

DATE FRUIT PROCESSING AND COMPOSITION

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Abstract

Consumers are increasingly looking for foods with health benefits which eventually change the diet patterns. High-fiber diets are in great demand in the market. Date fruit is an important product in the world and plays a significant role in the economic and political life in date growing regions. Date palm (*Phoenix dactylifera* L.) is a monocotyledon plant that goes through the stages of hababauk, kimri, khalal, rutab, and tamer during ripening. The main constituents of date include water, sugar, protein, fat, pectin, ash, crude fiber, and polyphenols. Date flesh is found to be low in fat and protein but rich in sugars, mainly fructose and glucose. It is a high source of energy, as 100 g of flesh can provide an average of 314 kcal. Products from date processing includes paste, powder, oil, jam and jellies. They are also used in dairy products such as yoghurt. Date pit contains dietary fiber and phenolic compounds as such it can be used in functional foods

Keywords: Date fruit, processing, dietary fiber, nutritional composition

Received: 27.09.2021

Reviewed: 10.11.2021

Accepted: 11.11.2021

1. INTRODUCTION

Dates (*Phoenix dactylifera* L.) are a high-value fruit crop that is grown mostly in the arid desert regions of Southwest Asia and North Africa. With the current state of global food supply insecurity and a predicted growth in demand, the date palm is likely to remain a low-cost food source. From 4.60 million tons in 1994 to 8.52 million tons in 2018, global date production has increased (FAO, 2020).

Date fruit is not only a nutritional food that can be readily preserved, stored, and transported over long distances, especially in dry regions, but the date palm also provides a perfect spot for nomadic people to settle by providing shade and protecting against desert winds. The date palm is one of the oldest plants grown by humans, with a 6000-year history of use as a food source. It is a particularly important product in the world's arid and semi-arid regions, where it plays an important role in people economic and political lives (Besbes *et al.*, 2004).

Dates can be used to make a variety of

products, including date syrup, alcohol, animal feed, date powder, several varieties of bread, marmalade, sweet confectionery, chocolate, date paste, and more. Not only does the date palm play an important part in the desert ecosystem, but it also offers a number of agricultural and animal husbandry applications. The agricultural economy also relies on other elements of the date palm. The stem, for example, is used to make boats, cover the roofs of rural dwellings, and produce fiber in the paper and wood industries. Handicrafts such as fans and straw hats are made from the leaves (Ashraf, 2002).

Studies have focused in using date powder in the production of value-added products since it is particularly healthy. Invert sugars, particularly fructose, are abundant in date powder (Jagirdar, 1998). Date powder can be kept for a long time without losing its quality. Throughout the year, they can be used as a sugar alternative in a variety of culinary recipes (Nadeem *et al.*, 2017).

Soft and semi-dry types of dates are often stored after partial drying to a moisture level of

less than 25%, which has demonstrated to have an adequate shelf life. Date overproduction combined with limited processing results in significant losses, particularly for low-grade fruits. During harvesting, storage, conditioning, and processing, major losses of up to 2 million tons per year have been documented around the world (Besbes et al., 2009). In the desert, low-grade date fruits are dehydrated, crushed, and combined with grain to create a highly nutritious feed for camels and horses. Cattle, sheep, camels, and fowl are given date seeds in their feed.

Dates are a nutrient-dense fruit that enhance the nutritional content and sensory qualities of any product to which they are added (Al-Hoote et al., 1997). Table date consumption has dropped in recent years, while its use in food products such as bars, paste, honey, jam, vinegar, cookies, wafers, squares, and powder has increased (Ahmad et al., 2005).

Dates are high in bioactive substances as well as natural sugar. It has the potential to be used as an alternative to sugar. Dates come in a variety of forms, including fresh dates, date paste, and date syrup, and are used for a variety of purposes (Manickavasagan et al., 2012).

