The Pharma Innovation Journal 2022; SP-11(8): 519-526

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; SP-11(8): 519-526

www.thepharmajournal.com
Received: 22-06-2022
Accepted: 25-07-2022

Mirshad Musthafa
Department of Food Technology and Nutrition, School of Agriculture, Lovely Professional University, Phagwara, Punjab, India

Deepika Sandhu
Department of Food Technology and Nutrition, School of Agriculture, Lovely Professional University, Phagwara, Punjab, India

Corresponding Author
Mirshad Musthafa
Department of Food Technology and Nutrition, School of Agriculture, Lovely Professional University, Phagwara, Punjab, India

Utilisation of dates for the formulation of functional food product

Mirshad Musthafa and Deepika Sandhu

DOI: https://doi.org/10.22271/tpi.2022.v11.i8Sg.14774

Abstract
The date palm (*Phoenix dactylifera* L.) is one of the popular perennial fruit tree grown around the world, particularly in West Asia and North Africa. Its fruit (date) is popular all throughout the world. The tree is well-known for its beneficial health benefits and is regarded as a high-value commercial fruit crop in the worldwide market. Dates are a high-quality, low-cost source of macro- and micronutrients. Date fruits are mostly composed of carbohydrates, including soluble sugars and dietary fibre, with modest quantities of fats and proteins. Dates also poses antioxidant, anti-mutagenic, anti-microbial, hepato-protective, gastro-protective, anti-inflammatory, immune-stimulatory and anti-cancererous properties. Despite the lack of commercialization of many varieties, date palm fruits are important marketable crops. An explosion of interest in the numerous health benefits of dates in recent years has resulted in numerous *in vitro* and animal studies, as well as the identification and quantification of various classes of phytochemicals. Food scientists and the food industry have created a vast variety of food products made from dates, including paste, syrup, juice, sugar, jam, jelly, butter, chocolates, condiments, pickled dates, oils, coffee etc. This review includes updated information concerning the composition of several varieties of dates, as well as the possible health advantages of *Phoenix dactylifera* and processed items made from date fruit.

Keywords: *Phoenix dactylifera*, dates, date palm, value added products, phytochemicals, phytosterols

Introduction
Phoenix dactylifera Linn are commonly known as date fruits and date palm belongs to the family of Palmaceae and it is grown in arid and semi-arid regions of the world (Nasir *et al*., 2015) [57]. The tree is famous due to their advantageous health benefit and are considered as a high value commercial fruit crop in the international market (Saryono *et al*., 2016) [61]. With the present uncertainty in the world food supply and an expected increase in demand, the date palm is likely to continue to provide a reliable source of low-cost food. Date palm is considered a multipurpose palm because it is a source of multiple nonfruit and fruit products (Fadel *et al*., 2006). The number of date varieties grown globally exceeds 2000, but the two most widely known in the international market are the Medjool and Deglet Noor, but only a few notable ones have been studied for fruit quality (Siddiq *et al*., 2013) [63]. Date palm fruits are major marketable crops, despite the lack of commercialization of many types. Moreover, Consumer preferences are changing, and the global market is becoming more competitive, thus food businesses must engage in creative value-added activities. The date is a specialty fruit recognized for its active chemicals (e.g., dietary fiber and antioxidants) and biological activity, which has a wide range of applications in the development of novel products such as bioactive ingredients, sugar alternatives, dietary supplements, and functional foods (Ayad *et al*., 2020) [20]. The date palm is a versatile palm since it produces a variety of nonfruit and fruit goods. However, it has not yet been completely utilized. The nutritional value and functional characteristics of date fruits are well-known (Mousavi *et al*., 2014) [55]. Functional foods have a best role in health and nutritional claims. Date fruit needs to be promoted as a health food for infants, youth, healthy adults as well as patients with chronic diseases. Consumption of dates fruits reduces cancer and other chronic decease, and date fruits are used in a variety of ways to cure anemia and demineralization as well as cold infusion and gargle. histories saying that dates fruit is best medicine for whole the disease (Kamal-Eldin *et al*., 2012) [43]. The date fruit growing in Sahara's region is a stoppable diet for the people who live there and use it as medicine (Al-Turki *et al*., 2010) [15]. Now a days different clinics are trying to assess the effects of date fruits on different pregnancy outcomes including labor pain, cervical dilation (CD) on admission, duration of gestation, duration of various stages of labor, bleeding rate

after delivery, vomiting rate during delivery, mode of the delivery (Mirza *et al*., 2019) [53]. In terms of nutritional value, the dates fruits are high in sugar content and 80% of date palm is high energy value. The date fruit has long been touted as having significant nutritional qualities for human consumption and health (Al-Alawi *et al*., 2017) [5] The date palm fruit (*Phoenix dactylifera*) has long been touted as having beneficial nutritional benefits for human consumption and health. The nutritional study of date fruit revealed that it is mostly composed of carbs (70%) in the form of sugars (Ahmed *et al*., 2014) [3]. The sugar content of most dates is primarily inverted sugars, which are easily absorbed by the human body. Because they include an important level of dietary fibre, date palm fruit and by-products are also high in minerals like potassium, iron, and calcium (Johnson *et al*., 2014) [43]. Dates are one of the few foods that have a high potassium content and, at a certain stage of development, have a low sucrose content. Furthermore, the five stages of pre-maturation, maturation and ripening of date are Hababauk, Kimri, Khalal, Rutab, and Tamer (Mirza *et al*., 2018) [52]. Date palm fruit is divided into three main parts: date skin, date flesh and pit. Dates fruits have different maturation stages, their Sweet Khalaal is the first maturation stage, Rutab and Tamar is the edible and ripened stage. The edible stage is darker in color and well fragrance (Al-Shahib and Marshall, 2003). In the world there are 2000 varieties of dates there (Chang *et al*. 2016) [24]. The fruits are also divided into soft (> 30 percent moisture), semi-dry (20–30 percent moisture), and dry cultivars (less than 20 percent moisture) categories based on their moisture content at the fresh tamar stage (Benmeddour *et al*., 2013) [21]. Naturally dates fruits are high in sugar content and have a high nutritional value, the most part of date fruits contain high energy value (Habib *et al*., 2014) [36]. Dates fruits are rich in antioxidant chemicals, and it is extremely high in phenolic chemicals, we can intake date fruit as value added product, intake of date pulp is treated against anemia and de hydration and can that against colds and gargle for sour throats. Because of its high carbohydrate content, the date fruit is high in protein, lipids, fatty acids, water, minerals and trace elements, and vitamins, and it is an excellent source of energy (Maqsood *et al*., 2020) [47]. The date palm is a versatile fruit since it produces a variety of non-fruit and fruit goods, however, it has not yet been completely utilized (Martín-Sánchez *et al*., 2014) [48]. The nutritional value and functional characteristics of date fruits are well-known. They are readily available on the global market, particularly at the mature stage Tamar, and are eaten fresh, dried, or in various processed forms like as jam and jellying (Alasalvar *et al*., 2013) [5]. Date fruits have a wide variety of products available in the market. These products have several health benefits that are mentioned in the report. These products include- dried dates, date paste, date juice & syrup, date powder, date fiber concentrates & date oils. Therefore, this review gives complete details about nutritional composition and value addition products of dates are explained.

