Physicochemical Properties and Nutritional Value of Egyptian Date Seeds and Its Applications in Some Bakery Products

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ABSTRACT: The present study was carried out on an Egyptian Sukari date variety obtained from two different locations (Siwa and Alwady Algadid). Physicochemical properties and nutritional value as well as the effect of fortified bread and muffins with date seed powder were evaluated. Moisture, protein, crude fiber, ether extract, ash and carbohydrates were 8.8 and 9.6%, 3.88 and 5.62%, 15.84 and 18.01%, 10.7 and 8.5%, 1.98 and 1.48%, 58.80and 56.79%, recorded in Sukari date seeds collected from Siwa and Alwady Algadid, respectively. Among sixteen fatty acids detected, oleic was the predominant (44.03–45.88%) followed by lauric (18.94–20.17%), myristic (10.65–10.89%), palmitic (8.05– 8.21%), linoleic (6.45–7.13%) and stearic (2.80–2.96%) which composed together about 90% of the total oil in Sukari date seeds collected from two different places. Potassium was the highest mineral content in the two date seeds, it ranged between 2004.49 mg/kg DW in Siwa seeds and 2159.74 mg/kg DW in Alwadi Algadid seeds, followed by calcium (982.77 - 1367.64 mg/kg DW), magnesium (651.90–670.14 mg/kg DW) and phosphorus (590.57–856.18 mg/kg DW). The highest contents of phenolic (3500.59 mg GAE/100 g DW) and flavonoid (1400.88 mg RE/100 g DW) were observed in Siwa seeds, whereas the lowest amount of both, phenolic (3010.05 mg GAE/100 g DW) and flavonoids (1210.00 mg RE/100 g DW) was found in Alwadi Algadid seeds. Siwa date seeds exhibited the highest level of antioxidant activity based on DPPH assay. Prepared bread and muffins made with 10% and 15% of date seed powder received the highest overall score than those contained wheat flour without any supplementation.
Key words: *Dateseed, Dietaryfiber, Bakingproperties.*

INTRODUCTION

Date palm (*Phoenix dactylifera* L.) is one of the most cultivated palms around the world. The fruit of the date palm is one of the important agricultural commodities in the Egyptian Sahara as Siwa, Marsa Matruh and ALwadi Al gadid. It is served mainly as a vital component of the diet, staple food and constitute the principal source of remuneration and the basis of economy for the people of these regions (Abd El-Azeem *et al*., 2011; Mohamed *et al*., 2014, Hamad *et al*., 2015 and Al-Alawi *et al*., 2017).

In 2016, Egypt produced 6,968,801 metric tones of fresh dates representing about 30% of the total world production, Egypt is the first producer country followed by Iran, Saudi Arabia, Algeria and Iraq (FAO, 2016).

Fruit constitutes an important part of a balanced diet as they are natural sources of food nutrient which included protein, carbohydrate, fat, minerals, vitamins and dietary fiber as well as some bioactive compounds (Al-Harrasi *et al*., 2014, El- Sohaimy *et al*., 2015, Mrabet *et al*., 2016, Samad *et al*., 2016 and Al-Alawi *et al*., 2017).The date fruit is composed of a fleshy pericarp and seed which constitutes between 10 and 15% of date fruit weight (Al-Farsi *et al*., 2007; Elleuch *et al*., 2008; Nehdi *et al*., 2010 and Amira *et al*., 2011).

Date seeds can be discarded, used in animal feeding or used in making non-caffeinated coffee (Habib and Ibrahim, 2009). They are also listed in folk remedies for the management of diabetes, liver diseases and gastrointestinal disorders in traditional Egyptian medicine (Kchaou *et al*., 2016). It has been reported that the extracts of date seeds ameliorate gastric ulceration in rats (Al Qarawi *et al*., 2004; Al-Najada *et al*., 2014; and Al-Sayyed *et al*., 2014) and possess an anti-inflammatory activity in the rat adjuvant arthritis model (Doha and Al-Okbi, 2004 and Rahmani *et al*., 2014). Salah and Al-Maiman (2005), and Al-Alawi *et al*. (2017) have reported that feeding the defatted date seed flour to rats reduced the plasma triglycerides, total cholesterol and low-density lipoprotein.

Chemical composition of date seeds showed high amount of fiber (75–80%), fat (10–13%), proteins (5– 6%), and ash (Besbes *et al*., 2004; Al-Farsi *et al*., 2007 and Al-Farsi and Lee, 2008). Thus, utilization of such waste is very important to date cultivation and to increase the income to this sector. In addition, date seeds could be considered as a valuable source of functional ingredients and could therefore be used for different food products' formulation and for the development of different functional and medicinal supplements.

Bread wheat is an Egyptian product that represents the main diet component for rich and poor Egyptian consumers. In Egypt, there is a big gap between wheat production and its consumption, where the total production of wheat grains covers only about 55% of the total needs one of the ways, to overcome this problem is to search for other native cereal sources or else which could be used with wheat flour bread making (Eissa *et al*., 2007 and Litwinek *et al*., 2013).

Few researches have been carried out on incorporation of date seed powder into wheat flour for bread production (Golshan Tafti *et al*., 2017). According to Halaby *et al*. (2014), pan bread containing 15% date seed had the highest score in overall acceptability when compared to control and other levels of seeds. They also concluded that date seed powder had improving effect on the nutritive value of pan bread and also it had a hypoglycemic effect and could decrease the risk of diabetic diseases. It is reported that Saudi Mafrood flat breads containing 10% coarse seed powder had similar sensory properties to flat breads containing wheat bran. Flat breads containing fine seed powder had lower sensory scores (color, flavor, odor, overall acceptability) than wheat bran controls (Habibi Najafi, 2011). Hejri-Zarifi *et al*. (2013) milled date seeds into germ and residue and incorporated them in formulation of Iranian Barbari flat bread at the levels ranged in 0.5-3 g/100 wheat flour. The results of texture analysis during 5 days of bread storage showed that both fractions of germinated date seeds reduced the bread staling. The higher levels of flavonoids and antioxidant capacity were observed in Arabic bread containing date seed powder (Platat *et al*., 2013).

The aim of this research was to study physicochemical properties and nutritional value of date seeds from Sukari date fruit (*Phoenix dactylifera* L.) variety grown in two different places; Siwa' Oasis and Alwadi Algadid, Egypt. Moreover, sensory attributes of prepared bread and muffins incorporated with date seeds powder were evaluated.

