

Effect of Date Varieties on Chemical Properties, Fatty Acid Composition and Amino Acid Contents of Date (*Phoenix dactylifera* L.) Seed and Oils

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ABSTRACT: The chemical properties, fatty acid composition, and amino acid contents of the date (*Phoenix dactylifera* L.) fruit seeds (Barhi, Khulas, Monaif Rozaiz, Soukari, Soulag, and Soughi) were determined. While crude protein contents of date samples range from 5.70% (Soulag) to 7.59% (Bahri) ($p < 0.05$), oil contents of seed samples changed between 3.66% (Khulas) and 7.87% (Soulag). Glucose contents ranged from 0.69% (Bahri) to 2.31% (Soughi). Glutamic acid contents of samples ranged from 0.81% (Rozaiz) to 1.20% (Bahri) ($p < 0.05$). Myristic acid contents of seed oils changed between 11.79% (Khulas) and 15.13% (Soughi). In addition, palmitic acid contents of oils ranged from 8.13% (Monaif) to 10.63% (Rozaiz). While oleic acid contents of date seed oils vary between 32.84% (Monaif) and 43.51% (Khulas) ($p < 0.05$), lauric acid contents of oil samples ranged from 20.0% (Rozaiz) to 32.83% (Monaif). Future studies will be conducted on phenolic and bioactive compounds of date seeds.

KEYWORDS: Date seeds; Oil; Compositions; Sugars; Amino acid; Fatty acid.

INTRODUCTION

The date palm (*Phoenix dactylifera* L. (belong to Palmaceae) is cultivated in dry and semi-arid regions in the world [1,2]. The date has been an important crop in the desert regions of Arabian countries and an important economical support for indigenous populations [3-5]. Dates are rich in carbohydrate (70-80 %), minerals and phenolics. Most of the carbohydrates in dates are

in the form of fructose and glucose [6-9]. Date seeds considered as a waste product of many industries based on flesh of date fruit such as date syrup are ground and added to the feed of some animals. Also, date pits are used in making a caffeine-free drink [10-12]. In previous study, Khulas and Barhe date seeds contained 8.64% and 10.64% moisture, 5.84% and 5.68% crude protein, 7.92% and

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1021-9986/2020/4/305-310

6/5/5.06

7.52% crude oil, 0.96% and 1.06% ash and 3.94% and 2.43% carbohydrate, respectively [12]. Oleic, lauric, linoleic, palmitic and myristic acids were the most abundant fatty acids in date seed oil¹⁾. Date pits could potentially be used as ingredients in the production of some functional foods for human consumption [12,13]. Also, date seeds could be used in food as an important source of dietary fiber [14]. The aim of present study was to investigate the proximate analyses, sugar contents, fatty acid and amino acid compositions of different date pits.

EXPERIMENTAL SECTION

Material

Date fruits (Barhi, Khulas, Monaif, Rozaiz, Soukari, Soulag and Soughi) were provided from local markets. About 250 g sample was taken, stoned. The date flesh was removed from seeds. The seeds were washed with drinkable water, and they were dried. Dried seeds were ground, and its moisture content was determined. Seed samples were kept -18 °C until analyses.

Methods

Proximate Analysis

Determination of moisture and protein contents was done according to AACC approved methods 44-15.02 and 46-30.01, respectively. Moisture was measured by heating the sample for 1 hour at 135°C in a gravity oven [15]. The protein determination was made in Leco combustion analyzer and 6.25 was used as the conversion factor [16]. Total starch was measured using AACC approved method 76-13.01, using an assay kit from Megazyme (Megazyme International, Ireland). The samples were incubated with heat stable fungal α -amylase and amyloglucosidase to hydrolyze the starch to glucose. The glucose was treated with glucose oxidase/peroxidase (GOPOD) and the absorbance was read at 492nm. The starch content was calculated based on the glucose concentration [17]. Crude oil was determined by ether extraction, according to AOAC Official Method 920.39 (A) and crude fiber content was determined according to AOAC official method 978.10 [18].

Sugar composition

The free sugar composition of date seed was determined by chromatographic methods according to *Kakehi* and *Honda* [19].

Amino acid profile

The amino acid profiles of date seed powder was determined according to AOAC Official Method 982.30 E(a,b,c) [18].