2. MATERIALS AND METHODS

2.1. Nutritional Composition of Dates

2.1.1. Sugar

Dates are high in carbohydrates, with the majority of them being simple sugars. According to the USDA National Nutrient Database, a 100 g serving of dates contains around 75 g of carbohydrates, or 18% of the daily carbohydrate requirement. Dates contain about 85% of their total carbohydrate in the form of simple sugars. The sugar content of date fruit varies greatly depending on the cultivar, soil, meteorological circumstances, and stage of fruit maturity. The date sugars contain glucose, fructose, and sucrose, albeit sucrose is limited or non-existent in most date varieties, and the glucose-to-fructose ratio is about equal.

Kimri (the immature green), Khalal (the mature

full-colored, crunchy), Rutab (ripe, soft), and Tamar (relatively hard and ripe, reduced moisture) are the four phases of date ripening. During the kimri, khalal, and tamer phases, total soluble solids and total sugars gradually increase (Bacha et al., 1987). The decrease in date moisture content during these stages is proportional to the increase in sugar concentration from stage kimri to stage tamer (Al Shahib and Marshall, 2003). 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. Date pulps are high in easily digestible sugars (70%) such as glucose, fructose, and sucrose, as well as dietary fibers and low in proteins and lipids (Al-Farsi and Lee 2008a).

At the khalal and early rutab stages of ripening, sucrose makes up around 60% of the dry weight of the date (Samarawira 1987). Sugars increase during fruit development, peaking at the tamer stage and consisting primarily of reducing sugars (Bacha et al., 1987). Due to moisture loss at the ripening stage, dates have the highest total soluble solids and reducing sugars (Shenasi et al., 2002). El-tayeb et al. (2005) conducted an experiment on various Omani date types and discovered that the only sugar present at the kimri and khalal phases was fructose. The level of fructose increased significantly during the rutab stage, and fructose was the sole sugar measured at the tamer stage. There was a significant rise in soluble carbohydrates at this point. Fruit storage, on the other hand, enhanced fructose content. This is most likely due to the loss of moisture content in the fruit, which causes the weight of the fruit to drop (El-tayeb et al., 2005).

Dry dates have higher levels of sucrose than soft dates (Tafti et al., 2006). Except for a few cultivars that contain sucrose, soft dates contain reducing sugars (El-tayeb et al., 1999). Sucrose and reducing sugars make up about half of semi-dry dates. According to Eltayeb et al. (1999), semi-dry dates contain more sucrose than reducing sugars (Morton, 1987). Only

sucrose is present in the Deglet Nour cultivar, which is mostly grown in California (Ensminger *et al.*, 1995). Dry dates with firm and dry flesh have a higher sucrose content than decreasing sugars. (El-tayeb *et al.*, 1999). Dates are categorised into two varieties based on the type of sugars they contain: sucrose-containing dates and reducing sugar-containing dates (Sawaya, 1983).

Because dates with low moisture content contain high sugar and vice versa, moisture content is related to sugar content. Around 70% of reducing sugars are found in Saudi date varieties, with nearly equal amounts of glucose and fructose (Tafti *et al.*, 2006).

2.1.2. Protein

Lysine, histidine, arginine, aspartic acid, threonine, glutamic acid, serine, proline, glycine, alanine, cystine, valine, methionine, isoleucine, leucine, tyrosine, and phenylalanine are all present in various date cultivars. A highest concentration of glutamic acid is reported. During acid hydrolysis, tryptophan and half-cystine may have been lost (Al Aswad, 2008).

Date proteins were discovered to be high in acidic amino acids but low in sulfur-containing amino acids like methionine and cysteine. The amino acid concentration varies greatly within the same stage of maturation. Water decrease resulted in an increase in amino acid content in dried variety (Auda *et al.*, 1976). Dates, according to Al-Hooti *et al.* (1997), have a high protein content when compared to other fruits. During the Kimri stage, the highest content (5.5-6.4%) is seen, gradually decreasing to 2-2.5 % during the Tamar stage. Date flesh contains 0.2-0.5 percent oil, while date seeds contain 7.7-9.7 % oil. Ahmed *et al.* (1995) used phosphate- buffered saline (PBS) extraction to isolate proteins from diverse date cultivars from different countries (Oman, Saudi Arabia, Iran, and the United States), which were then examined using sodium dodecyl sulfate-polyacrylamide gel electrophoresis (SDS-PAGE). Dates had a variety of proteins with molecular weights ranging from 12,000 to 72,000 Dalton; however, most date cultivars

had two distinct bands with molecular weights of 30,000 and 72,000 Dalton.

