IJFANS
International Journal of Food And Nutritional Sciences

Volume 3, Issue 6, Oct-Dec 2014, www.ijfans.com e-ISSN: 2320-7876

INTERNATIONAL JOURNAL OF FOOD AND NUTRITIONAL SCIENCES

IMPACT FACTOR ~ 1.021

Official Journal of IIFANS

INTERNATIONAL JOURNAL OF FOOD AND NUTRITIONAL SCIENCES

e-ISSN 2320 –7876 *www.ijfans.com*
Vol.3, Iss.6, Oct-Dec 2014

Review Paper *Open Access*

NUTRITIONAL, SOCIOECONOMIC AND HEALTH BENEFITS OF DATES

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Received on: 3rd November, 2014 **Accepted on: 20th December, 2014**

ABSTRACT

Date palm (*Phoenix dactylifera*) is one of the oldest trees cultivated by man. The date palm fruit is a drupe exhibiting a high diversity in texture, shape, color and chemical composition depending on the genotype, environment, season and cultural practices. Although, fruit of the date palm served as the staple food for millions of people around the world for several centuries, studies on the nutritional, health and socioeconomic benefits are inadequate and hardly recognized as a healthy food by the health professionals and the public. Phytochemical investigations have revealed that dates contain anthocyanins, phenolics, sterols, carotenoids, procyanidins and flavonoids, compounds known to possess multiple beneficial effects. Date pits are also an excellent source of dietary fiber and contain considerable amounts of minerals, lipids and protein. In addition, despite the presence of several reports on the chemical composition and the nutritional value of dates, many other potentialities of the fruits remain unexplored. Studies have shown that dates possess free radical scavenging, antioxidant, antimutagenic, antimicrobial, anti-inflammatory, gastroprotective, hepatoprotective, nephroprotective, anticancer, antiulcer and immunostimulant activities. Dates are very rich in phenolics, in quality and quantity, which opens many fields of investigation in terms of new potential uses. Therefore, this review summarizes the phytochemical composition, nutritional significance, and health benefits of date fruit consumption and discusses its great potential in worldwide production/commercialization as a medicinal food for a number of diseases inflicting human beings.

Key words: Date palm, Dates, Nutitional, Health, benefits, Phenolics.

INTRODUCTION

Date palm, *Phoenix dactylifera*,is among the most important species in the Palm family (Arecaceae),which encompasses about 200 genera and more than 2,500 species (El Hadrami and El Hadrami, 2009) and includes *P. canariensis*(Canary Islands date palm), *P. reclinata*(Senegal date palm) and *P. sylvestris* (Indian sugar palm). There are over 600 kinds of dates based on the shape and organoleptic properties (Baliga*et al.*, 2011). The species name was inspired by the finger like shape of the fruit and the genus from the legendary bird of Ancient Greece (Abdelbasset and Jameel, 2012). It is a long-lived monocotyledonous species and one of the tallest domesticated trees (Jassim and Naji, 2010). This perennial and dioecious species represents a cornerstone of the economy in many producing countries, especially in the Middle and East North Africa. Over 100million trees are currently grown worldwide on an estimated area of 1 million ha. Date palm provides fruit, fuel, fiber and shade for other essential cover crops. The annual world production of dates has reached 6-8 million mt, representing a market exchange value of over 1 billion USD. The top three producing countries are Egypt, Iran and Saudi Arabia; the largest importer of dates is India (El Hadrami and El Hadrami, 2009; El Hadrami*et al.*, 2011).

Date fruits are a significant component of the diet in the majority of the Arab countries with low cost. For Muslims, dates are of religious value and have been mentioned several times in the Quran. They are usually breaking their long day fasting with dates in the month of Ramadan (Vayalil, 2002; Al-Farsi and Lee, 2008;Baliga*et al.*,2011). In Saudi Arabia, the annual production of dates palm is around 800 thousand tons in 2004 (Alhussein, 2009). The consumption of dates per household per day by Saudi families was 201.57 gm while the consumption of very ripe dates was 19.52 gm(Jassim and Naji, 2010). Date palm fruits consist of three essential parts: date flesh which constitutes between 85% to 90% of date fruit weight (Amira *et al.*, 2011), date seed or pit which constitutes about 6 to 12% of the total weight of the mature date and skin which is a thin layer surrounding the fruit to protect the fleshy part (El-Sohaimy and Hafez, 2010; Jassim and Naji, 2010; Shafiei*et al.*, 2010). This review sought to collect information and facts on nutritional, health and socioeconomic benefits of the dates been an emerging medicinal food with worldwide consumption.