MATERIALS AND METHODS

1. Materials

Egyptian Sukari date fruit variety was obtained at in tamer stage from Siwa Oasis and Al wadi Al gadid. Chemicals and reagents were acquired from Sigma–Aldrich (Dorset, UK).

2. Methods

1. Physical properties of date seeds

Ten date fruits were taken randomly from each variety to determine seed/date fruit weight ratio and dimensions (length and diameter).

2. Preparation of date seed powder

The seeds were directly isolated from Sukari date. The seeds were separately washed, dried and were milled using a heavy-duty grinder into a fine powder passing 1.2 mm screen.

3. Proximate composition of date seeds

The moisture was determined by oven-drying at 105 °C to constant weight (AOAC, 1999). Total nitrogen was determined by the Kjeldahl method (AOAC, 1999) and then the protein amount was calculated using a factor of 6.25. Crude fat content was measured by Soxhelt using hexane for 6 h (AOAC, 1999). The solvent was removed via a rotary vacuum distillation at 40-50c, the weight of the lipid extracted from 10 g of the seed powder was determined to calculate the lipid content, the result was expressed as the lipid percentage in the dry seed powder. Crude fiber and ash contents were determined using (AOAC, 2000), Carbohydrate content was estimated by difference of mean values 100-(sum of percentages of moisture, fiber, ash, protein, and lipids).

4. Extraction of date seed fat

The crude fat of each variety were extracted in a Soxhlet apparatus using n-Hexane as a solvent for 8 h. The solvent was removed using a rotary evaporator at 40 °C and the lipids were weighed and stored in a freezer at 4 °C until analysis.

5. Fatty acid analysis

The preparation of fatty acid methyl esters was done using transesterification with methanolic potassium hydroxide. The method used in this study is described by Tariq Bouhlali *et al*. (2017). The analysis was performed using gas chromatograph equipped with a flame-ionization detector and capillary

column (30 m - 320 lm i.d, 0.25 lm film thickness). The carrier gas was Helium. The Helium and air flows of FID detector were 45 and 300 ml/min, respectively.
The oven temperature was 100 °C at 0 min and was raised to 200 °C at a rate of 6 °C /min and hold for 50 min. The injector and the detector were maintained at 260 and 280 °C, respectively. The peaks were recognized, based on their retention times (RT) using standard fatty acids methyl esters (FAMEs). All samples were run in triplicate.

6. Minerals determination

The method of AOAC (1997) was employed for the determination of ash and mineral content. Two grams of the pulverized samples were placed in a crucible, and ignited in a muffle furnace overnight at 550 °C and then cooled in a desiccator and weighed at room temperature to get the weight of the ash.
To the resulting ash 5 ml of concentrated hydrochloric acid was added, and evaporated on a hot plate, some drops of H_2O_2 and 5 ml of distilled water were added and filtered in 100 ml volumetric flasks and then the volume was made up with distilled water. This solution was used for the determination of mineral content. Atomic absorption spectrophotometer (AAS) was used to determine Mg, Fe, Mn, Cu, Ca, K, Na and Zn.

7. Preparation of polyphenol extracts

The phenolic extract was prepared according to the method of Bouhlali *et al*. (2017). Briefly, 30 g of date seeds powder was extracted with 150 ml of methanol water (4:1, v/v), at 35 °C for 12 h using an orbital shaker-incubator. The mixture was then filtered and the filtrate was concentrated under reduced pressure at 40 °C until total evaporation of solvent using a rotary evaporator. The results of methanolic crude extract were kept at 20 °C in dark glass bottles until use.

8. Determination of total phenolic content:

The total phenolic content of the date seed extracts was determined by the Folin–Ciocalteu method (Singleton and Rossi, 1965) with some modifications. One hundred microliters of the sample were mixed with 1 mL distilled water and 100 µl of Folin–Ciocalteu reagent. After Five minutes, 800 µL of 7.5% Na_2Co_3 solution was added and the mixture was allowed to stand for 2 h. The absorbance was measured at 750 nm using Aquamate plus UV/Vis Spectrophotometer (Thermo Scientific, England). Standard solutions of Gallic acid (10–60 µg/ml) were similarly treated to prepare the calibration curve. Results were expressed as mg Gallic acid equivalent (GAE) / gram sample on a dry basis.

9. Measurement of flavonoid content

The total flavonoid content of date seed was determined by the method of Kim *et al*. (2003). One ml of date seeds extract was mixed with 4 ml of distilled water. Then 0.3 ml of sodium nitrite solution (5%) was added, followed by 0.3 ml aluminum chloride solution (10%). Test tubes were incubated for 5 min at ambient temperature, then 2 ml of sodium hydroxide (1 M) was added to the mixture and then the final volume was made up to 10 ml with distilled water. The mixture was

Thoroughly vortexed and the absorbance was determined at 510 nm. Measurements were calibrated to a standard curve of prepared Rutin solution and the results were expressed as mg Rutin equivalents (RE)/100 g of dry weight (DW).

10. DPPH radical scavenging activity

Scavenging Radical activity of date seed against stable DPPH was assessed as described by Blois (1958) method with slight modifications. The reaction mixture contained 100 µL of date seed at different concentrations and 1.9 ml of methanolic DPPH (0.3 µM). The mixture was incubated at room temperature for 20 min and the absorbance was determined at 517 nm. The IC50 (concentration providing 50% inhibition) values were calculated from the plotted graph of scavenging activity against the concentrations of the samples.

11. Preparation of bread and muffins

The bread formulation dough contained wheat flour, date seed flour (2.5%, 5%, 7.5% and 10%) salt, sugar, oil and instant dry yeast. The bread making were prepared according to Younis (1984) and Mohsen *et al*. (1997). The dry material individually blended to be homogenized (1.5 g yeast and 1 g salt) per 100 g of flour blend. Water was added to blends according to the water absorption of farinograph. The blends were manually mixed for 15 minutes to form dough. The dough was kept at 25 ±2 Ċ, 85% RH, for 25 min to complete fermentation. Then loaves baked at 450Ċ in mechanical gas oven for 1-2 min. The bread was allowed to cool, then packed in polyethylene bags.