Fatty acid profile

The fatty acid profile was according to AOAC official methods 996.06 [Analysis of methyl esters by Capillary GLC], Ce 2-66 [Preparation of Methyl Esters of Fatty Acids], 965.49 [Preparation of Methyl Esters of Fatty Acids] and 969.33 [Oils and Fat, Boron Trifluoride method] [18].

Statistical analyses

Results of the research were analysed for mean \pm standard deviation and statistical significance by analysis of variance [20].

RESULTS AND DISCUSSION

Chemical properties and sugar compositions of date seeds provided from Saudi Arabia (Riyadh) are presented in Table 1. Moisture contents of date seeds were found between 6.11% (Soulag) and 9.00% (Rozaiz). Crude protein contents of samples ranged from 5.70% (Soulag) to 7.59% (Bahri). In addition, while date seeds contain between 3.66% (Khulas) and 7.87% (Soulag) crude oil, their crude fiber contents of seeds changed between 19.52% (Bahri) and 34.65% (Monaif). While fructose content of samples change between 0.59% (Bahri) and 2.29% (Soughi), glucose contents ranged from 0.69% (Bahri) to 2.31% (Soughi) ($p < 0.05$). Sucrose content of samples changed between 0.48% (Rozaiz) and 3.18% (Soukari). But, Soughi and Khulas did not contain sucrose.

Amino acid contents of date seeds are given in Table 2. While aspartic acid content of date seeds change between 0.42% (Rozaiz) and 0.63% (Bahri), glutamic acid contents of samples ranged from 0.81% (Rozaiz) to 1.20% (Bahri) ($p < 0.05$). Also, arginine contents of samples varied between 0.46% (Rozaiz) and 0.77% (Bahri). In addition, leucine contents of seeds ranged from 0.29% (Rozaiz) to 0.41% (Bahri). Also, lysine content of date seeds were found between 0.26% (Rozaiz) and 0.36% (Bahri). Also, the lowest amino acid contents of samples ranged from 4.14% (Rozaiz) to 6.03% (Bahri).

Fatty acid composition of date seed oils are reported in Table 3. Myristic acid contents of date seed oils

Table 1: Proximate analysis and sugar composition of date pits.*

	Moisture	%						
		Protein	Ash	Crude oil	Crude fiber	Fructose	Glucose	Sucrose
Soughi	7.78±0.64**b	6.74±0.19b	1.13±0.17a	5.03±0.21c	33.49±2.57a	2.29±0.17a	2.31±0.08a	nd****
Monaif	8.58±0.98b***	7.21±0.48a	1.12±0.19a	4.52±0.37c	34.65±3.71a	1.54±0.21b	1.82±0.11b	1.13±0.21b
Soulag	6.11±0.38c	5.70±0.39c	0.96±0.11b	7.87±1.25a	24.57±2.67b	1.38±0.32b	1.58±0.18b	1.14±0.17b
Soukari	6.63±0.71c	7.52±0.51a	1.18±0.27a	6.75±1.13b	24.44±1.98b	0.72±0.08c	0.93±0.09c	3.18±0.73a
Bahri	6.32±0.58c	7.59±0.86a	1.02±0.18a	7.62±0.98a	19.52±1.28c	0.59±0.09c	0.69±0.07c	3.06±0.81a
Khulas	8.82±1.07b	6.39±0.78b	1.14±0.31a	3.66±0.36d	33.92±2.19a	1.93±0.16b	2.27±0.38a	nd
Rozaiz	9.00±1.29a	5.86±0.43c	0.94±0.13b	3.77±0.72d	32.12±2.98a	1.58±0.21b	2.08±0.61a	0.48±0.06c

* Dry Weight Basis, **mean±standard deviation, ***Values within each column followed by different letters are significantly different ($p < 0.05$)