GEOGRAPHICAL DISTRIBUTION OF DATE PALM

*P.dactyliferai*s a widely distributed species occurring in diverse geographic, soil and climatic areas (El Hadrami *et al.*, 2011). The vast majority of the trees are located in the Middle East and North Africa although the crop has been established in California, Arizona and Mexico in the Americas. The common requirement among all date palm growing areas is the high temperature (35^{o}C) necessary for an optimal development of pollen and the low relative humidity for fruit setting and ripening. Such desert-adapted tree requires large quantities of water drawn from deep in the soil through a well-established root system or from surface irrigation. Date palm grows in nearly rainless regions at 9-39^{o} North latitude, which are represented by the Sahara and Southern fringe of the Near East (Arabia Peninsula, Southern Iraq and Jordan) (El Hadrami *et al.*, 2011). Both wild and domesticated trees are morphologically and ecologically similar. Wild date fruits are small and inedible compared to those originating from domesticated trees. Cross hybridization between the two types of trees occurs in some regions, making their distinction quite difficult to determine (Omamor*et al*., 2000).

Date plantation in Nigeria started since17th century (AbdulQadir*et al*., 2011) through the trans-Sahara trade route from North Africa by Muslim pilgrims on pilgrimage to the Holy cities of Mecca and Medina (Omamor*et al*., 2000). Though Nigeria is not a major dates producer in the world, the crop strives in Northern parts of the country particularly regions above latitude 10^{0} North of the equator (Okolo*et al*., 2000). Despite the invaluable roles of dates in human life, the Nigerian date palm industry (production, processing and marketing) is beleaguered with lack of awareness of the nutritional importance of dates (AbdulQadir*et al*., 2011)

HISTORICAL IMPORTANCE OF DATE PRODUCTION

Historically, date palm cultivation was practiced by ancient civilizations and is nowadays considered one of the oldest domesticated fruit bearing trees. Remains of date palms were found in Jericho - the oldest site known to date to be the origin of agriculture. Date palm cultivation gained socioeconomic importance among tribes and countries due to its ecological plasticity and high adaptation to arid conditions where the annual precipitation rarely exceed 250 mm combined with hot summers up to 50°C and cold winters down to - 10°C. Production of dates provides jobs for a manpower population estimated at 50 million people, 35% of which are located in the southern Mediterranean countries (El Hadrami and El Hadrami, 2009).

Another important fact for date palm cultivation relates to the microclimate the tree creates in the desert, fostering the growth of cover crops and vegetables to sustain local human populations and their animals (Al-Shahib and Marshall, 2003).

Other parts of the palms such as the leaves are often dried, dyed and plaited into mats, hats, trays or baskets. Combined with other material, this high fiber foliage can also be used to produce ropes and twines. The woody midribs of the leaves are often used for roofing as well as to make dome-shaped traditional fishing cages. Sturdier trunks are used to make fishing crafts in some countries (Abdel basset and Jameel, 2012). Moreover, in a recent publication of Alananbeh et al., 2014, leaves of date palm mixed with other agro-wastes were used in oyster mushroom (*Pleurotus ostreatus*) production.

WORLDWIDE/ CURRENT SITUATION OF DATE PRODUCTION

The date palm is currently grown for fruit production intended for local consumption, trade and export in 37 countries around the world. A few other countries grow the crop on small areas intended for local market consumption (Abdelbasset and Jameel, 2012).

FAO estimates that the harvested area of date growing was 1.3 million ha in 2009 (FAO Statistics, 2010). This area had increased by 0.3 million ha over the previous decade. The largest area (833,351 ha) is located on the Asian continent, which includes the Middle Eastern producing countries, followed by Africa (416,695 ha), North Africa (392,200 ha). In the Americas and Europe the production covers only a few thousand hectares.

The worldwide production of dates was estimated in 2009 to 7.3 million mt, which represents an increase of over one million mt in a decade. The production mirrors the area of producing groves with production shared between Middle Eastern and North African countries (2.7 million mt).

According to FAO statistics, the world's largest producer over the last five years was Egypt with an average of 1.3 million mt followed by Iran (just over 1 million mt), Saudi Arabia (979,017 mt), United Arab Emirates (754,400 mt), Pakistan and Algeria (540,000 mt each) and Sudan (333,500 mt). Other significant producing countries are Oman, Libya, Tunisia, Morocco, Yemen, Mauritania, USA, Bahrain, Qatar, Spain and Kuwait. In terms of annual yields, the USA leads with an estimated average of 67.093 hg/ha. Next is Africa especially the Northern parts, producing 64.974 hg/ha on average. In the Middle Eastern countries, although a large area of producing groves, yields are below the world average (53.798 hg/ha).

DATE RIPENING STAGES

Dates ripen in four stages, which are known throughout the world by their Arabic denominations: the immature green, the mature full colored, the soft brown and hard raisin-like stage of development (Kimri, Khalal, Rutab and Tamr, respectively) (Al-Shahib and Marshall, 2003).

DATE FRUIT BY-PRODUCTS

Besides the use of fresh fruits for human consumption, a number of by-products derived from dates also have various uses. These include jam, jelly, juice, syrup and fermented beverage. Cull dates from grading and sorting, as well from storage and conditioning are often utilized as animal feed. Several reports show that a number of bioactive compounds can be extracted from these by-products, thereby adding industrial value which could compensate for the economic loss from under-

grading and/or deterioration. Various metabolites also are reported to be produced from dates or their by-products, such as citric acid, oxytetracycline and ethanol. In recent years, interest has been increasing to extract essential oils, polyphenols and dietary fiber from date seeds (Abdelbassetand Jameel, 2012).

