, and zinc) of the samples.

- To assess the nutritional value of dried dates in addressing micronutrient deficiencies and improving dietary function.

- To provide scientific data supporting the inclusion of dates in food fortification, processing and public health nutrition strategies.

Experimental

Sample Collection

The date fruits used in this study were sourced from two different local markets Agbara and Iyana iba in Lagos State, Southwest of Nigeria. The varieties selected were based on availability and local consumption patterns. All samples were collected in clean polyethylene bags, properly labeled, and transported to the laboratory for analysis.

Reagents and Chemicals

All reagents and chemicals used for the analysis were of analytical grade and purchased from certified suppliers. They are:

- Concentrated sulfuric acid (H_2SO_4)
- Sodium hydroxide (NaOH)
- Petroleum ether
- Hydrochloric acid (HCl)
- Nitric acid (HNO_3)
- Perchloric acid ($HClO_4$)
- Diethyl ether
- Phenolphthalein indicator
- Standard solutions for Atomic Absorption Spectroscopy (AAS)

Apparatus and Equipment

1. Muffle furnace
2. Hot air oven
3. Kjeldahl digestion and distillation unit
4. Soxhlet extractor
5. Desiccator
6. Analytical balance
7. Inductively coupled plasma - Optical emission spectroscopy (ICP-OES)
8. Crucibles
9. Measuring cylinders and beakers
10. Blender for sample homogenization

Methods

Sample Preparation: The date fruits were washed thoroughly with distilled water to remove dust and foreign particles, de-seeded manually, and sliced into smaller pieces. The samples were oven-dried at 60°C until constant weight was achieved. After drying, they were ground into fine powder using a laboratory blender and stored in airtight containers at room temperature until analysis.

Proximate Analysis: All proximate parameters were analyzed following the procedures outlined by the Association of Official Analytical Chemists (AOAC, 2016).

a. Moisture Content

Moisture was determined by drying 2 g of the sample in a hot air oven at 105°C until constant weight

Procedure:

Dry the empty at 105°C in the oven for 30 mins.

Cool the crucible to room temperature and weigh (w_1).

Weigh in duplicate 1g of the test sample into the crucible and note the weight (w_2).

Put the crucible and the sample in the oven and dry at the above temperature (105°C) for 3 hours.

Cool in desiccator and weigh soon after reaching the room temperature, note the weight of crucible and the dried sample to be (w_3). The weight loss was calculated as moisture content using:

Moisture content: $w_2 - w_3$

% moisture content = $w_2 - w_3/w_2 - w_1$ X by 100

b. Ash Content

2 g of the dried sample was placed in a pre-weighed crucible and incinerated in a muffle furnace at 550°C for 5 – 6 hours until white ash was obtained.

Ash (%) = {Weight of Ash}\{Weight of Sample} x 100

c. Crude Protein

Protein was determined by the Kjeldahl method. Nitrogen content was measured and multiplied by a factor of 6.25 to obtain crude protein.

{Protein (%)} = {Nitrogen (%)} x 6.25

d. Lipid

Fat was extracted using the Soxhlet apparatus with petroleum ether as the solvent. The extracted fat was weighed and calculated as:

% fat content: weight of beaker + fat – weight of empty beaker/ weight of sample

e. Crude Fiber

The fiber content was determined after digestion of defatted samples with acid and alkali, followed by incineration. The residue left was calculated as crude fiber.

Fiber (%) = {Weight of Residue} - {Ash} \ {Weight of Sample} x 10

f. Carbohydrate Content

Carbohydrate was calculated by difference:

Carbohydrate (%) = 100 - (Moisture + Ash + Fat + Protein + Fiber)

Mineral Analysis: Mineral elements (Ca, Mg, Fe, K, Na, Zn, CHO) were determined by wet digestion using a mixture of HNO_3 and $HClO_4$, followed by Inductively Coupled Plasma - Optical Emission Spectroscopy (ICP-OES) and flame photometry for Na and K.

Results and Discussion

The proximate and mineral composition of dried date fruits was determined through two independent analyses.