Nutritional and Chemical composition of dates

Nutritional Composition of Dates

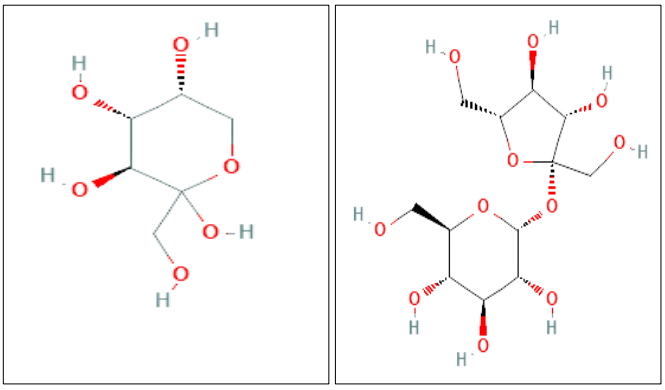
Dates are rich in carbohydrates, with fructose, glucose, mannose, maltose, and sucrose representing >80% of dry matter. As with other characteristics, sugar content and composition vary with fruit ripening and variety. The Deglet Noor variety contains more sucrose but less monosaccharides (glucose and fructose) than Allig dates (Hegazy *et al*., 2014) [38]. Different types of dates and their nutritional composition are detailed in table 1.

Table 1: Different types of dates and their nutritional composition

Variety of dates	Moisture content	Protein	Fiber	Ash	References
Saidy	15.23%	2.52%	2.52%	2.17%	Ramadan *et al*., 2016 [57]
Ajwa	13.4%	2.6%	-	1.5%	Ali *et al*., 2009 [11]
Zaitoon	19.7%	2.3%	1.9%	2.2%	Khan *et al*., 2015 [46]
Karbala	21%	1.8%	2.8%	1.7%	Hameeddullah *et al*., 2015 [37]
Deglet Noor	9.4%	5.0%	9.2%	1.0%	Al-Farsi *et al*., 2007 [9-10]
Khalas	7.1%	6.0%	-	1.8%	Hamada *et al*., 2002

Sugars

Date palm fruits are known for their high sugar content (77%). It has a 0.5% sucrose content, 34.5% glucose, and 25.6% fructose content. 14 According to Assirey, the total sugar content of a date can ranges from 71.2% to 81.4%t of dry weight. 15 Sugar concentration varies according to the variety, consistency, and stage of ripening (Zineb *et al*., 2012) [69]. The only sugars found in fresh and dried dates were fructose, glucose, and sucrose. The average content of fructose, glucose, and sucrose in fresh dates are 19.4, 22.8, and 4.03 g/100 g respectively figure 1, with an average total of 43.4 g/100 g. Sugars in- creased in dried dates to 29.4, 30.4, and 11.6 g/100 g for fructose, glucose, and sucrose respectively, with a total content of 64.1 g/100 g. when compared to other regularly consumed fruits, fully matured date fruit contains more than twice the quantity of fructose. The presence of high amounts of fructose in dates may have various favorable impacts on human health, including delaying or preventing the development of chronic diseases (Mohamed Al *et al*., 2008). In various stages of sugar profile of dates changes occur in the stage of maturation. After the khalal stage the fruit becomes sugar rich, and in the *Tamar* stage the fruit shows a sharp increase in sucrose content and dramatic drop in moisture content. In similar, in the initial stages of growth, sucrose content exceeds glucose and fructose content, and then sucrose begins to convert to monosaccharides until sucrose content is less than 5% in the Tamar stage (Jain *et al*., 2013) [41]. The average sugar content of date fruits at various stages of growth and maturity the rate of sugar conversion is influenced by the temperature and relative humidity of the storage environment, as well as the physiological activity of the fruit (Meftahizadeh *et al*., 2019) [50].



Fructose Sucrose

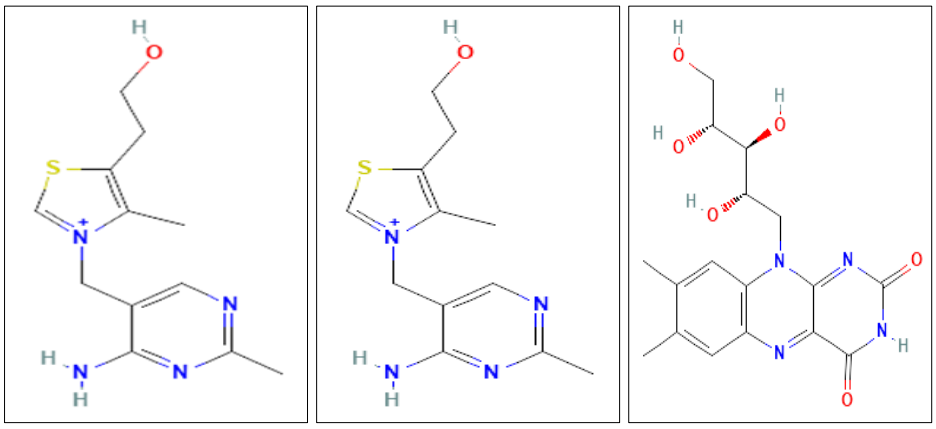
Fig 1: Chemical structures of sugars present in the dates

