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25 The Functional Values of Dates

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INTRODUCTION

The dates (*Phoenix dactylifera* L.) are produced largely in the hot desert regions of North Africa and Southwest Asia, and are marketed worldwide as a high-value fruit. With the present uncertainty in the world food supply and an expected increase in demand, the date palm is likely to continue to provide a good source of low-cost fruit.

Date flesh consists of 70% carbohydrates, most of which is in the form of sugars. In most varieties, the sugar content is almost entirely invert sugars, which is rapidly absorbed by the human body (Ahmed and Ahmed, 1995; Al-Hooti et al., 1997; Myhara et al., 1999; Al-Farsi et al., 2005). Dates also contain large amounts of dietary fiber, and are thought to be a good source of antioxidants and some minerals. However, relatively few detailed analyses of their composition have been published. In some instances, the variety analyzed has not been identified and, in addition, conflicting results for some constituents have been published.

There is a particular lack of information on functional (bioactive) constituents of dates and their potential value as functional foods. Functional foods are defined as those foods that provide health benefits beyond basic nutrition (IFICF, 1998). Epidemiological studies have consistently shown that there are clear significant positive associations between intake of fruits and vegetables and reduced rate of heart diseases mortality, common cancers, and other degenerative diseases as well as aging (Joseph et al., 1999; Dillard and German, 2000; Prior and Cao, 2000; Wargovich, 2000). This is attributed to the fact that these foods may provide an optimal mix of dietary fiber, natural antioxidants, and other biotic compounds.

The functional constituents of dates include dietary fiber, which is important for the health of the digestive tract. Dietary fiber consists of the edible plant material which is not hydrolyzed by the human digestive tract. Many studies recommend the public to consume adequate amounts of dietary fiber from a variety of plant foods (Institute of Medicine, 2001; Marlett et al., 2002; Mai et al., 2003).

Dates also contain significant quantities of antioxidants. Antioxidants are thought to play an essential role in the prevention of cardiovascular disease (Renaud and De Lorgeril, 1992; Fuhrman et al., 1995), cancers (Wargovich, 2000; Dragsted et al., 1993), neurodegenerative diseases, such as

Parkinson's and Alzheimer's diseases (Joseph et al., 1999; Okuda et al., 1992; Clarke, 1999), as well as inflammation (Joseph et al., 1999; Lietty et al., 1976) and aging (Prior and Cao, 2000; Ames et al., 1993; Gaulejac et al., 1999).

A dietary antioxidant is defined as a substance in foods that significantly decreases the adverse effects of reactive species, such as reactive oxygen and nitrogen, on normal physiological function in humans (Institute of Medicine, 2000). Antioxidants markedly delay or prevent oxidation of the substrate when they are present in foods or in the body at low concentrations (Halliwell, 1999; Shahidi, 2000). Natural antioxidants consist primarily of phenolics, vitamin C, carotenoids, and selenium (Institute of Medicine, 2000; Shahidi and Naczk, 2004). Examples of common plant phenolic antioxidants include flavonoid compounds such as anthocyanins, cinnamic acid derivatives, coumarins, and tocopherols (vitamin E) (Shahidi and Naczk, 2004).

This review examines the functional constituents of dates and discusses their functional properties. In order to compare the composition of fresh and dried dates with other dried fruits, all presented data from cited references have been recalculated on wet weight bases.

SELENIUM

The available data on selenium content of dates ranged between 0.24 mg/100 g in Brahi and 0.4 mg/100 g in Fard and Khasab. The recommended dietary allowance (RDA) of selenium per adult (male and female) per day is 0.055 mg (Whitney and Rolfes, 2002); thus, dates can be regarded as a major source of selenium and this could be used for promotion and marketing strategies. Selenium is a coenzyme for the antioxidant enzyme glutathione peroxidase, and therefore, has a role in the protection of body tissues against oxidative stress, maintenance of defenses against infection, and modulation of growth and development (Institute of Medicine, 2000).

VITAMINS

Dates contain mainly water-soluble vitamins (B-complex and C). They dissolve in water and are not stored in the body; they are eliminated in urine and therefore we need a continuous supply of them in our diets.

Table 25.1 shows the vitamin content of fresh and dried dates with their daily RDA/adequate intakes (AI). Vitamin C content in fresh dates ranged between 2.4 and 3.4 mg/100 g. Dried dates are generally a moderate source of vitamin B6, B9, B2, and B3 as 100 g of dates provide over 9% of the daily RDA/AI for adults. Dried fruits of plums, apricot, figs, raisins, and peaches contain, on average, 0.052 mg B1, 0.136 mg B2, 2.046 mg B3, and 1.980 mg vitamin C per 100 g (USDA, 2007). Therefore, compared to these dried fruits, dates are regarded as a reasonable source of vitamins, particularly vitamin C (3.9 mg/100 g).