Due to the high production potential of dates worldwide, it may not always be possible to consume all the freshly-harvested fruit locally or export them. This has opened, in recent years, new opportunities to turn the surplus production into value-added products such as syrup and fermented juice. Al-Hooti*et al*. (2002) reported on a new technology developed on a laboratory scale to produce syrup from dates of Kuwaiti commercial cvs., Birhi and Safri, both very rich in sugars (88%). The study showed that the procedure developed, using pectinase/cellulase enzymes, recovers 68% of total soluble solids, as compared to regular procedures not relying on enzymes which recover only 35%.

Other studies have concentrated on finding ways to add value to some second-grade dates with a hard texture. Besbes*et al*. (2009) found that these dates are equal to first-grade dates in terms of their sugar, fiber and total phenolic contents. To add value to this type, the authors explored using them to produce jam, and conducted a series of tests of the composition and physical characteristics, such as the content of reducing sugars, firmness, moisture retention capacity, as well as customer acceptability in comparison with the made jam from first-grade fruits and consumed locally. Overall, the study revealed that jam from hard texture second-grade dates represents a commercially viable venture.

PHYSICO-CHEMICAL COMPOSITION OF DATE FRUITS

In recent years, reports on the physico-chemical composition of dates and their derived by-products have been on the rise (El Hadrami*et al.*, 2011). Elleuch*et al*. (2008) analyzed the color, moisture and oil-holding capacities and the rheological behavior of the dietary fibers extracted from dates flesh of two Tunisian cvs. Deglet Noor and Allig. The findings showed that on a dry matter basis, Deglet Noor cv. constituted 53% sucrose, 14% glucose, 13% fructose, 14% total dietary fiber, 2% protein and 2.5% ash, in comparison with Allig (14, 30, 29, 18, 3, and 2.5%, respectively). In both cultivars, the content of total dietary fibers, which is water insoluble, represents 10% of the dry matter.

Al-Shahib and Marshall (2003) analyzed the fat content and fatty acid profiles of 14 cultivars of date seeds using gas chromatography-mass spectrometry. Quantitatively, the fat content range was 5-9% (w/w). In terms of quality, the authors reported the presence of 11 fatty acids; among them oleic acid was primary, representing up to 50% of the profile. Different results among samples were ascribed to both cultivar and cultural differences.

Studies of the saturated fatty acids in the flesh and seeds of dates revealed the presence of saturated fatty acids, including capric, lauric, myristic, palmitic, stearic, margaric, arachidic, heneicosanoic, behenic and tricosanoic acids (Al- Shahib and Marshall, 2003). Unsaturated fatty acids included palmitoleic, oleic, linoleic and linolenic acids. A number of reports list the content of these fatty acids in several commonly grown varieties (Fayadh and Al-Showiman, 1990; Al- Showiman, 1990). Other studies (Saafi*et al*., 2008) have reported the physicochemical composition of the pulp and the pit and showed total sugars of 63.4% (51.6% reducing sugars and 11.8% sucrose) on a dry-weight basis, 3.9% protein and 0.3% oil in the pulp; versus 8.2% (6.6% and 1.5%), 5.3% and 8.3% for the pit. Chromatographic analysis revealed differential fatty acid profiles between pulp and pit. While linoleic acid was the major unsaturated fatty acid found in the pulp (32.8%), oleic acid was highly abundant in the pit (47.66%). The major saturated fatty acids were palmitic (20.6%) and lauric acid (17.4%) in the pulp and the pit, respectively. Other fatty acids encountered in these date by-products included myristic, stearic and linolenic acids.

PHENOLIC CONTENT AND OTHER SECONDARY METABOLITES

In dates, three main families of phenolics (hydroxycinnamates; flavonols, flavan-3-ols, flavan-3,4-diols and proanthocyanidins) can be detected (El Hadrami*et al*., 1998; Daayf*et al*., 2003; El Hassni*et al.*, 2004; J'Aiti*et al.*, 2009). The major hydroxycinnamates found are derivatives of *p*-coumaric, chlorogenic, ferulic, andsinapic acids as well as their esters i.e. caffeoylshikimic acid derivatives (El Hadrami, 1995; El Hadrami*et al*., 1998; El Hassni*et al*., 2004; J'Aiti*et al.*, 2009). Flavonoids such as luteolin, quercetin, and kaempferol, as well as more or less polymerized proanthocyanidins are also found in abundant quantities in fresh dates.