Muffin formulation dough using wheat flour, date seed flour in different ratio, sugar, baking powder, corn oil, milk and egg. The muffins were prepared according to Yaseen *et al*. (2012). Date seed flour blends containing of 2.5%,5%,7.5%,10%,15% and 20%, the dry material individually blended to be homogenized (1.5 g baking powder and 1 g salt) per 100 g of flour blend. Water was added to blends then the blends were manually mixed for 15 minutes to form dough. The muffin baked at 175Ċfor 15 minutes. The muffins were allowed to cool, then packed in polyethylene bags.

12. Sensory evaluation

Sensory evaluation test was used for assessing the sensory acceptability of the muffins and bread using an acceptance test. Muffins and bread were assigned four-digit random codes and subjected to sensory evaluation by trained panel of 6 adults. Muffins and bread were evaluated for color, texture, flavor, odor and overall acceptability using a five-point scaling system; like very much (5), like (4), neither like or dislike (3), dislike (2) and dislike very much (1). The height of each whole muffin and bread were measured according to Arora and Camire (1994). Muffins and bread were sliced in half from top to bottom before the measurement.

RESULTS AND DISCUSSION

1. Physical properties of date seeds

The dimensions of seeds show differences as illustrated in Table 1. The diameter of date seeds varied between 0.94 cm for Siwa seed and 0.88 cm for Alwadi Algadid seed which possessed the highest date seed length 1.8 cm, the lowest 1.71cm was observed in Siwa seed. These results are in agreement with those reported by Al Juhaimi *et al*. (2012) who found that the length and the diameter ranged between 14.11–23.22 mm and 6.85–9.02 mm respectively. This characteristic is very used by the farmers to evaluate the quality of varieties. It can be influenced by climate factors and some cultural practices such as reducing the number of dates fruit bunches per palm trees, in addition to the varieties effect.

Table (1). Physical properties of date seeds

	Siwa Oasis Seeds	Alwadi Algadid seeds
Diameter (cm)	0.94 ± 0.047	0.88 ± 0.057
Length (cm)	1.71 ± 0.046	1.8 ± 0.044
Weight of 100 seeds (g)	794	804

2. Proximate composition

The proximate composition of analyzed date seeds is summarized in Table 2. The highest contents of protein (5.62 g/100 g DW) and crude fiber (18.01 g/100 g DW) were shown in Alwadi Algadid date seeds, which contain the lowest amount of ash (1.48 g/100 g DW) and ether extract (8.5 g/100 g DW), but contain the highest amount of moisture (9.6 g/100 g FW). The lowest contents of moisture (8.8 g/100 g FW), protein (3.88 g/100 g DW) and crude fiber (15.84 g/100 g DW) were determined in Siwa' Oasis date seeds, which contain the highest amount of ether extract (10.7 g/100 g DW) and ash (1.98 g/100 g DW). These results of proximate composition are very close to those reported by Saafi *et al*. (2008), Habib and Ibrahim (2009), Basuny and Al-Marzooq (2011) and Al Juhaimi *et al*. (2012).

The energy values of analyzed date seeds varied between 326.14 and 347.02 kcal/100 g DW are very lower than those reported by Al juhaimi *et al*. (2012) who found that the energy values of analyzed seven date seeds were ranged between 4340 kcal/kg and 4795 kcal/kg. The difference may be due to the method used to determine the energy value. That means that the calorimeter determined the raw energy, which incorporates the energy produced by fibers in addition to the energy produced by protein, lipid and digestible carbohydrate determined in our paper.

Table (2). Proximate composition of date seed

Components	Composition of date seeds (g/100 g DW)	
	Siwa'Oasis seeds	Alwadi Algadid seeds
Moisture	8.8	9.6
Protein	3.88 ± 0.18	5.62 ± 0.19
Crude fiber	15.84 ± 0.63	18.01 ± 0.71
Crude fat	10.7 ± 0.26	8.5 ± 0.16
Ash	1.98 ± 0.08	1.48 ± 0.06
Carbohydrates (by difference)	58.80	56.79
Energy value (kcal)/100 g DW	347.02	326.14

3. Fatty acid composition of date seeds oil

The results of fatty acid analysis of date seeds, which vary slightly within analyzed date seeds varieties, are given in Table 3. Among sixteen fatty acids detected oleic was the predominant (44.03 – 48.88%) followed by lauric (20.39–21.28%), myristic (10.65–10.89%), palmitic (8.05– 8.21%), linoleic (6.45–7.13%) and stearic (2.80–2.96%) which composed together about 90% of the total oil. Arachidic, gadoleic, behinic and lignoceric were present in low amounts and linoleinic, myristoleic and palmitoleic are in negligible amounts.

Date seed oil from Alwadi Algadid shows a lower amount of saturated fatty acid 43.50%, and a higher amount of monounsaturated fatty acid 50.00% than date seed oil from Siwa as described in Table 3. These findings are very close to the results presented by Sawaya *et al*. (1984), Besbes *et al*. (2004) ,Al juhaimi *et al*. (2012) and Karupaiah and sundram .(2013). The level of unsaturated fatty acid content of date seed oil was very lower than other vegetable oils. Golshan *et al*. (2017) found that the main fatty acids in different date seed oils were oleic acid (42.3%) and lauric acid (21.8%), followed by myristic (10.9%), palmitic (9.6%) and linoleic acid (13.7%). On the other hand, Biglar *et al*. (2012) stated that Iranian date seed oils had more unsaturated than saturated fatty acids, but some minor differences were found in the fatty acid profile among them due to the genetic variation.

According to Besbes *et al*. (2005), Deglet Nour seed oil had higher saturated fatty acid content (~ 44.3%) than Allig seed oil (~ 26.3%). Also it is reported that the seed oil of 24 date seeds contained 41- 59% oleic acid (Abdul Afiq *et al*., 2013). As shown in Table 3, the oleic, lauric, myristic and palmitic acids are the main fatty acids in date seed oil. Therefore, the date seed oil is a good source of oleic acid and the content of this fatty acid is almost similar to the oleic acid content found in rice bran oil and canola oil (Abdul Afiq *et al*., 2013). It should be noted that the linoleic acid content of date seed oil is low in compare to the commonly consumed vegetable oils (Sawaya *et al*., 1984). However, date seed oil may be regarded as an oleic-lauric oil (Devshony *et al*., 1992 and Biglar *et al*., 2012).

