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Nutritional and anti-nutritional composition of date palm *(Phoenix dactylifera* L.*)* fruits sold in major markets of Minna Niger State, Nigeria

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This study investigated the nutritional, anti-nutritional factors, functional properties, mineral and amino acid contents of *Phoenix dactylifera* L. fruits using standard analytical methods. The results revealed that date palm (*P. dactylifera* L.) contain some percentage crude protein (1.21 ± 0.02%), crude fat (1.73 ± 0.46%), crude fibre (2.26 ± 0.07%), ash (1.88± 0.03%), moisture contents (1.16± 0.16%), carbohydrate (91.76± 0.06%),and calorific values (1621.50± 0.12 kg/100 g) respectively. The anti-nutrient composition for oxalate, tannins, saponins, alkaloids, cyanide, and flavonoids were 7.57 ± 0.04, 5.25 ± 0.04, 1.89 ± 0.12, 5.20 ± 0.46, 0.80 ± 0.01 and 34.29 ± 3.49% respectively; these result indicated that the sample is free of toxic substance which might cause harm to the body. The non-essential amino acids which give rise to about 62% make the plant more desirable since non-essential amino acid play important role in the body structure of a human. Though, both essential and non-essential amino acid present were there to complement each other. The elemental analysis of the fruit in mg/kg indicated that the fruit contained appreciable levels of K (11105 mg/kg), Na (913 mg/kg), Mg (799 mg/kg) and P (793 mg/kg). This showed that the fruit can serve as good source of minerals.

Key words: Nutritional, anti-nutritional, functional, mineral composition.

INTRODUCTION

The date palm (*Phoenix dactylifera* L.) plays an important social, environmental, and economic role for many people living in arid and semiarid regions of the world. Fruits of the date palm are very commonly consumed in many parts of the world and considered as a vital component of the diet and a staple food in most Arab countries (Al-Farsi and Lee, 2008). It may be one of the oldest cultivated plants, with a history of more than 6000 years. The world production of dates has increased from about 4.6 million tons in 1994 to 7.68 million tons in 2010, with expectations of continuous increase (Al-Farsi and Lee, 2008). Nearly 2000 cultivars of date palm are known in the world, but only some have been evaluated for their performance and fruit quality. The importance of fruits as a source of nutrient has attracted attention of various researchers throughout the world, especially in Nigeria

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(Anhwange et al., 2004; Hassan and Umar, 2004; Umar et al., 2007). Malnutrition is a major health problem in Africa, despite government's efforts to promote food production. Protein-energy malnutrition in infants and children is one of the most common nutritional problems (Achu, 2004). date palm *(P. dactylifera* L.*)* belongs to the Palmae (Arecaceae) family. The date palm is a palm broadly developed for its palatable organic product (Rani et al., 2007). The products of the date palm (*P. dactylifera* L.) are sweet berries with a sugar substance of more than half. Regularly, this palm developed for nearby markets on little land possessions other than other. In light of its high nourishing worth, extraordinary yields and its long life the date palm has been specified as the "tree of life" (Augstburger et al., 2002). It contains abnormal state of sugar substance, vital vitamins and high supplement thickness. In perspective of the present rate of populace development in creating nations, date palm natural product may be more valuable in some sustenance definitions than for direct utilization in the wake of cooking/simmered. The use of any seed as a source of nutritious food arises from the knowledge of the chemical composition of its flour and other products (Ogungbenle, 2011).

MATERIALS AND METHODS

Collection and preparation of plant sample

The fruits were collected from different market namely Bosso, Maikunkere, Mobil and Kure market. Niger State, Nigeria. The sample was collected in month of June, 2013. The fruits were thoroughly washed with distilled water and air dried at room temperature. These were then grind into uniform powder manually and stored in air tight containers prior to the commencement of the analysis.

Proximate analysis

The standard analytical procedures for food analysis were adopted for the determination of the moisture content, crude protein, crude fibre, percentage lipids, carbohydrate, ash and calorific value.