The majority of date proteins were water-soluble albumins, according to sequential extraction of date pulps. Green dates had very little protein when they were immature, but this increased rapidly as they matured. The protein profiles of dates from Saudi Arabia, Oman, and Iran were similar because they included similar complex combinations of proteins with molecular weights ranging from 12,000 to 72,000 Dalton. A date variety from the United States has a low protein content and a simple protein profile with one main band at 30,000 Dalton.

2.1.3. Fibre

This is the edible component of a similar or plant carbohydrate that resists digestion and absorption in the human small intestine but ferments partially or entirely in the large intestine (Mudgil, 2003; Singh *et al.*, 2007). DF has numerous health benefits, including lowering cholesterol levels in the body by lowering low-density lipoprotein, or "bad," cholesterol levels, anti-obesity, a reduced risk of hemorrhoids, improved gut health and bowels through faecal bulk, the production of short-chain fatty acids, and anti-diabetic properties (Maqsood *et al.*, 2020; Otles, 2014). DF also had some functional features, such as gel formation, oil/water retention, and emulsifying abilities, which are useful in the production of innovative foods (Maqsood *et al.*, 2020). According to many research, date palms have a high DF content, implying that date goods are a better source of DF than grain products (Abdulhamid and Luan, 2000). If date seeds are correctly ground, they can serve as a rich source of fiber while having no negative impact on product sensory quality (Hamada *et al.*, 2002). Mrabet *et al.* (2017) discovered that Tunisian date varieties possessed 4.7-7 g/100 g of DF, water retention of > 17 mL/g fiber, and oil retention of > 4 mL/g fiber, respectively, in an experiment. As a basis, dates could be a good source of fiber in some food preparations. According to Shafiei *et al.* (2010), the antioxidant and antibacterial properties of dates

are linked to the tannin and lignin content. Tannin and lignin, on the other hand, are essential components of dietary fiber (Reed, 2001). Non-cellulosic fiber (75 % total fiber) in dates is made up of arabinoxylan, xylan, and pectin (Elleuch *et al.*, 2002). Due to the high activity of fiber-hydrolyzing enzymes such as pectinase and cellulase, the amount and content of fiber varies with the ripening phases of the dates (Maqsood *et al.*, 2020). β -glucan is another molecule found in dates, in addition to fiber (Maqsood *et al.*, 2020). β -glucan is a “biological response modifier” and a component of its cell wall that has a variety of health benefits, including intestinal health and anti-inflammatory properties (Ahmed, 2016). Cheese spreads, frozen desserts, salad dressings, and sour cream are some of the foods that use β -glucan as an ingredient (Maqsood *et al.*, 2020).

2.1.4. Fat

Date fruit has a low fat content, ranging from 0.5 % at the kimri stage to 0.1 % at the tamer stage of maturity (Hui, 2006). Date flesh contains roughly 0.1–0.5 % fat, which is concentrated in the crust. Fat as a nutritional content of date flesh is less significant than the protection it offers the fruit (Alshahib, 2003). In the flesh, eight fatty acids occur in very low concentrations. Lauric, myristic, and palmitic acids are the most abundant saturated fatty acids in dates, while oleic acid is the most abundant unsaturated fatty acid (Alshahib, 2003). Capric, caprylic, stearic, margaric, arachidic, linoleic, pelargonic, and a variety of other fatty acids are present in low amounts (Alshahib, 2003).

2.1.5. Minerals

The date fruit, according to Al Hadrami (2003), includes fluorine, which has been shown to protect against tooth decay. In addition, selenium has a variety of activities in the human body, including the prevention of cancer and the stimulation of the immune system. Dates are a good source of iron and can help with anemia and iron deficiency. Dates are high in phytochemicals such as phenolics, sterols, carotenoids, anthocyanins,

procyanidins, and flavonoids, in addition to carbohydrates, dietary fibers, several vital vitamins, and minerals. Apart from dietary fiber, minerals, lipids, and protein, date pits are a good source of phytochemicals. Phytochemicals contribute to the nutritional and sensory qualities of dates in addition to their pharmacological properties. Fruit phytochemicals have been proven to have strong antioxidant capabilities, which could be linked to a decreased incidence and mortality rate of degenerative diseases in humans (Baliga *et al.*, 2011 and Vayalil, 2012).

