
26 Nutritional and Medicinal Value of Date Fruit

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INTRODUCTION

Date, the fruit of date palm, can be considered as an ideal food that provides a wide range of essential nutrients with many potential health benefits. Traditionally, dates have been considered as the staple food in the Arab Gulf regions (Erskine et al., 2004). The important quality criteria for consumers are the appearance including color, size and shape, physical condition and absence of defects, mouth feel or texture, flavor, and nutritional value (Wills et al., 1998). Dates are consumed in a variety of ways. They are mainly consumed as fresh (30%–40%) or in the dried form (60%–70%) at Rutab (semiripe) and Tamar (fully ripe) stages with little or no processing (Al-Hooti et al., 1997). Dates are usually taken as such or with Arabian coffee, milk, or yoghurt. In the processed form, they are consumed as paste, syrup, pickles, jams, jellies, and are used in many bakery or confectionary products together with chocolate, coconut, honey, vinegar, and others (Khatchadourian et al., 1987; El-Shaarawy et al., 1986; Al-Hooti et al., 1997; Besbes et al., 2009). Masmoudi et al. (2010) reported that various types of jellies prepared from date fruit and lemon by-products had less

quantity of sugar, decreased pH, and resulted in significantly firmer jellies, with higher adhesiveness, chewiness, cohesiveness, and taste attributes and gave higher sensory evaluation. The average per capita daily consumption of dates varies in the Arab Gulf region. It has been estimated to be 164 and 114 g in Oman and the United Arab Emirates, respectively (MAF, 2005; Ismail et al., 2006). The average per capita consumption of fresh dates (68 g/day) in Bahrain appears to be lower as compared to other Gulf States (Allaith, 2008). This decline in date consumption, particularly among children and teenagers, is attributed to the changing dietary habits and lifestyle (Musaiger, 2009). The consumption of dates, however, reaches its peak in the Muslim's holy month of fasting "Ramadan," when dates are commonly taken to break the fast. Socioeconomic changes are, however, affecting the consumption of dates due to changes in eating habits, improvement in living standards, continued urban drift, as well as to the availability of a wide variety of other fruits all the year round. The consumption of dates by younger population is less as compared to the older population (Ismail et al., 2006).

Date is a delicious fruit with a sweet taste and a fleshy mouth feel. The major component of dates are carbohydrates (mainly the sugars; sucrose, glucose, and fructose), which may constitute about 70%. The sugars in dates are easily digested and can immediately be moved to the blood after consumption and can quickly be metabolized to release energy for various cell activities. Dates are also a good source of fiber, and contain many important vitamins and minerals, including significant amounts of calcium, iron, fluorine, and selenium (Barreveld, 1993; Makki et al., 1998; Myhara et al., 1999; Al-Shahib and Marshall, 2003; Al-Farsi et al., 2005a; Khan et al., 2008). Dates have also been shown to contain antioxidant and antimutagenic properties. Recent studies have shown that dates and their aqueous extracts have demonstrated the free radical scavenging activity, inhibition of free radical-mediated macromolecular damages, antimutagenic, and immunomodulatory activities (Vayalil, 2002; Al-Farsi et al., 2005b; Allaith, 2008; Saafi et al., 2009). Further research is required to explore the health benefits of date fruit and date pits as well as the use of their functional components in the development of various value-added food products and supplements. The market for dates and their products could therefore be increased significantly in the future.

RELIGIOUS SIGNIFICANCE OF DATE PALMS AND DATE FRUIT

All the three major Biblical religions, Judaism, Christianity, and Islam have given high priority and significance to date palm and its fruit because of Prophet Abraham's love and affection for date palm. In Judaism, date is regarded as one of the seven holy foods/seeds, the others being, barely, wheat, lentils, beans, garlic, and onion. In Genesis, the Hebrew word for date palm is "Tamar," which was often used to describe a beautiful woman and was regarded as a Jewish symbol of grace and elegance. Date palm leaves are used as a "lulav" (a closed frond of date palm tree) in the Jewish holiday of "Sukkot" the Feast of Booths. There are numerous references about date palm and its fruit in the Bible, which testify its manifold virtues. The New Testament Scriptures describe the spreading of Christianity throughout the lands of palm trees. Date palm leaves are also used for Palm Sunday in Christian religion. Islam has, however, given the highest priority to dates. The nutritional significance and health benefits of dates have also been mentioned in the Muslim's Holy Book "*Al-Qur'an (The Koran)*." Date palm and date fruit have been mentioned in 20 verses of 17 Surahs (Chapters) in *The Holy Qur'an*. Date has been honored as one of the blessings of paradise (Qur'an, 55:68). Allah (SWT) in Qur'an recommends Maryam (mother of Prophet Jesus) to eat this fruit. "*The pains of labour drove her to the trunk of a date palm. She [Maryam] said, "Oh if only I had died before this time and was something discarded and forgotten!"*" A voice called out to her from under her, "*Do not grieve! Your Lord has placed a small stream at your feet. Shake the trunk of the palm towards you and fresh, ripe dates will drop down onto you. Eat and drink and delight your eyes*" (Al-Qur'an, 19:23–26, Surah Maryam). Prophet Muhammad (peace be upon him) has urged Muslims to eat dates, maintain date orchards, and has mentioned that dates can cure many

diseases/disorders. According to a “*Hadith*,” the sayings of Holy Prophet Muhammad (peace be upon him), “*he who eats seven Ajwa dates every morning will not be affected by poison or magic on the day he eats them*” (Al-Bukhari, 2008).