The results are presented below.

Proximate Analysis of Result

Note:

A => Date sample gotten at Agbara

I => Date sample gotten at Iyana Iba

Proximate Analysis Results for Date A

The proximate composition of Date A and Date I revealed slight but important differences. Protein content was marginally higher in Date A (4.24%) compared to Date I (4.10%). This suggests that Date A may provide a slightly better contribution to dietary protein, although both values remain within the low protein range reported for dates in literature [12, 19].

Ash content, which indicates the total mineral matter present, was also slightly higher in Date A (0.76%) than in Date I (0.73%). This implies that Date A may contain more mineral residues after combustion, aligning with its higher values of some mineral elements in the subsequent analysis.

Carbohydrate content was more abundant in Date I (78.44%) compared to Date A (77.49%). This indicates that Date I provides more energy, which is consistent with the traditional recognition of dates as high-energy fruits. Moisture levels were very similar, with Date A having 14.05% and Date I 14.14%, reflecting that both samples possess good shelf stability and resistance to microbial spoilage typical of dried fruits.

Lipid content was notably higher in Date A (2.66%) than in Date I (1.85%), indicating that Date A may supply more dietary fat and fat-soluble components. Conversely, crude fiber was slightly higher in Date I (0.90%) compared to Date A (0.84%), suggesting that Date I could better promote digestive health.

Overall, Date A exhibited a better protein, ash, and lipid profile, while Date I excelled in carbohydrate and fiber content. These differences, although slight, may be due to environmental conditions, soil composition, and post-harvest handling (Table 1 and 2).

Table 1: Proximate Analysis Result for Date A.

Proximate Analysis (%)	First Analysis (%)	Second Analysis (%)	Mean Value (%)
Protein	4.13	4.34	4.24
Ash	0.84	0.68	0.76
Carbohydrate	77.85	77.12	77.49
Lipid	2.91	2.40	2.66
Moisture	13.37	14.72	14.05
Crude Fiber	0.91	0.76	0.84

Note: % - Percentage

Table 2: Proximate Analysis Results for Date I.

Proximate Analysis (%)	First Analysis (%)	Second Analysis (%)	Mean Value (%)
Protein	4.01	4.18	4.10
Ash	0.85	0.60	0.73
Carbohydrate	77.91	78.96	78.44
Lipid	1.88	1.83	1.85
Moisture	14.45	13.82	14.14
Crude Fiber	0.91	0.89	0.90

Note: % - Percentage

Table 3: Mineral Composition Analysis Result for Date A.

Mineral Analysis (ppm)	First Analysis (ppm)	Second Analysis (ppm)	Mean Value (ppm)
Mg	58.493	56.371	57.43
K	395.816	364.054	379.94
Na	1.057	2.113	1.59
Ca	12.379	11.974	12.18
Fe	4.853	3.275	4.06
Zn	1.958	2.743	2.35

Note: ppm – parts per million

Table 4: Mineral Composition Analysis Result for Date I.

Mineral Analysis (ppm)	First Analysis (ppm)	Second Analysis (ppm)	Mean Value (ppm)
Mg	46.073	50.184	48.13
K	277.389	303.412	290.40
Na	3.142	4.001	3.57
Ca	11.293	10.173	10.73
Fe	4.118	5.268	4.69
Zn	2.381	4.325	3.35

Note: ppm – parts per million

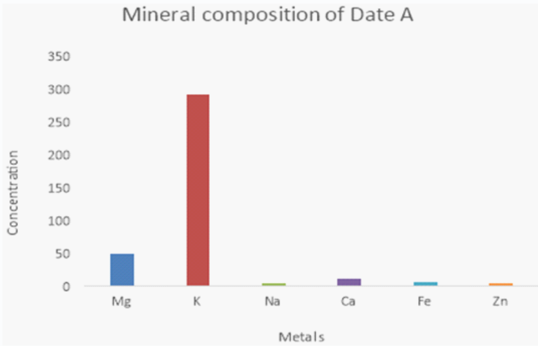

Figure 1: Bar Chart for Mineral Composition for Date A.

