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Date palm: Miracle tree for semi-arid region of India

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Abstract

“Trees for life” is becoming very popular slogan in an international context. Trees have been the way of life since time immemorial for livelihood security and reducing vulnerability to climate-related risks. The utilization of trees and their products (*viz.* 6F’s food, fruit, fiber, fertilizers, fodder and fuelwood) for the sustenance are intricately woven with indigenous, traditional, and farmers knowledge. In this context, one such important tree species of semi-arid tract of India is widely utilized for a number uses due to their multivarious benefits i.e. *Phoenix sylvestris* date palm tree. This tree is widely growing near water bodies, road side, canal side, wastelands, farmland, households and railway track in Madhya Pradesh, Maharashtra, Gujarat, Uttar Pradesh, Rajasthan, Haryana, Bihar and Deccan plateau of India. Traditionally date palm juice for jaggery and toddy; leaves for brooms, mattresses, thatching material, baskets, ropes, tiffins, marriage crowns, fodder; fruits for edible purpose; stem for beams or construction material and trees for ornamental etc. are used in rural areas. The every part of the tree is useful and providing livelihood supports to tree dependent communities. This plant has been instrumental for landless traditional craftsmen in providing a substantial livelihood through their own indigenous wisdom in every stage of the palm’s maintenance from collection to the processing of products. The agroforestry survey, exploration visits and interviews have provided very beneficial information about utilization and conservation status. In this paper, different case studies have been discussed to understand the utilization pattern and livelihood dependency of this neglected species. Also the unscientific harvesting of date palm is hampering the growth and reproduction. Therefore, the “Kalpavriksha of Semi-arid region” needs to be domesticated in farmland by developing suitable agroforestry models, so the livelihood of people and conservation of the species should be undertaken.

Keywords: Agroforestry, *Phoenix sylvestris*, semi-arid, livelihood, climate

Introduction

Date palm tree (*Phoenix dactylifera* L.) is considered as one of the oldest and main staple and ancient crops in Southwest Asia and North Africa. Besides, dates can be grown in Australia, Mexico, South America, southern Africa, and the United States, especially in southern California, Arizona, and Texas (Chao and Krueger, 2007; Al-Harrasi *et al.*, 2014; Hazzouri *et al.*, 2015) [18, 5, 40]. Date palm tree belongs to Arecaceae family (Angiosperms, monocotyledon) consisting of about 200 genera and more than 2,500 species. Phoenix (*Coryphoideae phoenicea*) is one of the genera with approximately 14 species (Table 1), which are native to the tropical or subtropical regions of southern Asia or Africa, including *Phoenix dactylifera* L (Siddiq *et al.*, 2013; Eoin, 2016) [63, 33].

Traditional knowledge and wisdom of the local people is very important to document our heritage. Asia in general and India in particular have a distinct traditional knowledge, which is found not just as oral tradition but also in form of classical literature. It is high time to work on traditional agriculture for strengthening and revitalizing of sustainable agriculture based on traditional knowledge and wisdom in various parts of India (Patil *et al.*, 2014) [57]. One such practice, which is being followed since decades, is agroforestry.

Agroforestry systems are believed to provide a number of ecosystem services; however, until recently, evidence in the agroforestry literature supporting these perceived benefits has been lacking (Jose, 2009) [45]. This paper is hence, put forth for the development of *Phoenix sylvestris* based agroforestry models for livelihood security.

The Palm family (Palme, or more recently Arecaceae), with some 2200 species, is distributed throughout the tropics and subtropics (Johnson, 1996) [44], representing an integral and important part of tropical forests (Johnson, 1995). *Phoenix sylvestris* Roxb., together with 13 other species, forms the genus Phoenix (Govaerts and Dransfield, 2005) [38].