Table (3). Fatty acid composition of date seed oil

Fatty acids	Fatty acid (%) on seeds oil	
	Siwa'Oasis seeds	Alwadi Algadid Seeds
Caprylic acid C8:0	0.88	0.41
Capric acid C10:0	0.41	0.38
Lauric ($C_{12:0}$)	21.82	20.39
Myristic ($C_{14:0}$)	10.80	10.65
Myristoleic ($C_{14:1}$)	0.55	0.64
Palmitic ($C_{16:0}$)	8.21	8.05
Palmitoleic ($C_{16:1}$)	0.15	0.16
Stearic ($C_{18:0}$)	2.96	2.80
Oleic ($C_{18:1}$) ω-9	46.03	48.88
Linoleic ($C_{18:2}$)	7.13	6.45
γ–Linolenic acid ($C_{18:3}$) ω -6	0.02	0.02
α-Linolenic acid ($C_{18:3}$) ω-3	0.03	0.03
Arachidic ($C_{20:0}$)	0.36	0.38
Gadoleic ($C_{20:1}$)	0.30	0.32
Behenic ($C_{22:0}$)	0.20	0.23
Lignoceric ($C_{24:0}$)	0.15	0.21
SFA	45.79	43.50
MUFA	47.03	50.00
PUFA	7.18	6.50
P/S	0.157	0.149

4. Mineral contents of date seeds

The content of date seeds on nine minerals that are usually analyzed are given in Table 4. Potassium was the highest mineral content in the two different seeds which ranged between 2004.49 mg/kg DW determined in Siwa seeds and 2159.74 mg/kg DW in Alwadi Algadid seeds, followed by calcium (982.77 - 1367.64 mg/kg DW), magnesium (651.90–670.14 mg/kg DW) and phosphorus (590.57–856.18 mg/kg DW). The sodium was the lowest macro elements and varied between 265.55 mg/kg DW in Siwa seeds and 305.44 mg/kg DW in Alwadi Algadid seeds. Among the microelement iron was found at high level with concentration of 85.57 mg/kg DW in Siwa seeds and 65.34 mg/kg DW in Alwadi Algadid seeds followed by zinc (24.27–26.97 mg/kg DW), manganese (15.90–18.20 mg/kg DW) and copper (15.71–22.06 mg/kg DW) was the lowest microelement. This variation within minerals content of analyzed date seeds varieties may be due to climatic conditions, soil type, water for irrigation, and fertilizer. These results are in agreement with those reported by Al Juhaimi *et al*. (2012), Rahman *et al*. (2007) and Habib and Ibrahim (2009) with a slight difference. As shown in Table 4 below, the consumption of 100 g of date seeds can provide over 14% of the recommended daily allowance of magnesium, iron, copper, and manganese and

more than 7% of zinc, however it covers less than 4% of calcium recommended daily allowance referred by Trumbo *et al*. (2002). Micronutrient deficiencies are a major public health problem in many developing countries, with infants and pregnant women especially at risk because they need adequate micronutrients to maintain normal (Batra and Seth; 2002: Rush, 2000).

Table (4). Mineral composition of date seeds

	Siwa'Oasis seeds (mg/kg)	Alwadi Algadid Seeds (mg/kg)	(mg/kg Dw) FAO(2016)
Calcium	982.77	1367.64	3.94–6.26%
Copper	15.71	22.06	53.72–114.65%
Iron	85.57	65.34	15.42–87.87%
Potassium	2004.49	2159.74	-
Magnesium	651.90	670.14	14.65–26.69%
Manganese	15.90	18.20	23.95–61.04%
Sodium	265.55	305.44	-
Phosphorus	590.57	856.18	-
Zinc	24.27	26.97	7.97–18.49%

5. Total phenolic and total flavonoids and antioxidant activity

The level of phenolic and flavonoids content of date seeds is presented in Table 5. The highest contents on phenolic (3500.59 mg GAE/100 g DW) and flavonoid (1400.88 mg RE/100 g DW) were observed in Siwa seeds, whereas the lowest amount of both phenolic (3010.05 mg GAE/100 g DW) and flavonoids (1210.00 mg RE/100 g DW) were found in Alwadi Algadid seeds. These data of analysis confirm previous results reported by Mistrello *et al*. (2014) who found that total phenol and flavonoids contents range between 2058– 2983 mg GAE/100 g FW and 1271–1932 mg CE/100 g FW. However, the present results are much higher than those reported by Al juhaimi *et al*. (2012) who found that phenolic content was ranging between 1.98 and 4.65 mg GAE/ g of seed. This variation may be owing to variety, growing condition, maturity, season, geographic origin, fertilizer, diseases, soil type and storage conditions as well as extraction system as shown in the results of Ardekani *et al*. (2010).

The antioxidant activity was estimated using DPPH assay based on the ability of antioxidant to scavenge 1,1-diphenyl-2picrylhydrazyl (DPPH) radical cations. Siwa seeds exhibited the highest level of antioxidant activity based on DPPH assay (257.19 g/l), the concentration of antioxidant which reduces the free radical DPPH about 50%. Alwadi Algadid seeds showed the lowest level of antioxidant activity based on DPPH. The different antioxidant levels obtained from the assays may reflect a relative difference in the activity of antioxidant compounds in the extracts (Thaipong *et al*., 2006).

Table (5). Phenolic and flavonoid contents and antioxidant activity of date seeds

	Siwa 'Oasis seeds	Alwadi Algadid seeds
Antioxidant activity DPPH (g/L)	257.19 ± 0.39	219.42 ± 0.58
Total phenolic content (mg GAE/100 g DW)	3500.59 ± 0.23	3010.05 ± 0.31
Flavonoids content (mg RE/100 g DW)	24.88 ± 0.39	21.00 ± 0.20

6. Sensory evaluations of prepared bread supplemented with date seeds flour

Mean sensory scores are given in table 6. Color, texture, odor, taste and overall acceptability were significantly different ($p \geq 0.05$) among the control and date seed supplemented with flour in bread. Most of panelists preferred the color, texture, odor and taste of prepared breads made from 10% and 15% of the date pits powder. They commented that the odor and taste of 5% of date pits with wheat flour was like the control bread. However, prepared bread made with 10% and 15% of date pits powder received the highest overall score than bread containing wheat flour only. These results are in agreement with Besbes *et al*. (2009), Bouaziz *et al*. (2010) and El-Porai *et al*. (2013) ,they published that by-product of date-processing industries could be regarded as an excellent source of food ingredients with interesting technological functionality that could also be used in food as an important source of dietary fiber. However, Najafi (2011) showed that bread containing 10% date seed had higher dietary fiber content and similar sensory properties to the wheat bran control, but lower color, flavor, odor, and overall acceptability sensory scores.