Determination of moisture content

Two grammes of the sample were put into the crucibles, dried in an oven at 105°C overnight. The dried sample was cooled in a desiccator for 30 min and weighed to a constant weight. The percentage loss in weight was expressed as percentage moisture content on dry weight basis (AOAC, 2006). This was repeated three times to obtain triplicate values.

Determination of ash content

From the dried and ground sample, 2.00 g was taken in triplicates and placed in pre-weighed crucibles and ashed in a muffle furnace at 600°C for 3 h. The hot crucibles were cooled in a desiccator and weighed. The percentage residual weight was expressed as ash content (AOAC, 2006).

Crude lipid content determination

From the pulverized sample, 2.00 g was used for determining the crude lipid by extracting the lipid from it for 5 h with (60 to 80°C) petroleum ether in a soxhlet extractor (AOAC, 2006). Triplicate samples were extracted to obtain triplicate values that were later averaged.

Protein determination

Total protein was determined by the Kjedahl method. 0.5 g of the sample was weighed in triplicate into a filter paper and put into a Kjedahl flask, 8 to 10 cm^3 of concentrated H_2SO_4 were added and then digested in a fume cupboard until the solution became colourless. Distillation was carried out with about 10 cm^3 of 40% NaOH solution. The condenser tip was dipped into a conical flask containing 5 cm^3 of 4% boric acid in a mixed indicator till the boric acid solution turned green. Titration was done in the receiver flaskwith 0.01 M HCl until the solution turned red (AOAC, 2006).

Determination of crude fibre

From the pounded sample, 2.00 g were used in triplicates for estimating the crude fibre by acid and alkaline digestion methods using 20% H2SO4and 20% NaOH solutions (AOAC, 2006).

Carbohydrate determination

The carbohydrate content was calculated using the following formula: Available carbohydrate (%), = 100 – [protein (%) + Moisture (%) + Ash (%) + Fibre (%) + Crude Fat (%)] (Mathew et al., 2014).

Caloric value

The caloric value was calculated in kilocalories per 100 g (kcal/100 g) by multiplying the crude fat, protein and carbohydrate values by Atwater factors of 37, 17 and 17 respectively.

Determination of mineral contents

The mineral elements were determined by the modification methods of Mathew et al. (2014), where sodium and potassium were determined using Gallenkamp Flame analyzer, while calcium, magnesium, iron, zinc and copper were determined using Buch Model 205 Atomic Absorption Spectrophotometer. Phosphorus level was determined using phosphovanado molybdate colorimetric techniques on JENWAY 6100 Spectrophotometer, blank (control) was also determined in the same manner.

Functional properties

The standard analytical procedures for food analysis as described below were used.

Bulk density

Firstly, a dried and empty 10 cm^3 measuring cylinder was weighed. The sample was filled gently into the weighed 10 cm^3 measuring cylinder and then gently tapped at the bottom on a laboratory bench several times until there was no further diminution of the sample level after filling to the 10 cm^3 mark. After this, the filled measuring

cylinder was weighed and recorded. This process was repeated three times.

Calculation (AOAC, 2006):

$$\text{The bulk density (g/cm}^3\text{)} = \frac{\text{Weight of sample (g)}}{\text{Volume of sample (cm}^3\text{)}}$$

pH measurement

The pH values of the samples were determined by suspending 10% W/V of the sample in distilled water in each case. It was then thoroughly mixed in a 100 cm^3 beaker, stirred and the pH was taken. This was repeated three times and the average calculated (Mathew et al., 2015).

Water/oil absorption capacity

From the ground sample, 1.00 g was weighed into a conical graduated centrifuge tube and 10 cm^3 of water or oil was added to the weighed sample. A warring whirl mixer was used to mix the sample for 30 s. The sample was allowed to stand at room temperature for 30 min and then centrifuged at 5000 rpm for 30 min. After then the mixed sample was transferred from the graduated centrifuge tube into a 10 cm^3 measuring cylinder to know the volume of the free water or oil. The absorption capacity was expressed as grammes of oil or water absorbed per gramme of sample. Calculation; water/oil absorption capacity of the sample was calculated as: (Total oil/water absorbed - free oil/water) × Density of oil/water (AOAC, 2006).