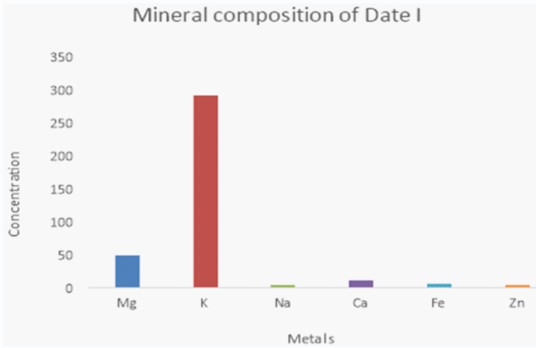

Figure 2: Bar Chart for Mineral Composition for Date I.

Mineral Composition

The mineral analysis further highlighted the nutritional differences between the two samples. Magnesium content was higher in Date A (57.43 ppm) compared to Date I (48.13 ppm), and potassium was also more abundant in Date A (379.94 ppm) than in Date I (299.40 ppm). These results establish Date A as a richer source of electrolytes critical for muscle function and cardiovascular health.

On the other hand, sodium content was higher in Date I (3.57 ppm) than in Date A (1.59 ppm). Although sodium is essential for fluid balance and nerve transmission, excessive intake is linked to hypertension, hence Date A may be more favorable for individuals requiring lower sodium diets.

Calcium was slightly higher in Date A (12.18 ppm) than in Date I (10.73 ppm), which suggests better contribution to bone and teeth health from Date A. However, iron content was higher in Date I (4.69 ppm) compared to Date A (4.06 ppm), indicating that Date I may better support hemoglobin formation and anemia prevention. Zinc followed a similar trend, being higher in Date I (3.35 ppm) compared to Date A (2.35 ppm), suggesting that Date I may better contribute to immune support and enzymatic functions.

In summary, Date A proved superior in magnesium, potassium, and calcium—minerals essential for bone strength, electrolyte balance, and cardiovascular health—while Date I was richer in iron, zinc, and sodium, making it more relevant in addressing anemia and supporting immune function (Tables 3-4) (Figures 1-2).

General Comparison

Both Date A and Date I share comparable proximate and mineral compositions with slight variations, underscoring the influence of geographic and environmental factors on nutrient profiles. Date A is more advantageous for energy metabolism and cardiovascular health due to higher potassium, magnesium, and lipid content, while Date I is better suited for addressing micronutrient deficiencies such as iron and zinc. These complementary differences suggest that consuming both varieties could provide a broader nutritional benefit.

Conclusion

The proximate and mineral analysis of dried dates collected from Agbara (Date A) and Iyana-Iba (Date I) revealed that both samples are nutrient-dense fruits with appreciable variations in their nutritional profiles. Proximate analysis showed that carbohydrates were the predominant component in both samples, confirming dates as excellent sources of energy. Moisture content was moderate and comparable between the two samples, supporting their good shelf stability. Protein, lipid, and ash contents were slightly higher in Date A, while Date I exhibited higher carbohydrate and crude fiber levels, highlighting differences in energy contribution and digestive benefits. Mineral analysis indicated that potassium was the most abundant mineral in both samples, followed by magnesium and calcium, which emphasizes the importance of dates in maintaining electrolyte balance, bone health, and cardiovascular function. Date A was richer in magnesium, potassium, and calcium, whereas Date I had higher levels of sodium, iron, and zinc. This suggests that Date A is more beneficial for cardiovascular health and electrolyte regulation, while Date I could play a stronger role in preventing anemia and supporting immune function. Overall, the findings demonstrate that both varieties of Nigerian dried dates contribute significantly to dietary energy and micronutrient intake, albeit in complementary ways. Incorporating both Date A and Date I into daily diets can enhance nutritional diversity and provide health benefits ranging from improved cardiovascular performance to better iron and zinc intake. These results underscore the nutritional value of locally available dates and support their promotion as functional foods in addressing malnutrition and micronutrient deficiencies in Nigeria.

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