Table 2: Amino acid composition of date pits (%)*

	Soughi	Monaif	Soulag	Soukari	Bahri	Khulas	Rozaiz
Taurine	0.09±0.01**c	0.10±0.03b	0.10±0.03b	0.10±0.01b	0.11±0.03a	0.10±0.02	0.10±0.01b
Hydroxyproline	0.02±0.01	0.02±0.0	0.02±0.01	0.02±0.01	0.02±0.01	0.02±0.00	0.02±0.01
Aspartic Acid	0.54±0.11b***	0.55±0.07b	0.45±0.03c	0.61±0.14a	0.63±0.09a	0.46±0.07c	0.42±0.03d
Threonine	0.18±0.03b	0.20±0.05a	0.16±0.03c	0.21±0.05a	0.22±0.03a	0.17±0.02c	0.16±0.03c
Serine	0.21±0.05b	0.24±0.06a	0.19±0.03b	0.24±0.07a	0.25±0.03a	0.20±0.03b	0.19±0.05b
Glutamic Acid	0.99±0.11	1.12±0.07a	0.90±0.17b	1.16±0.21a	1.20±0.13a	0.92±0.17b	0.81±0.18c
Proline	0.19±0.03b	0.20±0.07b	0.17±0.03d	0.22±0.09a	0.23±0.06a	0.18±0.04c	0.16±0.03d
Glycine	0.26±0.06c	0.29±0.07b	0.24±0.09c	0.31±0.05a	0.31±0.04a	0.25±0.03c	0.22±0.03d
Alanine	0.24±0.05b	0.26±0.08b	0.22±0.07c	0.29±0.03a	0.29±0.06a	0.23±0.08b	0.20±0.09c
Cysteine	0.09±0.01b	0.09±0.01b	0.08±0.03c	0.10±0.03a	0.10±0.01a	0.08±0.02c	0.07±0.01d
Valine	0.26±0.03c	0.29±0.07	0.24±0.05d	0.31±0.07a	0.32±0.06a	0.25±0.03c	0.22±0.04e
Methionine	0.10±0.03b	0.09±0.01	0.08±0.01c	0.11±0.03a	0.11±0.03a	0.08±0.01c	0.08±0.01c
Isoleucine	0.17±0.03b	0.18±0.01b	0.15±0.03c	0.20±0.07a	0.20±0.03a	0.16±0.09c	0.15±0.03c
Leucine	0.34±0.07c	0.37±0.05b	0.31±0.03d	0.40±0.07a	0.41±0.09a	0.32±0.05d	0.29±0.03e
Tyrosine	0.06±0.01b	0.06±0.01b	0.06±0.01b	0.07±0.01a	0.08±0.03a	0.05±0.01c	0.05±0.01c
Phenylalanine	0.20±0.03c	0.23±0.07b	0.19±0.05c	0.24±0.03a	0.25±0.07a	0.19±0.03c	0.17±0.01d
Hydroxylysine	0.02±0.01a	0.01±0.00b	0.01±0.00b	0.02±0.0a	0.02±0.01a	0.02±0.00a	0.01±0.00b
Ornithine	0.01±0.00	0.01±0.0	0.01±0.0	0.01±0.00	0.01±0.00	0.01±0.00	0.01±0.00
Lysine	0.30±0.07c	0.33±0.03b	0.28±0.05c	0.35±0.08a	0.36±0.07a	0.28±0.09c	0.26±0.03d
Histidine	0.11±0.01	0.12±0.03	0.10±0.02	0.13±0.03	0.14±0.01	0.10±0.01	0.09±0.01
Arginine	0.60±0.11d	0.68±0.13c	0.54±0.09d	0.73±0.11b	0.77±0.14a	0.57±0.13d	0.46±0.09e
Tryptophan	0.04±0.01	0.04±0.01	0.04±0.01	<0.04±0.01	0.04±0.01	0.04±0.01	0.04±0.01
Total	4.98	5.44	4.5	5.83	6.03	4.64	4.14

*Dry Weight Basis, **mean±standard deviation;***Values within each column followed by different letters are significantly different ($p < 0.05$)

Table 3: Fatty acid profile of date pit oils (%).