In a phylogenetic study combining morphological, anatomical and genetic data, it appears close to the date palm (*Phoenix dactylifera* L.) and to *Phoenix theophrasti* (Barrow, 1998) [17]. The phylogeny of the genus itself remains to be elucidated. Wild date palm,

is one of the oldest fruit trees in the world, having originated most likely in Mesopotamia (modern Iraq) 5000 to 10,000 years ago (Zohary and Hopf, 2000) [70] and the vast majority of the trees are located in northern Africa, the Middle East, Bangladesh, Sri Lanka, Pakistan and India (Hodel and Johnson, 2007) [41]. *Phoenix sylvestris* Roxb. Is a long-lived monocotyledonous medium-sized slow growing plant species, 7-20 m tall, with greyish-green leaves, textured trunk and yellow inflorescence. Leaves are very developed, erect, arranged in a special pattern on the trunk and can reach several square meters in area. Sheathing becomes denser at the top of the tree forming a crown with hundreds of leaves forming a terminal rosette. The use of *Phoenix sylvestris* for

medicinal purpose and oral dental care has been reported (Barh and Majumdar, 2008; Mohanty *et al.*, 2012) [15, 52]. This plant also provide a multitude of useful products such as handicrafts and mats, screens, thatching and fencing materials, baskets, crates, fuel wood and house brooms and is the main subsistence resource for the poorest people (Balslev and Barford, 1987; Dalibard, 2007 and Rana and Islam, 2010) [14, 21, 58].

Being such a versatile tree species not much work has been done on introduction of this species in agroforestry hence, the present paper presents different case studies to understand the utilization pattern and livelihood dependency of this neglected species.

Table 1: Species of the genus phoenix along with their common local name and geographical distribution

S. No.	Species	Local Name	Geographical distribution
1.	<i>Phoenix acaulis</i>	Stemless date palm	Bhutan, Nepal, Northern India
2.	<i>Phoenix andamanensis</i>	Andaman Island date palm	Myanmar
3.	<i>Phoenix atlantica</i>	Cape Verde Island	Cape Verde Islands
4.	<i>Phoenix caespitosa</i>	Oman	Saudi Arabia
5.	<i>Phoenix canariensis</i>	Canary Islands date palm	Australia, Bermuda, Canary Islands, Italy, Spain
6.	<i>Phoenix dactylifera</i>	Date palm	Arabian Peninsula, Australia, California, China, El Salvador, Fiji, Iran, India, Mauritius, northern and western Africa, Pakistan, Spain
7.	<i>Phoenix loureiroi</i>	Mountain date palm	China, Himalayas, India, Indochina, Philippines
8.	<i>Phoenix paludosa</i>	Mangrove date palm	Andaman, India, Indochina, Sumatra
9.	<i>Phoenix pusilla</i>	Ceylon date palm	India, Sri Lanka
10.	<i>Phoenix reclinata</i>	Senegal date palm	Africa, Arabian Peninsula, Comoros, Madagascar
11.	<i>Phoenix roebelenii</i>	Pygmy date palm	China (Yunnan) to North Indo-China
12.	<i>Phoenix rupicola</i>	Cliff date palm	Andaman Islands, Bhutan, India
13.	<i>Phoenix sylvestris</i>	Indian date palm	Indian Subcontinent, Myanmar, southern China
14.	<i>Phoenix theophrasti</i>	Cretan date palm	Greek Islands, Turkey

Chevalier (1952)

Importance of date palm

The date palm is a major agricultural crop in the Near East and North Africa, and it has historically been connected with sustaining human life in many of the hot and barren parts of the old world and has become an integral part of the culture and tradition of the people of these regions (Sawaya, 2000) [61].

Date palms grow from Morocco in the west across the lower-altitude expanses of the Arab countries up to the foothills of the Himalayas. It is also found in pockets elsewhere in the world, notably in the American South west where date cultivation was first introduced by Spanish missionaries and where early in the 1900's offshoots imported from Algeria and Iraq were planted for commercial purposes (Saudi Aramco World, 1962) [60]. The date palm needs a climate with plentiful sun, minimal rain, yet good access to water, which to a large extent is only provided by oases. They are very cold tolerant, salt tolerant; they can also take extreme heat, dry and wet conditions (Saudi Aramco World, 1962) [60]. Within the climatological limits of where the palms are now grown, the upper range of temperature tolerance is of little importance to the palm. Maximum temperatures of around 50°C as they occur do not harm the palm (Barrevel, 1993) [16]. In Arab countries, the date palm is considered one of the main fruit crops. The number of date palms, as well as date production and consumption, vary from one country to another due to prevailing environmental conditions, the intention paid to this crop and social conventions. The major producers of dates in the world are situated in the Arabia Gulf and North Africa. Kader and Hussein (2009) [46] reported that in 2006, world production of dates was about 7 million tones and the top 10 producing countries were Egypt, Saudi Arabia, Iran, United Arab Emirates, Pakistan, Algeria, Sudan, Oman, Libya, and