Foam capacity and stability

From the powdered sample, 2.00 g were weighed, blended with 100 cm^3 of distilled water using warring blender (Binatone BLG-555) and the suspension was whipped at 1600 rpm for 5 min. The mixture was then poured into a 100 cm^3 measuring cylinder and its volume was recorded after 30 s. Foam capacity was expressed as percent increase in volume using the formula of AOAC, (2006).

$$\text{Foam capacity} = \frac{\text{Volume after whipping} - \text{volume before whipping}}{\text{Volume before whipping}} \times 100$$

The foam stability of the sample was recorded at 15, 30, 60 and 120 s after whipping to determine the foam stability (FS).

$$\text{Foam stability} = \frac{\text{Foam volume after time}}{\text{Initial foam volume}} \times 100$$

Gelatinization temperature

In triplicates, 5% sample was suspended in test tubes, heated in a boiling water bath with continuous stirring and 30 s after gelatinization was visually noticed, the temperature of the samples were taken as the gelatinization temperature (Mathew et al., 2015).

Viscosity

In each case, 10% suspended sample in distilled water was taken and mechanically stirred for 2 h at room temperature. Thereafter, the viscosities of the samples were measured using Oswald type viscometer (AOAC, 2006).

Emulsification capacity (EC)

From the sample, 2.00 g of sample were blended with 25 cm^3 of distilled water at room temperature for 30 s in a warring blender at 1600 rpm. After complete dispersion, 25 cm^3 of vegetable oil was gradually added and the blending continued for another 30 s. Then the mixture was transferred into a centrifuge tube and centrifuged at 1600 rpm for 5 min. The volume of oil separated from the sample was read directly from the tube after centrifuging. Calculation: The emulsion capacity was expressed as the amount of oil emulsified and held per gramme of sample:

$$\text{Emulsion capacity} = \frac{X}{Y} \times 100$$

Where X = height of emulsified layer and Y = height of the whole solution in the centrifuge tube (AOAC, 2006).

Wettability

Triplicate samples were weighed and in each case, 1.00 g was introduced into a 25 cm^3 measuring cylinder with a diameter of 1 cm and a finger was placed over the end of the cylinder. The mixture was inverted and clamped at a height of 10 cm from the surface of a 250 cm^3 beaker containing 100 cm^3 of distilled water. The finger was removed to allow the test material to be dumped. In this case, the wettability was taken as the time required for the sample to become completely wet (AOAC, 2006).

Gelation capacity

In every case for triplicate samples, 5 cm^3 of 2-20% (w/v) suspended samples were in test tubes and heated for 1 h in a boiling water bath followed by rapid cooling under running cold tap water. The test tubes were further cooled for 2 h at 4°C and the gelation capacity was the least gelation concentration determined as the concentration when the sample from the inverted test tube did not fall or slip (AOAC, 2006).

Quantitative determination of phytoconstituents

Determination of cyanide

The alkaline pictrate method of Onwuka (2005) was adopted. 5.0 g of sample was weighed each and dissolved in 50 cm^3distilled water in corked conical flasks. The mixtures was allowed to stay overnight and then filtered. The extracts (filtrates) was collected, different concentration of hydrogen cyanic acid (HCN) was prepared containing 0.02 to 0.10 mg/ cm^3 cyanide. The absorbance of each was taken in a spectrophotometer at 490 nm and the cyanide standard curve was plotted. 1 cm^3 of each sample filtrate and standard cyanide solution was measured into three test tubes respectively and 4 cm^3 of alkaline pictrate solution was added to each and incubated in a water bath for 15 min. After colour development (reddish brown), the absorbance of each content in the test tubes was taken in a spectrophotometer at 490 nm against a blank containing only 1 cm^3 distilled water and 4 cm^3 alkaline pictrate solution (1 g of pictrate and 5 g of sodium carbonate (Na_2CO_3) were dissolved in a warm water in 200 cm^3 flasks and made up to 200 cm^3 with distilled water).