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	Soughi	Monaif	Soulag	Soukari	Bahri	Khulas	Rozaiz
Myristic	15.13±1.12*a	14.88±0.67b	14.84±0.67b	14.25±0.05b	12.8±1.08c	11.79±0.97d	12.37±1.27c
Palmitic	8.79±0.34b**	8.13±0.56b	8.78±0.87b	9.02±1.32a	9.85±1.13a	9.82±0.98a	10.63±1.21
Palmitoleic	0.08±0.01b	0.10±0.02a	0.09±0.01b	0.11±0.03a	0.10±0.03a	0.10±0.01a	0.10±0.03
Margaric	***	-	-	-	0.07±0.01	0.07±0.01	0.07±0.01
Stearic	1.5±0.03b	1.43±0.011b	1.92±0.12b	1.60±0.21b	2.20±0.56a	2.61±0.71a	2.43±0.91
Oleic	32.93±2.31d	32.84±1.78d	34.99±2.37c	34.47±2.67c	41.68±1.89b	43.51±2.87a	42.86±2.73
Linoleic	7.70±0.67c	7.51±1.23c	6.99±1.45d	8.52±1.82b	9.30±0.78a	7.65±0.91c	8.75±0.93
Linolenic	0.05±0.01b	0.07±0.02a	0.05±0.01b	0.08±0.01a	0.08±0.02a	0.05±0.01b	0.22±0.05
Arachidic	0.20±0.03c	0.15±0.02d	0.23±0.07c	0.20±0.03c	0.27±0.07b	0.36±0.09a	0.34±0.05
Gonodic	0.28±0.07c	0.20±0.03d	0.27±0.05c	0.32±0.03b	0.36±0.05a	0.36±0.07a	0.34±0.09
Behenoic	0.14±0.01d	0.09±0.02e	0.17±0.03c	0.15±0.03d	0.21±0.03b	0.26±0.02a	0.26±0.03
Clupanodonic	0.11±0.03b	0.14±0.01a	0.14±0.02a	0.12±0.03b	0.14±0.01a	0.10±0.01c	0.10±0.02
Behenoic	0.14±0.03c	0.09±0.01d	0.17±0.03c	0.15±0.03c	0.21±0.07b	0.26±0.05a	0.26±0.07
Lignoceric	0.10±0.01d	0.08±0.01d	0.13±0.03c	0.12±0.03c	0.18±0.05b	0.22±0.07a	0.19±0.03
Caproic	0.09±0.01d	0.11±0.02b	0.12±0.03b	0.18±0.05a	0.09±0.01d	0.10±0.01c	0.11±0.03
Caprylic	0.48±0.09c	0.59±0.07a	0.51±0.11b	0.52±0.13b	0.34±0.07e	0.41±0.13d	0.31±0.09
Capric	0.58±0.11b	0.67±0.13a	0.58±0.09b	0.53±0.07c	0.36±0.06d	0.44±0.09d	0.36±0.07
Lauric	31.28±1.13a	32.83±1.21a	29.83±1.09b	28.94±1.07b	21.44±1.13c	21.42±0.98c	20.07±0.78

*mean±standard deviation; **Values within each column followed by different letters are significantly different ($p<0.05$); *** Not Determined

were found between 11.79% (Khulas) and 15.13% (Soughi) ($p<0.05$). In addition, palmitic acid contents of samples varied between 8.13% (Monaif) and 10.63% (Rozaiz). Stearic acid contents of oil samples ranged from 1.43% (Monaif) to 2.61% (Khulas). While oleic acid contents of seed oils vary between 32.84% (Monaif) and 43.51% (Khulas), linoleic acid content of oils changed between 6.99% (Soulag) and 8.75% (Rozaiz) ($p<0.05$). Also, lauric acid contents of date seed oils varied between 20.0% (Rozaiz) and 32.83% (Monaif). The *Phoenix canariensis* seed contained 10.36% oil, 5.67% protein, 72.59% total carbohydrate and 10.20% moisture [21]. The main fatty acids of date seed oil were oleic (50.10%), linoleic (19.23%), lauric (10.24%), palmitic (9.83%) and stearic (7.51%) acids [21]. In other study, oleic (44.25%), lauric (17.5), myristic (11.45), palmitic (10.30%) and linoleic (18.45%) acids were the key fatty acids of date seed oil [22]. Date seed oils contained 31.5-37.6% oleic, 25.7-30.8% lauric 13.3-16.9% myristic, 11.9-13.1% palmitic,