Table(6). Average sensory scores for color, texture, odor, taste and overall acceptability in bread supplemented with date seed flour

	Color	Texture	Odor	Taste	Overall acceptability
Control (wheat flour)	3.60 ± 0.55	3.40 ± 0.45	3.60 ± 0.55	3.60 ± 0.55	3.55
S1	3.80 ± 0.84	3.60 ± 1.34	3.80 ± 1.30	3.60 ± 1.14	3.7
S2	4.0 ± 1.0	4.0a ± 0.71	4.0 ± 0.71	4.20a ± 0.45	4.05
S3	4.60a ± 0.55	4.80a ± 0.45	5.0a ± 0.0	4.80a ± 0.45	4.8
S4	4.20 ± 0.84	4.40a ± 0.55	4.40a ± 0.89	4.60a ± 0.55	4.4
W1	3.40 ± 0.89	3.40 ± 0.89	3.60 ± 1.14	3.60 ± 1.14	3.5
W2	4.0 ± 1.0	4.20a ± 0.84	3.80 ± 0.84	4.20a ± 0.84	4.05
W3	4.40a ± 0.55	4.60a ± 0.55	4.60a ± 0.55	4.80a ± 0.45	4.6
W4	4.20 ± 0.45	4.40a ± 0.55	4.40a ± 0.89	4.60a ± 0.55	4.4
F(p)	3.066*(0.010*)	5.627*(<0.001*)	3.406*(0.005*)	4.979*(<0.001*)	4.979*(<0.001*)

S1=5% date seed flour, S2=10%, S3=15%, S4=20%
W1=5%, W2=10%, W3=15%, W4=20%
F,p: F and p values for ANOVA test, Sig. bet. Grps was done using Post Hoc Test (Tukey)
a: Statistically significant with control group
*: Statistically significant at $p \leq 0.05$

7. Sensory evaluations of muffin samples supplemented with date seeds flour

Color, texture, odor, taste and overall acceptability of muffins were evaluated by panelists as shown in Table 7. Mean sensory scores for color, texture, odor and taste were significantly different ($p \geq 0.05$) among the control and date seed (10 – 15%) incorporated muffins. Date seed flour (10 – 15%) incorporated muffins exhibited a high acceptance score for texture and taste. Intensity of the color increased with increasing percentage of date seed flour. Height of the muffin did not change with the incorporation of date seed flour and ranged from 4.5 to 4.8 cm, this indicates that incorporation of date seed flour did not significantly affect the physical (rising) properties of the dough.

Muffins were tasted and found that date seed flour had a sweaty and slightly sandy taste in comparison to other muffins. Panelists liked the appearance and texture of muffins incorporated with date seed flour (10-15%) in comparison to the control muffin. The sensory evaluation showed that incorporation of date seed flour (10-15%) would not affect baking qualities and consumer acceptance.

Yaseen et al. (2012) studied the nutritional evaluation of date bran muffins. They concluded that increasing concentrations of date syrup and date seeds in date muffins caused an increasing level of protein, fiber, higher softness and more color development while calorific value decreased by increasing the amount of date syrup.

Table (7). Average sensory scores for color, texture, odor and taste in muffins supplemented with date seed flour

	Color	Texture	Odor	Taste	Overall acceptability
Control (wheat flour)	1.80 ± 0.84	2.20 ± 0.84	2.0 ± 1.0	1.80 ± 0.84	1.95
S1	2.80 ± 0.84	2.60 ± 0.55	2.60 ± 0.55	2.20 ± 0.84	2.55
S2	3.20 ± 0.84	3.20 ± 0.84	3.60 ± 1.14	3.40 ± 1.14	3.35
S3	3.40 ± 1.14	3.40 ± 1.14	3.80a ± 0.84	3.60a ± 1.14	3.55
S4	4.20a ± 0.84	4.80a ± 0.45	4.40a ± 0.55	4.80a ± 0.45	4.55
W1	2.40 ± 0.55	2.40 ± 0.55	2.60 ± 0.55	2.60 ± 0.55	2.5
W2	2.80 ± 0.84	2.60 ± 0.55	2.80 ± 0.84	2.80 ± 0.45	2.75
W3	3.0 ± 0.71	3.0 ± 0.71	3.20 ± 0.45	3.0 ± 0.71	3.05
W4	4.20a ± 0.84	4.60a ± 0.55	4.40a ± 0.55	4.60a± 0.55	4.45
F(p)	2.938*(0.004*)	6.328*(<0.001*)	4.420*(<0.001*)	6.234*(<0.001*)	

S1=2.5%, S2=5%, S3=7.5%, S4=10%
W1=2.5%, W2=5%, W3=7.5%, W4=10%
F,p: F and p values for ANOVA test, Sig. bet. grps was done using Post Hoc Test (Tukey)
a: Statistically significant with control group
*: Statistically significant at $p \leq 0.05$

CONCLUSION

Date seed is a by-product of date fruit industry. This study on date seed found that it can be as an excellent source of dietary fiber. In addition, the other component used such as protein and minerals also present in considerable amounts in the seed. Based on the fatty acid composition of date seed oil, it is suggested the use of this oil for nutritional purpose as edible cooking oil and also for the production of margarine due to the high stability and it could be an excellent source of functional foods components.

REFERENCES

Abd El-Azeem R. M., Hashem M. H., and Hemeida A. A. (2011). Identification and Genetic Similarity Analysis of Date Palm (Phoenix dactylifera L.) Collected from Different Regions in Siwa Oasis using Morphologically Traits and Molecular Markers. Egyptian Journal of Genetics and Cytology, 40: 281-300.

Abdul Afiq, M. J., Abdul Rahman, R., Che Man, Y. B., AlKahtani, H. A. and Mansor, T. S. T. (2013). Date seed and date seed oil. International Food Research Journal, 20: 2035-2043.