Saafi*et al.* (2009) examined the phenolic contents of dates derived from four commercial cultivars. The analysis revealed that the total phenolic ranged from 209.4 mg of gallic acid equivalents per 100 g fresh weight in cv. Kentichi to 447.7 mg equivalent in cv. Allig. Similar results were reported in other studies conducted using local cultivars grown in Oman and Bahrain (Al-Farsi *et al*., 2005; Allaith, 2008).. Mansouri *et al*. (2005) and Biglari*et al*. (2008) reported that total phenolic content ranged from 2.49 to 8.36 mg gallic acid equivalents per 100 g of fresh weight of Algerian and Iranian dates, respectively. Other studies conducted in the USA using Deglet Noor and Medjoolcvs showed a total phenolic content of 661 and 572 mg gallic acid equivalents per 100 g fresh weight.

A number of factors affect the phenolic content in dates and may justify the variation observed among studies. These include the cultivar, geographic origin, growing conditions, maturity of the tested dates, season, fertilizers, soil type, amount of sunlight received and conditions of storage, sampling and extraction (Allaith, 2008).

OTHER CHEMICAL PROPERTIES

Dates are rich in carotenoid and provatamin A. Boudries*et al*. (2007) analyzed the content of these two components in cvs. Deglet Noor, Hamraya and Tantebouchte, at khalal, rutab and tamar ripening stages. The major carotenoid pigments detected were lutein and β-carotene. Variation in total carotenoid content was detected among cultivars and ripening stages. Dates

derived from the Deglet Noor cv. contained 61.7-167 µg per 100 g of fresh weight, while Tantebouchte and Hamrayacvs. ranged from 32.6-672, and 37.3-773, respectively.The study also showed that in general carotenoids disappear during ripening from the khalal to tamar stages.

Provitamin A value also varied with cultivar and ripening stage. In Deglet Noor cv. the values were 0.4-0.5 RE per 100 g of dates and remain unchanged during ripening. However, these values decrease during ripening from 11.7 to 1.6 RE and from 3.9 to 0.5 RE per 100 g of dates derived from cvs. Tantebouchte and Hamraya respectively.

Dates possess a series of other characteristics due to their richness in dietary fibers. Rheological behavior, moisture- and oil-holding capacities are among the measurable parameters used to compare cultivars and ripening stages.

NUTRITIONAL VALUE OF DATES

The moisture content of dates decreases as they ripen (Al-Shahib and Marshall, 2003). The moisture content of fresh date is 42.4 g/100 g and it is 15.2 g/100 g on dried dates (Al-Farsi and Lee, 2008). Dates represent an important nutritional element in the diet of local populations where the trees are grown. The fruit also becomes a part of the daily intake of residents in countries importing this fruit (El Hadrami and El Hadrami, 2009). Dates contain a high percentage of carbohydrate (total sugars, 44-88%), protein (2.3-5.6%), fat (0.2-9.3%), essential salts and minerals, vitamins and an elevated proportion of dietary fiber (6.4-11.5%) (El Hadrami and El Hadrami, 2009). They also contain oil in the flesh (0.2-0.5%) and the seed (7.7-9.7%).The seed represents 5.6-14.2% of the entire fruit weight.

CARBOHYDRATES

Dates are particularly rich in carbohydrates. Sugars in dates are the most prevalent compounds (Mayo-Wilson *et al.*, 2011) as they provide a rich source of energy to humans. The average energy of fresh and dried dates is 213 and 314 kcal/100 g, respectively (Al-Farsi and Lee, 2008). Sugars, especially fructose, glucose, mannose, maltose, and other non-reducing sugars such as sucrose, represent over 80% of the dry matter. Glucose to fructose ratio varies between 1 and 2 depending on the cultivar and ripening stage. A small amount of the carbohydrates found in dates is represented by polysaccharides such as cellulose and starch (Shinwari, 1993; Al-Shahib and Marshall, 2003). Elleuch*et al*. (2008) studied the sugar content of cvs. Deglet Noor and Allig and showed that sucrose was predominant in Deglet Noor, whereas in Allig, reduced sugars were more abundant with an equal proportion of fructose and glucose. This difference was ascribed to the potential presence of high invertase activity in Allig cv. (Fayadh and Al-Showiman, 1990; Elleuch*et al*., 2008). Usually, the sugar content is lower in the kimri and khalal stages as compared to commercial dates at their full ripeness stage of tamar. Part of the sugar loss is also due to a well characterized nonenzymatic browning reaction, the Maillard reaction, which occurs during storage and involves sugars, free amino-acids and phenolics. The increase of the concentration of sugars from stage 1 to stage 4 is linked to the decrease in the water content of date during these stages (Al-Shahib and Marshall, 2003).

PROTEINS

The crude protein reduces as the fruit mature; it is 5.5- 6.4% at the kimri stage and gradually decreases to 2.0-2.5% at the tamr stage (Al- Hooti*et al*. 1997). Although dates are not a rich source of protein, they considered an important nutritional source because they contain essential amino acids (Al-Shahib and Marshall, 2003; Al-Farsi and Lee, 2008). The protein content of fresh and dried dates is 1.50 and 2.14 g/100 g, respectively. Increased amino acids content in dried dates are due to water reduction (Al-Shahib and Marshall, 2003; Al-Farsi and Lee, 2008).
Analysis of the amino acid profile of dates and their seeds derived from the cvs. Deglet Noor and Allig showed the presence of 17 different amino acids, including glutamic acid that was foremost in the seeds, representing 17-18% of total amino acids. Other essential amino acids detected in the seeds included lysine, isoleucine, leucine, methionine, threonine, valine and phenylalanine. A number of proteins with molecular weights ranging from 22 kDa to 70 kDa were also abundant in the seed of both tested cultivars.

