The chemical composition, total phenolic and antioxidant content of four date palm Saudi cultivars

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ABSTRACT
This work aims to study the antioxidant activities and chemical constituents of four Saudi date palm varieties (Ajwa, Kodari, Anbarah and Suqaey). Results showed variation in chemical composition and antioxidant activates. Carbohydrates (71.5–77.3 g/100 g dry matter) and moisture contents were the predominant constituents in all flesh date palms (80.44–82.82%). Anbarah reported the highest protein and ash contents (3.50% and 2.32%, respectively) between the four varieties, while fat contents were low in the four types. Total phenols and antioxidant activities were higher in Ajwa compared to the other varieties. IC50 of Ajwa, Kodari, Anbarah and Suqaey was 24.5, 25.55, 28.51 and 26.41 mg/ml, respectively. The antioxidant activities can be contributed to dates highly phenolic contents, which improve the antioxidant activities that could be used in food formulations.

1. Introduction
Date palm (Phoenix dactylifera L.) has been a contender as a multi-beneficial source of nourishment and a long-standing economic crop on a worldwide scale for numerous years due to its prominent, health, nutritional, medicinal and commercial benefit and properties. The flesh and pit of the Ajwa dates encompass an elevated concentration of antioxidant content, namely: phenolics, anthocyanins and carotenoids [1,2]. However, the degree of concentration depends on factors, including the selection and the portion of the date palm. Furthermore, the Ajwa dates and their exceptional assets are especially advantageous against bacterial, hyperlipidemia and cancer diseases, such as a high lipoprotein profile [3].

For instance, through a strict regime of an assortment of date flesh and camel milk, the human body constructs and secures a defense against generated free radicals [4]. Assirey [5] determined that date palm flesh was comprised of high quantities of minerals, which can be witnessed as the Ajwa date has high amounts of potassium (476.3 mg/100 g) while the Kodari date flesh has (289.6 mg/100 g) [5]. The antioxidants activity has become very important for nutritionists and medical research workers for their potential effects in the treatment of different diseases such as; diminish, Alzheimer, Cancer and cardiovascular diseases [6].

Phenolic contents of Algerian ripe date palm fruit (Phoenix dactylifera) showed [7] high antioxidant activities due to the occurrence of flavonoids and other phenolic compounds, which are known to have high scavenging activity. In another study, the leave extract of Phoenix dactylifera L was reported to have possible valuable biological and edible contents which can be used in manufacturing and biotechnology [9]. Some researchers [8] reported that dates contain a high source of phenolic compounds, anthocyanins and carotenoids.

Upon literature review, only a few investigations are available on the chemical composition and biological activities of the four date fruits varieties, which are the subjects of this study (Ajwa, Kodari, Anbarah and Suqaey) [5]. Thus, the current study is carried out to complete and add more studies to those date fruits type.

2. Materials and methods
2.1. Chemicals
2,2-Diphenyl-1-picrylhydrazyl (DPPH), 2,2′-azino-bis(3-ethylbenzothiazoline-6-sulphonic acid) diammonium salt (ABTS), Ascorbic acid, and Folin-Ciocalteu’s reagent were obtained from Sigma–Aldrich Co. (USA).

2.2. Dates
Four commercial date varieties were tested in this study, three of them (Ajwa, Suqaey, Anabarah) were obtained from Al-Madinah Al-Munawarah, while the fourth one (Kodari) was obtained from Qaseem, Saudi Arabia. All
date fruit samples were purchased from a local market in the tamer stage. Before experiments, it was confirmed that all samples were free of any impurities, fungal or bacterial infections.

2.2.1. Date samples preparation
About (500 g) of each date flesh variety was dried at 50°C for 20 h until a constant mass was obtained. The dried mass of each date type was separately crushed in a food grinder and kept at an ambient temperature of 25°C before analysis.

2.2.2. Extraction process
The dried crushed date’s flesh of each variety under investigation (500 g) was separately extracted by percolation [10] in methanol–water (4:1) (v/v) for two days at room temperature. The obtained methanol extracts were individually filtered off, and the leftover dates flesh parts were re-extracted four times till exhaustion using the same method. The collected ethanol extracts were separately freed from the solvent using reduced pressure at a temperature below 25°C. The gotten residues were kept for chemical and antioxidant tests.