Al-Alawi, R., Al-Mashiqri, J., Al-Nadabi, J., Al-Shihi, B. and Baqi, Y. (2017). Date Palm Tree (*Phoenix dactylifera* L.): Natural Products and Therapeutic Options. Frontiers in Plant Science, 8: 1-12.

Al-Farsi, M., Alasalvar, C., Al-Abid , M. , Al-Shoaily, K , Al-Amry, M. (2007). Compositional and functional characteristics of dates, syrups, and their by-products. Food Chem., 104: 943-947.

Al-Farsi, M. A. and Lee, C. Y.(2008). Nutritional and functional properties of dates : a review. Critical Reviews in Food science and Nutrition ,48, 877-887.

Al-Harrasi, A., Rehman, N. U., Hussain, J., Khan, A. L., Al-Rawahi, A., Gilani, S. A., (2014). Nutritional assessment and antioxidant analysis of 22 date palm (*Phoenix dactylifera*) varieties growing in Sultanate of Oman. Asian Pac. J. Trop. Med., 7: S591–S598.

AL-Hooti, S., Sidhu, J.S. and Qabazard, H.(1998). Chemical composition of seeds date fruit cultivars of United Arab Emarites for jam, butter and dates-in-syrup. Adv. Food science & Technology,35, 44-46.

Al juhaimi, F., Ghafoor, K., and Ozcan, M.M. (2012). Physical and chemical properties, antioxidant activity, total phenol and mineral profile of seeds of seven different date fruit (*Phoenix dactylifera* L.) varieties. Int. J. Food Sci. Nutr., 63: 84–89.

Al-Najada, A. R., and Mohamed, S. A. (2014). Changes of antioxidant capacity and oxidoreductases of Saudi date cultivars (*Phoenix dactylifera* L.) during storage. Sci. Hortic., 170: 275–280.

Al-Qarawi, A., Mousa, H.M., Ali, B.H., Abdel-Rahman, H. and El-Mougy S. A. (2004). Protective effect of extracts from dates (*Phoenix dactylifera* L.) on carbon tetrachloride– induced hepatotoxicity in rats. Intern. J. Appl. Res. Vet. Med., 2: 176- 180.

Al-Sayyed, H. F., Takruri, H. R., and Shomaf, M. S. (2014). The effect of date palm fruit (Phoenix dactylifera L.) on 7, 12-dimethylbenz (a) anthracene (DMBA)-induced mammary cancer in rats. Res. Opin. Anim. Vet. Sci., 4: 11–18.

Amira, E. A., Guido, F., Behija, S. E., Manel, I., Nesrine, Z., Ali, F., Mohamed, H., Noureddine, H. A. and Lotfi, A. (2011). Chemical and aroma volatile compositions of date palm (*Phoenix dactylifera* L.) fruits at three maturation stages. Food Chemistry, 127: 1744-1754.

AOAC (1997). Official methods of analyses, Association of Official Analytical Chemist, Washington, DC.

AOAC (1999). Official methods of analysis, 16th edn. Association of Official Analytical Chemists, Washington.

AOAC (2000). International Official Methods of Analysis, 17 th ed. Association of Official Analytical Chemists:Gaitherburg, MD.

Ardekani, M.R.S., Khanavi, M., Hajimahmoodi, M., Jahangiri, M. and Hadjiakhoondi, A. (2010). Comparison of antioxidant activity and total phenol contents of some date seed varieties from Iran. Iran. J. Pharm. Res., 9: 141–146.

Arora, A. and Camire, M.E.(1994). Performance of potato peels in muffins and cookies. Food Research International, 27: 15-22.

Basuny, A.M. and AL-Marzooq, M.A. (2011). Production of mayonnaise from date pit oil. Food Nutr. Sci., 2: 938–943.

Barta, J., and Seth, P.K. (2002). Effect of iron deficiency on developing rat brain. Indian J. Clin. Biochem.17(2),108-114.

Besbes, S., Blecker, C., Deroanne, C., Lognay, G., Drira, N.E. and Attia, H. (2004). Quality characteristics and oxidative stability of date seed oil during storage. Food Sci. Technol. Int., 10: 333–338.

Besbes, S., Blecker, C., Deroanne, C., Lognay, G., Drira, N. E. and Attia, H. (2005). Heating effects on some quality characteristics of date seed oil. Food Chemistry, 91: 469-476.

Besbes, S., Drira, L., Blecker, C., Deroanne, C. and Attia, H. (2009). Adding value to hard date (*Phoenix dactylifera* L.): Compositional, functional and sensory characteristics of date jam. Food Chem., 112: 406–411.

Biglar, M., Khanavi, M., Hajimahmoodi, M., Hassani, S., Moghaddam, G., Sadeghi, N. and Oveisi, M. R. (2012). Tocopherol content and fatty acid profile of different Iranian date seed oils. Iranian Journal of Pharmaceutical Research, 11: 873-878.

Blois, M.S. (1958). Antioxidant determinations by the use of a stable free radical. Nature 29: 1199–1200.

Bouaziz, M., Amara, W., Attia, H., Blecker, C. and Besbes, S. (2010). Effect of the addition of defatted date seeds on wheat dough performance and bread quality. Journal of Texture Studies, 41: 511–531.

Bouhlali, E.d.T., Ramchoun, M., Alem, C., Ghafoor, K., Ennassir, J. and Filali Zegzouti, Y. (2017). Functional composition and antioxidant activities of eight Moroccan date fruit varieties (*Phoenix dactylifera* L.). J. Saudi Soc. Agric. Sci., 16:257–264.

Devshony, S., Eteshola, A. and Shani, A. (1992). Characterisation and some potential application of date palm (Phoenix dactylifera L.) seeds and seeds oil. Journal of the American Oil Chemists Society, 69: 595–597.

Doha, M.A. and Al-Okbi, S.Y. (2004). In vivo evaluation of antioxidant and anti-inflammatory activity of different extracts of date fruits in adjuvant arthritis. Pol. J. Food Nutr. Sci., 13: 397–402.

Eissa, H., Hussein, A. and Mostafa, B. (2007). Rheological properties and quality evaluation of Egyptian balady bread and biscuits supplemented with flours of un germinated and germinated legume seeds or mushroom. J. Food Nutr. Sci., 57: 487–496.