Tunisia. There are thousands of date palm cultivars, including those with soft, semi-dry, and dry fruits (depending on their water and type of sugar content at harvest when fully-ripe), grown in these countries (Kader and Hussein, 2009) [46]. This is true as the Arab countries possess the majority of world's date palms and produce the majority of the world's total date crop (FAOSTAT, 2009) [34]. The date palm not only provides a concentrated energy food, it also creates a more amenable habitat for the people to live in by providing shade and protection from the desert winds. In addition, the date palm yields variety of products for use in agricultural production and for domestic utensils. Modern technological developments have made it possible to look at the palm as a raw material source for industrial purposes. Practically all parts of the date palm, except perhaps the roots, are used for a purpose best suited to them.

The fruit of the date is a drupe and has one seed, which can vary in size, shape, color and quality of flesh. The date itself is a high energy food item for both people and livestock. Since ancient times, the date palm has been a source of food for the inhabitants of the Arab countries. Dates have proved to be the best resource to ensure food security during food shortages and crises.

The date palm is a crop capable of establishing a sustainable system in subsistence agricultural areas and thus plays an important social role in reinforcing the subsistence base of a large population group by helping them to settle in rural areas versus migration to urban centers (Sawaya, 2000) [61]. The tree is a spectacular palm for landscaping large areas. It provides shade and protection from wind. It also prevents soil degradation and desertification, thus protecting the environment. In fact, the date palm represented an eloquent example of integrated sustainable use of renewable material

resources (EI-Mously, 1998) [29]. The most commonly used parts of the date palm are its fruits, bark and leaves and they have the many commercial and medicinal applications.

Date, the primary product of the palm, is rich in protein, vitamins, and mineral salts. So that it represents an essential element of diet for the cultivator himself and his animals (EI-Mously, 1998) [29]. In recent times, there has been a renewed interest in the date as a food source, not necessarily as a staple food, but rather as a component in food preparations like sweets, confectionery, baking products, institutional feeding and health foods (Barreveld, 1993) [16].

Suggested cultivation practices for date palm

The following cultivation practices:

Soil

There are no specific soil requirements but for higher production sandy loams with good moisture retaining capacity, proper drainage and aeration are recommended. Date palm is tolerant to soil salinity of up to 4 dsm⁻¹.

Climate

For the best growth, flowering and fruiting, along summer with long days as well as high temperature, a mild winter without for stand the absence of rain during flowering and fruit setting with low relative humidity and plenty of sunshine are required.

Irrigation

Adult palms need to be irrigated every 15 d during winter and every 7d in summer.

Pruning

This consists of pruning of diseased and old leaves, removal of spines, cutting of undesirable in florescence's and thinning of clusters/strands or fruits. Generally then number of leaves on the tree determines the number of retained in florescences. An insufficient number of leaves affects the fruit quality and reduces the number of mature fruits.

Intercropping

During the early years inter cropping can be do net generate additional income and to provide protection to young palm trees against heat. Plants likeable (Indian gooseberry), fig, bathal (monkey fruit, lakoocha), seethaphal (custard apple), red gram, green gram, horse gram, till (sesame), sunflower, maize, juwar (sorghum) and ragi (finger millet) can be grown. For such plantings additional irrigation must be provided.

Pollination is by hand

For better pollination honey bee rearing should be introduced. Date-palm flowering is during January to February. Fruit harvest is in June or July. After 5 yr of planting the fruit is collected at three stages. The fruiting begins from the fifth year of planting.

