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Evaluation of Fruit Quality Properties in Medjool and Amri Date Palm Cultivar (*Phoenix dactylifera,* L.)

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Abstract

DATE FRUITS exports represent a large part of the economy of some countries, where the Medjool date variety is considered one of the most desired varieties in terms of export due to its Morphological and nutritional qualities. Therefore, the aim of this study was to insert another variety with similar characteristics to the Medjool, called Amri. Physical and chemical tests were conducted to verify its properties, and the results were similar in both varieties. It is worth noting that both types contain a flesh percentage, which is the edible part, exceeding 90%, and this is a good result as it attracts customers. In both types, the pH values were higher than 6, and this is a good characteristic as the threshold value associated with sour taste was considered a bad trait by the consumer. Furthermore, the Amri date recorded a total sugar 69.15 g/100 g compared to 69.84 g/100 g for Medjool dates, but there wasn't significant difference between them ($p > 0.05$). The Amri variety also excelled in antioxidants, recording 11.62 % compared to 10.70 % for the Medjool and the increase was statistically significant. Therefore, it is necessary to promote Amri dates, as their physical and chemical properties are similar to Medjool dates, with increased productivity in Amri date palm trees. This aims to promote date exports and agricultural development, as Amri date is considered a promising variety in the future.

Keywords: Medjool date; Amri date; Physical properties; Chemical properties; Antioxidants.

Introduction

Date fruits *(Phoenix dactylifera,* L.*)* is a crucial fruit crop in the arid areas of the Arabian Peninsula, North Africa, and the Middle East. It serves as a primary source of income and a staple food for local communities in numerous countries where it is grown, significantly impacting the economy, society, and environment of these nations. (Chao & Krueger, 2007).Circa 10,000 years ago, the date palm tree is believed to have originated in the ancient Hejaz region of what is now Saudi Arabia. (Assirey, 2015). The total global production of dates amounted to 9,391,437 tons in 2023 with the top producing countries located in the Middle East and North Africa region (FAOSTAT, 2023). Saudi Arabia is recognized as the global leader in the cultivation of date palm trees, producing a total of 1,541,769 tons, which represents approximately 16.2% of the worldwide date production. (Aziz, 2024), while Egypt ranks first in the production of date fruit with approximately 1,814,936 tons (FAOSTAT, 2023).

The nutritional benefits of dates can be attributed to their elevated sugar levels, along with a variety of essential micro and macro nutrients, including potassium (which is 2.5 times more abundant than in bananas), calcium, magnesium and iron. Additionally, dates contain significant amounts of proteins, fats, vitamins, dietary fiber, fatty acids,

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polyphenols, antioxidants, and amino acids. (Alghamdi et al., 2018).

Date fruits are extensively accessible in the international market, primarily in the dried and fully matured Tamer stage with a moisture content of 20-25% (Alsmairat et al., 2019). One of the most significant varieties of dates is the Medjool cultivar, which originated in Morocco and has since been widely distributed globally (Elhoumaizi et al., 2023). This cultivar also known as Medjoul, Mejhoul or Majhool and holds substantial commercial value and is recognized as one of the highest quality dates for export, particularly in terms of its fruit size and quality when compared to other varieties (Elhoumaizi et al., 2023). The Medjool variety represents one of the primary types cultivated in the Middle East, with Jordan housing 300,000 Medjool trees among a total of 484,000 cultivated palm trees. The average annual yield of the Medjool palm tree is approximately 70-75 kg (Al-Hajaj et al., 2020).

The cultivar Amri, recognized for its favorable attributes that enhance its export potential, is regarded as one of the most promising varieties of Egyptian date palms. This variety yields between 70 to 90 kg per palm tree. The fruit is sizable, measuring 4.5 to 5.0 cm in length and 2.0 to 2.5 cm in diameter, with a swollen appearance in the middle. When the fruit reaches the khalal stage, it exhibits a yellowish-red hue, which transitions to a brownish-black color upon ripening. The flesh of the fruit is of medium thickness, offers a delightful taste and contains a low fiber content (El-Sharabasy S, 2019). Egypt ranks among the top three countries in the production of Amri dates, with a total output of 10.955 tons (Reclamation, 2023).