FATS

Fresh and dried dates contain 0.14 and 0.38 g/100 g respectively, of fat contents (Al-Farsi and Lee 2008). Fat content decreased as the fruit ripen. The fatty acids in dates are constituted of saturated oleic acid (50.10% of fatty acids) and linoleic acid (19.23%) and unsaturated acids lauric acid (10.24% of fatty acids), palmitic acid (9.83%), myristic acid (7.51%) and stearic acid (1.66%) (Al-Shahib and Marshall, 2003).Drying of dates increased fat contents (Al-Farsi and Lee, 2008).

VITAMINS

Dates are very rich in vitamins, especially β-carotene (vitamin A), thiamine (B1), riboflavin (B2), niacin, ascorbic acid (C) and folic acid (folacin) (Yousif*et al*., 1982; Considine, 1982; El Hadrami and El Hadrami, 2009; Al-Farsi and Lee, 2008; Baliga*et al.*, 2011). Some of these vitamins provide 10-50% of the daily recommended intake of an adult. Ripe fruits were reported to contain a substantial amount of carotenoids including lutein and various forms of β-carotene and minor carotenoids. The contents vary with the cultivar and stage of ripeness, with the total content of carotenoids decreasing towards the final ripening stages and in storage.

DIETARY FIBERS

Fully mature dried dates have an average dietary fiber content of 4.4-6.5% (Spiller, 1993; Al- Shahib and Marshall, 2003). Three quarters of this percentage represents insoluble fibers while the remaining proportion represents soluble ones. Depending on the method used for quantification, the content of these fibers can be more or less important (Al-Shahib and Marshall, 2003). Variation was also reported to be dependent upon the stage of ripeness (Al-Shahib and Marshall, 2003). According to some studies, such as the one conducted by Al-Shahib and

Marshall (2003),six to seven dates (approximately 100g) consumed daily by an adult would provide 50-100% of the recommended daily intake. Dates were also reported to contain 0.5-3.9% pectin, thought to possess health benefits (Al-Shahib and Marshall, 2003).

ESSENTIAL MINERALS

Dates are reported to contain at least 15 essential minerals, including phosphorus, potassium, sodium, zinc, manganese, magnesium, copper, iron, fluorine and selenium (Al-Shahib and Marshall, 2003). Depending on the mineral, content varies from 0.1 to 1000 mg per 100 g dry matter of dates. Variation also depends on thecultivar and ripening stage as well as the cultural practices during the growing season, and especially soil and plant fertility. Al-Hooti*et al*. (1995) reported on the mineral content of five cultivars of dates at various ripening stages. They found that the iron content decreased in four tested cultivars from kimri to tamar ripening stage, whereas it increased in cv. Lulu. On the other hand, the authors showed that the percentages of phosphorus, potassium, calcium, sodium, magnesium and zinc decreased in all five tested cultivars of dates from the kimri to tamar stage. Dates are also considered as a good supplement for correcting iron deficiencies and anemia.

OTHER NUTRITIONAL PROPERTIES OF DATES

Dates are known for numerous other nutritional properties due to their richness in non-starch polysaccharides and lignin (Elleuch*et al.*, 2008). Total insoluble and soluble non-starch polysaccharides estimated by Englyst*et al.* (1992) showed the presence of neutral sugars such as uronic and galacturonic acids. Other nutritional properties include a number of antioxidant molecules such as polyamines, phenolics, and glutathione, known for their health enhancement attributes.

Dates represent an important source of the nutritional daily intake, especially for local populations and to the other few millions who consume dates on a regular basis. In addition, dates contain a number of phenolics such as phenolic acids, hydroxycinnamates and flavonoids including tannins (Mansouri*et al.*, 2005). These compounds are known for their beneficial effects on human health as well as against oxidation-linked chronic or degenerative illnesses such as cancer and cardiovascular diseases. Dates are considered as a good source of antioxidants (Al- Farsi *et al.*, 2005; Al-Farsi and Lee, 2008). The antioxidant metabolites contained in dates seem to be linked to the role of these phytochemicals in maintaining specific cellular homeostasis, and contributing in a preventive manner to beneficial effects across diverse biological systems and cell types. Phenolics are well known for their inhibiting pathogens and parasites.

