

Minerals Content and Antimicrobial Efficacy of date Extracts against Some Pathogenic Bacteria

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Abstract: Dates contain many minerals, which is very important for healthy life. Sodium, potassium, calcium, manganese, copper, cadmium, nickel, lead, ferric, zinc, cobalt and magnesium were determined in twenty samples, collected from Jeddah, Saudi Arabia, of two types of dates, Safawy (*Phoenix dactylifera*) and Chinese date (*Ziziphus zizyphus*). The mean value of sodium was 3.5 µg/g and 3.8 µg /g in Chinese and Safawy dates, respectively. The mean concentrations of potassium were 1.34 µg/g and 1.04 µg/g but the mean concentrations of the detected calcium were 12.7 µg/g and 9.1µg/g in the Chinese date and Safawy date, respectively. Manganese concentration means were 1.50 and 2.64 µg/g in Chinese and Safawy dates, respectively. Copper, cadmium, nickel, ferric, zinc, cobalt, magnesium were detected in the two previous types of dates but lead was not detected in either Chinese or Safawy dates. The antibacterial activity of date water extracts was determined using agar well diffusion method. The water extract of Chinese date (inhibition zone ranged from 11-19 mm) was more active compared to the extract of Safawy date (inhibition zone ranged from 10-13 mm). The antibacterial activity of date water extracts was compared with that of Ampicillin (control antibiotic).

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1. Introduction

Phoenix dactylifera commonly known as the true date palm was cultivated for its edible sweet fruit (Salem and Hegazi, 1971). Due to its long history of cultivation for fruit, its exact native distribution is unknown, but probably originated somewhere in the desert oases of northern Africa and Western Asia. Fruits of date palm are a main source of staple food in the kingdom of Saudi Arabia, Middle East and south Asian countries. Dates have always played an important role in the economic and social lives of people of this area. El-Nakhal et al. (1987) added that date palm contained a high percentage of carbohydrate, fat which comprising 14 types of fatty acids, 15 salts and minerals, protein with 23 different amino acids, six vitamins and a high percentage of dietary fiber. It is highly nutritionally food product, rich in calories and many vitamins and mineral (Hasnaoui et al., 2010).

There are many different varieties of *Phoenix dactylifera* L. (Al-Shahib and Marshall, 2002) including Safawy which is grown mainly in Almadina. The nutritional and functional constituents of *Phoenix dactylifera* were studied by Al-Farsi and Lee (2008) where ten minerals were reported, the major being selenium, copper, potassium, and magnesium. *Phoenix dactylifera* contained a high percentage of carbohydrate, fat, minerals, protein, vitamins and a high percentage of dietary fiber (Al-Shahib and Marshall, 2003). There are at least 15 minerals in dates. The percentage of each mineral in dried dates varies from 0.1 - 916 mg/100 g date

depending on the type of mineral. In many varieties, potassium can be found at a concentration as high as 0.9% in the flesh. Other minerals and salts that are found in various proportions include boron, calcium, cobalt, copper, fluorine, iron, magnesium, manganese, potassium, phosphorous, sodium and zinc. Additionally, the seeds contain aluminum, cadmium, chloride, lead and sulphur in various proportions (Al-Shahib and Marshall, 2003).

Dates contain elemental fluorine that is useful in protecting teeth against decay. Selenium, another element believed to help prevent cancer and important in immune function, is also found in dates (Al-Shahib and Marshall, 2003). Its output in flesh added to its biochemical features, destine it to several potential technological transformations in the domain of food science as the moderate drying or the lyophilization in view to produce an enriched flours. The extraction pulp was carried in view to produce mash or bracing refreshing drinks, the fermentation of the juice in view of the production of vinegar and finally the treatment of the pulp in order to produce jam and other candy products. Furthermore, the fruit yields food products such as date vinegar, date chutney or sweet pickle, date paste for bakery products (Mikki et al., 1989; Gad et al., 2010; El-Sohaimey and Hafez, 2010).