Minerals

Dates is a good source of Minerals. Dates include vital elements such as potassium, which is required for muscle contractions and aids in the regulation of heart rate and blood pressure (Abdul-Hamid *et al*., 2018) [1]. A 100-gram date provides 696 mg of potassium, 90 mg of iron, 362 mg of copper, and 90 mg of magnesium, all of which are necessary for bone formation. Copper is also required for the formation of red blood cells (Vayalil *et al*., 2012) [65]. Copper is also required for the formation of red blood cells. Dates are ideal for patients with hypertension since they have a high potassium level and a low salt content. The dates pulps are rich in iron, calcium, cobalt, copper, fluorine, magnesium, manganese, potassium, phosphorus, sodium, copper, sulfur, boron, selenium, and zinc (Ibrahim *et al*. 2021) [39]. Potassium levels can be as high as 0.9 percent in the flesh of several date varieties, and as low as 0.5 percent in the pits/seeds of others. Boron, calcium, cobalt, manganese, phosphorus, and zinc are some of the other minerals and salts found in varied amounts. In addition, the seeds contain varying amounts of aluminum, cadmium, chloride, lead, and Sulphur (Al-Jasass *et al*., 2014) [3].

Vitamins

Vitamins are required for an organism's normal growth and development. Vitamins have a wide range of metabolic roles, despite the fact that they are only required in trace amounts (Al-Barnawi *et al*., 2020) [6]. Hormones, antioxidants, cell signaling mediators, and cell growth and differentiation regulators are all roles they play. Many vitamins, particularly the B complex vitamins, act as coenzymes in a wide range of enzyme processes (Maqsood *et al*., 2020) [47]. Vitamins like riboflavin, thiamine, biotin, folic acid, and ascorbic acid are found in date pulp and are vital for the body. B-complex vitamins like thiamine (B1), riboflavin (B2), niacin (B3), pantothenic acid (B5), pyridoxine (B6), and folate (B9), as well as vitamin K, are abundant in dates as shown in figure 3 (Falade *et al*., 2007). In some dates the niacin content is very high, and it varies between 1.27 and 1.61 mg/100 g. Water-soluble vitamins (B1, B2, B3, B5, B6, B9, B12) exhibited significant heterogeneity between cultivars and stages of date fruit development (Mechlouch *et al*., 2015) [49]. Vitamins B1, B3, B5, and B6 are most abundant in mature fruit, however vitamins B2, B9, and B12 have been found in immature fruit. Dates have an extremely low vitamin C concentration, according to report (Amorós *et al*., 2019). Vitamin B, which includes choline and its metabolite betaine, is also found in greater concentrations in date fruit. Choline is required for cell membrane structural integrity, cholinergic neurotransmission (acetylcholine production), and as a primary source of methyl groups. Betaine functions as an osmolyte and a source of methyl groups, which helps in the health of the liver, heart, and kidneys. As a result, when compared to commonly consumed fruits, date fruit may be regarded as a good source of several vitamins (Arasu *et al*., 2017) [19].



Thiamine Riboflavin Niacin

Fig 2: Chemical structures of vitamins

Amino acids and Dietary fibers

Date proteins were discovered to be high in acidic amino acids and low in sulphur amino acids like methionine and cysteine. Dates are high in fibre, with a small amount of pectin depending on the maturity level. The date fruit also includes -d-glucan, a particular fibre, and a polysaccharide with anticancer properties106, whose mechanism of action is like that of pectin (Díaz-Mula *et al*., 2009) [26]. Fiber, also known as dietary fiber (DF) or crude fiber, is a solid insoluble component of date meat that is mostly made up of cellulose, hemicellulose, lignin, and insoluble proteins. It may also be linked to non-carbohydrate components such as polyphenols, waxes, saponins, cutin, phytates, and resistant protein, among others. The fibre content of the date fruit is quite high in the initial stages (Besbes *et al*., 2010) [23]. Cellulase and pectinase enzymes in the fruit, on the other hand, break down insoluble polymers into smaller soluble molecules throughout the ripening process. In some reports says that dates' fruit content

reduces from 13.7 percent in the first stage of ripening to 3.6 percent in the fourth stage, when they are dried. Furthermore, when the dates ripen, the contents of pectin, hemicellulose, cellulose, and lignin decrease (Mrabet *et al*., 2012) [55].

Carotenoids

The major class of phytochemicals found in the lipid fractions of Date fruit is carotenoids, Carotenoids have been identified as a significant component of phytochemicals contained in date fruit lipid. Carotenoids are a varied collection of approximately 600 structurally related isoprenoids produced by plants, fungi, and bacteria that have been demonstrated to be beneficial to human health and disease prevention. The total carotenoid content in the date fruit decreases when it gets ripening from khalaal to the tamar stage (Khalid *et al*., 2017) [45]. Chemical structure of carotenoids is explained in figure 3. The carotenoid breakdown is caused by moisture loss during maturity and is unrelated to the ripening fruits' gradual darkening. Classification of carotenoids is dependent on the availability or absence of oxygen in the molecule. So, the based-on carotenoids they are divided into two groups: xanthophylls (which contain oxygen atoms) and carotenes (which do not) (absence of oxygen atom) (Echegaray ety al., 2021). The total carotenoid content ranging from 0.22 mg to 3.0 mg per 100 g of date depending on maturity and Date fruit variety (Sirisena *et al*., 2015).

