

Review Article

Date fruit (*Phoenix dactylifera* L.): Quranic perspectives, phytochemical composition, and antioxidant activities

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ABSTRACT

Date fruit (*Phoenix dactylifera* L.) is one of the fruits frequently found with several terms referring to ripening of date fruits including Tamar. The Holy Qur'an has stated Date fruits in several verses (20 times) indicating the valuable values of Date fruit (DF) both in terms of their uniqueness and usefulness. The nutritional values, phytochemical compositions, and biological activities are influenced by some factors. The aim of this review was to highlight the Quranic perspectives on date fruit and to describe nutritional values, phytochemical profiles, and antioxidant effects of DF. During this study, some databases of Scopus, American Chemical Society, Science direct, Springer, Google Scholar covering abstract and full texts are downloaded and evaluated to be used as references during this review. From Quranic perspective, dates are unique fruits because Allah mentions them 20 times in 16 different chapters in the Quran indicating something valuable both in terms of their uniqueness and usefulness. DF contained large numbers of phenolics and flavonoids compounds contributing to high antioxidant activities in vitro and in vivo. It is recommended to consume DF as a functional food to prevent oxidative stress-related diseases. These benefits prove that DF is a good source to improve the life quality of human health.

Keywords: Date fruit, Qur'anic perspective, phenolics, human health, antioxidant**INTRODUCTION**

Since ancient times, fruits constitute a major part of nutrients needed by human diet. Certain fruits acquire special attention in daily routine of certain populations owing to their religious practices. One of fruits stated in Holy of Quran is date fruit. Date palm (*Phoenix dactylifera*) belonging to the family Arecaceae. It belongs to a group of monocotyledon plants, composed of long, perpendicular stems without branches, which ends in a large, broadleaf cluster at the top. Date palm is a kind of paired tree. Male flowers are in one tree while female is in another. The different flowers meet in the female flower shell (Mahran & Al-'Adzim, 2010).

Date palm (*Phoenix dactylifera* L.) is one of the oldest cultivated variety of date palm trees. This fruit is the most popular fruit tree in the hot arid

regions of the world, particularly in North Africa and Western Asia (Khalid et al., 2017). Dates have many seeds, such as dried dates (jaf), dancing dates, Kabis dates, Ajwa dates (Ahmad, 2003). In Saudi Arabia, dates have drawn the most attention from the Kingdom. They also provide the date palm industry with subsidies and fertile lands. For these reasons, the date palm plantations are extensive in all parts of Saudi Arabia and other Arab countries (Baduwailan, 2009). Date palm has the potential to supply a reasonable and sustainable source of cheap food and an energy source due to the current unpredictability of worldwide food availability and an anticipated food need for the future. In 2010, date fruit production in the world with respect to five major producing countries (Egypt, Saudi Arabia, United Arab Emirates (UAE), Iran, and

Algeria) recorded an expansion to a range of 710,000 to 1,352,950 metric tons (Maqsood et al., 2020).

Dates are the plants mostly mentioned in the Quran. In the book entitled *Mu'jam Al-Mufahras li Al-Fazhil Qur'an*, 'Abd al-Baqi explains that in the Quran, dates are stipulated 20 times in 16 chapters (surah) (Baqi, 1996). Dates are mentioned in various names; sometimes called in singular form 'nakhl'. In chapter al-An'am: 141, in this verse, Allah talks about the creation of a date palm tree that does not uphold. In chapter al-Kahfi: 32, this verse discusses about a parable of two men, one with no faith, given two vineyards surrounded by palm trees. In chapter Thaha: 71, this verse tells about the story of Pharaoh who crucified his sorcerers at the pole of a date palm tree (Najjar, 2006).

Date palm plays an important role in human health due to some nutrients contained and its correlation with some biological activities from preventing effects to traditional treatments of certain illnesses. From nutritional values, Date Fruit (DF) is rich in carbohydrates (77.13 g/100 g), predominantly glucose and fructose, but low in proteins (2.61%) and fats (0.35%). DF also contains some minor components including vitamins, minerals, amino acids, fatty acids, organic acids, dietary fiber, flavonoids, phenolics, carotenoids. These phytochemicals are related to beneficial health activities of DF including antioxidant, anti-inflammatory, hepato-protective, anticancer, immune-stimulant activities, antidiabetic, hypocholesterolemia effects (Gnanamangai et al., 2019). These beneficial effects and nutritional values of DF confirmed Islamic hadith, Prophet Mohammad (SAW) saying, "If Somebody takes seven Ajwa dates in the morning, neither magic nor poison will hurt him that day" (Mirza et al., 2019). Based on this hadith, DF variety Ajwa is one of the most studied issues in terms of nutritional compositions and biological activities and the most reported publications in scientific literature (Nor et al., 2018; Abdul-Hamid et al., 2020). Therefore, it is not surprising that Middle Eastern folklore and Ayurveda, a traditional Indian medicine, well documented DF due to its potential therapeutic effects (Periyathambi et al., 2019).