HEALTH BENEFITS OF DATES

ROLE OF DATES AS ANTIOXIDANT

For several years, a special interest has been paid to oxidative stress; situation of an excessive production of reactive oxygen species in the organism (Saafi*et al.*, 2011). A large number of experimental and epidemiological studies have indicated that the reactive oxygen species (ROS) contribute to organ injury and in many systems (Pitsch*et al.*, 2010). A building body of evidence suggests that oxidative stress plays a key role in the pathogenesis of micro- and macro vascular diabetic complications, the pathophysiology associated with atherosclerosis, neoplasia and neurodegenerative diseases. The increased oxidative stress in subjects with type 2 diabetes is a result of several abnormalities, including hyperglycemia, insulin resistance, hyperinsulinemia, and dyslipidemia (Folli*et al.*, 2011). Therefore, a great deal of attention has focused on the naturally occurring antioxidant phytochemicals as potential therapy for cardiovascular diseases (Das and Das, 2007).

Antioxidants are compounds that can delay or inhibit the oxidation of lipids or other molecules by inhibiting the initiation or propagation of oxidative chain reaction. An antioxidant, which can reduce reactive free radicals, can prevent the oxidation of other molecules. Therefore, have health-promoting effects in the prevention of degenerative diseases (Sanzari*et al.*, 2011).

Natural dietary antioxidants from fruits such as dates are believed to activate the enzymatic and non-enzymatic antioxidant systems (El Hadrami*et al*., 2005). Epidemiological evidence suggests that a diet rich in fruits and vegetables promotes a lower incidence of chronic diseases such as cancer, cardiovascular disorders and diabetes (Tapiero*et al.*, 2002; Duthie*et al*., 2003). Date consumption, therefore, can make a contribution to management of these degenerative oxidative diseases. Among all thedietary components of dates, phenolics account for most of the antioxidant properties, exhibiting a broad range of biological effects that can be classified into two main categories. One, the direct effect of phenolics as free radical quenchers, preventing nucleic acids, proteins and lipids oxidative damage (Morel and Barouki, 1999; Jakus, 2000; Droge, 2002). Two, the ability of phenolics to biochemically and physiologically or molecularly modulate cellular physiology.

In most Muslim countries, dates are consumed in quantity during the fasting month of Ramadan. This is believed to help protect the gastric mucosa from the damaging effect of gastric acid and prevent the development of peptic ulcers (Abdelbasset and Jameel, 2012).

ANTI-MICROBIAL PROPERTIES OF DATES

In the current era, there is great reliance on processed food to feed burgeoning human populations. Modern methods of food production and processing have opened the door to invasive pathogens and pests, which cause yield and quality losses. Often fresh and transformed products still contain traces of pathogen toxins and other metabolites that can harm consumers in many ways causing temporary chronic diseases. Being very rich in phenolics, dates are known to exhibit anti-viral, -bacterial and –fungal properties, making them a remedy for certain diseases and prevention of chronic inflammations. The fruit and its by-products are rich in dietary fibers, selenium, carotenoids, ascobate, and other essential antioxidant which may prevent the oxidative damages caused as a result of lymphocytes phagocytosis activity of invasive pathogens and pests.

Although date fruit contains a significant amount of nutrients that can be utilized by microorganisms to support their growth, date fruits can typically be stored healthily in a normal warehouse for several months without showing signs of microbial growth (Zohary and Hopf, 1993). Because of this, it has been postulated that dates may contain antimicrobial and antifungal agents that may prevent microbial contamination. At the same time, several studies have shown that water or organic extraction can be used to extract and release antimicrobial compounds from plant materials (Madeha, 2012).

ANTIHYPERLIPIDEMICPROPERTIES OF DATES

Atherosclerosis is a disease of the large arteries; it is the primary cause of heart disease and stroke. Epidemiological studies have revealed that it is the underlying cause of about 50% of all deaths in the world (Lusis, 2002).The decreasing of the concentrations of high-density lipoprotein cholesterol and increasing of low-density lipoprotein cholesterol are the major cause of Coronary heart disease (Baliga*et al.,* 2011).

Studies showed that feeding rats with diet containing defatted date seed flour at 1.5%, 2.5% and at 5.2% concentration caused decreasing in plasma triglycerides, total cholesterol and low density lipoprotein (Al-Maiman, 2005). Rock *et al.* (2009) investigated that after 4weeks Medjool or Hallawi dates consumption, the VLDL-cholesterol levels tended to be reduced (by 8 or 15%, respectively, with value of $0.1 > p > 0.05$). As well as in human, the dietary fiber feeding reduces blood cholesterol concentration. The findings of these studies suggested that diet based on date seed fiber had a good major source of dietary fiber (Evans *et al.,* 1992; Kattak, 2002). Date Plant leaves (DPL) extracts could have a protective effect against hyperlipidemia through improvement of lipid profile (Abuelgassim, 2010). However, the total lipids in the date decreased with the maturity stage progressing (Amira *et al.,* 2011). The fat component of the date skin plays a potential protective role for the date contents (Shafiei*et al.,* 2010).