Ziziphus zizyphus commonly called jujube, red date, or Chinese date, is a species of *Ziziphus* in the buckthorn family Rhamnaceae, used primarily for its fruits. Common names in Arabic are nabq, dum, tsal, sadr, zuzuuf and sidr. Although date fruit contains a

significant amount of nutrients that can be utilized by microorganisms to support their growth, date fruits can typically be stored healthily in a normal warehouse for several months without showing signs of microbial growth (Zohary and Hopf, 1993). Because of this, it has been postulated that dates may contain antimicrobial and antifungal agents that may prevent microbial contamination. At the same time, several studies have shown that water or organic extraction can be used to extract and release antimicrobial compounds from plant materials.

Little information concerning minerals and antimicrobial activity of *Ziziphus zizyphus* and *Phoenix dactylifera* were found. For this reason, the aims of this study were to determine and compare the minerals content and antimicrobial activity in two date types collected from Jeddah, Saudi Arabia.

2. Materials and Methods

Plant Materials

The plant materials used in the study, *Phoenix dactylifera* and *Ziziphus zizyphus*, were purchased from the local market of Jeddah, Saudi Arabia. Moisture content of the samples was measured according to AOAC (1990). The total solids content is a measure of the amount of material remaining after all the water has been evaporated. Thus, % total solids = (100 - % Moisture content). Total fibers contents were determined by the method described by Garcia et al. (1997). Ash content was determined according to Gan et al. (1998). Chemical analysis for the determination of total carbohydrate was adapted from the phenol-sulphuric acid method as described by Dubios et al. (1956). The total amount of carbohydrate was determined based on a standard calibration curve prepared using glucose. The total Lipid extracted from date samples according to Folch et al. (1957) using a mixture of chloroform: methanol (2:1 v/v). Protein content was determined according to Lowry et al. (1951).

Determination of minerals content

Mineral content of dates were determined both qualitatively and quantitatively using the inductively coupled plasma optic emission spectroscopy (Perkin Elmer 4300DV) according to Brekken and Steinnes, (2004).

Bacterial isolates and Culture medium:

The tested bacteria were collected from culture collection of Microbiology laboratory, Faculty of Science, KAU. Tested bacterial isolates were *Escherichia coli*, *Pseudomonas aeruginosa*, *Shigella* sp., *Klebsiella* sp., *Bacillus subtilis*, *Staphylococcus aureus* and *Micrococcus* sp. which were suspended in Tryptic Soy Broth (TSB, Difco,

USA) and incubated at 37°C for 20 h. Mueller Hinton Agar (MHA, Difco, USA) was used for detection of the antimicrobial activity using paper disc diffusion method.

Preparation of plant extracts:

The fruits of dates used in this study were air-dried in the dark at room temperature and then ground to powders using a mechanical grinder. Approximately 50 g of the powdered materials were extracted by maceration in 200 ml of boiling water for 8 hr. The volume of the obtained extract was then reduced to 20 ml using Lypholization followed by and filtration using Whatman No. 1 filter papers and the crude extracts were stored at -20°C until required for testing.

Screening of Antibacterial Activity by the Agar Diffusion Method:

The antibacterial activities of some bacterial isolates to two plant extracts were tested using the disk-agar method standardized by the National Committee for Clinical Laboratory Standards. Six mm-diameter paper discs were bored in the agar plates and 20 µl of each extract at concentration of 400 µg/ml was dispensed into the discs. Antibacterial activity was evaluated by measuring inhibition zone diameters. Ampicillin was included as positive controls and water served as negative controls.

Statistical analysis:

Each value is the mean of three reading. Statistical analysis was carried out using student t-test.

3. Results

The two types of date fruits (*Phoenix dactylifera* and *Ziziphus zizyphus*), were collected and extracted. Moisture content, protein, carbohydrates, lipids and total solid were differed significantly in the two date types (table 1). The Chinese date contained higher protein and lower lipids than the other investigated type. The results obtained for the two date mineral contained were summarized in table 2 and figure 2. The values showed the mean value of every mineral in both Safawy and Chinese date.