CHEMICAL COMPOSITION AND NUTRITIONAL QUALITY OF DATES

Date fruit can be distinguished from most of other fruits as it achieves its botanical maturity at various distinct maturation levels (Barreveld, 1993), which are known throughout the world by their Arabic names Kimri (green, unripe), Khalal (full-size, crunchy), Rutab (ripe, soft), and Tamar (ripe, sun-dried) (Dowson and Aten, 1982; Fayadh and Al-Showiman, 1990). These stages of maturity are traditionally described by changes in color, texture, taste, and flavor (Myhara et al., 1999). The chemical composition of dates can vary depending on cultivar, soil conditions, agronomic practices as well as the ripening stage (Al-Hooti et al., 1997; Al-Kharusi et al., 2009). During the ripening process, the fruit starts losing its moisture content and its sugars are converted to glucose and fructose. Small amounts of mannose and maltose have also been reported to be present at this stage (Shinwari, 1993). Myhara et al. (1999) reported that moisture content of Omani dates in the last stage of maturity (Tamar) was 21.5 and 18.1 g/100 g in the Fardh and Khasab varieties, respectively. The moisture content of 10 fresh date varieties ranged between 37.6 and 50.4 g/100 g (mean value 42.4 g/100 g). Whereas the moisture content of 16 dried date varieties ranged between 7.2 and 29.5 g/100 g with a mean value 15.2 g/100 g (Al-Farsi and Lee, 2008). Ali et al. (2008) observed that the moisture content of three dried Omani dates varieties (Khasab, Khalas, and Fardh) ranged between 18.77 and 23.71 g/100 g of date flesh. The variation in the moisture contents of different varieties of market-ready dates grown in the same country, or the same variety grown in different regions is largely because of differences in the harvest and post-harvest treatments (Aidoo et al., 1996).

CARBOHYDRATES AND SUGARS

The most important components of dates are the carbohydrates in particular sugars, which can constitute up to 78% (Makki et al., 1998) and provide a readily available source of energy to the human body. Ali et al. (2009) observed that the total carbohydrate contents of three dried Omani date varieties (Khasab, Khalas, and Fardh) ranged between 68.53 and 75.37 g/100 g of date flesh. The highest value 75.37 g/100 g was observed in Khalas variety. Myhara et al. (1999) reported that at the early green stage (Kimri), dates contained only small amounts of glucose and fructose. The carbohydrate contents in fresh and dried dates ranged from 47.8 to 59.4 (mean 54.9) and 66.1 and 88.6 (mean 80.6) g/100 g, respectively. At the intermediate stages (Khalal and Rutab), large amount of sucrose was accumulated but no additional glucose or fructose were detected. However, at the final stage of maturity (Tamar), almost all the sucrose is converted to glucose and fructose. The total sugar contents of three varieties of dried Omani dates (Khasab, Khalas, and Fardh) ranged between 56.1 and 62.2 g/100 g, the lowest in Khasab and highest in Khalas (Al-Farsi et al., 2005a). Whereas, Ali et al. (2009) reported that the total sugar contents of three dried Omani date varieties (Khasab, Khalas, and Fardh) ranged between 52.17 and 59.96 g/100 g. The highest total sugar content was found in Khalas.

The glucose, fructose, and sucrose contents ranged from 29.04 to 34.53 g/100 g, 20.72 to 23.65 g/100 g, and 1.86 to 2.34 g/100 g, respectively. The highest glucose level was found in Khasab whereas the highest fructose was observed in Khalas. The region of production and variety can significantly affect the glucose and total sugar contents of date fruit (Ahmed et al., 1995; Ismail et al., 2006; Ali et al., 2009). Glucose and fructose contained in date flesh are readily absorbed during the digestion and can lead to a rapid elevation of blood sugar (Liu et al., 2000). The sugars are responsible for the sweet taste of foods. The dates contain almost half of the amount of sugars in the form of fructose, which is twice as sweet as glucose and can induce a feeling of satiety. Ali et al.

(2009) observed an overall glucose-to-fructose ratio of 1.3 in three different Omani date varieties. However, Ismail et al. (2006) reported higher fructose concentrations, with a glucose-to-fructose ratio of <1 at Tamar stage, in five different date varieties (Khalas, Barhee, Fard, Boumaan, Ruzeiz) grown in the UAE.