IMMUNO-MODULATORY PROPERTIES OF DATES

Dates being rich in both phenolics and dietary fibers can play an important role in the modulation of the immune system and prevention of cardiovascular diseases. Lower incidences of cardiovascular disorders are expected in populations relying on a regular intake of dates. This is believed to occur through the inhibition ofthe oxidation of low-density lipoprotein (Frankel *etal*., 1993) and through the prevention of platelet aggregation. Phenolics contained in dates may also be able to reduce blood pressure and have antithromboticand anti-inflammatory effects as shown for other fruits (Gerritsen*et al.* 1995; Muldoon and Kritchvesky, 1996). In addition, phenolics are known to inhibit α-amylase and α-glucosidase activities behind the postprandial increase in blood glucose level, often manifesting in type-II diabetes (Andlauer and Furst, 2003; McCue and Shetty, 2004).

The immune modulatory activities of phenolics derived from dates include anti-allergic (Noguchi *et al*., 1999) properties able to suppress the hypersensitive immune response. It also includes anti-inflammatory responses triggered by the suppression of the tumor necrosis factor-α- mediated pro-inflammatory pathways (Ma and Kinneer, 2002).

HEPATOPROTECTIVEACTIVITY OF DATES

Liver diseases are one of a global problem and the major threats to public health, with high endemicity in developing countries (Asha and Pushpangadan, 1998; Adewusi and Afolayan, 2010). The majority of the hepatotoxic chemicals damage liver cells by inducing lipid peroxidation and other oxidative damages (Recknagel, 1983;Adewusi and Afolayan, 2010). Liver plays an essential role in transforming and clearing metabolites and xenobiotics, and is susceptible to the toxicity from these agents (Hrvoje*et al.,* 2009).

According to Muslims believe that ‘‘who eats seven dates every morning will not be affected by poison or magic on the day he eats them’’ (Miller *et al.,* 2003; Bruck*et al.,* 2001; Bastwayet *al.,* 2008;Jassim and Naji, 2010; Al-Qarawi*et al.,* 2001). Several studies assess the ability of date flesh and pits in prevention or treatment of some of the toxic actions of different substances such as carbon tetrachloride (CCl4), thioacetamide (TAA) and dimethoate poisoning on the liver of rats. Which are model for acute viral hepatitis, induced hepatotoxicity, elevation in plasma enzyme and bilirubin concentration and increase significantly serum glucose level (Al-Qarawi*et al.,* 2001; Brucket *al.,* 2001; Al-Qarawi*et al.,* 2004;Bastway*et al.,* 2008; Pitsch*et al.,* 2010).

Studies showed that feeding rats with the aqueous extracts of date flesh or pits reduce significantly the levels of the hepatic markers enzymes (alkaline phosphatase, transaminases, gamma-glutamyl transferase and lactate dehydrogenase), hepatic levels of malondialdehyde and concomitantly increased the levels of antioxidant enzymes (Bastway*et al.,* 2008). In addition, date pit extract shown its ability to restore the normal functional status of the poisoned liver, and protect against subsequent carbon tetrachloride hepatotoxicity on the liver of rats (Al-Qarawi*et al.,* 2004; Jassim and Naji, 2010). Moreover, Studies confirmed that selenium, ferulic acid, anthocyanin, caffeic acid, quercetin, chlorogenic acids, proanthocyanidins, β-carotene, apigenin and luteolin are the date constituents which have all been reported to acquire hepatoprotective effects against the CCl4-induced hepatic damage in rodents (Al-Qarawi*et al.,* 2004;Pitsch*et al.,*2010). Similarly, Al-Qarawi*et al.*(2004) showed that the daily oral consumption of an aqueous extract of dates was protective agonist CCl4 poisoning by 80% for flesh and 70% for pits of dates.

FUNCTIONAL AND NUTRACEUTICAL ADDED-VALUE OF DATES

In recent years there has been increasing interest in identifying food and by-products that can serve as functional foods and nutraceticals to enhance the well-being of individuals and reduce the risk of various diseases and disorders. Dates consumed fresh or in by-products represent a good source for many nutritional elements, making them a potential source of both functional food and nutraceuticals (Abdelbasset and Jameel, 2012).

Metabolic processes in humans generate oxidant by-products that over time cause extensive damages to DNA, protein and lipid. These damages contribute to various degenerative diseases and disorders linked to aging, such as cancer, cardiovascular disease, immune-system decline, brain dysfunction and cataracts. There are several other exogenous factors that contribute to an increase in oxidative damage. These include smoking, a diet rich in iron and/or copper (i.e., excessive meat uptake) and a poor diet that does not include sufficient fruits and vegetables.

Defences against oxidative damage include ascorbate, tocopherol and carotenoids; dates represent a good source for these antioxidants. In recent years, an increasing demand on the exploration of potential nutraceuticals derived from dates has been noted. Biglari*et al*. (2008) analyzed the total phenolics, especially flavonoids, in different cultivars of dates stored for six months and suggested that certain storage conditions could diminish the antioxidant activity of the fruits. Other studies have focused on adding value to various by products derived from dates such as the pits, jams, syrup, jellies and others (Elleuch*et al*., 2008).