The date palm in Arabic literature is derived from al-Nakhla. According to Ibn Faris (2008), al-Nakhla means choosing something. Therefore, Nakhla is referred to dates because dates are a choice of fruits with high nutritional values and often chosen by humans to consume. Dates are an economical food. For a long time, dates have

had a special position in the Arabs since ancient times in general, and so have for Muslims in particular. Dates have existed long ago, maybe even before humankind's were created. It is still unclear where the date plants originally came from. But a scientist, Sandy Becker, argues that dates originated from Bahrain and al-Hasa', then spread throughout the Arabian Peninsula. Date palm is a type of palm plant widely planted in the Middle East and North Africa because the fruit can be eaten and is the staple food for ancient to modern Arabians (Tayyara, 2009). Dates are unique since the Prophet Mohamed makes dates as a compulsory daily food for his family. Another reason why they are unique is because they can be consumed regardless of the length ages, from the tip of the root to the leaves do have benefits. Due to this uniqueness, it is believed that dates are miracles of the Quran which are very important to be studied and researched in terms of scientific and pharmacy fields. The dates mentioned 20 times by Allah are definitely something valuable both in terms of their uniqueness and usefulness.

In growth, dates have five developmental phases and appear to be ripe in the sixth month of growth. The first phase, called Hababuk or Sadda, is the phase where the palm-blossom granules containing pollen which is round and bitter are formed. The second phase, called Al-balh, raw seeds begins to grow long, green, and tastes extremely bitter. The third phase, called Al-khalal, raw dates start to turn green, starting to turn reddish yellow, and the taste starts to turn sweet and bitter (Najjar, 2006). The fourth phase, Al-Ruthab, wet dates begin to ripe, of which side begins to contain fruit flesh, colored like honey, soft-textured, and tastes sweet as sugar. In this phase, dates are mentioned in the Quran Chapter Mary verse 25. "And shake the trunk of the palm-tree toward thee, thou wilt cause ripe dates to fall upon thee". The fifth phase, called Al-tamar, the dates are fully ripe, of which color is more striking, and the skin is peeling (Tayyara, 2009). In this phase, it is considered as the best date type, because it is drier and has more concentrated food contents, like sugar concentrated in it to reach 70-80% of the fruit (Ahmad, 2003).

Some factors contributed to the nutritional composition, phytochemical compositions, and phytochemical properties of date fruits including harvest stage, fruit variety, ripening stage, and preparation treatment. The ripening stage of date fruit can be seen in Figure 1. In general, the fruit had immature and mature stages. For mature stage, there are three ripening steps namely Khalal, Rutab and Tamar (Hussain et al., 2020).

METHODS

This research used a thematic method based on literature review, referring to scientific articles from reputed journals, book literatures, conference papers. During this study, some databases of Scopus, American Chemical Society, Science direct, Springer, Google Scholar covering abstract and full texts are downloaded and evaluated to be used as references during this review. In addition, other sources came from books related to scientific miracles of the Quran compiled by experts in their fields.

DATE FRUITS FROM QURANIC PERSPECTIVES

Today, Quran has not only become the main focus of merely study objects and classical interpretations, but also the attention of various scientific studies, including scientific and medical fields. The effort to comprehend the Quran with a scientific and medical approach by experts is called scientific interpretation. This style of interpretation is an attempt to understand the verses of the Quran containing scientific cues from the perspectives of modern science. Scientific interpretation is also an interpreter's striving effort to uncover the relationship between the verses of kauniyah in the Quran and scientific discoveries aimed at revealing its scientific miracles (Rahman, 1986). According to Al-Zahabi (2009), this scientific interpretation seeks to explore the scientific dimension and uncover the secrets of its miracles related to scientific information that may not have been known to humankind during the descent, so it becomes an evidence of the truth that the Quran is not a human work, but a revelation of the Creator instead. Dealing with this, many scientists have focused their studies on the Quran by attempting to put the verses of the Quran into logic and correlating them with treatments and medicines. The scientists have tried to combine the studies of plants mentioned in the Quran with medicines. The Quran does not mention all types of plants in general, just like modern botanical science does, but it is certain that all types of plants mentioned by the Quran are the top organisms of their respective species. For example, fig tree (the fruits of heaven) is the top of the species of "Ficus" of "Moraceae" types according to botanists, its species reaches about 700 scattered around the world. Likewise, olive trees, herbs of 1001 benefits, cure various diseases, internal and external ones (Ahmad, 2003).

In addition to fig and olive trees, dates are the top organisms that have ever existed in this world. Dates are a type of fruits growing in desert areas. They are the fruits of a palm-tree which have many benefits. The trunk of a date palm tree can

be used to warm, also as home appliances, such as wooden tables, etc. Moreover, the fruits can be used as medicine. Dates contain a myriad of features and are also referred by scientists as "mining goods" because they have a myriad of minerals and complete nutritional contents (Tayyara, 2009). According to modern biologists, dates, both wet and dry, contain a lot of sugar up to 70% besides many important substances the body needs, such as potassium, calcium, phosphorus, and magnesium. Furthermore, dates hold within a lot of proteins and vitamins, especially vitamin A. Dates can also be medicine to cure various diseases, such as kidney disease, because they can facilitate urine. Unripe dates are usually used as a remedy for colds, kidney stones, and many other diseases (Mahran & Al-'Adzim, 2010). Even in the Quran, it is mentioned that dates were used as a medicine by Mary after giving birth.

