Characteristics and Some Potential Applications of Date Palm (*Phoenix dactylifera* L.) Seeds and Seed Oil

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The seeds of four date palm (*Phoenix dactylifera* L.) cultivars, Dekel Noor, Zahidi, Medjool and Halawy, grown in the Arava Valley of southern Israel were analyzed for their inorganic and some organic constituents. The following average values were obtained for the four cultivars on a dry-weight basis: protein 5.60%, oil 8.15%, fiber 16.13%, and ash 1.13%. Analysis of the mineral elements in the ash gave the following average values: Ca, 1.55%; Na, 0.97%; Mg, 8.07%; K, 27.60%; Fe, 0.73%; Cu, 0.13% and Mn, 0.08%. The oil exhibited the following characteristics (average for the four cultivars): acid value ~1.04, iodine value 49.5, saponification value 221.0, and unsaponifiable matter 0.8%. Gas-liquid chromatography revealed that the major unsaturated fatty acid was oleic acid (42.3%), while the main saturated fatty acid was lauric (21.8%). Myristic, palmitic and linoleic acids were also found, average values being 10.9, 9.6 and 13.7%, respectively. Potential uses for date seed oil are considered for cosmetic, pharmaceutical and related specialty products, and to a lesser degree for food products.

KEY WORDS: Date, oil, *Phoenix*, potential application, seed.

The date palm *Phoenix dactylifera* L. is an important member of the family Palmacea, providing a staple food for millions of people in arid and semiarid regions of the world. Dates are an economically important crop in the Arava and Jordan valley areas of Israel. About 15,000 tons of dates were produced in Israel during 1990 (1). The value of Israel's modern date export industry is estimated at $12 million a year (2). Research by others suggests some potential uses for the date seed and its constituents in cosmetics, pharmaceuticals, feed and food industries (3–12). The literature indicates that no work has been carried out in Israel on the chemical constituents of domestically produced date seeds, and no serious attempts have been made to exploit the seeds as potential by-products of the date industry. In Israel, date seeds are discarded or utilized on a small scale as animal feed. Our work reported here includes the proximate composition and the mineral elements of seeds of the four date palm cultivars grown for processing in the Arava Valley and the physical and chemical characteristics of the extracted oils. This investigation may stimulate interest in date-seed components for use in feed, cosmetic and other industries in Israel.

EXPERIMENTAL PROCEDURES

Seeds (10% of fruit weight) of the date palm fruit from four cultivars, Dekel Noor, Zahidi, Medjool and Halawy, were used in this investigation. The seeds, obtained from the Merkaz Sapir Date Packing Center in the Arava Valley, were soaked in water and washed to free them of any adhering date flesh and then placed on drying nets and dried in the sun. Each variety was ground separately in a hammer mill, and 575 g of the ground seed was extracted exhaustively with petroleum ether (40–60°C) in a Soxhlet apparatus for 9 h. The physicochemical characteristics of seeds and oils were determined according to the Association of Official Analytical Chemists (13). Atomic absorption spectrometry was used for the determination of mineral elements in the ash of the date seeds. Between 50 and 60 mg of sample ash was weighed into a suitable container and heated in aqua regia on a water bath until the solution almost evaporated to dryness. A small quantity of deionized water was added to the solution and transferred to an Erlenmeyer flask, to which 25 mL of deionized water was then added. From this stock solution appropriate dilutions were made for the determination of each element. The oils were converted to methyl esters by the method of Morrison and Smith (14). The fatty acid methyl esters were analyzed in a Carlo Erba GC 6000 gas chromatography (Milano, Italy), equipped with a hydrogen flame ionization detector and an integrator. The stainless steel column (dimensions: 1.8 m length × 3.2 mm internal diameter) was packed with 10% Silar 10C supported on 100–120 mesh Chromosorb WHP. The column temperature was programmed from 185°C to 240°C at 8°C/min. Oxygen-free nitrogen was used as carrier gas at a flow rate of 35 mL/min. The identities of the peaks were established by comparison with authentic standards.