2.1.6. Vitamins

Vitamins as riboflavin, thiamine, biotin, folic acid, and ascorbic acid are found in date pulp and are vital for the body. B-complex vitamins, such as thiamine (B1), riboflavin (B2), niacin (B3), pantothenic acid (B5), pyridoxine (B6), and folate (B9), as well as vitamin K, are abundant in dates (Al-Farsi and Lee 2008a). It is worth noting that dates have higher concentrations of several vitamins (B3, B5, B6, and B9) than some typical fruits like apples, oranges, and berries. The niacin concentration is extremely high, ranging from 1.27 to 1.61 mg/100 g. Quantitative examination of water-soluble vitamins (B1, B2, B3, B5, B6, B9, and B12) revealed significant heterogeneity between cultivars and stages of date fruit development (Aslam *et al.* 2011). 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 are found to have a very low vitamin C concentration.

2.1.7. Volatile compounds

The volatile components of dates can be identified, allowing for an assessment of their organoleptic quality. Agro-industrialists interested in processing dates and creating flavor extracts from low-quality varieties will find this knowledge useful in boosting their commercial value (Harrak *et al.*, 2005). Scent is frequently employed as a fruit quality indicator, and various studies have looked at volatile components to characterize date aroma. With the introduction of the electronic nose (e-nose), which requires minimal sample

handling, these techniques have become a rapid and efficient alternative. This innovative instrument, which simulates the function of the human nose, piqued the interest for use in dating (Lebrun *et al.*, 2007). E-nose analysis was performed on nine Moroccan date cultivars in the Tamar stage. The e-nose was sensitive to the dates' volatile emissions, and all of the kinds investigated were well separated. The exact volatile components of the eight Moroccan date varieties were isolated and differences in their aromatic profiles were discovered. There were 47 components detected, 23 of which had never been seen before in dates. 2, 3-pentanedione, 2-methylbutanal, hexanal, n-pentanol, and limonene were detected in all of the types (Harrak *et al.*, 2005). At three different stages of maturity, the effect of maturity on the physicochemical composition and volatile components of date palm fruits was examined (El Arem *et al.*, 2011). Eighty volatile compounds were discovered in Tunisian date fruits at various stages of development, 43 of which were discovered for the first time.

2.1.8. Anthocyanins and procyanidins

Anthocyanins were found in a variety of fresh date cultivars, with concentrations ranging from 0.87 to 1.5 mg/100 g; there was a general association between anthocyanin levels and fruit color. Only fresh dates contain anthocyanins, implying that they are destroyed in sun-dried fruit (Al-Farsi *et al.* 2005b). Procyanidins have been found in date fruits, according to the literature. Procyanidins extracted with acetone–water–acetic acid were shown to exist as higher molecular weight polymers, undecamers through heptadecamers, and decamers, according to chemical analysis (Hong *et al.*, 2006).

2.1.9. Antioxidants

Dates have long been thought to be a good source of antioxidants. Antioxidants stop oxidative mechanisms from causing degenerative diseases like heart disease, cognitive malfunction, and arthritis (Prior *et al.*, 1999). Dates are said to have anticancer and antimutagenic qualities, as well as the

ability to cut cancer rates, particularly pancreatic cancer, activate the immune system, and regulate the role of antibiotics (Ishurd and Kennedy 2005, Vayalil 2002). Date flesh aqueous extract possesses significant free radical scavenging action against reactive oxygen species such as superoxide and hydroxyl radicals. The same extract also showed a strong inhibitory effect on in vitro macromolecular damages such as lipid peroxidation and protein oxidation.

2.2. Date fruit and by-products as a Functional Food Ingredient

Incorporating date fruits into food formulations would help to meet the growing demand among customers for items made with natural components. Furthermore, food matrixes are a great vehicle for the availability of biomolecules included in date palm products, which is a significant consideration (Echegaray *et al.*, 2021).