In chapter al-Mu'minun: 19, Allah sends rain down, with which Allah grows palm trees, which are full of fruits to eat. In chapter Qaf: 10, it talks about tall date palm trees that have stacks of trees. In chapter al-Qamar: 20, this verse speaks of the doom of the 'Ad tribes caused by a strong wind that makes them lying around like fallen date palm trees along with their roots. In chapter al-Rahman: 11, Allah stretches the earth for creatures in which there are dates with Mayal petals (Syafi'i, 2000). Allah refers dates to nakhlah, this is found in Chapter Mary: 23 and 25. Both verses talk about the pains and sufferings Mary had been through when she was about to give birth of Isaa. She leaned herself on the trunk of a date palm tree. Through Gabriel, Allah ordered Mary to shake the trunk toward her, then the ripe dates fell down, and were used to eat and as a medicine for pain-killing during childbirth times. The discussion of these verses about dates as a medicine will be discussed in detail in the next sub-chapter. Dates are sometimes referred to as plural form al-nakhil, as in chapter al-Baqarah: 266, this verse talks about a date palm garden and vineyard flowing underneath a river in which all kinds of fruits lie in. In al-Ra'd: 4, Allah states that on this earth, there are dates palm trees with branches on one side and with no branches on the other side. In chapter al-Nahl: 67, Allah declares that dates and wine can be used for in addition to intoxicating, earning a living from them. Meanwhile, in chapter al-Mu'minun: 19, this verse treats dates palm gardens and vineyards with a lot of fruits to eat in some parts (Baqi, 1996).

Date palm is a special tree that has many benefits and is a superior food. It contains various important elements in medicine and complete

compositions needed by the human body. Middle Eastern people even believe that dates can relieve pain especially during childbirth. To examine the benefits of dates in childbirth in the perspective of the Quranic interpretations, it can be seen in Chapter Mary verse 23-26. These verses talk about Mary's great difficulties when she was about to give birth. In Chapter Mary: 23, Allah says: 'And the pangs of childbirth drove her unto the trunk of the palm-tree. She said: Oh, would that I had died ere this and had become a thing of naught, forgotten!' (Quran Chapter Mary: 23). Ibn Kathir (2012) explained that Mary was very ill when she was about to give birth, forced to rely on the base of the date palm tree in her exile. Al-Baghawi (2000) interpreted that Mary suddenly felt ill to give birth to a child, then she leaned on the date palm tree where the surroundings were barren and the ground was dry even in the middle of desert, the weather was very cold and no one could help her from enduring pains during childbirth.

According to al-Zamakhsyari (2012), the date palm tree referred to the verse above is a special tree that Allah provides for Mary. This is a sign from Allah to Mary that the date palm is very suitable for women during and after childbirth. Along with the idea, Al-Alusi (1997) interpreted the date palm tree and its fruit which Allah created at that time was for Mary's needs, because it was winter and no dates usually bore fruits. Al-Fakhrurrozi (2012) stated that this extraordinary thing was a miracle (karamah) for Mary or extraordinary signs happening to the Prophet Isa before his prophetic news (irhash).

Then after that, in verse 24, Allah sent Gabriel and made a creek that could flow water from under Mary's feet, Allah then commanded Mary to: " And shake the trunk of the palm-tree toward thee, thou wilt cause ripe dates to fall upon thee. So eat and drink and be consoled. And if thou meetest any mortal, say: Lo! I have vowed a fast unto the Beneficent, and may not speak this day to any mortal" (Chapter Mary: 25-26). These verses look interesting because Allah ordered Mary to shake the trunk of a sturdy date palm tree, in the midst of her weak condition and the surrounding conditions which are dry, cold, and lonely. Normally, for a woman who wants to deliver a baby is naturally unable to shake the sturdy palm tree, impossible to make the date seeds fall from the stem. However, by the power of Allah and Mary's efforts and self-submission (tawakkal), the wet dates were falling for her to eat after giving birth.

Another thing which is more interesting from the verses above is dealing with the reason why Allah commanded Mary to eat dates during the birth

process. As we all know that women who give birth will lose a lot of two things, namely energy and blood. But Allah overcame and completed these two losses only with Dates. According to Ttayara (2009), these verses imply a good effect of dates on childbirth. Dates are food, beverage, and sedatives for Mary and the most important factor that make her more resilient and calm in facing a very great difficult situation. More than that, scientists have revealed the benefits of wet dates in stretching the cavities of uterus during childbirth. Dates also contain hormones which can stop constant bleeding during childbirth. Likewise, the modern medical world has proven that dates help to strengthen the contraction of uterus and muscles, especially in the last months of pregnancy. Therefore, it can help facilitate labor and reduce bleeding after childbirth (Mahran & Al-'Adzim, 2010).

A number of modern researches confirm that consuming dates during pregnancy until delivery is very beneficial, because dates contain oxytocin which can facilitate labor. Oxytocin substances found in dates help the uterine system of contraception during labor and help restore the condition of the uterus postpartum. This is important to prevent moisture from the uterus which can result in postpartum bleeding. Oxytocin also plays an important role in increasing breast milk volume during lactation because it affects breast gland cells (Shehab, 2011). Dates contain vitamin A which stimulates resistance to inflammation of thyroid glands. Pregnant women generally experience inflammation of the thyroid glands, so very often they feel emotional or nervous. Based on this description, it can be concluded that dates are beneficial for pregnant women because they contain vitamin A which can prevent inflammation of thyroid glands and help strengthening mucous membranes to prevent various infections, especially postpartum infections (Ahmad, 2003).

