



# Dates palm (*Phoenix dactylifera* L.) Fruits: Nutritional Properties and Potential Applications

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## **Dates palm (Phoenix dactylifera L.) Fruits: Nutritional Properties and Potential Applications**

### **المستخلص :**

نخيل التمر هي واحدة من أقدم أشجار الفاكهة على وجه الأرض وترتبط ارتباطاً وثيقاً بالحياة البشرية في الشرق الأوسط منذ العصور القديمة، بما في ذلك المملكة العربية السعودية، التي تعتبر البلد الأم لنخيل التمر وثاني أكبر منتج لفاكهة التمر في العالم وصفوف البلدان المتقدمة في زراعة وإنتاج التمور بجميع أنواعها. ويعزى التمييز النسبي إلى سببين في هذا المجال ؛ الموقع الجغرافي، الواقع في المنطقة الصحراوية، وتجربة المزارعين السعوديين. التمر له قيمة غذائية عالية، وهو غني بالكربوهيدرات الغذائية والألياف والبروتينات والمعادن والفيتامينات المتعددة، بما في ذلك مركب فيتامين ب. لذلك، كان هناك اهتمام متزايد بخصائص التمر المعززة للصحة، مما أدى إلى الحاجة إلى تطوير منتجات غذائية تستخدم التمر كمصدر غني للمغذيات. وبالنظر إلى زيادة الهدر السنوي للتمور، الذي يقدر بنسبة ٢٠-٣٠ في المائة، وهو أمر غير قابل للتسويق أو فائض الإنتاج عن السنوات السابقة، فإن القيمة الغذائية لا تستخدم أو تستغل. وبالتالي، يركز هذا الاستعراض على الاستفادة من هذه التمور في تطبيقات غذائية متنوعة ذات قيمة تغذوية عالية.

**الكلمات المفتاحية:** التمور، القيمة الغذائية، مضادات الأكسدة، المنتجات الثانوية، الأغذية الوظيفية.

### **Abstract:**

Date palm is one of the oldest fruit trees on Earth and has been closely associated with human life in the Middle East since ancient times, including Saudi Arabia, which is the parent country of date palm, the second largest producer of date fruit in the world and the ranks of developed countries in the cultivation and production of dates of all kinds. Relative discrimination is due to two reasons in this area; Geographical location, located in the desert area, and the experience of Saudi farmers. Dates have a high nutritional value, and are rich in dietary carbohydrates, fibers, proteins, minerals, and multivitamins, including vitamin B compound. Therefore, there has been growing interest in the health-enhancing properties of dates, resulting in the need to

develop food products that use dates as a rich source of nutrients. Given the increase in dates' annual wastage, estimated at 20-30 %, which is not marketable or excess production from previous years, the nutritional value is not used or exploited. Accordingly, this review focuses on the use of diversified dietary applications with high nutritional value.

**Keywords:** Dates, Nutritional Value, Antioxidants, By-Products, Functional Foods.

### **Introduction:**

The date palm (*Phoenix dactylifera* L) is the most important crop of the Gulf region in the Middle East (Al-Abdoulhadi et al., 2011). There is a difference between historians in determining the original homeland of the date palm, as opinions suggested that it belongs to the Arab Gulf region, as it is the largest palm region in the world, and then it was transferred to Iraq about four thousand years BC (Ali, 2010). More than 2,000 different types of dates are grown around the world (Tang et al., 2013). The date palm (*Phoenix dactylifera* L.) is a common tree in Saudi Arabia, especially in desert locations. It is important for food production as well as food security. Arab countries produced 75 percent of global date production (about 5,096.99 tons) (Elfeky & Elfaki, 2019).

According to (Shaikh et al., 2019) the Kingdom of Saudi Arabia is one of the top 10 dates producing countries in the world. A considerable portion of the dates in countries producing dates (e.g., 30% of total production) is lost owing to poor quality, damage, and smaller fruits for the consumer's unattractive appearance (Besbes et al., 2009).