Underdrip irrigation the yield in year 5 is 50 kg, year 6 is 60 kg, years 7 and 8 is 100 kg and in year 9 reaches 150 kg. The average of 150 kg date palm fruit spray ear for a tree assumes that it is healthy. The date palms yield well for up to 50 yr but for following 50 yr the yields decrease. For better pollination and fruit yield 10 males are necessary for 100 female plants (Dates India, 2011b).

Uses of dates and date palms

Date palms produce many products that are useful to humans. The primary product is the date fruit, which can be eaten

fresh, dried, or in various processed forms. In North Africa and the Middle East, some dates are harvested and consumed during the Khalal stage, when the fruit are still very astringent with a high tannin content (Dowson and A ten, 1962; Glasner *et al.*, 2002; Kader, 1992) [24, 37]. However, most dates are harvested during the fully ripened Rutab and Tamar stages, when they are high in sugar and low in moisture and tannin. Cultivars of dates can be classified into "soft," "semidry," or "dry" dates, depending upon the time of harvest and associated water content. Some cultivars are used in more than one manner. Fruit quality is influenced by size, color, texture, cleanliness, freedom from defects (sunburn, insect damage, sugar migration to surface, fermentation), and the effects of decay-causing pathogens. Date fruit are available in different forms, including whole pitted and UN pitted, dehydrated pieces, diced, extruded date pieces, and macerated fruit. Dates can be used in cereal, pudding, bread, pressed cakes, cookies, candy bars, ice cream, and date shakes (a California specialty). Date fruit also can be made into juice, vinegar, wine, beer, sugar, syrup, honey, chutney, pickle, paste, dip, and food flavoring (Barreveld, 1993; Glasner *et al.*, 2002) [16, 37].

Date fruit are high-energy food sources with 72% to 88% sugar content at maturity. During the Khalal stage, nearly all (80% to 85%) of the sugar is sucrose. As ripening progresses, the sucrose is hydrolyzed introduced sugars such as glucose and fructose. Date fruit are good sources of iron and potassium; a fair source of calcium, chlorine, copper, magnesium, and sulfur; and a minor source of phosphorus. In addition, dates are a source of 16 amino acids and vitamins A, B1, and B2 (Ahmed *et al.*, 1995; Vandercook *et al.*, 1980) [3, 67].

Nutritional value of dates

The moisture content of dates decreases as they ripen (Al-Shahib and Marshall, 2003) [10]. 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) [4]. 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) [30]. 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) [30]. 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) [49] 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) [4]. 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) [62, 10]. Elleuch *et al.* (2008) [32] 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) [35, 32]. 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 non enzymatic 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) [10].

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 Tamar stage (Al-Hooti *et al.* 1997) [7]. 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) [10, 4]. 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) [10, 4]. 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) [4]. 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) [10]. Drying of dates increased fat contents (Al-Farsi and Lee, 2008) [4].

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) [69, 20, 30, 4]. 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) [64, 10]. 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) [10]. Variation was also reported to be dependent upon the stage of ripeness (Al-Shahib and Marshall, 2003) [10]. According to some studies, such as the one conducted by Al-Shahib and Marshall (2003) [10], 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) [10].

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) [10]. Depending on the mineral, content varies from 0.1 to 1000 mg per 100 g dry matter of dates. Variation also depends on the cultivar and ripening stage as well as the cultural practices during the growing season, and especially soil and plant fertility. Al-Hooti *et al.* (2002) [6] 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.