The physical attributes of the date fruit, including its size, shape, color, flavor, skin texture, and the visual assessment by consumers, play a vital role in determining its price (Kamal-Eldin & Ghnimi, 2018). The price of large Medjool dates fluctuates between 52.5 and 54 US dollars for every 5 kg at the terminal market in Los Angeles (USDA-AMS, 2025), and the price of large Medjool dates in Egyptian market ranges between 57-59 US dollars for every 5 kg (FARMS, 2025), While the price of large Amri dates ranges between 10 and 13 US$ Per 5 kg in the Egyptian markets (Reclamation, 2023).

Accordingly, and due to the importance of medjool dates to increase the economy this intensive work was conducted to investigate the possibility of adding another variety "Amri" similar to medjool for an increase in productivity.

Materials and Methods

Preparation of dates samples

The required quantity of Medjool and Amri date fruits were collected from a farm located in South Sinai, Egypt called El-Maghraby Farm. The ages of the Medjool palm trees ranged from 7 to 8 years, while the age of the Amri palm trees were 9 years, once they reached the Tamar stage on the palm trees and were promptly transported to the laboratory. To prepare the samples for analysis, any foreign materials, including spoiled and contaminated sections, were completely eliminated from the dates. Then the Medjool and Amri dates were distributed into 10 groups, every group content 10 dates fruits, 5 Medjool and 5 Amri as shown in figure 1.

Morphological Properties

The dimensions, including length and width, of the Medjool and Amri Tamar utilized in the experiment were measured using a digital caliper (TMT321506, China; ±0.01 mm). Additionally, the weights of the flesh and seeds were determined with an electronic digital balance (BS-Series, China) that has an accuracy of 0.001 g.

The true volume of Tamar was assessed using the water displacement method (WDM). The WDM is recognized as one of the most straightforward and widely used techniques for determining the volume of items such as fruits and vegetables (Vahedi Torshizi et al., 2020). Initially, date weight was estimated on a scale before being submerged in water with a sinker rod. The weight of the water displaced is determined by subtracting the weight of the container filled with water from the weight of the container when it holds the fruit. This resultant value is subsequently employed to compute the volume of the dates using equation 1 (Mohsenin, 1970):

$$Volume\ (cm^3) = \frac{wieght\ of\ displaced\ water\ (g)}{water\ density\ (\frac{g}{cm^3})} \qquad (1)$$

Physical Properties

The density may also be determined by using the earlier data (mass and volume of dates) through the following equation:

$$Density = \frac{Mass\ of\ dates\ (g)}{Volume\ of\ dates\ (cm^3)} \qquad (2)$$

The color of the samples was assessed utilizing a Minolta CR–400 Chroma Meter (Ltd., Japan). Color was quantified in the CIE system as L*, a*, and b*, where the L* value indicates a change in brightness with a value range of 0 black to 100 white. Value of a* signifies the red-green mixed chromatic color, where (+a) range of 0 to +100 for red, and (-a) value ranging from 0 to 80 for green. Meanwhile, the b*

value represents the chromatic color of the blue-yellow mixture with a value of (+b) from 0 to +70 for blue, and (−b) from 0 to −70 for yellow, it is also obtained chroma and hue from Minolta automatically, where Chroma mean to the purity of color and Hue that mean to the color type. Additionally, the color differences ΔE between Medjool and Amri dates were computed using equation (3) (ElGamal et al., 2025):

$$\Delta E^*_{1,2} = \sqrt{(L^*_1 - L^*_2)^2 + (a^*_1 - a^*_2)^2 + (b^*_1 - b^*_2)^2} \quad (3)$$

Where ΔE is the color difference, 1 and 2 subscripts refer to the Medjool and Amri dates samples, respectively.

Chemical Properties

One gram of pulp derived from dried date fruits was extracted with 10 ml of distilled water utilizing a mortar and pestle. The extract underwent centrifugation at a speed of 3000 rpm for 15 minutes, and the remaining liquid was used for analysis. The total dissolved solids were assessed using a digital refractometer (DR-193C, Japan), the findings were expressed as a percentage of Brix following multiplication by the dilution factor (Dadzie & Orchard, 1997).