DATES AND DIABETES

Diabetes is the most common endocrine disorder, which can lead to hyperglycemia which is related to microvascular and macrovascular complications (Mokhtari*et al.,* 2008; Aryangat and Gerich, 2010; Ovbiagele*et al.,* 2011). Prevalence of diabetes increased recently due to rapid social and lifestyle change (Miller *et al.,* 2002). The incidence of diabetes is expected to increase in the future (Mokhtari*et al.,* 2008).

The glucose: fructose ratio of the date was approximately 1.5:1 at the kimri stage, but decreased to 1:1 at the tamr stage (Al-Hooti*et al.,* 1997). The ratio of glucose to fructose in dates can be of great interest because fructose is about twice as sweet as glucose and it is considered less diabetogenic than glucose (Biglari, 2009). Using low glycemic index (GI) diets are useful in the management of diabetes (Brand-Miller *et al.,* 2003). El-Mougy*et al.* (1991) and Gilbertson *et al.,* (2001) showed that consuming low-GI diet improved glycaemic control and quality of life for children with type 1 diabetes.

Dates can be classified as low (GI) (Ovbiagele*et al.,* 2011) that reduces HbA1c (Brand-Miller *etal*., 2003; Jenkins *et al*., 2008; Alkaabi*et al.,* 2011). Low (GI) likely to be due to the high fructose in dates (Miller *et al.,* 2003). There is evidence to support dates benefits when mixed with meals in terms of glycaemic control (Brand *et al.,* 1991; Gilbertson *et al.,* 2001). Composition of various types of dates alone or in mixed meals with plain yoghurt may be of benefit in glycemic control in diabetic patients (Miller *et al.,* 2002; Miller *et al.,* 2003). This does not result in significant postprandial glucose excursions (Alkaabi*et al.,* 2011). Diabetic patients cannot be worrying for consumption of six to eight tamer and eight to 10 rutab dates (Miller *et al.,* 2003).

Dietary fiber content of date changes during ripening (Al-Shahib and Marshall, 2002). Fiber consumption helps in regulation of glucose absorption and insulin secretion and decreased HbA1c (Jenkins *et al.,* 2008). So high-fiber diets are recommended for diabetic patients.Magnesium and zinc in dates stimulate the synthesis and secretion of insulin. Manganese also mimics insulin properties, which lead to hypoglycemic effect (Mokhtari*et al.*, 2008).

ANTI-TUMORAL AND ANTI-ULCER PROPERTIES OF DATES

Several studies have demonstrated the anticarcinogenic properties of phenolics, several of which are abundantly present in dates (Mitscher*et al*. 1996; Uenobe*et al*., 1997). Phenolics are believed to interfere with the development of malignant tumors at various stages (Kuroda and Inoue, 1988). The anti-carcinogenic effect of phenolics has also been linked to their anti-mutagen activity (Mitscher*et al*., 1996; Uneobeet *al*., 1997) or their ability to inhibit the activity of enzymes involved in the formation of procarcinogens (i.e., cytochrome P450 class).

Phenolics were shown to be responsible for the decrease in carcinogenic potential resulting from mutagen exposure (Bravo, 1998). Phenolics such as caffeic and ferulic acids, highly present in dates, are known to react with nitrite and inhibit the in vivo formation of nitrosamine, hence inhibiting skin tumors (Kaul and Khanduja, 1998).

In addition to controlling oxidation-mediated disorders, phenolics have been ascribed the ability to reduce the impact of infectious diseases. Yoshida *et al.* (1990) examined the effects of quercetin, one of the flavonoid commonly found in dates, on cell growth of human malignant cells derived from the gastrointestinal tract and on cell cycle progression. Results showed that quercetin noticeably inhibited the growth of human gastric cancer cells with an IC50 value of 32-55 μM. The flavonoid was also able to suppress DNA synthesis by 14% as compared to the control while blocking cell progression from the G1 to the S phase.

Al-Qarawi*et al*. (2005) used ethanol-induced gastric ulceration in rats as a model, to test the medicinal claim that dates are effective against gastric ulcers in humans. The study showed that both the aqueous and ethanolic extracts of dates derived from the fruit were effective in improving the severity of gastric ulceration and in extenuating the ethanol-induced increase in histamine and gastrin concentrations, and the decrease in mucin gastric levels. The basis of the gastro protective action of date extracts may be multi-factorial, and may include an anti-oxidant action given the fact that ethanolic un-dialyzed extract was more effective than the other extracts used.

CONCLUSION

Date palm is one of the oldest trees cultivated by man. Dates have been a part of human diet for over 6, 000 years and are proven to contain high levels of carbohydrate, proteins, vitamins, dietary fibers, and essential minerals and antioxidants, while containing low levels of fat. The nutritional value of this fruit consumed fresh or in the form of many other derived by-products is important worldwide. This detailed information on nutritional and health promoting components of dates

enhance ourknowledge and appreciation for the use of dates in our daily diet and as a functional food ingredient.

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