DIETARY FIBER

Dates are a good source of dietary fiber and depending upon the variety and stage of ripening, it ranged from 6.4% to 11.5% in 14 different varieties (Al-Shahib and Marshall, 2003). Some of the low-quality dates, which are used for industrial purposes, have been found to contain up to 10% of crude fiber (Barreveld, 1993). Dates contain both the soluble and insoluble fibers. The main fractions are cellulose, hemicelluloses, pectin, lignin, and insoluble proteins. In one particular determination, date flesh was found to contain (on fresh weight basis) 1.55% cellulose, 1.28% hemicellulose, and 2.01% lignin (Barreveld, 1993). Insoluble fiber is the major component of dietary fiber in dates. Soluble pectins, on the other hand keep on accumulating regularly until the date fruit reaches the Rutab stage (Myhara et al., 1999). During the ripening process, the enzymes gradually break down these substances into more soluble compounds, which render the fruit more tender and soft (Fennema, 1996). Myhara et al. (1999) reported that dietary fiber, determined as nonstarch polysaccharides by gas chromatography, decreased from 250 (Kimri) to 50 g kg⁻¹ (Tamar) on a dry weight basis.

Dates contain 0.5%–3.9% of pectin (Fayadh and Al-Showiman, 1990). Pectin starts accumulating during the period of fast fruit growth and reaches a maximum at the beginning of sugar accumulation. It, however, drops with the further growth of fruit. El-Zoghbi (1994) observed that the percentage of pectin decreased from stage 1 (1.58/100 g tissue) to 0.54% at stage 4 of the dried dates. The pectin esterase activity in date increases during ripening stages to reach 60.8 units/100 g tissues, which explains the loss of pectin. The hemicellulose content also decreases from 5.25% to 1.29% from stage 1 to stage 4, while the cellulose content also decreases from 3.4% to 1.4%. The lignin content decreases from 3.5% to 0.3% and the total fiber content decreases from 13.7% in green date, stage 1, to 3.6% in the black date, stage 4. The cellulase activity in date increases during ripening and therefore the cellulose, hemicellulose, and lignin contents decrease with the ripening stage (El-Zoghbi, 1994). Dietary fiber content of dates can further contribute to their nutritional significance as dates can be used in the preparation of fiber-based foods and dietary supplements. Daily intake of 100 g of dates can meet the 32% of recommended dietary allowance for dietary fiber (Marlett et al., 2002). Higher content of the insoluble fiber induces satiety and has a laxative effect due to increased stool weight. Dietary fiber exhibits many therapeutic benefits and helps in lowering the blood cholesterol levels and has been shown to reduce the risk of many disease conditions such as diabetes, hypertension, bowel and colon cancers, cardiovascular diseases, and diverticulosis (Marlett et al., 2002; Cummings et al., 1992).

PROTEINS AND LIPIDS

Protein and lipid occur in small amounts in dates. Proteins occur in the date fruit in the range of 1%–3%. The increased protein and lipid contents after drying are mainly due to loss of moisture. However, their concentrations differ between the varieties due to differences in cultivation, drying conditions, and the analytical methods used for their determination. The average protein content of fresh and dried dates is 1.50 and 2.14 g/100 g, respectively. Little variation was observed in the protein contents of different date varieties (Al-Farsi et al., 2005a; Ismail et al., 2006; Sawaya et al., 1982b, 1983). Ishurd et al. (2004) reported a reduction in the amino acid contents through maturation stages. Within the same stage of maturation, the amino acid content can vary significantly. Proteins also play a role in the nonoxidative browning and the precipitation of tannins during ripening (Barreveld, 1993). Makki et al. (1998) reported that the protein content of the pulp ranged

between 1.7% and 2.95% on fresh weight basis, whereas the date seeds on the average contained 5.22%. Although, the amount of protein is too small to be considered as a significant nutritional source, dates contain many essential amino acids and their amino acids pattern is favorable to the human needs.

Lipids are mainly concentrated in the skin and have a higher physiological importance in the protection of fruit than contributing to the nutritional value of the date flesh (Barrevelde, 1993). The average lipid content is about 0.14 g/100 g in fresh and 0.38 g/100 g in dried dates. Al-Hooti et al. (1997) reported that the date flesh contained 0.2%–0.5% saponifiable oil, whereas the date seed contained 7.7%–9.7% oil. Seeds usually contain more lipids than the flesh that may reach to about 8.49% on a fresh weight basis (Makki et al., 1998). Date seeds have been reported to contain relatively high amounts of protein (5.1 g/100 g) and fat (9.0 g/100 g) as compared to date flesh (Almana and Mahmoud, 1994; Hussein et al., 1998). Date pulp can contain lipids ranging from 0.31% to 1.9% on fresh weight basis. The date seeds are also a rich source of dietary fiber (73.1 g/100 g), phenolics (3942 mg/100 g), and antioxidants (80,400 μ mol/100 g) and therefore could potentially be considered as an inexpensive source of dietary fiber and natural antioxidants (Almana and Mahmoud, 1994; Hussein et al., 1998). The sugars mannose and maltose are only present in the seeds (Al-Showiman, 1990). The seed of date fruit can constitute from 4.6% to 15.2% of the total weight of the date (Mossa et al., 1986; Al-Showiman, 1990).