Determination of oxalate

A modification of the titrimetric method of Krishnaiah et al. (2009)

was used in the determination of oxalate in the frog meat samples. In this method, 75 cm^3 of 1.5 M H_2SO_4 (made from 99% BDH AnalaR grade) was added to 1 g of the ground samples and the solution was carefully stirred intermittently with a magnetic stirrer for 60 minutes and filtered using Whatman No 1 filter paper after which 25 cm^3 of the filtrate was collected and titrated against hot (90°C) 0.1M $KMnO_4$ (BDH AnalaR grade) solution until a faint pink colour that persisted for 30 s appeared. This was repeated twice more and the concentration of oxalate in each sample was obtained from the calculation: 1 cm^3 of 0.1 M $KMnO_4$ = 0.006303 g Oxalate.

Determination of alkaloids

The quantitative determination of alkaloids was carried out by the alkaline precipitation through gravimetric method. Two grammes (2.00 g) of the sample was soaked in 20 cm^3 of 10% ethanolic acetic acid (BDH AnalaR grade). The mixture was allowed to stand for 4 h at room temperature. Thereafter, the mixture was filtered through Whatman filter paper no. 40. The filtrate (extract) was concentrated by evaporation over a steam bath to ¼th of its original volume. For the alkaloids to be precipitated, concentrated ammonia solution was added in drops to the extract until it was in excess. The resulting alkaloid precipitate was recovered by filtration using a previously weighed filter paper. After filtration, the precipitate was washed with 1% ammonia solution and dried in the oven at 60°C for 30 min, cooled in a desiccator and reweighed. The experiment was repeated two more times and the average was taken. The weight of alkaloids was determined by difference and expressed as a percentage of the weight of the sample analysed as shown.

$$\% \text{ Alkaloids} = \frac{w_2 - w_1}{\text{wt of sample}} \times 100$$

Where; w_1 = weight of filter paper and w_2 = weight of paper + alkaloid precipitated (Krishnaiah et al., 2009).

Determination of flavonoids

1 g of the sample was weighed and repeatedly extracted with 100 cm^3 of 80% methanol at room temperature. The mixture was then filtered through filter paper into a 250 cm^3 beaker and the filtrate was transferred into a water bath and allowed to evaporate to dryness and weighed. The % flavonoid was calculated using the formula:

$$x = \frac{w_2 - w_1}{w_3} \times 100$$

Where x = percentage flavonods, w_1 = weight of empty beaker, w_2 = weight of empty beaker + flavonoid and w_3 = weight of sample (Krishnaiah et al., 2009).

Determination of saponin

0.5 g of the sample was added to 20 cm^3 of 1MHCl and was boiled for 4 h. After cooling it was filtered and 50 cm^3 of petroleum ether was added to the filtrate and the ether layer evaporated to dryness. 5 cm^3 of acetone/ethanol mixture was added to the residue. 0.4 cm^3 of each was taken into 3 different test tubes. 6 cm^3 of ferrous sulphate reagent was added into them followed by 2 cm^3 of concentrated H_2SO_4. It was thoroughly mixed and after 10 min the absorbance was taken at 490 nm. Standard saponin was used to establish the calibration curve (Krishnaiah et al., 2009).

Amino acid profile

The amino acid profile date palm sample was determined using methods described by Benitez (1989). From the ground sample, 0.50 g was defatted with chloroform and methanol mixture in a ratio of 1:1. Then, 0.25 g of the defatted sample was put into a glass ampoule, 7 cm^3 of 6 M HCl prepared from 36% BDH stock solution was added and oxygen expelled by passing nitrogen into the ampoule. This was put in the oven at 105°C for 22 h, allowed to cool and filtered. The filtrate was then evaporated to dryness at 40°C under vacuum in a rotary evaporator. The residue was dissolved with 5 cm^3 acetate buffer (pH 2.0) and loaded into the amino acid analyser and the samples were determined by ion exchange chromatographic (IEC) method using the Technicon Sequential Multi-sample Amino acid Analyzer (Technicon Instruments Corporation, New York).