Vitamins are essential nutrients found in foods; the daily requirements are small but they perform specific and vital functions essential for maintaining health. B and C vitamins serve as coenzymes that facilitate the work of every cell in our body. Vitamins are active in carbohydrates, fat, protein metabolism, and in the making of DNA of new cells. Vitamin C acts as well as an antioxidant, protects tissues from oxidative stress, and thus may play an important role in preventing diseases (Whitney and Rolfes, 2002).

DIETARY FIBER

There are several methods used to determine dietary fibers in foods. The references selected in this review used the same principle for determining dietary fiber (AOAC method), mainly cellulose, hemicelluloses, pectin, and lignin. Table 25.2 shows the content of soluble, insoluble, and total

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TABLE 25.1
Vitamins Content of Date (mg/100 g)[a]

Varieties	B1 Thiamin	B2 Riboflavin	B3 Niacin	B6 Pyridoxal	B9 Folate	C Ascorbic	References
				Fresh Dates			
Berhi						3.400	Allaith (2008)
Hallawi						2.900	Allaith (2008)
Khalas						2.400	Allaith (2008)
Average						2.900	
				Dried Dates			
Medjool	0.050	0.060	1.610	0.249			USDA (2010)
Deglet Noor	0.052	0.066	1.274	0.165		0.400	USDA (2010)
Hallawi	0.092	0.160			0.053	3.300	Yousif et al. (1982)
Sayer	0.120	0.125			0.065		Yousif et al. (1982)
Khadrawi	0.085	0.135			0.039	2.900	Yousif et al. (1982)
Zahdi	0.073	0.153			0.058	2.200	Yousif et al. (1982)
Khudari						1.000	Sawaya et al. (1982)
Sullaj						1.500	Sawaya et al. (1982)
Average	0.079	0.117	1.442	0.207	0.054	1.88	
RDA/AI[b] mg/day	1.200	1.300	16.000	1.300	0.400	90.000	Whitney and Rolfes (2002)

[a] All data are expressed on wet weight basis.
[b] RDA/AI is recommended dietary allowance/adequate intakes per adult male per day.

Q2

dietary fiber of fresh and dried dates. Insoluble dietary fiber is the major fraction of dietary fiber in dates. The total fiber content in fresh dates ranged between 6.9 and 8.6 g/100 g, whereas in dried dates it ranged between 3.6 and 13.5 g/100 g. The average total fiber content in fresh dates increased from 7.5 to 8.6 g/100 g in dried dates.

From the total dietary fiber content in dates and the recommended daily intake of total dietary fiber (25 g/day) (Marlett et al., 2002), dates could be a good source of dietary fiber in the diet, as 100 g of dates provide 34% of the recommended daily intake of dietary fiber. The high content of the insoluble fiber in dates induces satiety, and has a laxative effect due to increased stool weight. It therefore may reduce the risk of serious conditions such as bowel cancer, and diverticular disease (Marlett et al., 2002; Cummings et al., 1992). In comparison with other dried fruits (Table 25.5), their dietary fibers ranged between 3.7 and 9.8 g/100 g; thus, dates are regarded as a rich source of dietary fiber.

CAROTENOIDS

The average total carotenoids content of fresh and dried dates are 0.913 and 0.973 mg/100 g, respectively (Table 25.3). The carotenoids content of dates varied among varieties in the range of 0.033 and 3.03 mg/100 g in fresh dates and between 0.051 and 2.900 mg/100 g in dried dates. The factors causing these variations are probably due to the differences between maturation, methods of drying, and analysis methods. Also, the total carotenoids content in dates varied between the yellow- and red-colored varieties, with lutein, β-carotene, and neoxanthin being the major carotenoids. Fruits that are red usually contain hydrocarbon carotenoids such as lycopene, neurosporene, γ-carotene,

TABLE 25.2
Dietary Fiber of Fresh and Dried Dates[a]

Varieties	Soluble (g/100 g)	Insoluble (g/100 g)	Total (g/100 g)	References
		Fresh Dates		
Khalas			7.1	Myhara et al. (1999)
Fard			8.6	Myhara et al. (1999)
Hayani	0.96	5.9	6.9	El-Zoghbi (1994)
Average	0.96	5.9	7.5	
		Dried Dates		
Fard	1.3	6.7	8.0	Al-Farsi et al. (2005)
Khasab	1.1	7.4	8.4	Al-Farsi et al. (2005)
Khalas	0.4	5.9	6.3	Al-Farsi et al. (2005)
Deglet Noor			8.0	USDA (2010)
Deglet Nour	3.9	7.0	10.9	Elleuch et al. (2008)
Allig	4.9	8.6	13.5	Elleuch et al. (2008)
Medjool			6.7	USDA (2010)
Hayani	0.54	3.0	3.6	El-Zoghbi (1994)
Khalas			10.9	Myhara et al. (1999)
Fard			10.1	Myhara et al. (1999)
Average	2.02	6.4	8.6	