2.3. Chemical composition analysis
Following the published methods of chemical analysis, the four varieties of date palm flesh were analysed. These contents were dry matter [11], total fat content [12], total protein, sugars [13], ash content [14], total carbohydrate content [15,16] and total phenolic content (TPC) [16,17].

2.4. Antioxidant activities
The antioxidant activity of date flesh samples was carried out following the published method [18].

The stock solutions of 2,2-Diphenyl-1-picrylhydrazyl (DPPH) were executed by inserting 0.2 g of DPPH in 50 ml of the utilized methanol solvent. Correspondingly, the stock samples were formulated to comprise 1 mg extract/ml of acquired solvent. One millilitre of these particular stock mixtures was inserted into their corresponding assessment tubes, marked with their label. Furthermore, 2 ml from the operated DPPH solution was supplemented to every tube. Through identical means, the control mixtures were designed to contain 2 ml of DPPH and 1 ml of Gallic acid. Additionally, the incubation of these test tubes was performed in the absence of light at an ambient temperature for 30 min. The absorbance was measured using the spectrophotometer. (DPPH) (Containing no sample) was used as a control, and Ascorbic acid served as a standard.

The scavenging activity was calculated using the following equation:

\[
\text{Inhibition (\%)} = \left(1 - \frac{\text{Ac} - \text{As}}{\text{Ac}}\right) \times 100.
\]

where Ac is the absorbance of the control and As is the absorbance of the sample.

2.5. Statistical analysis
The statistical analyses were done with a one-way ANOVA test of variance methodology, followed by an unpaired two-tailed student’s t-test. Variances at \( p = .005 \) were reflected statistically important [19].

3. Results and discussion
3.1. Chemical composition analysis
The chemical composition of all date palm varieties methanol extracts is shown in Table 1. The higher content was reported in Anabarah (77.5 mg/100 g) followed by Suqaey (75.3 mg/100 g) and Ajwa (72.1 mg/100 g). The occurrence of high contents of carbohydrate in the four dates varieties confirms the importance of this constituent; this results match with the previously published data [20,21]. The carbohydrate concentration was approximately similar between tested date varieties.

Protein content was the highest in Anabarah followed by Khodari and Ajwa (3.49, 3.42 and 2.91 g/100 g dry matter, respectively) [5]. Thus, the dates were considered an insufficient source of protein [14]. On the other hand, fat contents present reported the lowest contents in all date samples in this study, it ranged from 0.18 to 0.51 g/100 g dry matter in Khodari and Anabarah, respectively. The results obtained were found to be similar to other varieties growing in Saudi Arabia [22] and Emirates [23]. Date palms are very desirable for human health due to the presence of low content of fat, and cholesterol [24], in addition to the suitable fibre contents that can be important to the digestive system. The ash content was 2.32 and 3.89 g/100 g dry weight in Anbarah and Suqaey, respectively. This variation could be explained by factors such as variety, soil type, and amount of fertilizer [5,25–27].

The date fruit can be an important source of energy for the human body. The energy values (kcal/100 g) were assessed for tested date fruit varieties. The results showed that the energy values of Khodari growing in El-qaseem region had significantly higher (\( P < .05 \)) energy values as compared to other varieties followed by Suqaey and Anbarah (Figure 1).

The energy of theselected four date varieties varied between 265 and 287.5 kcal/100 g, in Ajwa and Khodari, respectively. The best source of energy was reported from Khodari type followed by Suqaey, Anbarah and Ajwa. These results suggested that Khodari and Ajwa palm dates can play a major role in human nutrition and health. They have an important nutritional source of total phenol and antioxidant compound [28].
Table 1. The chemical composition (g/100 g dry weight) of methanol extracts from four date flesh varieties.

