

Phytochemical screening and mineral evaluation of fresh date fruits (*Phoenix dactylifera* L.) in wet season of Nigeria

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Abstract. The research was undertaken to determine the presence of some phytochemicals and minerals in five varieties of fresh date in wet season of Nigeria in June 2014 during the harvest period. The fresh date fruits varieties were selected from gene pool four (4) in the experimental field of Nigerian Institute for Oil palm Research (NIFOR) date palm substation, Dutse, Jigawa State. Results showed that tannins and reducing sugar were present in all the varieties analysed, while flavonoids and steroids were absent. However, saponins, anthraquinones, volatile oils and cardiac glycosides were present in some varieties. A high amount of calcium (Ca^{2+}) and phosphorus (P) were observed among the varieties while no iron (Fe^{2+}) was present. Zinc, manganese and nitrogen were observed generally in all the varieties. The paper is useful as it reveals active constituents in the fresh date fruit which can be very significant in drug development and for food manufactures.

Keywords: Date fruit, wet season, fresh, varieties, phytochemicals, minerals, Nigeria.

INTRODUCTION

The date palm (*Phoenix dactylifera* L.) is a palm extensively cultivated for its edible fruit belonging to the Palmae (Arecaceae) family (Rani et al., 2007). The date pulp is rich in phytochemicals like sterols, phenolics, carotenoids, procyanidins, anthocyanins and flavonoids (Faqir et al., 2012). The concentrations and ratio of these constituents depend on the stage of fruit picking, type of the fruit, location and soil conditions. These phytochemicals also add to the nutritional and organoleptic properties of the fruits (Abdul and Allaith, 2008). Dates are especially delicious as a fresh fruit. Beside direct consumption of the whole dates, the fruits are traditionally used to prepare a wide range of different products such as date juice concentrates (spread, syrup and liquid sugar), fermented date products (wine, bioethanol, vinegar, organic acids) and date pastes for different uses (e.g. bakery and confectionary) (Faqir et

al., 2012). Minerals are critical for enzyme activation, gene expression, bone formation, hemoglobin composition and amino acid, lipid along with carbohydrate metabolism (Jamil et al., 2010).

Minerals are also required for normal cellular functions (Institute of Medicine (IOM), 2000, 2001, 2004). Certain inorganic mineral elements (K, Zn, Ca and traces of Cr, etc) play an important role in the maintenance of normal glucose tolerance and in the release of insulin from beta islets of Langerhans (Choudhary and Bandyopadhyay, 1999). The reports on mineral composition of dates are based on non representative samples or old methodology. The mineral compositions of fruit reflect the trace mineral contents of soils in any geographic region (Jamil et al., 2010).

In Nigeria, date fruit is commonly called Dabino, as it is mainly consumed in the Northern part of the country and

it thrives well in this region above latitude 10° North of the Equator (Okolo et al., 2000). The states where Date palm is grown in Northern Nigeria includes Kaduna, Katsina, Kano, Sokoto, Kebbi Jigawa, Yobe, Borno, Gombe, Bauchi and Adamawa States, this is generally referred to as the Nigerian main date palm growing belt of the country. Other state where it is grown includes Plateau, Taraba, Nassarawa, Southern Kaduna and Niger State, as these states are classified as marginal areas for date palm cultivation in the country.

Date production in Nigeria has two fruiting seasons (dry, that is, from February to June; and wet seasons fruits, that is, from July to August), but only the dry season fruit is economically useful, (Abdulqadir et al., 2011). Although little or no research is done on fresh date fruit in wet season, as it is also harvested and consumed during this season (wet season) in Nigeria, being a tropical country. There is the need to evaluate the presence of some phytochemicals and minerals of fresh date fruits during this period of harvest.

However, very few known academics have worked on this area of date palm studies and therefore this limited the literature review and references on this study. 80% of the dates produced in this country are usually domestically consumed directly, as scientist working in the research station, we have taken pain to undertake this study

Objectives of the study

The objectives of this study are to determine the presence of bioactive components (phytochemicals) and minerals in wet season (fresh) date fruit samples. Such detailed information is essential in order to advance the existing knowledge and to promote the use of these varieties.

MATERIALS AND METHODS

Plant material

Fresh dates fruits were obtained in gene pool four (4) from the experimental field of the Nigerian Institute for Oil palm Research (NIFOR), Date Palm substation Dutse, Jigawa State. The samples were grounded into fine powder using mortar and pestle and then the sample were stored in desiccators until it was used.