The pH of samples was determined after blending 5 g of the sample with 45 ml of distilled water using a pH meter (Jenway 3510; UK) according to (Choe et al., 2013).

Chemical Composition

Determination of chemical compositions (moisture content, protein, fat, fiber, and sugar) of dates fruits were performed according to the standard methods of the (AOAC, 2016).

Preparation of Bioactive Components and Antioxidants Extracts

Methyl alcohol (HPLC grade, with a purity of ≥99.9%, obtained from Fisher Scientific) was utilized as a solvent in the extraction procedure of bioactive compounds and antioxidants using the method of (Barros et al., 2011). One gram of chopped dates was combined with 25 mL of methyl alcohol utilizing an orbital shaker (LAB-LINE Instruments, Inc., USA) at a speed of 100 rpm for a period of 60 minutes at ambient temperature (35 ± 1 °C). An extra 25 mL of methanol was used to extract any residual material. After the mixing procedure, the methanol extracts were kept at 4°C until they were analyzed further.

Determination of Total Phenolics Content

The total phenolic content was evaluated in accordance with the methodology outlined by Barros et al. (2011) using the methanolic extract, a 1 mL aliquot of the extract (diluted at a 1:5 ratio with water) was mixed with 5 mL of Folin–Ciocalteu phenol reagent (diluted with water at a 1:10 v/v ratio) and 4 mL of sodium carbonate (75 g/l). To promote color development, the tubes were vortexed for 30 seconds and then allowed to sit at room temperature (30 ± 1 °C) for 60 minutes. The absorbance was recorded at 765 nm using a spectrophotometer. A calibration curve for gallic acid (0-0.10 mg/mL) was created (R2 = 0.99) and underwent similar treatments. The reagents used in this analysis included Folin-Ciocalteu reagent (Sigma-Aldrich, St. Louis, USA) and gallic acid (≥98% purity, Sigma-Aldrich, St. Louis, USA).

Antioxidant Activity Determination

The DPPH scavenging activity was assessed using the method of Ravichandran et al. (2013). In summary, a DPPH solution (2,2-Diphenyl-1-picrylhydrazy l, Sigma-Aldrich, St. Louis, MO, USA) at a concentration of 6×10^{-5} M was combined with a 5-fold dilution of the methanol extracts for a duration of 30 seconds. The reaction was allowed to proceed for 30 minutes, after which the samples were measured at 515 nm. For comparison, a blank consisting of the DPPH solution without any extract was analyzed. The antioxidant activity was calculated as:

$$\text{DPPH antioxidant activity (\%)} = \left[\frac{(A_{blank} - A_{sample})}{A_{blank}}\right] \times 100 \quad (4)$$

where A is the absorbance measured at 515 nm.

Determination of Vitamin C

The methods outlined by (AOAC, 2012) The determination of Vitamin C was conducted using the following method. A clean beaker was used to weigh five (5.0) grams of the sample, to which 112.5 ml of distilled water and 12.5 ml of oxalic acid were added. The mixture was allowed to shake for 30 minutes at room temperature, after which it was adjusted and made up to a total volume of 50 ml. Subsequently, ten (10 ml) milliliters of the sample were pipetted into a 100 ml volumetric flask and titrated with the indophenol solution until a faint pink hue remained for 15 seconds. The concentration was calculated as milligrams of ascorbic acid equivalent to V ml of the dye solution, specifically noting that 10 ml of ascorbic acid solution is equivalent to 2 mg of ascorbic acid. It was observed that 2 mg of ascorbic acid required 1 ml of dye solution for neutralization, after that 1 ml dye solution:

Vit C = $\frac{V \times T}{W}$ ×100 ascorbic acid (mg)/100g sample (5)

V = ml dye utilized for the titration of a sample aliquot

T = Ascorbic equivalent or dye solution quantified as ml/mg, W = g of sample in aliquot titrated