FATTY ACID CONTENTS OF DATE FLESH AND SEEDS

The date flesh and seed both contain a wide range of saturated and unsaturated fatty acids. The saturated fatty acids include capric, lauric, myristic, palmitic, stearic, margaric, arachidic, heneicosanoic, behenic, and tricosanoic acids. Unsaturated fatty acids include palmitoleic, oleic, linoleic, and linolenic acids. The data published so far, however, does not distinguish between α - and γ -linolenic acid contents. Al-Shahib and Marshall (2002, 2003) observed significant variability in the fatty acids content in seeds of 14 date cultivars. They reported that the concentration of oleic acid varied from 41.1% to 58.8% and suggested that date seeds could be used as a source of oleic acid provided the technical problems related to its extraction are overcome. The presence of organic acids and olfactory oils is regarded as taste enhancer and can help improve the sensory characteristics of specialty date products.

VITAMIN AND MINERAL CONTENTS

Dates contain many important vitamins and minerals and their mineral content in dried dates can vary from 0.1 to 916 mg/100 g of date flesh (Barrevelde, 1993; Al-Farsi et al., 2005a; Khan et al., 2008). Dates contain high levels of selenium, copper, potassium, and magnesium, moderate concentrations of manganese, iron, phosphorus, and calcium and small quantities of boron (Barrevelde, 1993). Date varieties were also found to be an excellent source of selenium (Al-Farsi et al., 2005a). The high potassium and low sodium contents in dates are desirable for people suffering from hypertension. Boron is useful in the treatment of cancer of the brain. Boron and vitamins are also used in the treatment of rheumatism (Al-Showiman, 1998). The date can be used as a practical supplement for iron deficiency without any side effects such as nausea, headache, and anorexia that may occur with iron tablet supplements. At least six vitamins (thiamin, riboflavin, niacin, ascorbic acid, pyridoxin, and vitamin A) have been reported to be present in dates in visible concentrations (Al-Hooti et al., 1995; Al-Shahib and Marshall, 2003). As compared to other dried fruits, dates can therefore be considered a reasonable source of vitamins (USDA, 2011). Fresh dates contain higher concentrations of vitamins as compared to dry dates as the vitamins are lost in the drying process. Dried dates can be regarded as a moderate source of vitamin riboflavin, pyridoxine, niacin, and folic acid. Thiamin, ascorbic acid (vitamin C), and vitamin A are present in relatively low concentrations in dried dates.

PIGMENTS AND ANTIOXIDANTS

Dates contain various types of phytochemicals such as carotenoids (beta-carotene, lycopene, lutein, zeaxanthin, neoxanthin, etc.), the phenolics, mainly the cinnamic acids and their derivatives (ferulic, sinnapic, syringic, vanillic, gallic, caffeic, protocatechuic, coumaric acids, and their derivatives such as dactilyferic acids, etc.), flavonoid glycosides (luteolin, methyl luteolin, quercetin, and methyl quercetin) flavones, flavonols (catechin, epicatechin), flavoxanthin, anthocyanins, and so on (Shahidi and Naczka, 2004; Al-Farsi et al., 2005a; Biglari et al., 2008). The concentration of these phytochemicals, however, decreases with advancing stage of fruit maturity. The astringent taste of date fruit during the early stages of maturity is closely associated with its level of tannins (Barreveld, 1993; Al-Farsi et al., 2005a) that decreases with the ripening of fruit and almost disappears at Rutab stage (Makki et al., 1998; Myhara et al., 1999). The most astringent dates were found to be at the *Kimri* stage of maturity with highest fresh weight tannin content of 2.8 g/kg. The least astringent dates were found to be at *Rutab* stage of maturity with the lowest fresh weight tannin content (1.0 g/kg). The protein content of dates plays an important role in the nonoxidative browning (Maillard reactions) of dates and helps in the precipitation of tannins during the ripening process (Barreveld, 1993; Makki et al., 1998). Tannins in dates are made mainly of polyphenols and to a lesser extent of flavones. These are responsible for the dark color of dates in the postharvest period (Makki et al., 1998).