Preparation of extracts

The grounded date (*Phoenix dactylifera*) fruits samples were extracted using soxhlet extractor with 70% petroleum ether at room temperature for 3 h and extract was collected. The extract was evaporated to dryness

and stored at 4°C until use (Pusapati et al., 2012).

Phytochemical screening procedure

Test for flavonoids

Two grams of the extract were weighed and placed in a test tube, followed by the addition of 10 ml of dimethylsulphoxide (DMSO). The mixture was heated, followed by the addition of magnesium metal and 6 drops of concentrated hydrochloric acid (HCl). Formation of orange, pink, red to purple colours indicated the presence of flavonoids (Sofowora, 1993).

Tests for saponins

Five (5) grams of the extract were weighed and placed in a test tube, followed by the addition of 5 ml de-ionised distilled water. The content was vigorously shaken. The appearance of a persistent froth that lasted for 15 min was indicative of the presence of saponins (Brain and Turner, 1975).

Tests for tannins

Two grams of the extract were weighed and placed in a test tube, two drops of 5% ferric chloride solution was then added. The appearance of a dark green colour was indicative of the presence tannins (Ciulci, 1994).

Test for anthraquinones

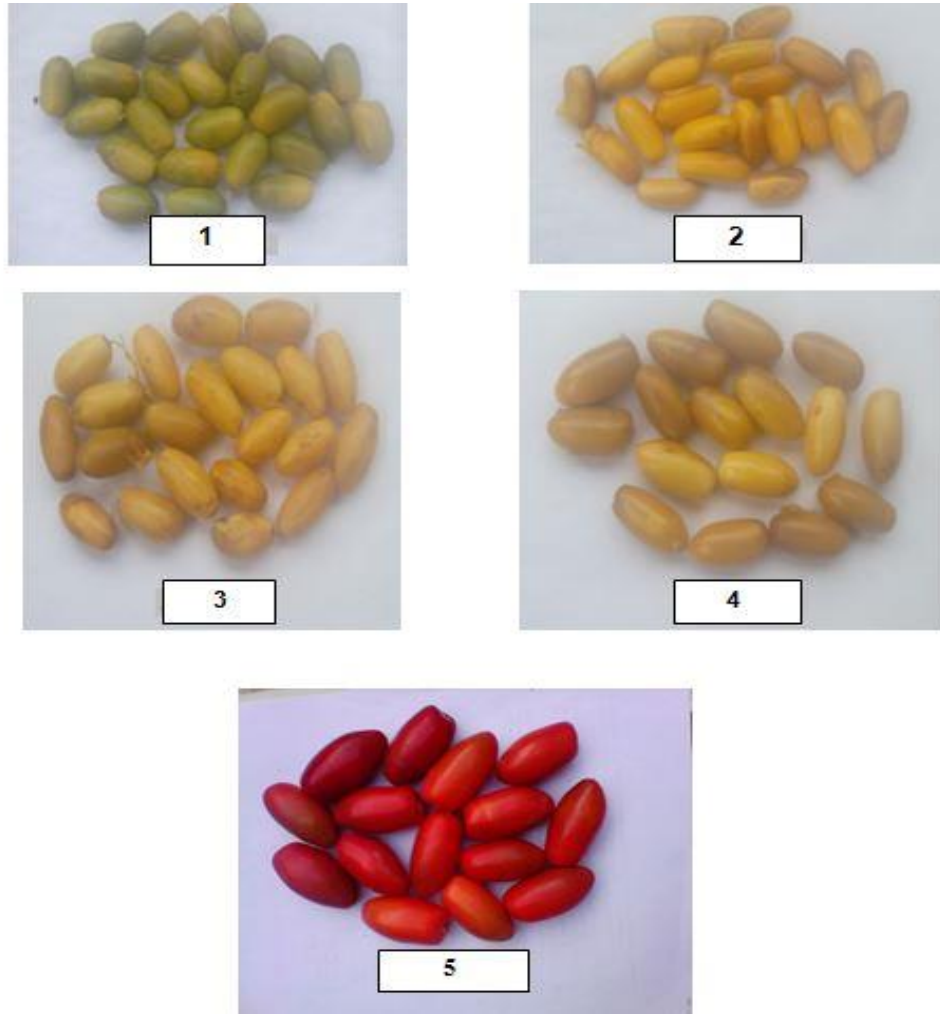
Five (5) ml of the extract solution was hydrolysed with diluted concentrated H₂SO₄ extracted with benzene, and then (one) 1ml of ammonia was added to it. Rose pink coloration suggested the positive response for anthraquinones (Harborne, 1998).