Statistical analysis

A statistical analysis of the experimental data was conducted utilizing the SPSS software (version 17.0, SPSS Inc, Chicago, USA). Where the analysis was conducted for each trait individually using the independent T test

Results and Discussion

Morphological properties

It should be noted that the morphological properties have decreased in the Tamar stage compared to the fresh stage due to the reduction in moisture content and the shrinkage of the fruits (Muralidhara et al., 2016). Table (1) presented the Morphological characteristics of Medjool and Amri date fruit. It was observed that there is no significance difference in the dimensions (length and width) between Medjool and Amri dates ($p > 0.05$), as well as in total weight, flesh weight and total seeds ($p > 0.05$) as shown in table (1). Since the edible part is the pulp, while the seeds are considered co-products, the edible part in both varieties exceeds 90%. It was noted that the volume of Medjool dates is larger than that of Amri dates, but there is no significant difference between them ($p > 0.05$). This indicates that there is a great similarity between the two types in terms of morphological characteristics as shown in figure 2.

Physical Properties

Density is considered an important factor in determining the quality of agricultural products, as each agricultural product has its own specific density; if it increases or decreases from that, it indicates either spoilage or that it is not fully ripened (Chen, 1996). The density of Medjool dates was higher than Amri dates as shown in Table (2), which may be attributed to the lower moisture content in Medjool dates compared to Amri, as increased moisture content decreases density (Saikia et al., 2015).

Color is regarded as a crucial element affecting consumer visual acceptance. In the context of date fruits, pronounced color variations are intricately linked to cultivar and quality (Al-Qarni & Bazzi, 2020; Ghnimi et al., 2017). During the ripening process, noticeable alterations in the coloration of date fruits occur due to the breakdown of chlorophyll, signifying a shift from one developmental stage to another. Date fruits are abundant in carotenes, which are orange-yellow to red crystalline pigments (fat-soluble) that gives it its vibrant and distinctive color. Additionally, studies have indicated that while the concentration of chlorophyll diminishes during ripening, the levels of carotenoids may not increase and could even decline, as evidenced by the appearance of a yellow-brown coloration in dates (Al-Okbi, 2022). During the final ripening phase (Tamar), date fruits typically exhibit reduced luminosity and a darker hue compared to the initial stages, a phenomenon attributed to water loss (Hazbavi et al., 2015). Table (2) shows the color parameters of the surface of Medjool and Amri date fruits at the Tamar stage. It was observed that the values of L* and b* are higher in the Amri than in the Medjool and there are significant differences between them ($p < 0.05$), which explains the brightness found in Amri dates as indicated in figure 1. It was observed that there was no significant difference between Medjool and Amri dates in a* value, which can be attributed to the proximity to the color greenness–redness percentage in Amri dates than medjool. The chroma determines the level that reflects color purity, where the chroma of the dates from both cultivars was the same ($p > 0.05$), corresponding to the same level of purity. It was observed that the value of hue in the Amri was higher than that in the Medjool, but there is no significance between them ($p > 0.05$). the color differences between 'Amri' dates and 'Medjool' dates were less than 3 degrees, which indicates the similarity of color characteristics between the two varieties (Muñoz-Bas et al., 2023).

Chemical properties

Total soluble solid is the one of important main factor that affecting fruit taste (Mortazavi et al., 2015). It was observed that the TSS value in Medjool date was higher than that in Amri date; however, the increase was not statistically significant ($p > 0.05$), as shown in Table (3). This was attributed to the similarity in total sugar content and the rest of the chemical composition between the two varieties as shown in Table (3).

The pH is one of the most important parameters affecting their processing and storage quality. The results in Table (3) reveal higher pH values ($p < 0.05$) in Medjool than in Amri dates. Both pH levels fall within the range documented for fruit dates at the Tamar stage (Borchani et al., 2010). In both instances, the pH levels exceeded 5, surpassing the threshold value linked to an acidic flavor, which was perceived negatively by the consumer, where the sour taste in fruits may indicate spoilage or decay or the incomplete ripening (Chidi et al., 2018).