The carotenoids and phenolic compounds (flavonoids and anthocyanins) can contribute to varying degrees of antioxidant and antimutagenic activity. The contribution of total phenolics toward antioxidant activity in dates is greater than that of ascorbic acid (Shivashankara et al., 2004). The date fruits as well as its water extracts have shown free radical scavenging activities (Ahmed et al., 1995; Al-Shahib and Marshall, 2003; Al-Farsi and Lee, 2008; Al-Farsi et al., 2005a; Elleuch et al., 2008; Vayalil, 2002; Mansouri et al., 2005; Allaith, 2008; Biglari et al., 2008). Most of the antioxidants in dates have been reported to be hydrophilic or water soluble (Al-Farsi et al. 2005a). The data reported on the antioxidant activity of date fruits from different parts of the world such as from Algeria (Mansouri et al., 2005), Kuwait (Vayalil, 2002), Iran (Biglari et al., 2008), Bahrain (Allaith, 2008), Oman (Al-Farsi et al., 2005b), and the United States (Vinson et al., 2005) suggest that dates cannot only be considered as a good source of natural antioxidants, but can also serve to improve the product's flavor and color because of their high contents of active phenolic acids.

CAROTENOIDS

Dates can be considered a moderate source of carotenoids as compared to other dried fruits (Hart and Scott, 1995; Boudries et al., 2007). The level of carotenoids in date fruit can, however, vary depending upon the variety, stage of maturation, drying, and postharvesting conditions. Boudries et al. (2007) reported the total carotenoids content of different date varieties from Algeria from 32.6 to 773 $\mu\text{g}/100\text{ g}$ of fresh date weight. Major carotenoids found in dates are lutein, β -carotene, zeaxanthin, and neoxanthin. Although all carotenoids do not act as provitamin A, dates are likely to contribute to the human requirement for vitamin A. The pro-vitamin A value in different Algerian date varieties ranged between 0.4 and 11.7 RE/100 g in fresh dates. The values, however, decreased with the ripening of dates and were lower at Tamar stage (on the average 0.5 RE/100 g). The total carotenoids content in three varieties of fresh Omani dates (Fard, Khasab, and Khalas) were found to be 1.39, 1.31, and 3.03 mg/100 g, respectively (Al-Farsi et al., 2005b). The yellow color date variety (Khalas) showed higher total carotenoids as compared to red-colored date varieties (Khasab and Fardh). The yellow-colored fruits are reported to also contain a complex mixture of carotenol fatty acid esters (Fennema, 1996). The red color dates on the other hand contain hydrocarbon carotenoids such as lycopene, neurosporene, γ -carotene, δ -carotene, α -carotene, β -carotene, phytofluene, and phytoene (reference). The average total carotenoids content of fresh and dried dates have been reported as 913 and 973 $\mu\text{g}/100\text{ g}$, respectively (Al-Farsi et al., 2005b). Freeze-dried dates have

been reported to contain much less concentration of carotenoids, 0.18 mg/100 g of fresh weight (Ben-Amotz and Fishler, 1998).

PHENOLIC ACIDS

As compared to other fruits, dates can be considered a good source of phenolics (Vayalil, 2002; Guo et al., 2003). Guo et al. (2003) reported that dates had the second-highest antioxidant value out of 28 fruits commonly consumed in China. Date varieties contain different concentrations and patterns of phenolic acids, which are mostly present in the bound form. Al-Farsi et al. (2005b) reported that the average contents of total phenolics in fresh and dried dates were 193.7 and 239.5 mg/100 g, respectively. They also detected a total of nine free and bound phenolic acids of which five consisted of hydroxylated derivatives of benzoic acid (gallic acid, protocatechuic acid [PCA], *p*-hydroxybenzoic acid, vanillic acid, and syringic acid) and four were cinnamic acid derivatives (caffeic acid, *p*-coumaric acid, ferulic acid, and *o*-coumaric acid). Several other unknown compounds associated with both free and bound phenolic acids were also reported in fresh and sun-dried Omani date cultivars (Fard, Khasab, and Khalas). The predominant phenolic acids were PCA, ferulic acid, caffeic acid, *p*-coumaric acid, and *o*-coumaric acid (Al-Farsi and Lee, 2008; Al-Farsi et al., 2005b). The total concentrations of these phenolic acids varied from 2.61 to 12.27 mg/100 g and from 6.06 to 14.77 mg/100 g in fresh and dried dates, respectively. Fard showed the highest contents of free phenolic acids, followed by Khalas and Khasab in both fresh and sun-dried samples. Overall, the total phenolic acids of sun-dried dates were found to be significantly ($p < 0.05$) higher than those of fresh dates (Al-Farsi and Lee, 2008).