Test for volatile oils

Five (5) grams of the extract were dissolved in 90% alcohol and drops of ferric chloride were added. Green coloration indicates the presence of volatile oils (Trease et al., 1989; Edeoga, 2005).

Tests for cardiac glycosides

The extract was hydrolysed with HCl for few hours on a water bath. To the hydrolysate, 1 ml of pyridine was added and a few drops of sodium nitroprusside solutions were added and then it made alkaline with sodium



Magnification = 8.0 mega pixel

Figure 1. Fresh date fruit varieties studied. Key: 1- Variety-01; 2- Variety-02; 3- Variety-03; 4- Variety-04; 5- Variety-05.

hydroxide solution. Appearance of pink to red colour shows the presence of glycosides (Harborne, 1998).

Tests for reducing sugar

One gram of the extract was weighed and placed into a test tube. This was diluted using 10 ml of de-ionised distilled water and then Fehlings solution was added. The mixture was then warmed to 40°C in a water bath. Development of brick-red precipitate at the bottom of the test-tube was indicative of the presence of reducing sugar (Brain and Turner, 1975).

Test for steroids

One gram of the extract was weighed and placed in a test

tube. This was dissolved in 2 ml of acetic anhydride, followed by the addition of 4 drops of chloroform. Two drops of concentrated sulphuric acid were then added by means of a pipette at the side of the test tube. The development of a brownish ring at the interface of the two liquids and the appearance of violet colour in the supernatant layer were indicative of the presence of steroid (Ciulci, 1994).

Determination of mineral contents

The Nitrogen (N) content was analyzed using flame photometer (Sheerwood 450 flame Photometer) (Horwitz, 1980). The trace metals (Zn, Mn, Ca, Fe and P) concentrations were analyzed by atomic absorption spectrometry (Perkin Elemer Analyst 300 spectrometer). All mineral elements were determined by adopting the

Table 1. Phytochemical Screening of the fresh date fruit varieties studied.

Phytochemicals	Varieties studied				
	Variety- 01	Variety- 02	Variety-03	Variety- 04	Variety- 05
Flavonoids	-	-	-	-	-
Saponins	-	-	-	+	+
Tannins	+	+	+	+	+
Anthraquinones	+	-	+	-	+
Volatile oils	+	+	+	+	-
Reducing sugar	+	+	+	+	+
Cardiac glycosides	-	-	-	+	+
Steroids	-	-	-	-	-

+ = presence; - = Absence

method described by (Kaneez et al., 2001).

Statistical analysis

All samples were analyzed in triplicate to ensure reproducibility. All statistical analysis were subjected to analysis of variance (ANOVA) and Duncan multiple range test (DMRT) was used to separate the mean value \pm standard deviation (SD), using statistical software package (SPSS) version 16.0. (Leversque, 2007).

RESULTS AND DISCUSSION

The references on the phytochemical screening and mineral analysis of wet season (fresh) dates are currently scarce or extremely discrepant, as it is also harvested and consumed during this season (wet season) in Nigeria, being a tropical country. For the phytochemical analysis, all the five varieties of the fresh date fruit studied showed the absence of flavonoids and steroids, although tannins were present generally among all the varieties studied.

However, the presence of saponins and cardiac glycosides were found only in variety (04) and variety (05), while anthraquinones were observed in variety (01), (03) and (05). All the fresh date fruit varieties showed the presence of reducing sugar respectively. The presence of tannin and volatile oils showed that fresh date fruits can be used as purgative and herbal medicine (Gills, 1992). Phytochemicals are natural plant products that are utilized to a large extent by the pharmaceutical, cosmetics, food, agrochemical, and chemurgy industries. Economically, important plants serve as irreplaceable sources of industrial oils (both volatile and fixed), flavors and fragrances, resins, gums, natural rubber, waxes, saponins, surfactants, dyes, pharmaceuticals, as well as pesticides (e.g., insecticides and rodenticides), and many specialty products (Balandrin and Klocke, 1988). From this study, the presence of tannins was observed on the fresh date fruit, and this compound play an important role

in plant growth regulation and against predation. Volatile oils which is an essential oil used in perfume and flavourings were however detected in the fresh date fruits varieties studied. The results obtained from this research showed that fresh date fruits are an excellent source of volatile oils as four (4) fresh date fruit varieties studied indicated the presence of volatile oil. This research is inline with the work of Jain et al. (2013), who reported that date fruits also contain many classes of bioactive components including carotenoids, phenolic acid, flavonoids, tannins, and sterols.