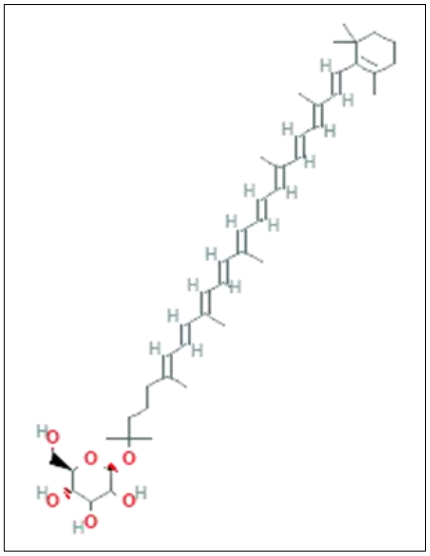


Fig 3: Chemical structure of carotenoids

Flavonoids

Flavonoids are a major part of polyphenolic plant derived secondary metabolites. And flavonoids are present in the form of glycosides, they were antioxidant-rich, which could aid in the prevention of chronic and cardiovascular diseases. In some dates fruits flavonoids such as catechin and rutin were observed (Shaba *et al*., 2015). Date fruit flavonoids have antifungal activity against tiny fungus like mycoses, and their presence in date extracts can cause these effects. Depending on the degree of oxidation of the C ring, the hydroxylation of the flavone unit, and the structure of the C3 carbon substituent, one or more of their hydroxylated functions are then glycosylated (Ahmed., 2016) [2]. The flavanols (hydroxy-3-flavone) are distinguished from the flavanols by the presence of OH in position 3. Flavonoids are the most frequently asked about; the three main structures are kaempferol, quercetin, and myricetin. Quercetin is the most responsive phenolic chemical found in nature (Amira *et al*., 2012) [17]. The flavanols (hydroxy-3-flavone) are distinguished from the flavanols by the presence of OH in position 3. Flavonoids are the most frequently asked about; the three main structures are kaempferol, quercetin, and myricetin. Quercetin is the most responsive phenolic chemical found in nature (Farag *et al*., 2021) [35].

Phytochemical composition of date fruit

Phytosterols

Phytosterols are another significant group of lipid-soluble compounds found in date fruits (Daniyan *et al*., 2008) [25]. Plant sterols (as food and supplements) are known to have numerous health benefits; it aids in blood cholesterol control by lowering LDL cholesterol concentrations. These phytochemicals are only present in plants and have a structure that is similar to cholesterol, there are about 200 phytosterols in nature, and many of them are found in fruits (Slama *et al*., 2013) [30]. Date fruit contains many phytosterols in the eating portion of the fruit. The main reservoirs of phytosterols are date palm seeds (date pits) and pollen grains, which have been employed for the treatment of numerous hormone-related health conditions since ancient times. Campesterol, stigmasterol, -sitosterol, and isofucosterol were the first crystalline plant sterols isolated from the edible flesh of the date, and they were identified as campesterol, stigmasterol, sitosterol, and isofucosterol (El Hilal *et al*., 2018) [31].

Polyphenols

According to various studies, the fruit of the date palm has a large number of polyphenols that can be used in the development of functional food items (Razali *et al*., 2017) [58]. Quercetin, luteolin, apigenin, chrysoeriol, kaempferol, isorhamnetin, 3-methyl-isorhamnetin, sulphates, and malonyl derivatives are the primary phenolic compounds found in date fruit. Date cultivars were high in phenolics, flavonoids, flavanols, and condensed tannins, all of which can inhibit the action of reactive oxygen species, which are linked to human ailments like heart disease and cancer (Al-Kuran *et al*., 2011) [12]. The role of polyphenols in date fruits is prevent against decease, date cultivars were high in phenolics, flavonoids, flavanols, and condensed tannins, all of which can inhibit the action of reactive oxygen species, which are linked to human ailments like heart disease and cancer (Younas *et al*., 2020) [67]. The nature, composition, and distribution of phenolic compounds in dates are determined by the variety, growth stage, and environmental. There are around 8000 polyphenol compounds recognized. The shikimic acid and acetate pathways are used to make them mostly from carbs. 28 According to species, organs, diseases, and physiological stages, their qualitative and quantitative distribution is asymmetrical (Al-MSSalleM *et al*., 2020) [13]. Phenols are molecules that contain one or more aromatic rings with one or more hydroxyl (OH) groups.

Value addition products of Dates

Dried dates

Fresh dates must be dried since they contain a lot of moisture, which reduces their shelf life. Furthermore, numerous customers demonstrate a preference for dry and semi-dry fruits, owing to lesser astringency, sweeter taste, and ease of storage. Drying consist in the reduction of the moisture content of the date fruits. Sun-drying is a traditional way of preserving dates (Tang *et al*., 2013). The term "drying" refers

to the process of reducing the moisture content of date fruits. Sun-drying dates is a time-honored method of preserving them. Drying method was different temperatures (50 °C, 60 °C, 70 °C, and 80 °C) and air velocities (0.5, 1.0, and 2.0 m/s) were used in the drying tests. Temperatures between 60 and 70 °C with a 2 m/s air velocity were shown to be the best drying conditions for date fruits to minimize color and texture changes (Ilce Gabriela *et al*., 2017). In some studies, mention that e effect of microwave (360, 540 and 720 W) and conventional drying (70, 90 and 110 ºC) on the antioxidant activity, the polyphenol content and the mineral profile of date pulp 110 ºC) on the antioxidant activity, the polyphenol content and the mineral profile of date pulp (Elsharawy *et al*., 2019; Echegaray *et al*., 2020) [32, 29].

Date paste

Date paste is one of the most popular date products in several countries. It's produced from pitted and minced dates and consumed as a paste, but it's also a vital ingredient in biscuits, sweetbreads, and candy bars in the baking and confectionery industries (Al-Farsi *et al*., 2007) [9-10]. Date paste can also be used as a texture modifier, a lipid-rich food, or an emulsion stabilizer. Sugar (sucrose, fructose, and glucose), dietary fiber, and phenolic chemicals are abundant in date paste. To increase the amount of dietary fiber and phenolic compounds in date paste, date seeds can be added (Karizaki *et al*., 2017) [44].