[a] All data are expressed on wet weight basis.

and δ-carotene, whereas yellow-colored fruit contains α-carotene, β-carotene, and a mixture of carotenol fatty acid esters (Fennema, 1996). Drying processes can result in degradation or formation of *cis*-isomers of carotenoids (Chen et al., 1995; Sánchez-Moreno et al., 2003). Al-Farsi et al. (2005) reported that the destruction ranged between 4% and 30% of dates carotenoids during sun drying. This destruction was attributed to the drying temperature (30–50 °C) and the duration of the process (7–10 days) (Al-Farsi et al., 2005).

Typical carotenoid concentrations in other dried fruits range from 0.032 mg/100 g for figs to 2.2 mg/100 g in apricot (Table 25.5). Therefore, dates (0.973 mg/100 g) can be considered a moderate source of carotenoids compared to other dried fruits.

ANTHOCYANINS

Table 25.4 shows the total content of anthocyanins, phenolics, and antioxidants of fresh and dried dates. Anthocyanins were found only in fresh date varieties, especially the red-colored varieties, and ranged between 0.2 and 1.5 mg/100 g. The absence of anthocyanins from dried dates is probably due to their destruction during the drying process (Al-Farsi et al., 2005; Markakis, 1982; Shahidi and Naczk, 1995). Al-Farsi et al. (2005) reported 100% destruction of date's anthocyanins during drying. In addition, many other factors such as genetics, light, agronomic factors, and storage are also responsible for the degradation of anthocyanins (Shahidi and Naczk, 2004; Mazza and Miniati, 1993). In comparison with other fruits, anthocyanins present in red grapes ranged from 7.0 to 15.0 mg/100 g (Cantos et al., 2002), whereas in peaches it ranged from 5.4 to 14.3 mg/100 g for white varieties and from 8.6 to 27.4 mg/100 g for the yellow varieties (Tomas-Barberan et al., 2001).

TABLE 25.3
Carotenoids Content of Fresh and Dried Dates (mg/100 g)[a]

Varieties	α-Caro.	β-Caro.	Zeax.	β-Zea.	Lute.	Neox.	Total	References
				Fresh Dates				
Date (unknown)	0.003	0.018	0.033	0.009			0.063	Ben-Amotz and Fishler (1998)
Deglet Nour		0.006			0.156		0.167	Boudries et al. (2007)
Tantebouchte		0.003			0.028		0.033	Boudries et al. (2007)
Hamraya		0.003			0.034		0.037	Boudries et al. (2007)
Hayany		0.116			0.541	0.381	1.270	Gross et al. (1983)
Deglet Noor		0.060			0.461	0.230	0.920	Gross et al. (1983)
Fard							1.390	Al-Farsi et al. (2005)
Khasab							1.310	Al-Farsi et al. (2005)
Khalas							3.030	Al-Farsi et al. (2005)
Average	0.003	0.034	0.033	0.009	0.244	0.306	0.913	
				Dried Dates				
Deglet Nour		0.003			0.060		0.064	Boudries et al. (2007)
Tantebouchte		0.010			0.129		0.145	Boudries et al. (2007)
Hamraya		0.003			0.046		0.051	Boudries et al. (2007)
Hayany		0.146			0.520	0.365	1.260	Gross et al. (1983)
Deglet Noor		0.054			0.485	0.206	0.920	Gross et al. (1983)
Barhee		0.143			0.491	0.184	1.320	Gross et al. (1983)
Fard							1.200	Al-Farsi et al. (2005)
Khasab							0.900	Al-Farsi et al. (2005)
Khalas							2.900	Al-Farsi et al. (2005)
Average		0.060			0.289	0.252	0.973	

[a] All data are expressed on wet weight basis. α-Caro.: α-carotene; β-caro.: β-carotene; zeax.: zeaxanthin; β-zea.: β-zeaxanthin; lute.: lutein; neox.: neoxanthin.

PHENOLICS

The average phenolics content ranged from 150.7 mg/100 g for fresh dates to 353 mg/100 g for dried dates (Table 25.4). The total phenolics of dates varied among dried varieties, although they used the same methodology (Folin Ciocalteu). The use of different phenolic acid standards, such as ferulic acid and gallic acid, makes the quantitative comparison invalid. In general, drying is regarded as unfavorable due to the possibility of inducing oxidative decomposition either enzymatically by polyphenol oxidase and glycosidase or by thermal degradation of phenolic compounds (Shahidi and Naczk, 2004). However, phenolics increased after drying of some varieties. This could be explained by the degradation of tannins by heat and maturation enzymes during the drying process, which leads to the release of phenolic compounds (Maillard and Berset, 1995). According to Maillard and Berset (1995), the linkages between *p*-coumaric acid and lignin and between ferulic acid and arabinoxylans could be broken at a high temperature. In comparison with other dried fruits in Table 25.5, which ranged between 160 and 1065 mg/100 g, dates can be considered to be a good source of total phenolics.