Dairy products that have been fermented are good for health (Parodi, 1999). Hashim (2001) investigated the properties and acceptance of date-based yoghurt. The results showed that adding 10-20% date paste with or without 5% date syrup had no effect on yogurt acidity, protein, or fat content, but greatly increased total solids. In addition, the addition of 15% date paste and 5% date syrup gave yogurt the ideal sensory quality. Gad *et al.* (2010) employed dates to reconstitute skimmed milk powder in a 14 % solids yogurt. When compared to plain yogurt, the results showed that yogurt enhanced with 10% dates had a greater sweetness, antioxidant properties, HCl soluble minerals, and folate content. The addition of date syrup to the probiotic yogurt increased the number of bifidobacteria in the products and improved their survival over a 10-day cold storage period. This could be explained by the fact that date syrup included micronutrients including vitamins and minerals that would promote bifidobacteria growth. Bifidobacterium lactis Bb-12, Bifidobacterium longum Bb-46, and Lactobacillus acidophilus La-5 were added to date pastes by Al-Otaibi and Saleh (2010). In dates, all probiotic

bacteria were able to survive. Until the third week of storage, the viable count of *L. acidophilus* maintained above 6-log₁₀ CFU/g. Until the eighth and tenth weeks of storage, the viable count of *B. lactis* and *B. longum* maintained over 6-log₁₀ CFU/g.

Hashim *et al.* (2009) looked into the impact of date fiber fortification on yoghurt quality. Although the pH of fresh yogurt fortified with 1.5 percent, 3.0 %, and 4.5 percent date fiber increased, there were no significant changes in yogurt acidity. Date fiber-enriched yogurt had a harder texture (higher hardness values) and a darker color. When date fibers were increased to 4.5 percent, sensory ratings and acceptability of yogurt declined dramatically. The addition of 3% date fibers to yogurt resulted in palatable yogurt with health benefits. Hartati *et al.* (2012) used varied percentages of date in yogurt drinks to gain information on sugar usage in fermenting milk. Adding date increased from 3.19 to 3.32 %, reducing sugar increased from 2.15 to 2.99 percent, and pH value reduced from 3.8 to 3.76 %, according to the results. The addition of a date to a yogurt drink, on the other hand, had no influence on the sourness. Lactose and decreased sugar concentrations, as well as the pH value of fermented milk, were found to be influenced by the lactic acid bacteria's use of date in this investigation (LAB). When date syrup and bovine colostrum were added to yoghurt, the content of total solids (TS), total protein, immunoglobulin G (IgG), lactoferrin, and minerals increased significantly when compared to the control. In addition, most nutrients increased slightly throughout the advanced storage time (Abdel-Ghany and Zaki, 2018). Bouaziz *et al.* (2016) developed new chocolate spreads with soluble and insoluble dietary fibers derived from Tunisian Deglet Nour date seeds. When compared to the control (102 %), chocolate spread supplemented with 5% DSSFC had the highest oil binding capability (304.62%). In varied amounts, date pit powder was added to yoghurt. The appearance, flavor, texture, consistency, and general acceptance of yogurt made with up to

3% date pits powder were found to be identical to that of control yogurt (Jambi, 2018). In the production of set yoghurt, dates seed powder can be added as a natural prebiotic stabilizer. The sensory and rheological qualities of the yoghurt were improved at a concentration of 0.5 % (El-Kohly, 2018).

2.3. Processed Products from Dates

2.3.1. Date paste

Date pastes with the appropriate moisture content, texture, and softness are ideal for mixing and supplementing with other products. Date paste, an intermediate product (20–23 % moisture) with a water activity of 0.6, is frequently used in the baking industry as a filler in pastries and biscuits, as well as an ingredient in cereals, puddings, breads, cakes, cookies, ice cream, and confectioneries. When sucrose is replaced with date paste in breads and cookies, the nutritional quality improves due to higher quantities of minerals, vitamins, and phenolic antioxidants. Date sugars, which are primarily invert sugars, make bread and cookies softer and sweeter. The addition of up to 15% date paste to the formulation of bologna-type meat products resulted in improved nutritional (lower fat content and higher fiber content than the control), technological (redder-colored and less hard, chewy, and cohesive product than the control), and sensory quality attributes (Manickavasagan *et al.*, 2012). Razavi and Karazhiyan (2012) investigated the rheological and textural qualities of date paste. Except for springiness and cohesiveness, all parameters obtained for black date pastes were higher than those obtained for golden date pastes, according to the results of texture profile analysis. However, the Ottawa results showed that golden date pastes were firmer and less adhesive than black date pastes.