Date Jam

Date jam was made from date fruits that had reached the "rutab" stage. Pitted dates are combined with an equal amount of water and simmered for 45 minutes. A sugar-to-date pulp ratio of 55:45 was utilized to extract the pulp. The pH of the pulp and sugar mixture is adjusted to 3.2 using citric acid. The pulp extract and sugar mixture are heated to a TSS of 68 °Brix with constant stirring. Hot date jam is put into clean, dry glass jars, sealed, labelled, and kept at room temperature (Vijayanand *et al*., 2012) [66].

Date Jelly

Date jelly is made by boiling date juice and sugar until the TSS reaches 65 degrees Brix. Date jelly is made with the addition of citric acid, pectin, ascorbic acid, and benzoic acid. Date jelly is made from the "Ruzeis" variety of dates. To make date paste, dates are cleaned, pitted, and soaked in enough water in a 1:2 ratio at 25 °C for 5 minutes, then drained and crushed. Date juice is made by diluting date paste with water in a 3:1 (w/w) ratio. The mixture is gently cooked for 5 minutes with continuous stirring, then filtered to remove the fibre and other contaminants. A 1:1 ratio of date juice to sugar is used. Separately dissolved citric acid and pectin are added to the boiling mixture. Boiling is continued till TSS of 65 °Brix is reached. Ascorbic acid (0.1%) and benzoic acid (0.01%) are dissolved in small quantities of hot syrup and added to the jelly. Date jelly is filled hot in glass bottles and stored (Echegaray *et al*., 2021) [27-28].

Date Butter

Date butter was made from date fruits that had reached the "tamar" stage. Date pulp is extracted by pitting the fruits, mixing them with an equal amount of water, and cooking them for 45 minutes. The sugar-to-date-pulp ratio is 40:60. The pH is adjusted to 4.5-4.7 with the addition of citric acid. To achieve a TSS of 74-75 °Brix, the date pulp extract and sugar combination are boiled with constant stirring. Hot date butter is placed into clean, dry glass jars, sealed, and kept at room temperature. Date butter has a water activity ranging from 0.61 to 0.66, making it an intermediate moisture product. Saudi date varieties are being tested for date butter manufacturing. The inclusion of orange, banana, or almond flavorings is said to have produced date butter of acceptable quality (Echegaray *et al*., 2020) [29].

Date Candy

A method for making date candy from immature dates has been devised. Date candy was made from immature dates, which are quite astringent. Dates are blanched in boiling water after being washed. For 10 minutes, blanched date fruits are cooked in a sugar syrup of 60 °Brix in a 1:3 ratio. In the syrup, the fruits are equilibrated for 6 hours. By heating the syrup to 65 °Brix, it is filtered and condensed. The dates are added to the syrup after the citric acid is added at a rate of 0.2 g/kg of syrup. The date candy is drained and dried in a hot air drier at 60 °C for 3 hours after the syrup has been equilibrated to >70 °Brix. The date candy is wrapped and packaged in flexible pouches (Benyahia-Krid *et al*., 2021) [22].

Date Chutney

Dates are peeled with an abrasive peeler after being sorted and cleaned in tap water. Date fruits are peeled and pitted by hand, then sliced into eight longitudinal slices. Slices of fruit are combined with spices and cooked lightly in mustard oil for 25-30 minutes, stirring constantly, until softened. After adding the vinegar, heat for another 10 minutes over a medium temperature, stirring constantly. Sugar is added, and the chutney is heated until it reaches 105-106 °C. A little amount of potassium sorbate is dissolved in water and added to the mixture. Date chutney is poured into clean sterilised dry glass jars while still hot (85-90 °C). The water activity of date chutney made from "kimri" and "khalal" fruits was 0.62 and 0.63, respectively. The texture of chutney made from "khalal" stage fruit is substantially softer than that of chutney made from "kimri" stage fruit (Salomón-Torres *et al*., 2021) [59]

Date Relish

Date fruits at the "tamar" stage are pitted, mixed with an equal amount of water, and cooked for 45 min. "Rutab" dates are washed, pitted, and chopped into circular rings. Carrots, onions, and ginger is peeled, chopped, and cooked for 15-20 min on low heat. Salt, sugar, and seasonings are then added and cooking was continued for another 20 min. Pectin, skim milk powder, and acetic acid are added to the mixture and cooked to a temperature of 105-106°C. Potassium sorbate is dissolved in a small amount of water and stirred into the cooked mass. Date relish is poured hot into clean dry glass jars that are capped and labeled (Elsharawy *et al*., 2019) [32].

Date Pickles

Dates are washed, dried, and sliced into four long, uniform slices. The slices are blanched in boiling water for 2 minutes before being drained of excess water. The dried pieces are used to make pickles with olive oil. Fenugreek, fennel, nigella, and cumin are cooked to a light brown colour in mustard oil. To the cooled fried spice mixture, add salt, turmeric, red chilli powder, and date fruit pieces. A little amount of potassium sorbate is dissolved in water and then added. Fill clean, dry glass jars with date pickle and seal. For a week, the sealed jars are maintained in the sun for 6 hours

during the day, following which the samples are kept at room temperature. Sensory analysis of the pickle in-oil samples made from "kimri" and "khalal" stage fruits showed that "kimri" pickles were acceptable for up to 1 month of storage, but the overall acceptability dropped after 5 months of storage. The pickles made from "khalal" stage fruit were acceptable only initially (Alyahya *et al*., 2022).

Date Oil

Oil from date seeds is extracted by pulverizing in a mill and cooking in a steam kettle. The flour, which contains 8% oil, is then processed with a solvent. Date seed oil is yellow in color and can be refined and bleached to a lighter shade. Date seed oil is suitable for making soaps. Deoiled cake contains a high percentage of proteins and can be used as animal feed (Alyahya *et al* 2022; Meghwar *et al*., 2021) [15-16, 51].