| Cultivars | Dry matter [5] | Moisture [5] | Total protein [5] | Total fat [5] | Total carbohydrate [5] | Ash [5] |
|-----------|----------------|--------------|-------------------|---------------|------------------------|--------|
| Ajwa      | 92.00 ± 0.42b  | 22.8 ± 0.1ab | 2.91 ± 0.07a     | 0.48 ± 0.03a  | 72.1 ± 0.35b          | 3.43 ± 0.04a |
| Anabarah  | 93.64 ± 0.05ab | 29.5 ± 0.2a  | 3.49 ± 0.15a     | 0.52 ± 0.03a  | 77.3 ± 0.34a          | 2.33 ± 0.05b |
| Khodari   | 90.14 ± 0.33c  | 19.5 ± 0.1b  | 3.42 ± 0.12a     | 0.18 ± 0.08b  | 71.5 ± 0.27b          | 3.42 ± 0.04a |
| Suqaey    | 94.02 ± 0.02a  | 14.5 ± 0.1c  | 3.73 ± 0.10a     | 0.41 ± 0.03a  | 75.3 ± 0.45a          | 2.29 ± 0.02a |

Notes: mean value ± standard error. Mean values with different letters in same column are significantly different at two-tailed Student’s t-test. Probability level at .05.

Figure 1. The total energy of the methanol extracts of four date varieties.

These results revealed that dates have high contents of energy and carbohydrates but have a low percentage of protein and lipid when compared with other dried fruits.

Total phenolic contents (TPC) were varied between the different four date palm varieties under investigation (Figure 2). Among all of them, Ajwa palm contained greater quantities of TPC (113.70 mg/100 g), while Anbarah displayed the lowest concentration (81.41 mg/100 g) in contrast to the other flesh arrays. Some researchers [29] proposed that the date samples can supply an ample amount of phenolic and antioxidants, which confirm the significance of the date palm’s rich energy and antioxidant properties to human health [29,30]. TPC results obtained in the current study were in agreement with previously published work [31,32].

Total phenolic contents (TPC) concentration may contribute to the antioxidant activity of date flesh [32]. The present results were found to disagree with other studies [33] as it suggested that Ajwa palm contained a high amount of TPC (82.4%). The observed differences in the results could be due to many environmental, experimental and/or cultivation conditions. Phenolics and flavonoids represent the largest phytochemical group among the other plant chemical constituents. Many researchers reported that it has health benefits for humans due to its

Figure 2. Total phenol content of the methanol extracts of four date varieties.
antioxidant activities [29]. Accordingly, the date palm fruit can play a very good source of natural antioxidants and is considered a functional food ingredient [34–36]

3.2. Antioxidant activities

DPPH is a stable free scavenged radical that alters from purple to yellow after receiving a radical of an electron/proton, when antioxidants are encountered, to develop into a stable diamagnetic molecule [18]. DPPH radical scavenging behaviour of the four flesh date extracts as well as the radical scavenging aptitude of the ascorbic acid, a referenced molecule, is demonstrated in Figure 3. The results showed that date fruits were moderate in their activities comparing to standard ascorbic acid. The Ajwa date represents the higher antioxidant activity between the four date varieties.

The antioxidant activity ranged between 70.14% and 81.33% in Anabarah and Ajwa, respectively, with an IC50 of 24.50 and 28.51 mg/ml, respectively. The maximum rate of the antioxidants activity was 81.33% in the Ajwa date, surpassing the outcomes described by Siddeeg et al. [20], who established that the scavenging rate of the isolated EPS from the Sukkari date was 76%, while others uncovered rates at 72% for Serratia ureilytica and 77% for Paenibacillus s sp. [28].

The aforementioned results revealed that the Ajwa date palm has free radical scavenging capabilities, concuring with earlier performed studies for the diverse collection of date palm fruits [29]. Though the methanol extracts reported that superior antioxidant behaviour (p<0.5), the differences were deemed insignificant Anwar and Przybylski [30]. In addition, DPPH results demonstrated that the Ajwa date sample includes a variety of bioactive materials, hence, providing considerable shielding against the oxidation of the critical biological macromolecules.

4. Conclusions

The current report study a comparative analysis between the date varieties (Ajwa, Kodari, Anabarah and Suqaey), which presented elevated quantities of carbohydrates, total phenolic and antioxidant contents in the appraised date flesh. The Ajwa date has the greatest scavenging rate of the antioxidants (81.33%), followed by, Kodari (87.29%), Suqaey (75.72%) and Anbarah, which exhibited the lowest value (70.14%). Similarly, the Ajwa date contained the greatest quantity of TPC (113.70 mg/100 g) in comparison to the assessed varieties. In the evaluation of all the dates’ varieties, the Ajwa and Kodari included a superior level of nutrient elements, phenol and antioxidant characteristics, contributing more means of consumption in the food industry.

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