THE PHYTOCHEMICAL COMPOSITIONS OF DATE FRUIT

Currently, there is public interest and health professional's awareness towards the importance of functional foods in the prevention of diseases, and as a result, there is an increased demand for exploration of fruits capable of preventing chronic diseases. The phytochemical constituents in DF have been explored to be correlated with certain biological activities (Maqsood et al., 2020). Phenolics, flavonoids, and tannins are classes of phytochemicals believed to contribute in antioxidant activities of DF in vitro and in vivo. As a consequence some extraction conditions were

optimized to get maximum levels of these phytochemicals (Sedraoui et al., 2020).

Table 1 reported the phenolics, flavonoids, and other phytochemicals compounds present in extracts of DF. The varieties and ripening stages of DF are the most evaluated factors contributing to the differences in terms of nutritional composition, phytochemical profiles, and biological activities. It is reported that the polyphenolic contents of DF are highest in the early stage of ripening, and then they are reduced with ripening. Also, the variety of Ajwa DF at Khalal stage contained higher levels of polyphenols than other evaluated stages and cultivars, significantly ($p < 0.001$) (Eid et al., 2013). Besides, the location of DF cultivation sometimes is more influencing than varieties in terms of variation of chemical compositions. Using variables of chemical composition and mineral contents combined with chemometrics of discriminant analysis, it is reported that DF originated from various regions indicated that the place of cultivation is the main factor determining the tested chemical composition, not the variety (Kuras et al., 2020). This is supported by the fact that mineral contents of potassium, calcium, and magnesium were the predominant factors contributing to the variation of phenolics, flavonoid and tannin contents (Bouhlali et al., 2017). Another factor contributing to the levels of phytochemicals is drying process of DF. Two varieties of (Mazfati and Kalute) at ripening stages of khalaal, rutab, tamar and dried date from Bam and Jiroft date from Iran were analyzed to quantify total phenolic contents (TPC). The result showed that TPC is influenced by drying process, as indicated by decreased levels of TPC by increase of drying temperature, namely from 667.3 to 610.5 mg GAE/100 g in sun dried dates, decreased to 314.2 and 210.4 in dried dates at temperature of 80°C of Mozafati and Kaluteh, respectively (Shahdadi et al., 2015).

The levels of total phenolics contents (TPC), total flavonoid contents (TFC), and condensed tannins contents (CTC) of DF from Tunisia with varieties of Gondi, Gasbi, Khalt Dhahbi, and Rtob Ahmar at different ripening stages were also evaluated. At the better stage, all of the four date cultivars displayed the highest level of TPC, in which cultivar Rtob Ahmar had the highest TPC (563.71 mg GAE/100 g) and Gondi revealed the lowest TPC (304.24 mg GAE/100 g FW). TPC decreased significantly ($p < 0.05$) from better to tamar stage which can be explained by the decreased levels of phenolic substances as the dates matured to tamar stages. TFC contents of DF were also influenced by maturation stages, in which TPC gradually decreased as maturity proceeded. The

order of TFC in cultivars of DF Rtob Ahmar > Khalt Dhabi > Gasbi > Gondi. The better stage was also characterized by the greatest levels of CTC, and the levels of CTS decreased as the dates matured (Amira et al., 2012).

The differences in composition phenolics, hydroxycinnamates, and flavonoid of DF varieties of Ajwa, Barni, and Khalas from Al-Gudaibi and Al-Qassim (Saudi Arabia) at ripening stages of kimri, khallal, rutab, and tamar, as determined by HPLC and LC-ESI-MS/MS have been reported. The highest levels of phenolics contents were found in early stages of ripening and then these phenolics concentrations were reduced with ripening. At the same ripening, the khallal stage of the Ajwa cultivar contained the higher phenolics contents significantly ($P < 0.001$) than those in the Barni and Khalas dates. The cultivar of Ajwa, especially at khallal stage, was the only cultivars containing significant quantities of anthocyanidins (flavonoids) (Eid et al., 2013).

ANTIOXIDANT ACTIVITIES

Date fruit has a large number of bioactive compounds with high antioxidant activities. Currently, fruits-derived antioxidants are explored to substitute synthetic antioxidants. Antioxidants are defined as any phytochemicals capable of delaying or preventing the oxidation of substrate significantly when they are present at low levels compared with those of an oxidizable substrate. The oxidizable substrate refers to everything found in the living cells which include lipids, DNA, proteins, and carbohydrates (Rohman et al., 2020).

Antioxidant activities of date fruit in vitro

The evaluation of antioxidants activities derived from natural samples in vitro are typically carried out by several assays (Alam et al., 2013), namely (1) radical scavenging methods using several radicals namely 2,2'-azinobis-(3-ethylbenzothiazoline-6-sulfonic acid) (ABTS•+) which is also known as Trolox Equivalent Antioxidant Capacity (TEAC), 2,2'-diphenyl-1-picrylhydrazyl (DPPH), nitric oxide, hydrogen, and peroxy nitrite radicals, (2) reducing power including ferric reducing antioxidant power (FRAP), ferric thiocyanate, phosphomolybdenum method, cupric ion reducing antioxidant capacity (3) metal chelating power, (4) the inhibition of lipid peroxidation oxidation using beta-carotene bleaching linoleic-ferric-thiocyanate, and thiobarbituric acid (TBA) methods and (5) synergistic effects by evaluation of in vitro antioxidant methods (Chaves et al., 2020).