El-Porai, E., Salama, A., Sharaf, A., Hegazy, A. and Gadallah, M. (2013). Effect of different milling processes on Egyptian wheat flour properties and pan bread quality. Annals of Agricultural Science, 58: 51–59.

Elleuch, M., Besbes, S., Roiseux, O., Blecker, C., Deroanne, C., Drira, N.E and Attia, H. (2008). Date flesh:chemical composition and characteristics of the dietary fiber.Food chem.,111: 676-682.

El Sohaimy, S., Abdelwahab, A., Brennan, C., and Aboul-enein, A. (2015). Phenolic content, antioxidant and antimicrobial activities of Egyptian date palm (*Phoenix dactylifera* L.) fruits. Aust. J. Basic Appl. Sci., 9:141–147.

FAO (Food and Agriculture Organization of the United Nations). (2016). Statistical Databases. Downloaded from http://faostat.fao.org on April 24, 2016.

Golshan Tafti, A., Solaimani Dahdivan, N. and Yasini Ardakani, S.A. (2017). Physicochemical properties and applications of date seed and its oil. International Food Research Journal, 24: 1399-1406.

Habib, H. M. and Ibrahim, W. H. (2009). Nutritional quality evaluation of eighteen date pits varieties. International Journal of Food Sciences and Nutrition, 60: 99-111.

Habibi Najafi, M. B. (2011). Date seeds: A novel and inexpensive source of dietary fiber. Paper presented at the International Conference on Food Engineering and Biotechnology, Singapore.

Halaby, M. S., Farag, M. H. and Gerges, A. H. (2014). Potential effect of date pits fortified bread on diabetic rats. International Journal of Nutrition and Food Sciences, 3: 49-59.

Hamad, I., Abd Elgawad, H., Al Jaouni, S., Zinta, G., Asard, H. and Hassan, S. (2015). Metabolic analysis of various date palm fruit (Phoenix dactylifera L.) cultivars from Saudi Arabia to assess their nutritional quality. Molecules, 20: 13620–13641.

Hejri-Zarifi, S., Ahmadian-Kouchaksaraei, Z., Pourfarzad, A. and Haddad Khodaparast, M. H. (2013). Dough performance, quality and shelf life of flat bread supplemented with fractions of germinated date seed. Journal of Food Science and Technology, 51: 3776- 3784.

Karupaiah, T. and Sundram, K. (2013). Modulation of human postprandial lipemia by changing ratio of polyunsaturated to saturated (P/S) fatty acid content of blended dietary fats: a cross-over design with repeated measures. Nutr. J., 12: 122-126.

Kchaou, W., Abbès, F., Mansour, R. B., Blecker, C., Attia, H., and Besbes, S. (2016). Phenolic profile, antibacterial and cytotoxic properties of second grade date extract from Tunisian cultivars (*Phoenix dactylifera* L.). Food Chem. 194, 1048–1055.

Khan, F., Ahmed, F., Pushparaj, P. N., Abuzenadah, A., Kumosani, T. and Barbour, E. (2016). Ajwa date (Phoenix dactylifera L.) extract inhibits human breast adenocarcinoma (MCF7) cells in-vitro by inducing apoptosis and cell cycle arrest. PLOS ONE, 11: 158 - 163.

Kim, D.O., Jeong, S.W. and Lee, C.Y. (2003). Antioxidant capacity of phenolic phytochemicals from various cultivars of plums. Food Chem., 81: 321–326.

Litwinek, D., Gambuś,H., Mickowska,B., Zięć,G. and Berski,W. (2013). Amino acids composition of proteins in wheat and oat flours used in breads production. J. Microbiology, Biotechnology Food Sciences, 2 (Special issue on BQRMF): 1725-1733.

Mistrello, J., Sirisena, S.D., Ghavami, A., Marshall, R.J. and Krishnamoorthy, S., (2014). Determination of the antioxidant capacity, total phenolic and flavonoid contents of seeds from three commercial varieties of culinary dates. Int. J. Food Stud., 3: 34–44.

Mohamed, R., Fageer, A. S., Eltayeb, M. M., and Mohamed, I. A. (2014). Chemical composition, antioxidant capacity, and mineral extractability of Sudanese date palm (*Phoenix dactylifera* L.) fruits. Food Sci. Nutr., 2: 478–489.

Mohsen,S.M., Hussein, A. A. and Salem, E. M. (1997). Balady bread characteristics as affect by addition of corn, barley or soy flour. Presented at the International Confrence and Exhibition for bread Industries, Quality Control, Food quality Alex. Egypt:12, 1-3.

Mrabet, A., Jiménez-Araujo, A., Fernández-Bola-os, J., Rubio-Senent, F., Lama-Mu-oz, A. and Sindic, M. (2016). Antioxidant phenolic extracts obtained from secondary Tunisian date varieties (*Phoenix dactylifera* L.) by hydrothermal treatments. Food Chem., 196: 917–924.

Najafi, M. (2011). Date Seeds: A Novel and Inexpensive Source of Dietary Fiber. International Conference on Food Engineering and Biotechnology, Singapore. Pp. 323- 326.

Nehdi, I., Omri, S., Khalil, M. I. and Al-Resayes, S.I. (2010). Characteristics and chemical composition of date palm (*Pheonix canariensis*) seeds and seeds oil. Industrial Crops and Products, 32: 360-365.

Platat, C., Habib, H. M., Ibrahim, W. H., Isameldin Bashir Hashim, I. and Kamal Eldin, A. (2013). Date seed powder-containing bread exhibits higher levels of flavonoids and antioxidant capacity compared to regular and whole wheat bread. The Journal of the Federation of American Societies for Experimental Biology. 27: 371-376.

Rahman, M.S., Kasapis, S., Al-Kharusi, N.S.Z., Al-Marhubi, I.M. and Khan, A.J. (2007). Composition characterization and thermal transition of date pits powders. J. Food Eng., 80: 1–10.

Rahmani, A. H., Aly, S. M., Ali, H., Babiker, A. Y., Srikar, S., and Khan, A. A. (2014). Therapeutic effects of date fruits (*Phoenix dactylifera*) in the prevention of diseases via modulation of anti-inflammatory, anti-oxidant and anti-tumour activity. Int. J. Clin. Exp. Med., 7: 483–491.