Besides, during the post-harvest process, up to 20% of the annual production of date fruits might be lost due to overripening, rough handling and transportation, incorrect

storage, contamination, and improper packaging (Nancib et al., 2015). These low-quality dates have great nutritional value as they are rich in carbohydrates, dietary fiber, antioxidants, and phenolic compounds, which makes them an added value in the food industry( Al-Farsi et al., 2007; Rambabu et al., 2020). Thus not using them as a by-product is a real economic loss (Elleuch et al., 2008).

### **The Nutritional Value of Dates:**

The date palm's fruit is high in nutrients and is mentioned multiple times in the Holy Quran. The date is recommended in Islamic and traditional medicine for health and disease prevention since it contains several micronutrients in addition to being a good energy source (Mousavi et al., 2014). kimri, khalal, rutab, and tamer are the four stages of ripening of date fruits (Ashraf & Hamidi-Esfahani, 2011). The chemical composition of date fruits changes depending on the stage of maturity, cultivar, growing environment, post-harvest conditions, and a variety of other factors. The chemical composition of the date fruit also influences its nutritional and therapeutic properties (Tang et al., 2013).

Carbohydrates, which include reducing sugars like glucose and fructose as well as non-reducing sugars like sucrose, and small amounts of polysaccharides like cellulose and starch, are the major chemical constituents of dates (Aljaloud et al., 2020). Dried dates have a higher sucrose content than soft dates. Soft dates contain reducing sugars, except for a few varieties that contain sucrose (Eltayeb et al., 1999; Tafti & Fooladi, 2006). Dates are a high source of energy because they contain 70% carbohydrates, with 100 grams of the pulp containing around 314 calories(Baliga et al., 2011).

Dates contain between 1% and 7% protein, which includes essential amino acids required for human metabolic function. Date proteins, contain twenty-three (23) different amino acids,

some of which are not found in common fruits like oranges, apples, and bananas. The amino acids lysine, histidine, arginine, aspartic acid, threonine, glutamic acid, serine, proline, glycine, alanine, cystine, valine, methionine, isoleucine, leucine, tyrosine, and phenylalanine are found in most date cultivars (Ayad et al., 2020).

Dates have a low-fat content. Fresh dates (kimri stage) have about 0.14 g fat per 100 g, while dried dates have about 0.38 g per 100 g (tamer stage). Lipids are mostly concentrated in the skin and are more important for protecting the fruit than for contributing to the date's nutritional value. Dates contain both saturated and unsaturated fatty acids. 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 (Ibrahim et al., 2021).

Dates contain dietary fiber, which may contribute significantly to raising their nutritional value (Maqsood et al., 2020). The total dietary fiber content of date fruits has been estimated to be between 6.5 and 11.5%. (up to 90 percent of which is insoluble and 10 percent of soluble dietary fiber) (Al-Shwyeh, 2019). Dates have a total dietary fiber level of 6.26 to 8.44 g/100g, with 84 % to 94 % insoluble fiber (Ishurd et al., 2002).

A daily intake of 100 g of dates delivers around 50% to 100% of the recommended daily fiber intake (Aljaloud et al., 2020).

Dates are rich in many nutrients, with dried dates containing 15 minerals that are beneficial as a dietary supplement for an example magnesium, manganese, phosphorus, iron, calcium, potassium, sodium, and zinc. Depending on the mineral, the percentage of each mineral in dried dates varies (Ibrahim et al., 2021). Each mineral's percentage in dried dates

varies from 0.1 to 916 mg/100g of date flesh (Aljaloud et al., 2020; Khan et al., 2008). Dates flesh contains a high percentage of potassium, as it is the predominant microelement in them (Ayad et al., 2020). They also contain low levels of sodium and high concentrations of iron (Gnanamangai et al., 2019). Dates contain a wide range of vitamins such as vitamin A, B1, B2, B3, B5, and vitamin C. Dates contain vitamin A, which possesses antioxidant properties (Gnanamangai et al., 2019). Furthermore, because vitamins are depleted during the drying process, fresh dates have higher vitamin concentrations than dried dates (Hamad et al., 2015; Hassan et al., 2017).