The concentration of phenolics in different date varieties varied significantly ($p < 0.05$). The total bound phenolic contents were in the range of 6.84–30.25 mg/100 g in fresh dates and 14.18–49.67 mg/100 g in sun-dried dates. Regnault-Roger et al. (1987) identified eight phenolic acids (gallic acid, PCA, *p*-hydroxybenzoic acid, vanillic acid, caffeic acid, syringic acid, *p*-coumaric acid, and ferulic acid) in dried Tunisian date cultivars. Mansouri et al. (2005) reported the presence of *p*-coumaric acid, ferulic acid, and sinapic acid as well as some derivatives of cinnamic acid in seven different varieties of Algerian dates. Three different isomers of 5-*o*-caffeoylshikimic acid were also detected. The concentration of phenolics in Omani date cultivars has been reported to be much higher than those of Tunisian date varieties (Al-Farsi et al., 2005b). The variations in the reported results about the phenolics may be due to the analytical procedures, in particular the use of different phenolic acid standards, such as ferulic acid and gallic acid, which make it difficult to have the valid quantitative comparisons. It has been reported that caffeic acid, sinapic acid, ferulic acid, and *p*-coumaric acid have more antioxidative potential than PCA, syringic acid, and vanillic acid (Cuvelier et al., 1992). PCA is a polyphenol antioxidant with mixed effects on normal and cancer cells. PCA has been reported to induce apoptosis in human leukemia cells, as well as in malignant HSG1 cells taken from human oral cavities. Depending on the amount of PCA and the time before its application, PCA can reduce or enhance the tumor growth (Babich et al., 2002; Lim et al., 2007; Guan et al., 2009).

TOTAL ANTHOCYANINS

The different colors (blue, red, violet, and purple) in most of the edible plant species and their fruits (berries, grapes, cherries, cherry laurels, plums, etc.) are due to anthocyanins (Mazza and Miniati, 1993; Kaehkoenen et al., 2003; Wrolstad, 2004). Compared to other fruits such as grapes, blueberries, and so on, dates are a poor source of anthocyanins. The anthocyanin contents of different varieties of fresh dates expressed as cyanidin 3-glucoside equivalents can differ significantly (Eong et al., 2006; Al-Farsi et al., 2005a). The differences in the anthocyanin contents could be associated with the color of date fruit and red color varieties have usually higher concentration as compared to others (yellow etc.). The anthocyanins were reported to be present only in fresh dates as the drying

may destroy anthocyanins (Al-Farsi et al., 2005a). The drying temperature, light, agronomic practices, and storage conditions affect the fruit anthocyanins. Commercial sun-drying of dates at 30–50°C for 7–10 days can completely destroy the anthocyanins due to enzymatic and nonenzymatic browning reactions (Wrolstad, 2004; Al-Farsi et al., 2005a).

The variability in the data about the total antioxidants content of dates could be attributed to different extraction techniques and analytical methods used for their estimation. Higher antioxidant activity has been reported in fresh dates as compared to dried dates, which may be due to decomposition of natural antioxidants during the drying process. Sun-drying can cause a significant loss ranging from 29.7% to 42.5% in the antioxidant activity of dried dates (Vayalil, 2002; Guo et al., 2003; Al-Farsi et al., 2005a). There are, however, few studies which have reported either an increase or no change in antioxidant activity of some fruits such as plums after drying (Piga et al., 2003). Vayalil (2002) stated that the antioxidant and the antimutagenic activity in dates implicate the presence of compounds with potent free radical scavenging activity. Guo et al. (2003) reported that dates had the second-highest antioxidant value of 28 fruits commonly consumed in China, and the Hawthorn fruit showed the highest amount of antioxidants. The role of antioxidants in minimizing or preventing the risk several chronic diseases such as cancer, cardiovascular diseases, neurodegenerative diseases, and inflammation is well recognized (Benzie, 2003; Kris-Etherton et al., 2004; Cooper, 2004). Because of their high fiber content, certain minerals and vitamins as well as the presence of many antioxidant and antimutagenic phytochemicals, dates can potentially be considered as a functional food in human health. Further research is therefore needed to study the various date varieties in terms of their total antioxidant capacity, free radical scavenging activities, reducing power, anti-inflammatory properties, and protection against chronic diseases.

MEDICINAL VALUE OF DATE FRUIT

ANTIOXIDANT, ANTI-INFLAMMATORY, ANTIMUTAGENIC, AND ANTICANCER ACTIVITIES

In addition to their significance as an ideal high-energy food, in the folklore, the dates are believed to have many medicinal properties such as to provide strength, fitness, and relief against a number of ailments and pains including fever, stomach disorders, memory disturbances, nervous disorders, as well as aphrodisiac and to boost the immunity. They are also considered to protect against many chronic diseases including cancer and heart diseases (Lambiote, 1982; Duke, 1982; Vyawahare et al., 2009) as they have been shown to contain antioxidant and antimutagenic properties (Al-Farsi et al., 2005b; Vayalil, 2002; Allaith, 2008). Aqueous extracts of dates have also been shown to inhibit the lipid peroxidation and protein oxidation as well as exhibit a potent superoxide and hydroxyl radical scavenging activity (Allaith, 2005). Panahi and Asadi (2009) reported that extract of date fruit were useful in controlling the blood cholesterol levels and also protected the CA1 neurons against oxidative injury. Methanolic and aqueous extracts of date flesh and seeds have also been shown to exhibit anti-inflammatory properties and suppressed the swelling in the foot and adjuvant arthritis (Mohammed and Al-Okbi, 2004).