Rush, D. (2000). Nutrition and maternal mortality in the developing world. Am. J. Clin. Nutr, 2125-2405.

Saafi, E.B., Trigui, M., Thabet, R., Hammami, M. and Achour, L. (2008). Common date palm in Tunisia: chemical composition of pulp and pits. Int. J. Food Sci. Technol., 43: 2033–2037.

Salah, A., and Al-Maiman, A. (2005). Effect of date palm (*Phoenix dactylifera*) seed fibers on plasma lipids in rats. J. King Saud Univ., 17: 117–123.

Samad, M. A., Hashim, S. H., Simarani, K., and Yaacob, J. S. (2016). Antibacterial properties and effects of fruit chilling and extract storage on antioxidant activity, total phenolic and anthocyanin content of four date palm (*Phoenix dactylifera*) cultivars. Molecules, 21: 419- 421.

Sawaya, W.N., Khalil, J.K. and Safi, W.J. (1984). Chemical composition and nutritional quality of date seeds. J. Food Sci., 49: 617 - 619.

Singleton, V. L., and Rossi, J. A. (1965). Colorimetry of Total Phenolics with Phosphomolybdic-Phosphotungstic Acid Reagents. American Journal of Enology and Viticulture, 16: 144-158.

Tariq Bouhlali, E., Chakib, A., Jamal E., Mohamed B., Addi, M., Younes, Z. (2017). Phytochemical compositions and antioxidant capacity of three date (*Phoenix dactylifera* L.) seeds varieties grown in the South East Morocco. Journal of the Saudi Society of Agricultural Sciences, 16, 350–357.

Thaipong, K., Unaroj Boonprakob, U., Crosby, K., Cisneros-Zevallos, L., Byrne, D.H. (2006). Comparison of ABTS, DPPH, FRAP, and ORAC assays for estimating antioxidant activity from guava fruit extracts. J. Food Compos. Anal., 19, 669–675.

Trumbo, P., Schlicker, S., Yates, A.A. and Poos, M. (2002). Dietary reference intakes for energy, carbohydrate, fiber, fat, fatty acids, cholesterol, protein and amino acids. J. Am. Diet. Assoc., 102:1621–1630.

Yaseen, Y., Salim-ur-Rehman, I., Iram, A., Sakhawat, A. and Imran, P. (2012). Development and Nutritional Evaluation of Date Bran Muffins. J. Nutr. Food Sci., 2: 1-4.

Younis, M.A.A. (1984). Chemical and technological studies on utilization of new maize verities flour in Egyptian bread. M.Sc Theses. Faculty of Agriculture, University of Alexandria.

الملخص العربي

الخواص الفيزيوكيميائية والقيمة التغذوية لنوي البلح المصري وتطبيقاتها في بعض انواع المخبوزات

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اجريت هذه الدراسة علي الصنف المصري سكري والذي تم الحصول عليه من منطقتين مختلفين (واحة سيوة والوادي الجديد) حيث تم تقدير الخصائص الطبيعية والكيميائية و التغذوية للنوي ودراسة تاثير تدعيم المخبوزات مثل الكيك والخبز بمطحون نوي البلح وتقدير كل من المحتوي الرطوبي والبروتين الخام والمستخلص الاثيري والالياف والرمادوالمعادن في كلا من نوي بلح واحة سيوة والوادي الجديد كماتم استخلاص الزيت من النوي وتقدير الاحماض الدهنية كما تم تقديرالمواد الفينولية والفلافونويدات وفاعلية مضادات الاكسدة بالاضافة لما سبق تم دراسة تاثير اضافة مسحوق النواة بنسب مختلفة الي الكيك والخبز وتاثير الاضافة عي الخواص الحسية للمنتج

اوضحت النتائج الخاصة بالتركيب الكيماوي لنوي التمر في واحة سيوة والوادي الجديد حيث كانت نسبة المستخلص الاثيري١٠.٧ % و ٨.٥% علي الترتيب كما اوضحت النتائج ان نوي تمر الوادي الجديد كان الاعلي في نسبة البروتين من واحة سيوة حيث كانت النسبة ٥.٦٢ % و٣.٨٨%بينما كانت نسبة الرماد بينهما اعلي في واحة سيوة من الوادي الجديد .بينما كانت نسبة الرماد بينهما اعلي في واحة سيوة من الوادي الجديد كما اظهرت النتائج ان المحتوي الرطوبي كان اعلي في الوادي الجديد وكذلك المحتوي في الالياف الخام عنه في واحة سيوة .

اظهرت النتائج ايضا ان نوي التمركان من احد المصادر الجيدة للعناصر حيث كان عنصر البوتاسيوم اعلي العناصر التي تم تقديرها في نوي واحة سيوة والوادي الجديد فكانت النسبة ٢٠٠٤.٤٩و٤ ٢١٥٩.٧ملجم /كجم في حين كان عنصر المنجنيز هو الاقل فكانت النسبة ١٥.٩٠ و١٨.٢٠ علي الترتيب في حين وجود كلا من العنصرين الحديد والماغنسيوم بنسب متقاربة حيث كانت ٨٥.٥٧ و ٦٥١.٩٠في واحة سيوة و ٦٥.٣٤ و٦٧٠.١٤ في الوادي الجديد علي الترتيب اظهر النتائج ان محتوي الفينولات والفلافونويدات وفعالية مضادات الاكسدة كانت اعلي في الصنف المزروع في واحة سيوة عنه في الوادي الجديد. واتضح من النتائج المتعلقة بالتحليل الغازي الكروماتوجرافي للاحماض الدهنية ان اكثر الاحماض الدهنية الغير مشبعة وجودا في زيت النواة هي الاوليك حيث يمثل ٤٦–٤٨% من حيث الكمية ثم اللينوليك بينما كانت الاحماض اللوريك والميرستيك اكثر الاحماض الدهنية المشبعة الاكثر وجودا.

واظهرت النتائج تطبيقات تدعيم المخبوزات بمسحوق نوي التمر ان اضافة نوي التمر بنسبة ١٠%وكذا ١٥%اعطت افضل النتائج في التقييم الحسي للمخبوزات المدعمة بنوي التمر وبالتالي يمكن استخدام نوي التمر للحصول علي العديد من الاغذية الوظيفية .