Dates are a rich source of antioxidants. Among them, especially carotenoids (beta-carotene, lycopene, lutein, zeaxanthin, and neoxanthin), phenols; Cinnamic acids and their derivatives, flavonoid glycosides, flavones, flavonols, flavoxanthin, anthocyanins. On the other hand, the concentration of these phytochemicals in dates diminishes as they continue to progress into the ripening stage (M. Al-Farsi et al., 2005; Ghnimi et al., 2017). The phenolic content of fresh and dried dates is 193.7 mg/100g and 239.5 mg/100g, respectively (Nasir et al., 2015).

#### **Antioxidant Activities:**

Dates contain diverse therapeutic benefits and biological activities, as well as a high nutritional value, and have been used as a natural cure to treat a variety of noncommunicable illnesses and disorders. Dates compositional study reveals that they have a high antioxidant potential due to their capacity to scavenge free radicals. The primary antioxidants contained in dates include carotenoids, polyphenols, and tannins. These antioxidants impede neuroprotection by functioning as a signal of antioxidant enzymes in the defense process (Pujari et al., 2014). Natural antioxidants have a variety of health advantages, including cancer prevention, protection against microorganisms and

chronic inflammation, a lower risk of heart disease, and anti-mutagenic characteristics (Neeser & Bruce German, 2004).

Due to their high concentration of related phytochemicals such as carotenoids, phenolics, tocopherols, flavonoids, and ascorbic acid, dates are vital for improving the intake of natural antioxidants in the human daily diet (Younas et al., 2020). Furthermore, the antioxidant potential of dates differs depending on cultivar, data type, and provenance. Moreover, the antioxidant content of dates varies depending on the region (Idowu et al., 2020). As a result, it is necessary to consider these variables when choosing date fruit as a nutraceutical.

### **Dates by-Products:**

Data by-product research has not accurately reflected the crop's value and promise. Dates fruits are a great alternative to common sweeteners, such as honey, artificial sugars, and jams. Due to its health benefits and long shelf life. A large variety of products are crafted using fresh or dry dates. The whole date fruits are traditionally used to prepare a wide range of products such as date juice concentrates (spread, syrup, and liquid sugar), fermented date products (vinegar, and organic acids), and date pastes for different uses (e.g. bakery and confectionary) besides their direct consumption.

Here are some popular products made from date fruits.

### **Date Syrup (Dibs):**

Date syrup (dibs), the most common by-product of dates, is used to make jams, marmalades, concentrated drinks, chocolates, ice cream, confectioneries, sweets, snacks, bakery items, and health foods (Riedel, 1986). Date syrup is a natural sweetener used to formulate food items to increase their nutritious qualities (Raiesi et al., 2014).

Date syrup comprises a variety of ingredients including carbs, proteins, lipids, pectin, salts, and minerals. Although sugar is the most important component (80%), it may be used after the

invention of the sugar continuous manufacturing method (Gabsi et al., 2013).

It has a complex combination of various saccharides, amino and organic acids, polyphenols, and carotenoids in addition to being high in carbs and a great source of minerals. The date syrup has a higher portion of antioxidants. The antioxidant activity of this component has been linked to several activities, including the suppression of continued hydrogen abstraction, peroxide breakdown, and radical scavenging (Atmani et al., 2009). As a result, antioxidants are thought to be helpful to human health because they reduce the risk of degenerative illnesses and some forms of cancer by reducing oxidative stress and inhibiting macromolecule oxidation (Soobrattee et al., 2005).

Date syrup is the most widely used in conjunction with fruit preserves or date palm syrup (dibs) in a range of food items, including functional foods and components in nutraceuticals (El-Nagga & Abd El-Tawab, 2012). It is either consumed directly or utilized as an ingredient in a variety of food items such as ice cream, beverages, confectionery, bread goods, sesame paste/date syrup mixes, jam, and butter (Abbès et al., 2013).

#### **Date Jam:**

In the majority of date-producing countries, jam is one of the most popular preserves (Al-Hooti et al., 1997). While the skill of jam making has a long history, dates have only lately been sculpted into a jam. Dates with high sugar content, such as 65 % sugars, 1 % pectin, and a pH of 3.0-3.2, are ideal for jam-making (Shi et al., 2005).

#### **Date Honey:**

Date honey is an intense date juice that has been stripped of its colloidal components and the majority of its colors. It may be found in drinks, chocolate, ice cream, marmalade, and confectionery (Ashraf & Hamidi-Esfahani, 2011).