Dates and diabetes

Diabetes is the most common endocrine disorder, which can lead to hyperglycemia which is related to microvascular and macro vascular complications (Mokhtari *et al.*, 2008; Aryangat and Gerich, 2010; Ovbiagele *et al.*, 2011) [53, 12, 55]. Prevalence of diabetes increased recently due to rapid social and lifestyle change. The incidence of diabetes is expected to increase in the future (Mokhtari *et al.*, 2008) [53]. The glucose: fructose ratio of the date was approximately 1.5:1 at the kimri stage, but decreased to 1:1 at the Tamar stage (Al-Hooti *et al.*, 1997) [7]. 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) [19]. Using low glycemic index (GI) diets are useful in the management of diabetes (Brand-Miller *et al.*, 2003) [20]. El Mougy *et al.* (1991) and Gilbertson *et al.*, (2001) [36, 41] 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) [63] that reduces HbA1c (Brand-Miller *et al.*, 2003; Jenkins *et al.*, 2008) [19, 47]. Low (GI) likely to be due to the high fructose in dates (Miller *et al.*, 2003) [56]. There is evidence to support dates benefits when mixed with meals in terms of glycaemic control (Brand *et al.*, 1991; Gilbertson *et al.*, 2001) [18, 41]. 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.*, 2003). Diabetic patients cannot be worrying for consumption of six to eight tamer and eight to 10 rutab dates (Miller *et al.*, 2003) [56]. Dietary fiber content of date changes during ripening (Al-Shahib and Marshall, 2002) [55]. Fiber consumption helps in regulation of glucose absorption and insulin secretion and decreased HbA1c (Jenkins *et al.*, 2008) [43]. 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)^[53].

Health importance of dates

It is believed that natural antioxidants present in dates are helpful to activate both enzymatic as well as non-enzymatic antioxidant system (El. Hadrami *et al.*, 2005)^[31]. Fruits and vegetables are an important source of these dietary antioxidants and epidemiological studies showed that their regular intake in diet may decrease the risk of several chronic diseases like diabetes, cancer and cardiovascular (Tapiero *et al.*, 2002; Duthie *et al.*, 2003)^[66, 28]. Antioxidants present in dates are glutathione, polyamines and phenolic. Among the phenolics present in dates are hydroxycinnamates, phenolic acids and flavonoids. In this way, date consumption may contribute towards the management of these degenerative diseases. The Major antioxidant activity of dates is due to phenolics. Biological effects caused by phenolic can be categorized into two main groups. First, one is the prevention of lipids, nucleic acids and proteins from oxidative damage by acting as a free radical scavenger (Al-Farsi and Lee, 2008; Jakus, *et al.* 2000; Dröge, 2002)^[4, 25]. Second one is its ability to modulate the cell physiology by physiologically or biochemically. From ancient times, date has been used in several medicines to treat diseases like hypertension, diabetes, cancer (Tahraoui *et al.*, 2007)^[65], atherosclerosis (Duke, 2000)^[27] and as an antibacterial (Sallal, 1988)^[59], antifungal and immune-modulator (Abu-Elteen, 2000)^[2]. Dietary antioxidants in dates help to protect the body from various degenerative disorders like neurological, cardiovascular diseases and ulcer (Halliwell, 1999; Abdollahi M. *et al.*, 2004)^[39, 1] and gastric ulcer by minimizing oxidative stress (Al-Qarawi, 2005)^[9].

Immuno-modulatory properties

Dates due to their high fiber and phenolic contents can play a potent role in the prevention of cardiovascular disease and modulation of the immune system. Prevention of cardiovascular disease may be due to inhibition of platelet aggregation as well as oxidation of low density lipoprotein. Phenolics due to their anti-inflammatory and antithrombotic effect may be able to reduce blood pressure (Gerritsen *et al.*, 1995; Muldoon and Kritchevsky, 1996)^[36, 54]. In addition to these benefits, phenolic are also able to manifest in type- II diabetes by inhibiting the activities of α -glucosidase and α -amylase to increase blood glucose level (McCue and Shetty, 2004)^[50]. Phenolic derived from dates are also able to suppress the hypersensitive of immune response due to their anti-allergic immunomodulatory activities. The immunomodulatory activities of phenolic also include anti-inflammatory responses triggered by the suppression of pro-inflammatory pathways (Ma Q, 2002)^[48].

Medicinal value of date fruit

Antioxidant, Anti-inflammatory, Ant mutagenic, 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 (Lambiotte, 1982; Duke, 1992; Vyawahare *et al.*, 2012)^[47, 26, 68] as they have been shown to contain antioxidant

and antimutagenic properties. 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, 2008)^[8]. Panahi and Asadi (2009)^[56] 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)^[51].

Conclusion

Date palm is one of the oldest trees cultivated by man. Dates have been a part of human diet for over 6000 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 our knowledge and appreciation for the use of dates in our daily diet and as a functional food ingredient. 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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