RESULTS AND DISCUSSION

Table 1 show the result of proximate composition of the proximate composition of date palm (*Phoenix dactylifera* L.). The result revealed that the moisture content in the sample was 1.16±0.16±0.16%. This value is lower than 5.24+0.05% and 11.0% reported by Ogungbenle (2011). The moisture content of different varieties of date palm as 14.81 ± 0.396 (Dora), 9.90 ± 0.042 (Dhaki), 12.3 ± 0.242 (Karbaline) respectively was reported by Faqir et al. (2012). The result of Rehman et al. (2012) also shows higher content of 17.70±0.03 for hard date palm. These differences may be due to the location, time, environments, longitivity and maturity of the sample used for the analysis. The low moisture content as saw in the sample is an evidence that this specimen may not be more inclined to decay, since nourishments with high dampness substance are more inclined to perishability (Fennema and Tannenbaum, 1996). It might be profitable in perspective of the specimen timeframe of realistic usability. This outcome is not shocking in perspective of the way that the advertisers of the item assert to the truth, that it can be put away for a year or more. The ash content of the sample was 1.88±0.03%. This result review that the sample have low ash content when compare to 3.27+0.02% by Ogungbenle (2011). These result is similar with 2.6 ± 0.12 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 1.4 ± 0.171 for (Dora) , 1.9± 0.297 (Dhaki)and1.6 ± 0.017 (Karbaline) respectively (Faqir et al., 2012). This result is within the acceptable ash content mean values of legumes of 2.4 to 5.0% recommended by FAO (1989). The result of the ash content in the sample is a suggestion of a low deposit of mineral elements in the samples compare to the recommended values by the FAO. This may indicate that date palm fruit would likely contain very high qualities essential minerals. Since ash content is an index to evaluate and grade the nutritive quality of foods (Pearson, 1976). Dietary fiber serves as a

Table 1. The proximate composition of date palm fruit.

Parameter	Values in % except for the calorific value
Moisture content	1.16±0.16
Ash content	1.88±0.03
Crude fibre	2.26±0.07
Crude protein	1.21±0.02
Fat (lipid)	1.73±0.04
Carbohydrate	91.76±0.06
Calorific value (kJ/100 g)	1621.50±0.12

The values are means of triplicate determinations ± standard deviations (SD).

Table 2. The anti-nutritional factors of date palm fruit.

Anti-nutritional factor	Concentration (%)
Oxalate	7.57±0.04
Tannin	5.25±0.04
Saponin	1.89±0.12
Alkaloid	5.20±0.40
Cyanide	0.80±0.01
Flavonoid	34.29±3.49