Several factors contributed to antioxidant activities of DF, mainly due to different composition of

phytochemicals, namely varieties of DF, ripening stages, the cultivation of DF (origin of regions) and drying process. Table 2 compiled the reported antioxidant activities in vitro of DF along with its varieties, country of origins, and ripening stages. Among antioxidant assays, radical scavenging methods are the most commonly used for antioxidant screening of plant extracts. The parameter of IC_{50} (concentration of sample solution capable of scavenging 50% DPPH radicals) is used to assess the power of antiradical. DF from several countries with different varieties have been evaluated for its antioxidant activities in vitro and in vivo. Antioxidant activities of DF from six varieties namely Bouskri, Boursdon, Bousthammi, Boufgous, Jihl and Majhoul which are considered as DF premium quality in Marrocco have been evaluated in vitro using ABTS radical scavenging assay, DPPH radical scavenging activity, FRAP assay. These antioxidant activities were correlated with total phenolics, flavonoid and tannin contents. Based on DPPH radical assay, all six varieties exhibited significant different antiradical assay in which Jihl cultivar showed the highest antiradical with lowest IC_{50} value of 2.046 g of DF/L. The order of DPPH radical activity was: Jihl > Bouskri > Boufgous > Bousthammi > Majhoul > Boursdon. However, all DF varieties have lower DPPH antiradical than positive control of Trolox (IC_{50} of 0.0101 g of Trolox /L). The IC_{50} values of DPPH antiradical activities correlated with phenolic, flavonoid and scavenging activity with R-values of -0.90, -0.842 and -0.942, respectively (Bouhlali et al., 2016).

Seven varieties of Algerian DF namely Tazizaout, Akerbouche, Deglet-Nour, Ougherouss, Tantbouchte, Tafiziouine, and Tazerzait were evaluated for DPPH antiradical activity together with phenolics contents. Phenolics contents, as determined by Folin-Ciocalteu and expressed as gallic acid equivalent (GAE), were in the range of 2.49 ± 0.01 mg GAE (Tazizaout) to 8.36 ± 0.60 mg GAE/per 100 g fresh fruit (Tantbouchte). Among these varieties, Tantbouchte had the highest antiradical activities with effective concentration of 50% (EC_{50}) of 4.55 ± 0.05 μ g sample/ μ g DPPH, while Tazizaout had the lowest one with EC_{50} of 12.7 ± 0.01 μ g sample/ μ g DPPH. EC_{50} is amount of antioxidant needed to decrease initial concentration of DPPH radicals by 50%. The antioxidant efficiencies, defined as $1/EC_{50}$, of both varieties were of 0.22 and 0.08, respectively. The antiradical activities of all varieties correlated with total phenolics contents with R-value of 0.98-0.99 (Mansouri et al., 2005). Identification of phenolics composition using LC-MS/MS confirm the presence of

phenolics acids namely p-coumaric, ferulic and synaptic acids and some cinnamic acid derivatives. Three different isomers of 5-o-caffeoylshikimic acid were also identified. Some flavonoids in the class of flavones, flavanones and flavanol glycosides were also detected.

DPPH and nitric oxide (NO) radical scavenging activities were also used to evaluate antioxidant activities of nine Saudi DF varieties, namely Berni (BR), Halaoua (HL), Shalabi, (SB), Sogaai (SG), Sukkari (SK), Nebtat Ali (NB), Anbara (AN), Ajwa (AJ) and Medjoul (MJ). The sample used is ethanolic extract of freeze-dried flesh and peel (whole DF). Using DPPH assay at the same concentration of sample extract (125 mg/mL), MJ and NB varieties had the higher antiradical activities with inhibition percentage of 40.0 and 36.7, respectively than other varieties. The varieties of AN, SG, SB and BR showed DPPH radical inhibition (%) 31.5, 30.2, 30.7 and 29.6, respectively, which are not significant differences at $p > 0.05$. The variety of SK had the least DPPH inhibition at 22.7%, while quercetin, used as positive control at the same concentration, showed percentage of DPPH inhibition of 96.5. In addition, AJ variety demonstrated the highest percentage of NO radical scavenging activities compared to others (Abdul-Hamid et al., 2020).

DPPH and ABTS antiradical activities and its correlation with phenolic and flavonoid contents of methanolic extracts of five varieties of DF fruits from Algeria, namely Deglet Nour (DN), Degla Baidha (DB), Ghars (GH), Tamjhourt (TM), and Tafezaouine (TF) were evaluated. Total phenolic and flavonoid contents in the range of 41.80-84.73 mg GAE/100 g and 7.52-14.10 mg RE/100 g, respectively. Effective scavenging concentration (IC_{50}) on DPPH radical ranged from 10.83 to 21.27 μ g/L, in which DN had the highest DPPH radical activities with IC_{50} of 10.83 μ g/L followed by GH > TM > DB > TF. In addition, DN also revealed the highest ABTS radical cation scavenging activity with Trolox equivalent of 1.66-mM followed with the same order to DPPH radical assay (Zineb et al., 2012).

Antioxidant activities of six Marroccan DF have been evaluated using FRAP assay. The variety of Jihl had the highest antioxidant activity with FRAP value of 860.89 μ mol Trolox equivalents (TE)/100 g dry weight, followed by varieties of Boursdon, Boufgous, Bousthammi, Majhoul, and Bouskri, respectively (Bouhlali et al., 2016). The methanolic extracts of five varieties of DF fruits from Algeria, namely Deglet Nour (DN), Degla Baidha (DB), Ghars (GH), Tamjhourt (TM), and Tafezaouine (TF) were evaluated using $K_3Fe(CN)_6$ complex assay. The studied extracts have the antioxidant capacities of in the range of 2.06 -

4.21 mM ascorbic acid equivalents, in which variety of GH revealed the most active as reducing power followed by > TM > DB > DN > TF (Zineb et al., 2012).