Dates are a rich source of hydroxyl pope folic acid and therefore eating on dates can increase the body's immunity and resistance to cancers. Ishrud and John (2005) observed that the preparations made from the extracted polysaccharides (glucans) from Lybian dates exhibited a dose-dependent anticancer activity by suppressing the growth of Sarcoma 180 tumor cells in female CD1 mice. It is a common belief in the Middle East that the consumption of dates, particularly in the morning on an empty stomach, can reverse the actions of any toxic material that the subject may have been exposed to (Vyawahare et al., 2009). Date extracts (DE) have been reported to inhibit the benzopyrene-induced mutagenicity in *Salmonella* tester strains TA-98 and TA-100 with metabolic activation (Vayalil, 2002). It has also been suggested that the extracts of date flesh and pits can reverse the carbon tetra chloride (CCl₄)-induced liver damages in rats (Al-Qarawi et al., 2004). The DE have also been shown to reduce the oxidative stress by normalizing the increased hepatic levels of

malondialdehyde (MDA) and by increasing the hepatic glutathione levels (Mohammed et al., 2008). DE and products can also be used prophylactically as a dynamic liver support and can counteract the alcohol intoxication. A number of herbal formulations are available in the markets, which have been shown to reduce or prevent the alcohol-induced hangover symptoms in human volunteers as well as protection against liver disorders in acute and chronic alcoholics (Thornfeldt et al., 2006). It is also believed that consuming seven dates daily can protect the children from anxiety and nervous disorders.

TREATMENT OF ABDOMINAL TROUBLES

Dates are used for the treatment of abdominal troubles. Because of their high phenolic contents, dates are used medicinally as a detergent (cleansing agent) and astringent in intestinal troubles. Water extracts of date flesh have been shown to induce a dose-dependent increase in the gastrointestinal transit time of foods in rats (Al-Qarawi et al., 2003). The aqueous extracts of dates have also been shown to have antidiarrheal effects in rats (Al-Taher, 2008). The ethanolic and aqueous extracts have been reported to have positive protective effects on the ethanol-induced gastric ulceration in rats (Al-Qarawi et al., 2005). Because of its antidyentery and laxative effects, it is believed that a daily dosage of seven dates soaked in water and taken before sleeping can kill *Ascaris* (giant intestinal roundworms). According to folklore medicine to secure a laxative effect, the dates should be immersed in water at night and taken after making them into fine syrup the next morning. Decoction of dates, free from fibrous material together with some table salt, can be used as a remedy to treat the dehydration resulting from vomiting and diarrhea. Water extracts of dates are also considered to help in lowering the stomach hyperacidity as well as blood acidity. For children with sensitive stomachs, the water extracts of dates are sometimes added to milk to help in the digestion of milk because the date fibers are soft and do not irritate a sensitive bowel or stomach. Dates crushed and boiled in milk are very nourishing and restorative especially during convalescence.

ANTIANALGESIC, ANTIPYRETIC, AND PROTECTION AGAINST COLDS, SORE THROAT, AND FEVER

Date products in the form of infusion, decoction, syrup, or paste are administered as a treatment for sore throat, colds, bronchial catarrh (inflammation of mucus membranes). Although, no clinical data are available in the literature for such claims, the antioxidant and anti-inflammatory properties of dates (Mohammed and Al-Okbi, 2004; Allaith, 2008; Vyawahare et al., 2009) could be regarded as the main contributing factor for such effects. The traditional recipe that is considered as an effective expectorant consists of a mixture of 50 g dates, 50 g fig, 50 g hibiscus, and 50 g raisins boiled in 1 L of water. This mixture is recommended to be taken three times daily to control throat and chest infections. Decoction of dates and fenugreek is recommended in the treatment of bronchial asthma. Date pastes with margarine are considered to act as analgesic and antipyretic and are therefore applied externally on the abscesses as well as on the poisonous bites to avert the poisonous effect. Pastes prepared from powdered seeds are given to relieve the ague (malarial fever). Date pastes in water are also believed to act as antihistaminic to control allergies when externally applied to skin. Zinc is regarded as an active ingredient inducing allergic inhibition. Soaps prepared with powdered date seeds are used for treatment of skin allergy and Acrodermatitis enteropathica (AE). AE is a rare inherited autosomal metabolic recessive disorder that results from poor absorption or uptake of zinc and can be resolved by oral supplementation of zinc (Park et al., 2010). Daily diets containing dates can produce sedative action to allergy. It is believed that continuous feeding on dates can relieve the hemorrhoids pain and may increase the body's resistance to this disease. However, no clinical data are available to prove this statement. Coffee made from powdered date stones drunk twice daily is believed to relieve the gout pains. The roots of date palm are used against toothache.