It was observed that the total sugar value in the Medjool was higher than Amri dates, but the increase was not statistically significant, meaning they are similar in their total sugar ($p > 0.05$) as shown in table (3). It was recorded that the moisture content in Amri is higher than Medjool dates, and there are significant difference between them ($p < 0.05$), however, the moisture content of Amri and Medjool was within the normal range of (Tamar stage), which ranges between 20-25% (Alsmairat et al., 2019). It also was observed that there was no considerable difference in protein levels between Amri dates and Medjool dates, and the same applies to ash content ($p > 0.05$). Although the protein content in dates is not particularly significant, it has been documented that they contain 9 out of 15 essential amino acids in high amounts (Hussain et al., 2020). Certain components are absent from widely consumed fruits like oranges, apples, and bananas. It has been observed that the levels of fat, protein, and ash diminish during the ripening of dates, attaining their minimum values at the conclusion of the Tamar stage (El Arem et al., 2012). Additionally, it was observed that the moisture content, fiber and fat values were higher in Amri dates, but the increase was not statistically significant ($p > 0.05$).

Polyphenols, Antioxidants Activities and Vitamin C

The total phenol content in Medjool dates was observed to be higher than in Amri dates, but it was not statistically significant. However, the percentage of DPPH was higher in Amri dates, and the increase was statistically significant as shown in table (4), which may be attributed to the active antioxidant percentage that oxidizes DPPH dye is higher in Al-Amari dates (Dawidowicz et al., 2012).

Phenols serve as powerful antioxidants; they are substances that inhibit biomolecules (such as proteins, nucleic acids, polyunsaturated lipids, and sugars) from experiencing oxidative damage caused by free radical-mediated reactions (Heleno et al., 2015) and the advantageous effects they offer encompass anti-inflammatory, antidiabetic, cardioprotective, neuroprotective, antitumor, and antiaging characteristics. (Zhang et al., 2018). Date fruits are regarded as a beneficial source of antioxidant compounds, particularly polyphenolic compounds, especially during the initial stages of edible ripening. The characteristics, composition, and distribution of these compounds in dates differ based on various factors, including the variety, ripening stage, geographical location, and environmental conditions (Fernández-López et al., 2022; Hussain et al., 2020).

Vitamin C is an important cofactor that is involved in the regulation of development, function, and maintenance of several cell types in the human body (Aghajanian et al., 2015). It was also observed that the vitamin C content matched in both the Amri and Medjool dates, where the values of vitamin C did not exceed 0.3 mg/100 g and these results are consistent with (Ahmed et al., 2013) as it is known that dates do not contain high values of vitamin C.

Conclusions

After conducting physical and chemical tests, a great similarity in the physical and chemical properties of both Amri date variety and Medjool date variety was revealed. The Amri dates recorded a total sugar of 69.15 g/100 g compared to the total sugars of 69.84 g/100 g for 'Medjool' dates. Additionally, they had a flesh percentage exceeding 90% in both varieties and a pH level greater than 6. Thus makes Amri date promising variety in the future. This study helps draw attention to other varieties of dates that have distinctive and attractive characteristics, which may help increase exports and agricultural development.

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Not applicable

Conflicts of Interest

The author declares no conflict of interest.

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Fig. 1. Sample of dates fruits at the Tamar stage of Medjool and Amri

Fig. 2. Flesh and seeds of Medjool and Amri dates fruit

TABLE 1. Morphological properties of Medjool and Amri date fruits.

Date cv.	Length (cm)	Width (cm)	Total weight (g)	Flesh & Peel weight (g)	Seeds weight (g)	Fruit volume (cm^3)
Medjool	4.85 ± 0.17	2.24 ± 0.09	15.97 ± 1.52	14.79 ± 1.42	1.18 ± 0.11	11.23 ± 0.21
Amri	5.13 ± 0.25	2.15 ± 0.7	15.28 ± 1.47	13.98 ± 1.31	1.30 ± 0.17	10.70 ± 0.22
***p* value**	0.279	0.180	0.541	0.436	0.299	0.065

TABLE 2. Physical properties attributes of Medjool and Amri date fruits include lightness (L*), red/green coordinate (a*), yellow/blue coordinate (b*), chroma (C*), hue (H*), and density.