Antioxidant activities of date fruit in vivo

Antioxidant activities of water extract of DF (WDE) were evaluated in vivo using male adult Wistar rats as animal models (El Arem et al., 2014a). WDE was prepared by soaking distilled water on fruit flesh in ration of 3: 1 (w/v) with continuous stirring. The mixture was kept for 48 h at 4 °C followed by centrifugation at 4 °C (4000 g for 20 min). The supernatant was taken and used for experiment. Some enzymatic antioxidant activities including catalase (CAT), superoxide dismutase (SOD), and glutathione peroxidase (GPx) along with levels of hepatic TBARS (thiobarbituric acid reactive substances) and hepatic DNA fragmentation were evaluated. ADE effectively protected the rats treated with dichloroacetic acid (DCA)-induced liver damage against lipid peroxidation, as indicated by decreased levels of TBARS formation. In addition, ADE also restored the activities of SOD, CAT and GPx and reduced the hepatic DNA fragmentation. From this study, the authors concluded that WDE protects rat liver from DCA-induced injury. These antioxidant activities attributed from phenolics and flavonoid contents found in WDE accounting of 417.71 ± 1.59 mg GAE and 285.23 ± 1.48 mg catechin equivalent per 100 g of fresh weight, respectively. The water extract of Fresh ripened DF variety Deglet Nour (WEDN) was evaluated for its capability to reduce TBARS levels and to increase antioxidant enzymes (CAT, SOD and GPx) in rats treated with dimethoate. Ascorbic acid (vitamin C) capable of giving a protection against the dimethoate toxicity was used like a positive control. The results showed that after a 2-month exposure to dimethoate, the levels of hepatic malondialdehyde (MDA, a product occurring during lipid peroxidation), were increased in rats treated with dimethoate-treated group, indicating the presence of lipid peroxidation in the liver. The administration of water WEDN and vitamin C in dimethoate-treated rats showed reduced levels of MDA formation in the liver. In addition, the levels of SOD, GPx, and CAT were increased in dimethoate-treated rats added with WEDN and vitamin C compared to control rats. This result indicated that WEDN was capable of healing the cellular damage caused by oxidative stress and lipid peroxidation in rat's liver after sub-chronic exposure to dimethoate (Saafi et al., 2011). Evaluation of lipid peroxidation inhibition and enzymatic antioxidant activities (CAT, SOD, GPx along with reduced glutathione) of DF cultivar

Degla from Tunisia were carried out by El Arem et al. (2014a). The water extract of DF var. Degla (WED) was administrated on rats induced with dichloroacetic acid (DCA). Rats treated with DCA revealed the dramatically increased activity of CAT compared to control rats. Nevertheless, the oral administration of WED was capable of returning SOD and GPx activities and GSH level to normal values. Treatment of rats with DCA also induced significant ($p < 0.05$) increases in renal MDA levels compared to control rats. But, treatment of rats with the WED reversed the MDA level back to the control level. This study exhibited the ability of WED to repair the oxidative stress and cellular damage in rat's kidney induced by DCA (Arem et al., 2014a). The aqueous date extract also effectively alleviated the oxidative stress induced by DCA, thereby restoring these antioxidant enzymes to normal values (Arem et al., 2017).

DF extract Deglet Nour variety from Tunisia has been evaluated for the antioxidant activities on rats treated with dimethoate-induced oxidative stress. Some parameters including the levels of MDA and SOD activity were used for evaluation of this activity. The rats treated with dimethoate orally were marked with renal failure as characterized by increased levels in serum creatinine and decreased levels in serum uric acid significantly ($p < 0.05$). This indicated the enhancement of lipid peroxidation in kidney, indicating a significant induction of oxidative damage ($p < 0.01$) and dysfunctions of enzymatic antioxidant defenses. The treatment of rats with DF extract and also with vitamin C significantly ($p < 0.05$) reversed the serum renal markers to their near-normal levels when compared with dimethoate-treated rats. DF extract and vitamin C could reduce lipid peroxidation, as indicated by decreased levels of MDA levels significantly and could increase the levels of antioxidant defense enzymes (SOD) in the kidney, and improve the histopathology changes significantly (Saafi et al., 2012). The treatment of aqueous extract of DF could restore the liver damage induced by trichloroacetic acids by inhibiting the hepatic lipid peroxidation and ameliorating the antioxidant enzymes (SOD, CAT, and GPx activities) and improving the histopathology changes (El Arem et al., 2014b). These results concluded that DF extracts may be useful for the inhibition of oxidative stress-induced nephrotoxicity and revealed the protective effects on hepatic oxidative damage in rat liver.

The in vivo effects of consumption of DF varieties of Medjool or Hallawi on healthy subjects were evaluated in terms of triacylglycerol and oxidative stress (Wasseem et al., 2009). Total phenolics

composition, especially ferulic acid and coumaric acid derivatives as well as chlorogenic and caffeic acid derivatives, in Hallawi variety are higher of 20-31% than those of Medjool. From in vitro studies, Hallawi varieties also revealed higher antioxidant activities than Medjool by 24%. During in vivo studies, ten subjects consuming DF varieties of Medjool and Hallawi revealed the decreased levels of serum triacylglycerol levels ($p < 0.05$), significantly by 8 or 15%, respectively. The levels of basal serum oxidative status were also decreased significantly ($p < 0.01$) by 33%, compared to those before consumption of Hallawi variety. In addition, the lipid peroxidation of serum induced by 2,2'-Azobis-(2-amidino-propane) hydrochloride (AAPH) was decreased by 12%. The serum activity of the HDL-associated antioxidant enzyme paraoxonase-1 due to Hallawi consumption was also significantly increased by 8%. This result confirmed the beneficial effects of DF on serum triacylglycerol and oxidative stress.