useful tool in the control of oxidative processes in food products and as functional food ingredient (Mandalari et al., 2010). The crude fibre content was 2.26±0.07% which is similar to 4.34+0.03% and 4.00±0.02 obtained by Ogungbenle (2011) and Rehman et al. (2012). This result is lower than 9.4 ± 0.10 reported by Gamal et al. (2012). Fibre content of foods helps in digestion process and prevention of cancer (Saldanha, 1995; UICC/WHO, 2005). Legumes are known to contain a percentage amount of fibre (Salunkhe et al., 1989). 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). The crude protein content of was 1.21±0.02% which is slightly lower than 2.1 ± 0.315 (Dora) 2.4 ± 0.052 (Dhaki) and 2.7 ± 0.187(Karbaline) respectively (Faqir et al., 2012). It has been reported that crude protein serves as enzymatic catalyst, mediate cell responses, control growth and cell differentiation (Whitney and Rolfes, 2005). Fat content of 1.73±0.04% was recorded from the analysis. The importance of lipids in food substances cannot be over-emphasized as it contributes significantly to the energy value of foods. The sample is so rich in carbohydrate (91.76±0.06%). The results showed that the date palm is a good source of carbohydrate which may give rise to good source of energy as an adult need about 400 to 500 g carbohydrate intake as starch. This value is slightly higher than 80.67+0.05 obtained Ogungbenle (2011). 1621.50±0.12 kJ/100 g calorific value was also recorded. The nutritional importance of a given food depends on the nutrients and anti-nutritional constituents of the food (Aletor et al., 2007*).* The result of the anti-nutritional factors of date palm *(Phoenix dactylifera* L.) is presented in Table 2. The low value of7.57±0.04% oxalate in the sample is evidence that utilization of date palm might not have any negative impact that is connected with abundance utilization of oxalate, for example, complex development with divalent metals, which may have impact on natural action of the metal particles in the body. Oxalate have been accounted for to have negative impact on accessibility of mineral which will prompt assimilation of fundamental minerals in body particularly calcium by framing insoluble salts (Onyeike and Omubo-Dede, 2002).The concentration of the value of saponins from the analysis was 1.89±0.12% which is within the WHO permissible limit of (48.50 mg/100 g) as recommended 2003 (WHO, 2003). The fruit contain 7.57% of tannin due to this result taking the fruit may not lower the availability of protein in the body or clothing with red blood cell as cause by excess tannin and saponins in human body. This suggests that this fruit may be safe for consumption. The fruit contain very low cyanide (0.80 %) which indicates that the fruit will not cause any effect as regard to cyanide. The flavonoid and alkaloid content was 34.29 and 5.20% respectively. The anti-nutritional composition of the sample was low. This indicates that the fruit can be used effectively since the anti-nutritional composition is low and there would be no interference with the nutrient like protein and minerals in the body.

Table 3. The functional properties of date palm fruit.

Parameter	Value
Bulk density (g/cm^3)	0.67±0.02
pH	5.33±0.06
Water absorption capacity (%)	2.50±0.05
Oil absorption capacity (%)	1.22±0.10
Foam capacity (%)	5.15±1.07
Foam stability (%)	35.05±5.00
Emulsification capacity (%)	45.63±2.76
Gelation capacity (%)	16.67±1.16
Gelatinization temperature (^{0}C)	72.01±0.60
Wettability (sec.)	7.37±0.45
Viscosity (sec.)	36.16±0.10

Table 4. The essential amino acid profile of date palm fruit.

Parameter	Concentration (g/100 g Protein)
Histidine	1.63±0.01
Isoleucine	1.85±0.10
Leucine	5.33±0.01
Lysine	2.50±0.03
Methionine	0.63±0.01
Threonine	1.25±0.05
Tryptophan	0.36±0.02
Valine	1.92±0.15
TEAA	37.18%

TEAA = Total essential amino acid.

The result of essential and non-essential amino acid profile of the date palm (*P. dactylifera* L.) were presented in Tables 4 and 5. The result showed that the essential amino acids content had higher Leucine (5.33±0.01) which is very useful in the body to counterbalance the isoleucine which help in the regulation of the thymus, spleen, pituitary, the metabolism and forming haemoglobin. The sample also had higher value of lysine (2.5±0.03) which helps in the functions of the liver, gallbladder and pineal and mammary glands. The sample contains histidine (1.63±0.01), isoleucine (1.85±0.10), threonine (1.25±0.05), valine (1.92±0.15), methionine (0.63±0.01), tryptophan (0.36±0.02) respectively. The presence of tryptophan, threonine, and valine is an indication that the plant can help in the generation of cells, red and white blood corpuscles, involved in the functioning of the mammary glands and ovaries. The major non-essential amino acid were glutamic acid (5.21±0.01), arginine (4.08±0.01), alanine (3.01±0.02), aspartic acid (3.37±0.02), phenylalanine (3.21±0.25), proline (2.02±0.01) and serine (2.35±0.12) respectively. The percentages of total essential and non-essential amino acid recorded in this work were 37.18 and 62, respectively. The total percentage of essential amino acids (% TEAA) in the food samples was far above average, and this indicate that it may serve as good source of essential amino acids. Amino acids play central roles both as building blocks of proteins and as intermediates in metabolism. The consumption of this fruit can help reduce the effects associated with mal-nutrition.