Date cv.	Density (g/cm^3)	L*	a*	b*	C*	H*
Medjool	1.093 ± 0.02	11.40 ± 0.32	6.75 ± 0.20	14.45 ± 0.36	15.95 ± 0.25	25.06 ± 1.22
Amri	1.046 ± 0.02	13.05 ± 0.04	7.25 ± 0.22	13.63 ± 0.13	15.44 ± 0.12	28.00 ± 0.77
***p* value**	0.018	0.018	0.071	0.041	0.081	0.055

TABLE 3. Chemical properties and chemical composition of Medjool and Amri date fruits.

Date cv.	TSS (ºBrix)	pH	Moisture (%)	Protein (g/100 g)	Fat (g/100 g)	Ash (g/100 g)	Fiber (g/100 g)	Sugars (g/100 g)
Medjool	68.33 ± 0.47	6.60 ± 0.07	22.54 ± 0.07	2.75 ± 0.14	1.68 ± 0.07	1.75 ± 0.07	1.44 ± 0.91	69.84 ± 0.27
Amri	67.00 ± 0.81	6.31 ± 0.04	23.03 ± 0.17	2.91 ± 0.03	1.77 ± 0.11	1.78 ± 0.09	1.36 ± 0.08	69.15 ± 0.25
***p* value**	0.116	0.013	0.020	0.157	0.414	0.735	0.448	0.061

TABLE 4. Total phenols contents, antioxidant capacity and vitamin C (mean ± SD) of Medjool and Amri dates.

Date cv.	Total phenols (mg GAE per 100 g)	DPPH %	Vitamin C (mg/100g)
Medjool	133.01 ± 3.00	10.70 ± 0.11	0.3 ± 0.01
Amri	126.60 ± 3.00	11.62 ± 0.06	0.3 ± 0.01
***p* value**	0.100	0.022	0.999

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تقييم خصائص جودة الثمار في صنف نخيل التمر المجدول والعمري

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الملخص

تمثل صادرات التمور جزءًا كبيرًا من اقتصاد بعض البلدان، حيث تُعتبر تمور المجدول واحدة من أكثر الأنواع المرغوبة من حيث التصدير بسبب خصائصها الشكلية والغذائية. لذلك، كان الهدف من هذه الدراسة هو إدخال صنف آخر ذو خصائص مشابهة للمجدول، يسمى (عمري). وقد أجريت اختبارات فيزيائية وكيميائية للتحقق من خصائصه، وكانت النتائج مشابهة في كلا النوعين. وتستحق الإشارة إلى أن كلا النوعين يحتويان على نسبة لحم، وهي الجزء القابل للأكل، تتجاوز 90%، وهذه نتيجة جيدة حيث تجذب المستهلكين. في كلا النوعين، كانت قيم الحموضة أعلى من 6، وهذه سمة جيدة حيث اعتُبرت القيمة الحدية المرتبطة بالطعم الحامض سمة سيئة من قبل المستهلكين. علاوة على ذلك، سجلت تمور عمري سكرًا إجماليًا يبلغ 69.15 جرام/100 جرام مقارنة بـ 69.84 جرام/100 جرام لتمور المجدول، لكن لم يكن هناك فرق كبير ($p > 0.05$) . تميزت مجموعة عمري أيضًا بمحتوى عالي من مضادات الأكسدة، حيث سجلت 11.62% مقارنةً بـ 10.70% لمجموعة المجدول، وكانت الزيادة ذات دلالة إحصائية. لذلك، من الضروري الترويج لتمور صنف العمري، حيث إن خصائصها الفيزيائية والكيميائية مشابهة لتمور المجدول، مع زيادة الإنتاجية في أشجار نخيل تمر العمري. يهدف ذلك إلى تعزيز صادرات التمور والتنمية الزراعية، حيث يعتبر تمر العمري صنف واعد في المستقبل.

الكلمات الدالة: تمر مجدول، تمر عمري، الخصائص الفيزيائية، الخصائص الكيميائية، مضادات الأكسدة.