When date paste is mixed with cooked meat, it lowers lipid content while increasing total dietary fibers, resulting in a product that is more sticky, less hard, chewy, and cohesive (Sánchez-Zapata *et al.*, 2011). Fresh date paste added to some meat products during storage

may reduce lipid and pigment oxidation (Martín-Sánchez *et al.*, 2013).

2.3.2. Extruded date

Extrusion cooking is used to make extended snack foods and ready-to-eat cereal items all around the world. Date pops were made by substituting locally produced date powder for PT and heat-treated flour for 25 % or 50 % of the recipe. Control and blends were extruded at 250 rpm, 15-20 g/min feeding, and 10-20 ml water/min, with the extruder's four heating zones set to 70, 91, 120, and 150 °C. Due to heat treatment, water absorption, departure time, mixing time, and dough stability of PT (the control) increased, whereas amylograph results suggested an increase in the starch paste's final viscosity. Dates are pressed through dies with 14-inch round holes, and the resulting "sausage" is sliced into lengths ranging from 12" to 1" while being coated with dextrose (solid glucose) or oat flour to keep the pieces from adhering together. For added firmness or consumer choice, this product is occasionally air dried (Alruqaie and Al Ghamidi, 2013).

2.3.3. Diced date

This product is made from cutting date into pieces by using a dicer. Date pieces are coated with dextrose or oat flour to prevent dices from sticking to each other. This product is usually consumed with cereals, cooked products like cake, different kinds of bread, and sweetmeats (Barreveld, 1993). Adding date pieces (10%) to ice cream slightly reduces the overrun (Yousif *et al.*, 1991).

2.3.4. Date powder

Date powder is a good sugar substitute in baked goods, and table sugar can be replaced up to 50% in baked goods (Nadeem *et al.*, 2017). It has the potential to improve the physical, nutritional, and sensory qualities of dairy products, confectionary, and snacks. It is also a good option to use it in diabetic meal compositions. After diluting the date paste with water, it is spread out on drier trays and dried using a tunnel or cabinet dryer until the moisture content is less than 5%. Dried dates are processed and sold in various granular

sizes. As a sweetening agent, this substance is utilized in confectionary and infant meals (Barreveld, 1993). Sablani *et al.* (2008) used oven drying to produce date powder from date paste. The date paste generated a non-sticky, free-flowing powder when dried with 1.0 kg maltodextrin/1.0 kg date paste. Raza *et al.* (2019) investigated the impact of various drying processes on the composition and functional qualities of various cultivars of dates. The drying processes affected some metrics, such as the wettability time of the powders produced.

2.3.5. Date seed

Date seed is regarded as a waste product (Besbes *et al.*, 2004). On average, it accounts about 10-15% of total date fruit mass, depending on ripeness, variety, and grade (Besbes *et al.* 2004; Al-Shahib and Marshall 2003). Given that global date fruit output exceeded 8 million tons in 2018, date seed represents a substantial quantity of trash (FAOSTAT 2018). Over 800,000 tons of date seed might be generated as a result. Date seed is traditionally used as livestock and poultry feed or as a soil fertilizer (Vandepopuliere *et al.*, 1995).

Date seed includes 60-80 % fiber, 4-14 % oil, and a low proportion of protein, according to chemical composition study. Date seed contains a variety of phytochemicals, including alkaloids, flavonoids, anthraquinone, saponin, terpenoids, and tannin, in addition to vital minerals like potassium and calcium (Hamada *et al.*, 2002; Al-Farsi and Lee 2008; Al-Farsi *et al.*, 2007). These findings suggest that the use of date seed in higher-value-added goods should be reconsidered. The total lipid content was likewise reported to be between 7.3 and 8.6 %. The most prevalent fatty acids in date seed oil were oleic, lauric, and myristic acid (Lieb *et al.*, 2019).