### **Date Juice:**

Date juice includes powerful free radical scavengers as well as significant antioxidant and antimutagenic properties (Vayalil, 2002). Date juice with pectin can be used to make a hard jelly with increased stickiness, chewiness, and consistency. The jelly that is obtained can be less sugar (73° Brix) and an increased pH of 3.57 (Johnson, 2014).

### **Date Paste:**

It is similar to date fruit in that it is abundant in sugar, insoluble dietary fiber, and natural antioxidants (Elleuch et al., 2008). Date paste is used in a variety of culinary products, including meat, bread, and confectionery. The addition of date paste to cooked meat reduces lipid content while increasing total dietary fibers (Sánchez-Zapata et al., 2011).

Date paste, due to its high sugar content, can also be utilized to make value-added goods such as date jam and date candy (Besbes et al., 2009; Shi et al., 2005). Date paste enhances the rheological properties of dough, decreases retrogradation, and increases the shelf life of baked goods (Ahmed & Ramaswamy, 2006).

### **Date Vinegar:**

Fermentation technology is one of the oldest techniques for preserving food and producing value-added food products from food sources. Almost all fruits and vegetables fit for human consumption have been fermented by bacteria to generate extra by-products such as organic acids, amino acids, and vitamins. Date fruit products have been recognized as potential raw materials for fermentation-based value-added commodities manufacture (Davati et al., 2007).

### **Fermentation Products from Date:**

Date sugar fermentation products include date wine, alcohol, organic acids, baker's yeast, antibiotics, and single-cell protein (Ashraf & Hamidi-Esfahani, 2011). Researchers studied

date fruit by-products as potential substrates for the synthesis of a few antibiotics. Date fruits were shown to be an effective substrate for the manufacture of Bleomycin and Oxytetracycline by *Streptomyces* species in the production medium (Abou-Zeid et al., 1993).

**Enzymes:**

Investigators also explored date fruit by-products as supplementary substrates in the enzyme production medium for a few industrial enzymes. Date fruits were shown to be an effective substrate for the manufacture of pectinases, end pectinases, and alpha-amylase by a few microorganisms in the production medium (Smaali et al., 2012).

**By-Products from Date Processing:**

Date fruit, date pits, and date press cake are some of the principal by-products produced by date fruit processing operations that are low-grade discarded (De Ancos et al., 2006).

The majority of the necessary amino acids are found in date pit, including lysine, isoleucine, leucine, methionine, threonine, valine, and phenylalanine (Bouaziz et al., 2008). The major reason for date pits high nutritional value is their dietary fiber, which makes them suited for use in fibrous and dietary dishes (Barreveld, 1993). Furthermore, its phenolic components boost antioxidant absorption through the gastrointestinal tract, making it ideal for supplementing various diets (M. A. Al-Farsi & Lee, 2008).

Press cake is a byproduct of the date juice extraction process. Depending on the process of juice extraction employed. Because press cake includes around 70% moisture; it forms 30 % of the date weight (Barreveld, 1993). According to research on date by-products, the most of protein is found in press cake and the majority of the fat is found in the date pit. The date press cake is abundant in dietary fiber, while the date pit has the highest concentrations of phenolic compounds and antioxidant

activity. Press cake is utilized in animal feed as well as microbiological transformations (M. Al-Farsi et al., 2007).

#### **Other by-Products of Dates:**

Date butter is used in the same way as peanut butter. Date candies are made with date paste, roasted nuts, and coconut, and may be coated with chocolate for a unique sensory experience. Sesame can be added to date bars containing almonds, coconut, groundnuts, and pistachios. Date fruits are used to make a variety of sweets, including ice creams, puddings, date sherbet, and fruit yogurt. Other items include macerated dates, fiber-rich dates, and date sauces like steak sauce that contain up to 10% ground date (Johnson, 2014).