The extract of the two types of date were tested for antibacterial activity against seven genera of bacteria (4 Gram -ve and 3 Gram +ve) which was characterized by their resistant to one or more of the used antibiotics. The antibacterial activity was detected using agar well diffusion method. The extract of chinese date was more active (diameter of inhibition zone ranged from 11-19 mm) compared to the activity of Safawy date (inhibition zone ranged from 10-13 mm).The antibacterial activity of date

water extracts was compared with that of Ampicillin (control antibiotic) which showed a high antibacterial

activity (Table 3).



Fig 1. A: Safawy (*Phoenix dactylifera*) and B: Chinese date (*Ziziphus zizyphus*).

Table 1: Chemical analysis of two cultivars of date (Safawy and Chinese dates), (n= 20)

Parameter measured (%)	Safawy date	Chinese date
Moisture	13.80%	9.2%*
Protein	2.11 %	4.7%*
Carbohydrates	73.00%	42.4%*
Lipids	2.90%	1.7%*
Crude fiber	4.8%	3.7%
Ash	4.13%	3.9%
Total Solid	76.60%	80.2%*

*: significant results

Table 2: Mineral analysis (Mean \pm SE) calculated in μ g/g dry weight of safawy and Chinese date (n= 20)

Mineral	Safawy date	Chinese date
Na	3.80 \pm 0.020*	3.5 \pm 0.01
K	1.04 \pm 0.003	1.34 \pm 0.01**
Ca	9.10 \pm 0.030	12.7 \pm 0.03 **
Mg	4.60 \pm 0.002	6.6 \pm 0.001**
Mn	2.64 \pm 0.010	1.50 \pm 0.01
Cu	1.13 \pm 0.020	2.43 \pm 0.02**
Cd	3.07 \pm 0.020	3.16 \pm 0.020*
Ni	16.27 \pm 0.030	17.85 \pm 0.01**
Pb	<dL	< dL
Fe	70.22 \pm 0.030	117.2 \pm 0.03**
Zn	20.41 \pm 0.12	32.21 \pm 0.03**
Co	50.13 \pm 0.020**	22.12 \pm 0.020

Values are expressed as mean of 20 samples \pm SE.

*= significance at $P \leq 0.05$, **= highly significant at $P \leq 0.001$, <dL = under limit of detection

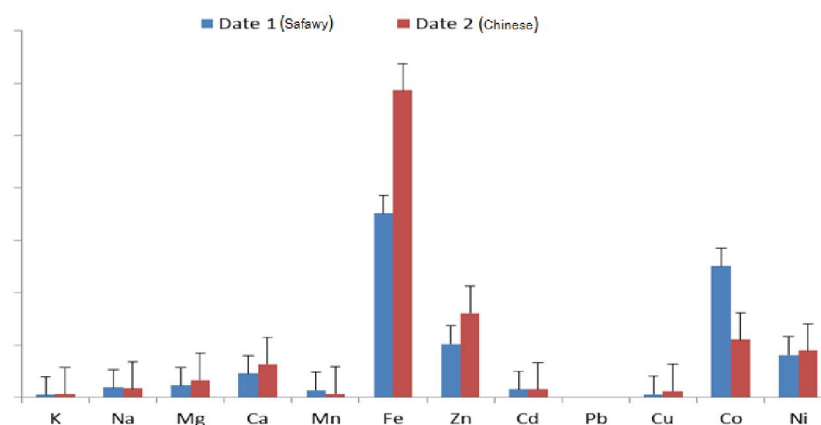


Fig 2. The mineral content of the two cultivars of date fruits

Table 3: The antimicrobial activity of the two cultivars of date fruits

Plant used	<i>Ziziphus zizyphus</i>	<i>Phoenix dactylifera</i>	Control antibiotic (Ampicillin)
Test organisms			
<i>Escherichia coli</i>	11±4.1	10±2.1	24±0.12
<i>Pseudomonas aeruginosa</i>	11±9.1	11±3.0	26±0.35
<i>Shigella</i> sp.	16±3.2	10±2.2	24±0.54
<i>Klebsiella</i> sp.	16±11.2	12±6.1	24±0.44
<i>Bacillus subtilis</i>	19±6.2	13±3.6	30±0.60
<i>Staphylococcus aureus</i>	13±4.4	11±2.4	30±0.31
<i>Micrococcus</i> sp.	13±2.3	12±2.2	31±0.11
Bacterial index	14.1	11.3	27