As a coffee alternative, some rural populations use roasted and powdered date seeds. Some Arabian marketplaces in Saudi Arabia and the United Arab Emirates sell coffee-like products made from date seeds. Ghnimi *et al.* (2015) compared traditional Arabic coffee to a coffee-

like beverage made from roasted date seeds. Date seed drinks are caffeine-free and contain fewer total phenolic chemicals than Arabic coffee. The date seed coffee-like preparations were accepted, but not as good as Arabic coffee, according to sensory evaluation. The potential estrogenic effects of roasted date seed extracts must be investigated before they are allowed for human consumption. (Ghnimi *et al.*, 2015).

2.3.6. Date syrup

The properties of date syrup are similar to those of date juice, although it is more concentrated. Date syrup, commonly known as "Rub" or "Dibs," is one of the most frequent date derivatives, and it can be made in one of three ways:

1. When date packages are stacked during storage, date juice seeps and leaks due to the weight of the dates. When dates are stored in particular containers, date syrup emerges from the bottom of the container. Only 15% of syrup can be retrieved using this ancient approach, whereas 60% can be extracted using industrial processes (Barreveld, 1993).

2. Boiling and evaporating of date juice.

3. Shi *et al.* (2005) employed an enzyme treatment with pectinase and cellulase enzymes to extract the juice, which was then concentrated to make date syrup. Soluble solids will be recycled to the fullest extent possible, virtually doubling the amount recovered over previous approaches (Shi *et al.*, 2005).

Date fruit of low quality is a good source of dry matter, sugars, and phenolic compounds, and it can be used to manufacture high-value-added goods like as syrup (Chandrasekaran and Bahkali 2013). Date syrup must meet the following criteria, according to the Iran National Standard Organization (2013): a minimum Brix of 70, a pH of 4.2 to 6, a maximum ash content of 2%, and a minimum reducing sugar concentration of 58% (Farahnaky *et al.*, 2016).

Date syrup can be found in ice cream, beverages, baked goods, jam, and butter, among other things (Barreveld, 1993; Jridi *et al.*, 2015; Razavi *et al.*, 2007). Date syrup and

date powder have a sweetening effect, increase viscosity, and cause spontaneous exudation in sweets due to their high fiber and sugar content (Ashraf and Hamidi-Esfahani 2011; Tang *et al.*, 2013; Elleuch *et al.*, 2008). It can also be used as a natural colorant and flavour.

The physicochemical, phytochemical, microbiological, rheological, and microstructural features of the date-added goods differed from those of the commercial sample examined in a study on the effects of date syrup and date powder in a dairy dessert (Djaoud *et al.*, 2020). Date syrup has been found to work well as a sugar substitute in various traditional Indian and Iranian dishes (Manickvasagan *et al.*, 2018; Ardali and Akbarian, 2014).

After adding date syrup to goods such as prebiotic chocolate milk and yogurt, the organoleptic characteristics and chemical composition improved (Kazemalilou and Alizadeh 2017; El-Nagga and Abd ElTawab 2012; Sayed *et al.*, 2010). Date syrup contains simple sugars (glucose, fructose, sucrose), vitamins (B1, B2, nicotinic acid), potassium, and chloride, all of which are essential for microbial growth (Al Eid, 2006). As a result, it has been used in the generation of biomass and the microbial fermentation process.

3. CONCLUSION

Date processing into palm fruits, seeds, and byproducts have the potential to be a promising fruit due to their therapeutic, nutritive, and bioactive properties. Dates can be made into powder, syrup, pastes, oils, and juices. Dates are primarily composed of water, sugar, protein, fat, pectin, minerals, vitamins, crude fiber, antioxidants, and polyphenols. Dates, like other fruits and vegetables considered functional foods (such as grapes and carrots), are equally valuable and referred to as super fruits due to their fiber and antioxidants. Overall, dates may be regarded as a super fruit capable of playing a significant role in human nutrition and health due to their diverse nutritional and health benefits.

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