The functional properties of the food materials are very important for the appropriateness of the diet, behavior of nutrients in food during processing, storage and preparation because they affect the general quality of foods as well as their acceptability (Omueti et al., 2009).The results of functional properties of date palm is presented in Table 3. Bulk density which is a function of particle size was 0.67±0.02 which is an indication that the particle size was high. Increase in bulk density is desirable because it offers greater packaging advantage, as a greater quantity may be packed within a constant volume (Fagbemi, 1999).The water absorption capacity was 2.50±0.05 indicating its heaviness, suggesting its suitability as a drug binder and disintegrate in pharmaceuticals industrials (Zaku et al., 2009). From

Table 5. The non-essential amino acid profile of date palm fruit.

Parameter	Concentration (g/100 g protein)
Alanine	3.01±0.02
Arginine	4.08±0.01
Aspartic acid	3.37±0.02
Cysteine	0.53±0.04
Glutamic acid	5.21±0.01
Glycine	1.07±0.01
Proline	2.02±0.01
Serine	2.35±0.12
Tyrosine	1.29±0.18
Phenylalanine	3.21±0.25
TNEAA	62%

TNEAA =Total non-essential amino acid.

Table 6. The mineral contents of date palm fruit.

Parameter	Concentration (mg/kg)
Sodium (Na)	913.00±1.00
Potassium (k)	11105.00±47.00
Calcium (Ca)	371.50±0.15
Magnesium (Mg)	799.50±4.50
Iron (Fe)	61.50±11.50
Zinc (Zn)	17.50±1.50
Manganese (Mn)	15.50±5.50
Copper (Cu)	10.00±0.16
Phosphorus	793.50±5.02

The values are mean of duplicate determination ± standard deviation (SD).

the table the result shows that the fruit had very higher gelatinization temperature of 72.01±0.60°C which affects the time required for the cooking of food substances. The result revealed very low value of oil absorption capacity of 1.22±0.10%. The pH of the sample was 5.33±0.06 has been reported by Tsakama et al. (2010) to increase solubility because of increased hydrophilic characters of the starch at these pH values. The pH value of 5.33±0.06 showed that this fruit is acidic in nature. The fruit contain Foam capacity (5.15±1.07%), foam stability (35.05±5.00%), emulsification capacity 45.63±2.76%), gelation capacity (16.67±1.16%), wettability (7.37±0.45 s) and viscosity (36.16±0.10 s) respectively.

Gelatinization includes the arrangement of a nonstop system which shows certain level of request. Gels are described by moderately high consistency, pliancy and flexibility. Gelation is one of the essential variables that focus starch practices in different sustenance and modern applications. It influences the nature of starch-based.

Table 6 shows that K, Na, Mg, P and Ca content of *P. dactylifera* fruit were 11105±47.00, 913±1.00, 799.50±4.5, 793.50±5.02 and 371.50±0.15 mg/kg respectively. Therefore, this fruit can serve as a good source of minerals that play significant roles in several biological processes.

Conclusion

The detailed information on nutritional and health promoting components of *P. dactylifera* enhances our knowledge and appreciation for the use of date palm fruits in our daily diet and as a functional food ingredient. *P. dactylifera* fruits are characterized by high carbohydrate content and relatively reasonable amounts of K, Na, P, Mg and Ca. They are also rich in leucine, glutamic acid, argine, aspartic acid and alanine. Thus these fruits could be of high nutritional value serving as a good source of these nutrients for man and his animals.

Conflict of Interest

The authors have not declared any conflict of interest.

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