Generally from the study, iron (Fe) content was not observed in all the fresh date fruit samples studied. Calcium (Ca^{2+}) concentration level was detected in all the varieties with variety (02) having the highest mean of 9.87 ± 0.01 while the lowest calcium concentration was observed in variety (04) with the mean 0.56 ± 0.01 , although no significant differences were observed between variety (03) and variety (05) with their means 4.62 ± 0.01 and 4.66 ± 0.01 at 5% level of significant statistically (Table 1). Calcium is the most abundant mineral in the body, because it regulates many cellular processes and has important structural role in living organisms. Skeletal muscle structure and function, polymerization of fibrin and conduction of impulses in the nervous system are regulated by calcium (Tandogan and Ulusu, 2005). From this study, the wet season fruits (fresh) were observed to have a high amount of calcium, making it an important fruit for bone structure and function to the body. This research is also in agreement with the findings of Jamil et al. (2010), who observed the dietary reference intakes (DRI) value for calcium in some date varieties from Pakistan to be 1000 mg/day.

The zinc concentration was highest in variety (01) with the mean (0.81 ± 0.01) while the lowest was observed in variety (04) but there were significant differences in the other varieties. A high amount of phosphorus was observed with variety (02) having the highest with the mean of 7.09 ± 0.01 while the lowest was observed in variety (03), (Table 2). The minimum amount of manganese was observed in variety (04) with the mean 0.03 ± 0.01 while there were no significant differences in

Table 2. Mineral analysis of fresh date fruit varieties studied.

Varieties	Mineral compounds (mg/g)					
	Iron (Fe ²⁺)	Calcium (Ca ²⁺)	Zinc (Zn ²⁺)	Phosphorus (P)	Manganese (Mn ²⁺)	Nitrogen (N)
Variety- 01	0.00 ± 0.00 ^a	5.46 ± 0.00 ^c	0.62 ± 0.01 ^c	5.93 ± 0.01 ^c	0.05 ± 0.03 ^b	0.48 ± 0.0 ^d
Variety- 02	0.00 ± 0.00 ^a	9.87 ± 0.01 ^d	0.81 ± 0.01 ^d	7.09 ± 0.01 ^e	0.07 ± 0.03 ^c	0.44 ± 0.01 ^c
Variety- 03	0.00 ± 0.00 ^a	4.62 ± 0.01 ^b	0.58 ± 0.01 ^b	4.33 ± 0.01 ^a	0.04 ± 0.03 ^b	0.40 ± 0.03 ^b
Variety- 04	0.00 ± 0.00 ^a	0.56 ± 0.01 ^a	0.46 ± 0.01 ^a	6.97 ± 0.01 ^d	0.03 ± 0.01 ^a	0.36 ± 0.03 ^a
Variety- 05	0.00 ± 0.00 ^a	4.66 ± 0.01 ^b	0.56 ± 0.01 ^b	5.34 ± 0.01 ^b	0.04 ± 0.01 ^b	0.50 ± 0.03 ^d

*Values are mean ± SD. Values followed by the same letter(s) within the same column do not statistically differ at 5% level according to Duncan multiple range test (DMRT), analyzed for the varieties studied.

the remaining varieties. There were significant differences in the nitrogen, with the highest observed in variety (01) and variety (05) while the lowest was observed in variety (04).

From this study, a high amount of phosphorus was observed, as this mineral plays an important role in growth and repair of body cells and tissues. However, researchers found out that the phosphorus present in date is similar to that found in the same quantities of apricots, pears and grapes put together (Abdulqadir et al., 2011).

CONCLUSION

Based on the results obtained in this study, the fresh date fruits contain some phytochemicals (saponins, tannins, anthraquinones, cardiac glycosides, volatile oils and reducing sugar) and minerals (calcium, zinc, phosphorus, manganese and nitrogen) which are useful for pharmaceuticals, cosmetics, and food industries so as to promote food security in the country and the world at large. The varieties studied were found interesting and could be useful for potential breeding sources due to their wide range of variation in phytochemicals and mineral components.

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