#### **Using Date Fruit as Functional Ingredients in Food Products:**

Functional food is a food that has nutritional content that improves a being's health, physical performance, or mental condition (Lau et al., 2021). The definition (Szwacka-Mokrzycka & Kociszewski, 2019) of functional food is the most popular, that is "a food could be declared functional if it has been proved to have a positive impact on one or more of the body's functions along with the nutritional benefit, and its wellbeing effect must be proven by science investigation". Numerous studies have been conducted to date on uses in various food formulations such as meat, bread, and dairy products. Date fruits were shown to improve the nutritional content and technological quality of goods (Manickavasagan et al., 2012). However, due to their qualities such as high fiber content, high level of bioactive compounds, plentiful production during seasons, and a broad variety of applications, date fruits have a significant potential to be exploited as functional food ingredients (Ghonimi, 2017).

Date palm fruit contains a high concentration of polyphenols, which may be used to produce functional foods. The effect of replacing palm syrup with a portion of the water used to replace skim milk powder in the manufacture of yogurt

was studied by (Gad et al., 2010). They discovered that the total phenolic content, hydrogen-donating capacity, and ferric decreasing antioxidant activity of yogurt fortified with 10% date syrup dramatically increased, boosting the yogurt's health benefits. The significant antioxidant activity of date fruit was related to the concentration of phenolic chemicals.

Previous research found that adding date palm fruit to bread as a sucrose alternative boosted dietary fiber while not influencing nutritional qualities (Nwanekezi et al., 2015). Likewise, muffins enhanced with 2.5 and 5% date fruit fiber concentrates (DFC) were shown to have increased dietary fiber content, antiradical activity, and secondary oxidation inhibition capability when compared to controls, especially when baked at 165 °C (Mrabet et al., 2017).

It is obvious that the addition of functional ingredients, such as dates fruit with high dietary fiber and polyphenols, enhances the functional and health-promoting qualities of baked products. Consumption of foods high in dietary fiber has also been linked to improved health by reducing the prevalence of numerous illnesses as a result of increasing faecal volume, shorter intestinal transit time, and stimulation of intestinal flora proliferation (Rodríguez et al., 2006).

With a growing acceptance of healthy snacks, low-level inclusion of vegetable and fruit by-products in functional biscuits may be a useful option (Lau et al., 2021). Dates were added to the making of functional biscuits that are high in iron and protein, provided that they are in appropriate quantities and do not impair the product's quality attributes during manufacturing. It has been discovered that increasing the number of dates included may result in an undesirable product for the consumer (Ibrahim et al., 2021). Another study found that dates pulp (Deglet Noor type) powdered and mixed into bread increased dietary fiber (Bchir et al., 2014). In comparison to the control,

date pit extracts improved total polyphenol and antioxidant activity and decreased TBARS in ground beef (Di Cagno et al., 2017). With growing demands for functional and nutritious diets, new food products containing dates as nutraceutical ingredients are expected to be generated. A significant proportion of -amino butyric acid, conjugated fatty acids, and insoluble dietary fibers was found in freeze-dried date powder made from fermented date fruits puree using *Lactobacillus Plantarum* strains.

As a consequence, it was suggested as a nutritious supplement that might be used in the food industry (Idowu et al., 2020). Through enzymatic hydrolysis, date fruit fiber concentrate was transformed into a novel product rich in antioxidant-soluble fiber (Mrabet et al., 2017). The impact of using Tunisian dates by-products as sweeteners in dairy sweets, such as syrup and powders, was assessed by (Jridi et al., 2015) . Date by-products improved apparent viscosity and rapid exudation while also increasing antioxidant activity.

### **Conclusions**

The cultivation of date palms is very vital in the Middle East. Besides being the main crop in some areas, the tree provides many additional benefits to the people. Date fruit is used in a variety of industrial applications. Dates are an excellent source of nutrients and antioxidants such as phenolics and carotenoids, essential fatty acids, and minerals, all of which play a vital role in human health maintenance and can thus be employed as functional foods and nutraceuticals. Nonetheless, there are still chances to utilize date fruits for creative and high-market-value goods. Dates are an excellent source of nutrients and antioxidants. The understanding of this crop's physicochemical and sensory qualities will motivate manufacturers to improve date by-product manufacturing on an industrial scale. Furthermore, substantial research and development operations are required to find novel products from

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date fruits due to their rich and varied biomolecules, which have the potential to return value-added compounds for commercial use.

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