Date Coffee

Date stones, which were washed, dried, roasted, and powdered, were used to make a coffee-like beverage. To make the beverage, the pulverized material was infused. Ground cardamom is an option. The drink had a good flavor and was confirmed to be caffeine-free (Echegaray *et al*., 2021; Salomón-Torres *et al*., 2021) [27-28, 59].

Conclusion

In this paper, we reviewed recent research on the composition of several varieties of dates, as well as their potential health advantages and the numerous processed food products made from date fruit. Dates are rich in carbohydrates, proteins, minerals, dietary fibres and numerous vitamins, including the B complex. Carbohydrates make up 70% of dates, primarily as fructose and glucose. Dates also include a variety of functional and bioactive substances such as carotenoids, anthocyanins, antioxidants, phenolics and dietary fibre, which contribute to their anti-tumoral, anti-microbial, anti-ulcer and immunomodulatory activities. Furthermore, dates are regarded as a nutraceutical and functional food. When compared to regular diet, a few dates can cover our daily nutrient needs. Although dates are high in sugar, many date varieties are low in GI diet and debunk the myth that dates are similar to candies and that regular use leads to chronic diseases. As a result, additional scientific research is required to establish their beneficial effects and methods of action, as well as to recognise their position as a functional diet for communities worldwide.

Reference

1. Abdul-Hamid NA, Maulidiani M, Mediani A, Yahya UII, Ismail IS, Tham CL, *et al*. Physicochemical characteristics, nutritional composition, and phytochemical profiles of nine Algerian date palm fruit (*Phoenix dactylifera* L.) varieties. Journal of Food Biochemistry. 2018;42(6):e12663.
2. Ahmed A, Bano N, Tayyab M. Phytochemical and therapeutic evaluation of date (*Phoenix dactylifera*). A review. J Pharm Altern Med. 2016;9:11-17.
3. Ahmed J, Al-Jasass FM, Siddiq M. Date fruit composition and nutrition. Dates: Postharvest Science, Processing Technology and Health Benefits, John Wiley & Sons, Ltd, 2014, 261-283.
4. Al-Alawi RA, Al-Mashiqri JH, Al-Nadabi JS, Al-Shihi BI, Baqi Y. Date palm tree (*Phoenix dactylifera* L.): natural products and therapeutic options. Frontiers in plant science. 2017;8:845.
5. Alasalvar C, Shahidi F. Composition, phytochemicals, and beneficial health effects of dried fruits: An overview. Dried fruits: Phytochemicals and health effects, 2013, 1-18.
6. Al-Barnawi HM. Preparation and characterization of a protein extract from date palm fruit (*Phoenix dactylifera* L.): investigation of nutritional and functional properties (Doctoral dissertation, Heriot-Watt University), 2020.
7. Aleid SM. Industrial biotechnology: Date palm fruit applications. In Date palm biotechnology. Springer, Dordrecht, 2011, 675-709.
8. Al-Farsi MA, Lee CY. Nutritional and functional properties of dates: A review. Critical reviews in food science and nutrition. 2008;48(10):877-887.
9. Al-Farsi M, Alasalvar C, Al-Abid M, Al-Shoaily K, Al-Amry M, Al-Rawahy F. Compositional and functional characteristics of dates, syrups, and their by-products. Food chemistry. 2007;104(3):943-947
10. Al-Farsi M, Alasalvar C, Al-Abid M, Al-Shoaily K, Al-Amry M, Al-Rawahy F. Compositional and functional characteristics of dates, syrups, and their by-products. Food chemistry. 2007;104(3):943-947.
11. Ali A, Al-Kindi YS, Al-Said F. Chemical composition and glycemic index of three varieties of Omani dates. International journal of food sciences and nutrition. 2009;60(sup4):51-62.
12. Al-Kuran O, Al-Mehaisen L, Bawadi H, Beitawi S, Amarin Z. The effect of late pregnancy consumption of date fruit on labour and delivery. Journal of obstetrics and gynaecology. 2011;31(1):29-31.
13. Al-MSSalle MMQ. The Role of Date Palm Fruit in Improving Human Health. Journal of Clinical & Diagnostic Research, 2020, 14(1).
14. Al-Turki S, Shahba MA, Stushnoff C. Diversity of antioxidant properties and phenolic content of date palm (*Phoenix dactylifera* L.) fruits as affected by cultivar and location. J Food Agric. Environ. 2010;8(1):253-260.
15. Alyahya S, Arif M, Wasim R, Kushwaha SP. *Phoenix dactylifera* L. (Ajwa Dates): An energetic plant fruit with immense nutraceuticals value for strengthening the power of resistance. Journal of Pharmacognosy and Phytochemistry. 2022;11(3):151-162.
16. Alyahya S, Arif M, Wasim R, Kushwaha SP. *Phoenix dactylifera* L. (Ajwa Dates): An energetic plant fruit with immense nutraceuticals value for strengthening the power of resistance. Journal of Pharmacognosy and Phytochemistry. 2022;11(3):151-162.
17. Amira EA, Behija SE, Beligh M, Lamia L, Manel I, Mohamed H, *et al*. Effects of the ripening stage on phenolic profile, phytochemical composition and antioxidant activity of date palm fruit. Journal of agricultural and food chemistry. 2012;60(44):10896-10902.
18. Amorós A, Pretel MT, Almansa MS, Botella MA, Zapata PJ, Serrano M. Antioxidant and nutritional properties of date fruit from Elche grove as affected by maturation and phenotypic variability of date palm. Food Science and Technology International. 2009;15(1):65-72.
19. Arasu MV, Al-Dhabi NA. *In vitro* antifungal, probiotic, and antioxidant functional properties of a novel *Lactobacillus paraplantarum* isolated from fermented dates in Saudi Arabia. Journal of the Science of Food and Agriculture. 2017;97(15):5287-5295.