CONCLUSIONS

Date fruit (DF) is one of the fruits mentioned in Alquran and Hadith of Prophet Muhammad SAW due to its uniqueness and usefulness. Some minor components of phytochemicals which are beneficial to human health are present in DF, mainly phenolics and flavonoids. These phytochemicals contributed to health beneficial effects to human health, especially antioxidants. Through in vitro and in vivo studies, DF is reported to have good antioxidant activities; therefore, DF is considered as a functional food. It is recommended to consume DF daily to get the protective effects from oxidative stress-related diseases.

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DECLARATION OF INTEREST

The authors declare no conflict of interest.

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Table 1: Some phytochemicals reported present in date fruit

Class of compounds	Phytochemicals	Found in	References
Phenolics	Gallic acid, Chlorogenic acid, Protocatechuic acid, Caffeic acid, Syringic acid, m-Hydroxybenzoic acid, Ferulic acid, p-Coumaric acid, m-Coumaric acid, o-Coumaric acid, Phenylacetic acid and Catechin	Water extract	(El Arem et al., 2014a)
	Protocatechuic acid, syringic acid, gallic acid, protocatechuic acid, p-hydroxybenzoic acid, vanillic acid, caffeic acid, syringic acid, p-coumaric acid, ferulic acid, and o-coumaric acid	Water extract	(Al-Farsi et al., 2005)
	caffeoylshikimic acid hexoside or di-caffeoyl shikimic acid, sinapic acid hexoside, 5-O-caffeoyl shikimic acid, caffeoyl shikimic acid and its isomers.	Extracts of DF variety Ajwa at Tamar stage	(Nematallah et al., 2018)
	gallic, protocatechuic, syringic, iso-vanillic and 3-hydroxybenzoic acids, chlorogenic, caffeic, ferulic, p-, m-, and o-coumaric, and cinnamic acids, as well as two other phenolic acids; hydroxyphenylacetic and phenylacetic acids,	Extracts of DF varieties of Gondi, Gasbi, Khalt Dhahbi, and Rtob Ahmar, Tunisia	(Amira et al., 2012)
Flavonoid and its glycosides	quercetin, apigenin, isorhamnetin, luteolin, and chrysoeriol, chrysoeriol rhamnosyl dihexoside, luteolin dihexosyl sulfate, and luteolin hexosyl sulfate	Extracts of DF variety Ajwa at Tamar stage	(Nematallah et al., 2018)
	Quercetin, isorhamnetin, luteolin, apigenin, chrysoeriol, isorhamnetin-3-O-β-D-glucoside	Date fruits from Egypt	(Farag, et al., 2014)
	Chrysoeriol-7-O-(2,6-dirhamnosyl)-glucoside	DF Ajwa variety from Medina (Saudi Arabia)	(Zhang et al., 2013)
	Catechin and apigenin,	Extracts of DF varieties of Gondi, Gasbi, Khalt Dhahbi, and Rtob Ahmar	(Amira et al., 2012)
Triterpenoid	Lup-20(29)-en-3-one, Lupeol	DF Ajwa variety from Medina	(Zhang et al., 2013)
Triglycerides	1,2-Dilinoleoyl-3-stearin	DF Ajwa variety from Medina	(Zhang et al., 2013)
Steroids	β-Sitosteryl-3β-glucopyranoside-6'-O-palmitate	DF Ajwa variety from Medina	(Zhang et al., 2013)

Table 2: The antioxidant activities of date fruit using in vitro methods reported in scientific publications

Country of origins	Varieties	Ripening stages	Assays	Results	References
Oman	Fard, Khasab and Khalas	Tamar	ORAC	The antioxidant capacities in the range of 11687-20604 μmol of TE/g. The order is Khalas > Fard > Khasab	(Chaves et al., 2020)
Israil	'Amari' and 'Hallawi'	Tamar	FRAP and DPPH	Using FRAP method, the phenolics and flavonoids contents present in Amari and Hallawi showed the same FRAP values.	(Borochoy-Neori et al., 2015)
Medina region (Saudi Arabia)	Ajwa	Tamar" or ripened stage	Inhibition of lipid peroxidase (LPO)	The ethyl acetate, methanolic, and water extracts of Ajwa fruits at concentrations of 250 μg/mL could inhibit LPO by 88, 70, and 91%	(Zhang et al., 2013)