EFFECTS ON PREGNANCY, LACTATION, AND REPRODUCTIVE SYSTEM

The most common medicinal use of dates and its products is as a tonic, especially for women who are close to delivery and at postpartum stage. The consumption of dates by women before and after delivery can act as a tonic to strengthen the uterine muscles. Dates not only help in activating the delivery process but may also prevent the postdelivery bleeding due to the presence of some constricting substances. The typical example given for such use is the case of Virgin Mary's delivery as mentioned in Holy Quran when she was recommended to eat dates to relieve her delivery pains (Al-Qur'an, 19:23–26). The potassium, glycine, and threonine content of dates are thought to activate the production of milk hormone (prolactin). Small quantities of oxytocin have also been detected in dates and therefore dates can act as lactagogue if used in the daily meal plan of a woman during her lactation period.

Dates mixed with milk and cinnamon are considered as aphrodisiac as they can activate sexual desire. In the Middle East, it is common to consume about 10 to 30 dates daily as part of their normal diet. Studies have shown that DE increased the sperm count in guinea pigs and enhanced the spermatogenesis by increasing the concentration of testosterone, follicle-stimulating hormone, and leutinizing hormone in rats (Elgasim et al., 1995). Dates can help solve the infertility problems in males. Date palm pollen grains have been shown to regulate the sexual hormonal balance in rats (Reshod and Al-Shagrawi, 1998). The date pollens yield an estrogenic principle, estrone that has been shown to have a gonadotropic effect in young rats (El-Moughy et al., 1991).

NEPHROPROTECTIVE AND HEMOLYTIC ACTIVITIES

Dates are also considered as renal restorative and their daily consumption can prevent the formation of renal calculi due to its diuretic and anti-inflammatory actions. A cup of hot decoction of seven dates, when taken twice daily for a period of 15 days, is considered as a remedy for lithontriptic and diuretic. A drink made from powdered date stones is also considered as lithontriptic for hepatic and renal calculi. A gum that exudes from wounded trunk of date palm is employed in India for treating diarrhea and a genito-urinary ailment as it works as diuretic (increase in urine output) and demulcent (soothing effects on the irritated mucous membrane). Extracts of date flesh and pits have been shown to reduce the gentamycin-induced nephrotoxicity in rats (Al-Qarawi et al., 2003). It was suggested that vitamin E, ascorbic acid, and melatonin fractions of dates were responsible for nephroprotection. Siddiqi et al. (2009) reported that ingestion of few dates does not cause any significant hyperkalemia in hemodialysis patients without hyperkalemia. They suggested that hemodialysis patients could be allowed to eat few dates on the days prior to their dialysis sessions.

The DE have been shown to neutralize the hemolytic activity of *Streptococcal exotoxin* and *Streptolysin O*. The inhibitory substance has been found to be steroidal in nature and not proteinaceous as deproteinization of DE did not decrease its inhibitory effects (Abuharfeil et al., 1999). DE have also been reported to inhibit the hemolytic activity of snake and scorpion venoms by interfering with their degenerative effects on the fine structure of hepatocytes (Sallal et al., 1995). In a recent study, the immune-modulatory and immune-stimulant activities of date fruit extracts have also been demonstrated (Puri et al., 2000).

OTHER MEDICINAL BENEFITS OF DATE FRUITS

The daily consumption of dates with meals and its decoction as eye-lotion is considered to help in the maintenance of eye hygiene and a remedy for night blindness and ophthalmic disorders. Because of their high-potassium and low-sodium contents, dates can help alleviate potassium deficiency, maintain the sodium–potassium balance in the body and may help in treating the cardiac disorder especially after diarrhea, vomiting or after the use of diuretic medications. Dates have been shown to have low-to-medium glycemic index values (Ali et al., 2009) and therefore can have some beneficial effect

in the glycemic and lipid control of diabetic patients (Miller et al., 2003). In folklore traditional medicine, the date seed powder is considered to be the best medicine for diabetic patients. Studies have also reported the antiviral and heavy metal-absorbing properties of date fruit and date pits.

CONCLUSION

Date is a delicious fruit with a sweet taste and a fleshy mouth feel and can be considered as an almost ideal food that provides a wide range of essential nutrients with many potential health benefits. Its major components are carbohydrates (mainly sucrose, glucose, and fructose), which may constitute to about 70%. Dates are a good source of fiber and contain many important vitamins and minerals, including significant amounts of calcium, iron, fluorine, and selenium and low in sodium. Date fruit also contains a number of phytochemicals such as carotenoids, phenolics, flavonoids, anthocyanins, which possess antioxidant and antimutagenic and immune-modulatory properties. In addition to its nutritional significance, in the folklore, the dates are believed to have many medicinal properties such as aphrodisiac, boost the immunity and provide strength, fitness, and relief against pains as well as protection against many disease including cancer and heart diseases. The date published so far has many unanswered questions but has renewed an increased interest to further explore the nutritional and health benefits of date fruit and date pits. Further research is therefore required to systematically explore the health benefits of date fruit and date pits as well as on the use of their functional components in the development of various values-added food products and supplements.

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