20. Ayad AA, Williams LL, Gad El-Rab DA, Ayivi R, Colleran HL, Aljaloud S, *et al*. A review of the chemical composition, nutritional and health benefits of dates for their potential use in energy nutrition bars for athletes. Cogent Food & Agriculture. 2020;6(1):1809309.
21. Benmeddour Z, Mehinagic E, Le Meurlay D, Louaileche H. Phenolic composition and antioxidant capacities of ten Algerian date (*Phoenix dactylifera* L.) cultivars: A comparative study. Journal of Functional Foods. 2013;5(1):346-35.
22. Benyahia-Krid FA, Khemissat E, Zitoun OA, Djafri K, Bergouia M, Meghzili B, *et al*. Technological Valorization of Algerian Dates Downgraded from Deglet Nour Variety to Semi-Candied Dates in Dates Syrup. Food and Nutrition Sciences. 2021;12(6):627-642.
23. Besbes S, Ghorbel R, Salah RB, Masmoudi M, Jedidi F, Attia H, *et al*. Date fiber concentrate: chemical compositions, functional properties and effect on quality characteristics of beef burgers. J Food Drug Anal. 2010;18(1):8-14.
24. Chang SK, Alasalvar C, Shahidi F. Review of dried fruits: Phytochemicals, antioxidant efficacies, and health benefits. Journal of Functional Foods. 2016;21:113-132.
25. Daniyan SY, Muhammad HB. Evaluation of the antimicrobial activities and phytochemical properties of extracts of *Tamaridus indica* against some diseases causing bacteria. African Journal of Biotechnology, 2008, 7(14).
26. Díaz-Mula HM, Castillo S, Martínez-Romero D, Valero D, Zapata PJ, Guillén F, *et al*. Sensory, nutritive and functional properties of sweet cherry as affected by cultivar and ripening stage. Food Science and Technology International. 2009;15(6):535-543.
27. Echegaray N, Gullón B, Pateiro M, Amarowicz R, Misihairabgwi JM, Lorenzo JM. Date Fruit and Its By-products as Promising Source of Bioactive Components: A Review. Food Reviews International, 2021, 1-22.
28. Echegaray N, Gullón B, Pateiro M, Amarowicz R, Misihairabgwi JM, Lorenzo JM. Date Fruit and Its By-products as Promising Source of Bioactive Components: A Review. Food Reviews International, 2021, 1-22.
29. Echegaray N, Pateiro M, Gullon B, Amarowicz R, Misihairabgwi JM, Lorenzo JM. *Phoenix dactylifera* products in human health: A review. Trends in Food Science & Technology. 2020;105:238-250.
30. El Arem A, Saafi EB, Slama RB, Zayen N, Hammami M, Achour L. Phytochemical composition, antibacterial and antioxidant activities of common date palm (*Phoenix dactylifera* L.) fruit during three maturation stages. Tunisian Journal of Medicinal Plants and Natural Products. 2013;10(2):33-48.
31. El Hilaly J, Ennassir J, Benlyas M, Alem C, Amarouch MY, Filali-Zegzouti Y. Anti-inflammatory properties and phenolic profile of six Moroccan date fruit (*Phoenix dactylifera* L.) varieties. Journal of King Saud University-Science. 2018;30(4):519-526.
32. Elsharawy NT, AL-Mutarrafi M, Al-Ayafi A. Different types of dates in Saudi Arabia and its most fungal spoilage and its most preservation methods. International Journal of Recent Scientific Research. 2019;10(11):35787-35799.
33. Fadel M, Kurmestegy L, Rashed M, Rashed Z. Fruit color properties of different cultivars of dates (*Phoenix dactylifera*, L.). Agricultural Engineering International: CIGR Journal, 2018.
34. Falade KO, Abbo ES. Air-drying and rehydration characteristics of date palm (*Phoenix dactylifera* L.) fruits. Journal of Food Engineering. 2007;79(2):724-730.
35. Farag MA, Otify A, Baky MH. *Phoenix dactylifera* L. Date Fruit By-products Outgoing and Potential Novel Trends of Phytochemical, Nutritive and Medicinal Merits. Food Reviews International, 2021, 1-23.
36. Habib HM, Platat C, Meudec E, Cheynier V, Ibrahim WH. sPolyphenolic compounds in date fruit seed (*Phoenix dactylifera*): Characterisation and quantification by using UPLC-DAD-ESI-MS. Journal of the Science of Food and Agriculture. 2014;94(6):1084-1089.
37. Hameeddullah K, Faisal N, Khan MF, Saima R. Nutritional values of selected date palm varieties in Pakistan. American-Eurasian Journal of Agricultural & Environmental Sciences. 2015;15(5):764-768.
38. Hegazy EM, El Sayed HZ. Chemical, Physical Properties and Aflatoxins Content of Palm Date Fruit Sprinkled with Some Spices and Herbs. World Applied Sciences Journal. 2014;32(12):2375-2381.
39. Ibrahim SA, Ayad AA, Williams LL, Ayivi RD, Gyawali R, Krastanov A, *et al*. Date fruit: A review of the chemical and nutritional compounds, functional effects and food application in nutrition bars for athletes. International Journal of Food Science & Technology. 2021;56(4):1503-1513.
40. Ilce Gabriela MM, Girish G. Fruit Processing By-Products: A Rich Source for Bioactive Compounds and Value-Added Products. Food Processing By-Products and their Utilization, 2017, 11-26.
41. Jain SM. Health benefits of dates: Phytochemicals and their functions. In Regional Workshop on the Improvement of the Dates Value Chain in the Near East and North Africa Region Kuwait, 2013 Dec 9-12.
42. Johnson DV. Dates: Postharvest Science, Processing Technology and Health Benefits. Emirates Journal of Food and Agriculture. 2014;26(11):1028.
43. Kamal-Eldin A, B Hashim I, O Mohamed I. Processing and utilization of palm date fruits for edible applications. Recent patents on food, nutrition & agriculture. 2012;4(1):78-86.
44. Karizaki VM. Iranian dates and ethnic date-based products. Journal of Ethnic Foods. 2017;4(3):204-209.
45. Khalid S, Khalid N, Khan RS, Ahmed H, Ahmad A. A review on chemistry and pharmacology of Ajwa date fruit and pit. Trends in food science & technology. 2017;63:60-69.
46. Khan H, Nouroz F, Khan MF, Rizwan S. Nutritional Values of Selected Date Palm Varieties in Pakistan, 2015.
47. Maqsood S, Adiamo O, Ahmad M, Mudgil P. Bioactive compounds from date fruit and seed as potential nutraceutical and functional food ingredients. Food chemistry. 2020;308:125522.
48. Martín-Sánchez AM, Cherif S, Ben-Abda J, Barber-Vallés X, Pérez-Álvarez JÁ, Sayas-Barberá E. Phytochemicals in date co-products and their antioxidant activity. Food Chemistry. 2014;158:513-520.
49. Mechlouch RF, Ayadi A, Thabet G, Hannachi EOEH, Elfalleh W. Changes in the Physico-Chemical Properties of Palm Date using different drying methods. University Bulletin. 2015;17(1):59-78.
50. Meftahizadeh H, Ghorbanpour M, Asareh MH. Changes