4. Discussion:

The date fruits are regarded as a popular food commodity for thousands of years in Egypt, the Arabian Gulf peninsula and its neighboring region and provide unique functional and nutritional values. Numerous health benefits beyond its nutritional value have been associated with consuming date palm fruits to enrich nutrition values of different kinds of food. (El-Sohaimy and Hafez, 2010). Date palm fruits contain a variety of minerals, which have a variety of functions that help maintain a healthy body. Magnesium and calcium are essential for healthy bone development and for energy metabolism. Iron is essential to red blood cell production. Red blood cells carry all the nutrients to cells throughout the body. Dates contained an ideal amount of sodium and were a great source of potassium, a nutrient that is great in the maintenance of a healthy nervous system and in balancing the body's nervous system. Phosphorus works with calcium to help with bone strength and growth, potassium that helps to keep your muscles working correctly and selenium is important for cell growth and repair. The date palm fruits provide unique functional and nutritional values. Numerous health benefits beyond its nutritional value have been associated with consuming date palm fruits to

enriched nutrition values of different kinds of food. Dates could have an important all-round role to play in dietary health. There is every possibility that they contain other components that may have useful functional properties.

The concentrations of nitrogen, potassium, phosphorous, calcium, magnesium and iron were detected in four cultivars of date palm during 1978 and 1979 seasons. The average concentrations of these nutrient elements in the date palm cultivars ranged from 0.97 -1.36 %N, 0.11 to 0.178% P, 1.36 to 1.59% K, 1.00 to 1.29% Ca, 0.39 to 0.47 % Mg and 208 to 267 ppm Fe. Furthermore, El-Sohaimy and Hafez (2010) found that the date palm extracts contained 13.80 % moisture, 86.50 % total solid, 2.13% ash and 5.20% fibers contents but the protein, carbohydrates and lipids contents were 3.00%, 73.00% and 2.90 % respectively. They added that the low level of lipids content compared with its content of sugars means that, the date palm is save to heart and blood patients because its containing a very low level of fatty acids and cholesterol.

As illustrated in table (1), the Chinese date content in protein is higher than the Safawy date while, the later has a higher lipid than the previous one. The Safawy date content of carbohydrate

(73.00%) is higher than the Chinese date (42.4%). These characteristics may affect the taste of both of them. The moisture content of the Safawy date is higher than the Chinese date this property may affect the storage capacity that mean the Chinese date may be better in storage than the Safawy date.

From table (2) and figure (2) it is obvious to find a high content of the macronutrient in the Chinese date than the Sawafy date except for the Na⁺ content. However, it is clearly to see a very highly significant content of the Fe content in both types. Nevertheless, the content is high in Chinese date than the Sawafy date. Regarding the micronutrient it is clear to find a high content of Cu, Ni, and Zn in the Chinese date than the Sawafy date. However, the Sawafy date has a high content of Mn and Co than the Chinese date. For the Pb in both types was not detected while for Cd in both types is almost the same content.

One of the goals of this study was to determine inhibitory effect of palm extract on some pathogenic bacteria. Moderate antibacterial activates was recorded compared to control antibiotic. Palm kernel extract containing di peptides of different degree of hydrolysis against spore-forming bacteria *Bacillus cereus*, *B. circulans*, *B. coagulans*, *B. licheniformis*, *B. megaterium*, *B. pumilus*, *B. stearothermophilus*, *B. subtilis*, *B. thuringiensis*, *Clostridium perfringens*; and non-spore forming bacteria *Escherichia coli*, *Lisibacillus sphaericus*, *Listeria monocytogenes*, *Pseudomonas aeruginosa*, *Salmonella typhimurium* and *Staphylococcus aureus*. Potentially PKE peptides could be used in food preservation and developed as antibacterial agent in the pharmaceutical industry (Tan et al., 2011).

Conclusion:

This detailed information on nutritional and health promoting components of dates enhance our knowledge and appreciation for the use of dates in our daily diet and as a functional food ingredient.

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