ANTIOXIDANTS

The total antioxidant content of fresh and dried dates were reported by two different methods, oxygen radical absorbance capacity (ORAC) and ferric reducing ability of plasma (FRAP). The

TABLE 25.4
Anthocyanins, Phenolics, and Antioxidants of Fresh and Dried Dates[a]

Varieties	Anthocyanins (mg/100 g)	Phenolics (mg/100 g)	Antioxidants ORAC (μmol/100 g)	Antioxidants FRAP (μmol/100 g)	References
			Fresh Dates		
Fard	0.9	280	1738		Al-Farsi et al. (2005)
Khnaizi		135		0.62	Allaith (2008)
Ashaal		88		0.80	Allaith (2008)
Berhi		100		0.70	Allaith (2008)
Khasab	1.5	167	1169		Al-Farsi et al. (2005)
Khalas	0.2	134	2060	0.73	Al-Farsi et al. (2005), Allaith (2008)
Average	0.87	150.7	1656	0.71	
			Dried Dates		
Fard	nd	343	999		Al-Farsi et al. (2005)
Khasab	nd	217	821		Al-Farsi et al. (2005)
Khalas	nd	339	1254	0.99	Al-Farsi et al. (2005), Allaith (2008)
Ruzaiz		301		1.01	Allaith (2008)
Hallaw		342		0.65	Allaith (2008)
Deglet Noor		661	3895	1.97	Wu et al. (2004), Allaith (2008)
Medjool		572	2387		Al-Farsi et al. (2005)
Kharak		130			Biglari et al. (2008)
Kentichi		272			Besbes et al. (2009)
Average		353	1871	1.16	

[a] All data are expressed on wet weight basis; nd: not detected.

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antioxidants by the FRAP method ranged between 0.62 and 0.80 μmol/100 g for fresh dates and between 0.65 and 1.97 μmol/100 g for dried dates. Most data available for antioxidants in dates are reported by the ORAC method. ORAC values of fresh dates Fard, Khasab, and Khalas averaged 1656 μmol trolox/100 g and reduced after drying to average 1025 μmol trolox/100 g (Al-Farsi et al., 2005). The reduction in antioxidants on drying has been reported by Al-Farsi et al. (2005). They found that the antioxidant loss ranged from 29.7% to 42.5% during sun drying of three date varieties.

The antioxidant content of other dried fruits ranged between 1863 μmol/100 g for peaches and 3383 μmol/100 g for figs (Table 25.5). Thus, in comparison with these fruits, dates are a good source of antioxidants. This finding is supported by other studies published on date antioxidants; Vayalil (2002) and Guo et al. (2003). Vayalil (2002) stated that the antioxidant and the antimutagenic activity in dates is potent and implicates the presence of compounds with potent free radical scavenging activity. Guo et al. (2003) reported that dates had the second-highest antioxidant value among 28 fruits commonly consumed in China, and Hawthorn fruit had the highest amount of antioxidants. The variation between samples could be due to varietal, extraction techniques, and instrumental analysis.

CONCLUSION

The data presented in this chapter show that dates are a good source of nutrients and antioxidants that may play an important role in human health. Dates are rich in dietary fiber and natural antioxidants,

TABLE 25.5
Composition of Common Dried Fruits[a]

Fruits	Moisture (g/100 g)	Fiber (g/100 g)	Carotenoids (mg/100 g)	Vitamin C (mg/100 g)	Phenolics (mg/100 g)	Antioxidants[b] (μmol/100 g)	References
Dates	15.2	8.6	0.973	3.900	353	1871	
Plum	30.9	7.1	0.69	0.600	500		USDA (2010), Guo et al. (2003), Vizzotto et al. (2006)
Apricot	30.9	7.3	2.2	1.000	160		USDA (2010), Guo et al. (2003), Ruiz et al. (2006)
Figs	30.1	9.8	0.032	1.200	960	3383	USDA (2010), Wu et al. (2004)
Peaches	31.8	8.2	2.08	4.800	163	1863	USDA (2010), Wu et al. (2004)
Raisins	15.0	3.7		2.300	1065	3037	USDA (2010), Wu et al. (2004)

[a] All data are expressed on a wet weight basis.
[b] Antioxidants was measured by the ORAC method.

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such as selenium, phenolics, and carotenoids. Therefore, dates could potentially be used as a supplement of fiber and antioxidants in nutraceutical, pharmaceutical, and medicine industries.

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