4.4-6.9% linoleic and 1.9-2.3% stearic acids [23]. In previous study, the most abundant fatty acids of the date seed oil were oleic (47.66%), lauric (17.39%), linoleic (10.54%), palmitic (10.20%) and myristic acids (10.06%)¹. Besbes et al. [24] determined 47.7% oleic, 21% linoleic and 5.8% lauric acids in date seed oil. The seed oils contained between 40.51% (Soughi) to 45.74% (Rozaiz cv) oleic, between 17.95% (Rozaiz) to 25.01% (Soughi cv) lauric, between 12.07% (Rozaiz cv) to 13.94% (Soughi) myristic, between 9.75% (Khulas cv) to 11.00% (Rozaiz cv) palmitic and 7.03% (Khulas cv) to 9.28% (Barhi cv) linoleic acids [25]. Nedhi et al. [26], determined the physicochemical properties and chemical composition of the date seed oil obtained from six different types of dates grown in Saudi Arabia (*Rezeiz, Barhi, Manifi, Sukkari, Khalas* and *Sulaj*) and compared them with traditional date oil. The average oil content of the date seeds was about 7%. The oleic acid was found to be 48.67% and was determined as the major fatty acid.

were Following that, 17.26% lauric acid, 10.74% stearic acid, 9.88% palmitic acid and 8.13% linolenic acid were also detected. The mean value for the free fatty acid content of the samples was 0.5% [26]. Result were found partly similar with literature values [1,21,23,27,28]. Some differences for fatty acids may be probably due to genetic factors, harvest time, soil structure and climatic factors.

Habib and Ibrahim ¹²⁾ reported that eighteen date pits contained 8.64% and 12.45% moisture, 4.81% to 5.83% crude protein, 5.71% to 7.92% crude oil, 0.82% to 1.14% ash and 2.43% to 4.65% carbohydrate. In addition, according to the same researchers, Khulas and Barhe date seeds contained 8.64% and 10.64% moisture, 5.84% and 5.68% crude protein, 7.92% and 7.52% crude oil, 0.96% and 1.06% ash and 3.94% and 2.43% carbohydrate, respectively [12].

Also, while crude oil content of seeds is established between 4.68% (Khulas cv) and 7.96% (Monaif cv), crude protein contents were found between 3.71% (Soulag cv) and 5.47% (Barhi cv) [25]. The glucose contents of date seeds changed between 3.13 g/kg (Khulas) to 3.60 g/kg (Monaif cv). In addition, fructose contents were found between 3.40 g/kg (Khulas) to 3.93 g/kg (Monaif) [25]. The averages of different constituents of date pits were as follows: reducing sugars 2.4%, protein 6.43%, oil 9.2% and ash 1.2% [10]. According to *Al-Juhaimi et al.* [25], date seeds contained 4.68-7.96% oil, 3.71-5.47% crude protein. While ash contents changed between 1.02% (Rozaiz cv) to 1.26 % (Soukari cv), crude fiber contents changed between 17.07% (Khulas cv) to 23.46% (Rozaiz cv) [25]. *Saafi et al.* [1] reported that date pit contained 6.88 g/100g (FW) moisture, 8.12 g/100 g total sugars, 6.63 g/100g (DW) reducing sugar, 1.49 g/100 g sucrose, 5.31 g/100

\crude protein and 8.33 g/100g fat. The present study emphasized that in ancient times these fruits were largely used by the natives of tribal area as a prime source of natural medicine and food using their traditional wisdom in the form of fresh fruits, dry fruits, fruit juice, fruit powder and drugs. Date seed varieties showed significant ($p < 0.05$) differences among crude oil, crude fiber, fatty acids and mineral contents of the seven date seed varieties. These properties changed depending on date varieties.

CONCLUSIONS

As a result, our results provide important data to explain the proximate, sugar, amino acid, and fatty

acid content changes of seven different date varieties. Generally, amino acid contents of Bahri were found higher than those of results of other date varieties. As seed, date seed oil rich in saturated fatty acids such as oleic and linoleic acids. But their lauric and myristic acid contents are high levels too. In our study, while oleic acid is the highest unsaturated fatty acid, lauric acid was the highest amount among saturated fatty acids in all date seed varieties. Future studies will be carried out on phenolic and bioactive compounds and corresponding effects of date seeds.

Received : Aug. 10, 2019 ; Accepted : Dec. 22, 2019

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