Southern Morocco	17 dates varieties and clones	Tamar stage	FRAP, DPPH	the phenolic contents are 101.06-478.37mg GAE/100 g, flavonoids contents are 1.79-216.12 mg RE/100 g, the levels of condensed tannins 5.29 - 152.15 mg CE /100 g. IC ₅₀ using FRAP 0.219-2.028 mg/mL and IC ₅₀ using DPPH 2.411- 9.738 mg/mL.	(Alahyane et al., 2019).
Southern Tunisia	Bouhattam, Deglé Nour Matteta, Kenta, Eguwa, Garen Gaze, Limsi, Rochdi, Smeti, Mermella, and Korkobbi	Tamar stage	DPPH radical assay	Deglé Nour (DN) had the highest soluble phenolics contents (221 mg GA/100 g). DN also had the highest DPPH scavenging activity (50 mmol Trolox/kg), followed by Korkobbi and Bouhattam cultivars, each with 28.68 and 24.60 mmol Trolox/kg. The lowest values were found in Rochdi and Mermella, each with 3.07 and 3.18 mmol Trolox/kg.	(Mrabet et al., 2012)
Tunisia	Gondi, Gasbi, Khalt Dhahbi, and Rtob Ahmar	Besser, rutab and tamr.	ABTS, DPPH, reducing power	There is a relationship between antioxidant capacity TEAC values (ABTS assay) and phytochemical class (total phenols, $r = 0.848$; total flavonoids, $r = 0.767$ and condensed tannins, $r = 0.891$, $p < 0.01$), DPPH and class of phytochemicals (TPC, $r = 0.811$; TFC, $r = 0.769$ and total TCT, $r = 0.770$, $p < 0.01$), as well as EC50 values of reducing power-TPC ($r = -0.806$), TFC ($r = -0.735$) and CTC ($r = -0.661$).	(Amira et al., 2012)
Saudi Arabia	Ajwa, Barni, and Khalas	kimri, khalal, rutab, and tamr	FRAP, expressed with vitamin C equivalent	There was also a significant reduction in the antioxidant capacity of DF extracts with increasing degree of ripeness. The varieties of Ajwa and burni revealed the same FRAP values ($P > 0.05$), which are higher than those in Khalas variety	(Eid et al., 2013)
Iran	Soft dates varieties Berehi, Mordasang, Mazafati, Kabkab, Khanizi, Shahabi and Medjool dates; semidry dates varieties of Piarom, Zahedi,	Tamar stage	TEAC or ABTS assay	TEAC values of studied DFs were in the range of 21.31–29.94, 33.36–35.85 and 33.71 μ mol Trolox equivalents/100 g fresh weight, while TPC contents were in the range of 250.75–328.57, 356.55–398.23, and 361.46 mg gallic acid equivalents (GAE)/100 g. There is a high correlation between TEAC values and TPC (R^2 of 0.98).	(Hemmateenejad et al., 2015)

	Halavi and Karoot; dry date of Rabbi variety				
Iran	Mazfati and Kalute at different drying conditions	Khalaal, rutab, tamr	DPPH, Reducing powe	Antioxidant activities varied with temperature and they are decreased by increased drying temperature	(Shahdadi et al., 2015)

ABTS = 2,2'-azino-bis (3- ethylbenzothiazoline-6-sulfonic acid); DPPH = radical scavenging using 2,2-diphenyl-2-picryl-hydrazyl radical scavenging; FRAP = Ferric-Reducing Antioxidant Power (FRAP); ORAC = Oxygen Radical Absorbance Capacity; TEAC = Trolox equivalent antioxidant capacity, CE = catechin equivalent; GAE = gallic acid equivalent; QE = quercetin equivalent

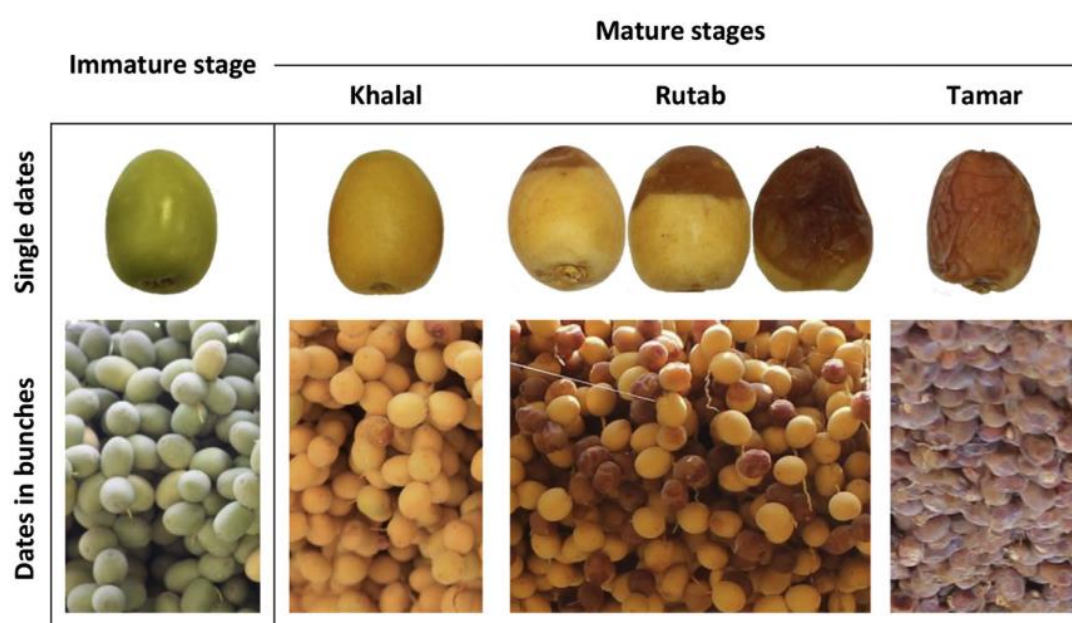


Fig.1: The ripening stages of date fruit (Khalid et al., 2017). Taken with permission from publisher.