in phenological attributes, yield and phytochemical compositions of guar (*Cyamopsis tetragonoloba* L.) landaraces under various irrigation regimes and planting dates. Scientia Horticulturae. 2019;256:108577.
51. Meghwar P, Shar NA, Shaikh SA, Baloch AB, Kumar D, Dhanker P, *et al*. Traditional Process of Dates, COVID-19 Pandemic Observation, and Challenges in Sindh: Dates traditional processing techniques, and challenges. Proceedings of the Pakistan Academy of Sciences: B. Life and Environmental Sciences. 2021;58(3):83-94.
52. Mirza MB, Elkady AI, Al-Attar AM, Syed FQ, Mohammed FA, Hakeem KR. Induction of apoptosis and cell cycle arrest by ethyl acetate fraction of *Phoenix dactylifera* L.(Ajwa dates) in prostate cancer cells. Journal of ethnopharmacology. 2018;218:35-44.
53. Mirza MB, Syed FQ, Khan F, Elkady AI, Al-Attar AM, Hakeem KR. Ajwa Dates: A Highly Nutritive Fruit with the Impending Therapeutic Application. In Plant and Human Health, Springer, Cham. 2019;3:209-230.
54. Mousavi T, Rafiei A, Yoosefpour M. Nutritional value and health benefits of dates according to islamic recourses and traditional medicine. Journal of Mazandaran University of Medical Sciences. 2014;24(117):247-265.
55. Mrabet A, Rodríguez-Arcos R, Guillén-Bejarano R, Chaira N, Ferchichi A, Jiménez-Araujo A. Dietary fiber from Tunisian common date cultivars (*Phoenix dactylifera* L.): chemical composition, functional properties, and antioxidant capacity. Journal of agricultural and food chemistry. 2012;60(14):3658-3664.
56. Nasir MU, Hussain S, Jabbar S, Rashid F, Khalid N, Mehmood A. A review on the nutritional content, functional properties and medicinal potential of dates. Sci. Lett. 2015;3(1):17-22.
57. Ramadan BR, El-Rify MNA, Abd El-Hamid AA, Abd El-Majeed MH. Effect of some treatments on chemical composition and quality properties of Saidy date fruit (*Phoenix dactylifera* L.) during storage. Assiut J Agric. Sci. 2016;47(5):107-124.
58. Razali N, Mohd Nahwari SH, Sulaiman S, Hassan J. Date fruit consumption at term: Effect on length of gestation, labour and delivery. Journal of Obstetrics and Gynaecology. 2017;37(5):595-600.
59. Salomón-Torres R, Valdez-Salas B, Norzagaray-Plasencia S. Date Palm: Source of Foods, Sweets and Beverages. In The Date Palm Genome. Springer, Cham, 2021;2:3-26.
60. Saryono MDWI, Rahmawati E. Effects of dates fruit (*Phoenix dactylifera* L.) in the female reproductive process. International J of Recent Advances in Multidisciplinary Res. 2016;3(7):1630-1633.
61. Shaba EY, Ndamitso MM, Mathew JT, Etsunyakpa MB, Tsado AN, Muhammad SS. Nutritional and anti-nutritional composition of date palm (*Phoenix dactylifera* L.) fruits sold in major markets of Minna Niger State, Nigeria. African Journal of pure and applied Chemistry. 2015;9(8):167-174.
62. Siddiq M, Aleid SM, Kader AA. (Eds.). Dates: postharvest science, processing technology and health benefits. John Wiley & Sons, 2013.
63. Sirisena S, Ng K, Ajlouni S. The emerging Australian date palm industry: Date fruit nutritional and bioactive compounds and valuable processing by-products. Comprehensive Reviews in Food Science and Food Safety. 2015;14(6):813-823.
64. Tang ZX, Shi LE, Aleid SM. Date fruit: chemical composition, nutritional and medicinal values, products. Journal of the Science of Food and Agriculture. 2013;93(10):2351-2361.
65. Vayalil PK. Date fruits (*Phoenix dactylifera* Linn): An emerging medicinal food. Critical reviews in food science and nutrition. 2012;52(3):249-271.
66. Vijayanand P, Kulkarni SG. Processing of dates into value-added products. Dates Production, Processing, Food and Medicinal Values, 2012, 255-264.
67. Younas A, Naqvi SA, Khan MR, Shabbir MA, Jatoi MA, Anwar F, *et al*. Functional food and nutra-pharmaceutical perspectives of date (*Phoenix dactylifera* L.) fruit. Journal of food biochemistry. 2020;44(9):e13332.
68. Zilker M, Sörgel F, Holzgrabe U. A systematic review of the stability of finished pharmaceutical products and drug substances beyond their labeled expiry dates. Journal of pharmaceutical and biomedical analysis. 2019;166:222-235.
69. Zineb G, Boukouada M, Djeridane A, Saidi M, Yousfi M. Screening of antioxidant activity and phenolic compounds of various date palm (*Phoenix dactylifera*) fruits from Algeria. Mediterranean Journal of Nutrition and Metabolism. 2012;5(2):119-126.