RESULTS AND DISCUSSION

The characteristics and composition of the seeds of the four date palm cultivars are presented in Table 1. The values fall within the ranges quoted by other investigators (3,5–12,15). The low protein content, coupled with the relatively high fiber content, will seriously limit the use of the defatted date seed meal in feeds without significant supplementation.

The extracted pale-yellow date seed oils were semi-solid at 5°C. Their iodine values were similar to palm oil, 48–58, and their saponification values were between those of palm and palm kernel/coconut oils.

The most abundant fatty acids were oleic (41–44%) and lauric (19–24%), followed by myristic, palmitic and linoleic (8–15%). Fatty acid composition of the date seed oils are compared in Table 2 with reported values for palm oil and palm kernel/coconut oils (16,17). Date seed oil may be regarded as an oleic-lauric oil, distinct from palm oil (palmitic-oleic) and palm kernel/coconut oils (lauric-myristic).

Date seed oil would appear to be useful in cosmetics, pharmaceuticals, soaps and detergents, chemical intermediates and food applications. However, the low oil content of date seeds (*ca.* 8%) results in little commercial interest by the oil extraction industry (18).

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TABLE 1

Physicochemical Characteristics and Composition of Seeds and Oils of Four Cultivars of *Phoenix dactylifera* L. Grown in Israel

	Cultivar			
	Dekel Noor	Zahidi	Medjool	Halawy
Seed				
Average wt of each seed (n = 50) (g)	0.70	0.84	1.05	1.0
Moisture (% wet wt)[a]	4.33	4.78	4.22	4.67
Ash (%)[a,b]	0.50	1.17	1.67	1.17
Oil (%)[a,b]	8.40	8.13	7.98	8.10
Protein (%)[a,b]	5.66	5.28	5.81	5.66
Crude fiber (%)[a,b]	15.10	15.70	16.40	17.30
Mineral in ash (%)				
Calcium	1.58	1.87	1.40	1.35
Sodium	1.48	1.37	0.38	0.64
Magnesium	7.78	6.74	8.38	9.36
Potassium	25.40	28.90	28.50	27.60
Iron	1.68	0.78	0.25	0.22
Copper	0.20	0.19	0.07	0.07
Manganese	0.09	0.09	0.06	0.09
Oil[a]				
Acid value	1.03	11.94[c]	1.15	0.94
Iodine value (Wijs)	50.0	48.0	50.60	49.40
Saponification value	221.60	221.60	222.70	218.20
Unsaponifiable matter (%)	0.66	0.96	0.73	0.80
Fatty acid[d]				
Capric	—	—	0.3	0.3
Lauric	24.0	19.6	22.7	21.1
Myristic	9.6	12.1	10.7	11.2
Palmitic	9.6	10.2	8.7	9.7
Stearic	1.3	1.9	1.4	1.6
Oleic	41.1	44.1	41.4	42.8
Linoleic	14.5	12.0	14.9	13.5

[a]Data are the means of three determinations.

[b]Dry wt basis.

[c]The acid value obtained for the semidry cultivar Zahidi was exceptionally high. This apparent discrepancy may be due to the age of the seeds.

[d]Percent by wt of total fatty acids.

TABLE 2

Comparison of the Characteristics of Date Seed Oil with Selected Vegetable Oils[a]

	Source of oil			
Analysis	Date seed[b]	Palm[c]	Palm kernel[c]	Coconut[c]
Iodine value	49.5	53.3	17.8	9.5
Saponification value	221.0	195.7	245.0	256.0
Fatty acid composition				
Caprylic C_8			4.4	8.0
Capric C_{10}	0.3		3.7	7.0
Lauric C_{12}	21.8	0.2	48.3	48.2
Myristic C_{14}	10.9	1.1	15.6	18.0
Palmitic C_{16}	9.6	44.0	7.8	8.5
Stearic C_{18}	1.5	4.5	2.0	2.3
Oleic $C_{18:1}$	42.3	39.2	15.1	5.7
Linoleic $C_{18:2}$	13.7	10.1	2.7	2.1

[a]Values are expressed as percentage of the total fatty acids.

[b]Figures are the calculated average for the four cultivars.

[c]Reference 17.

Based on the information obtained from the Israel Date Growers' Association in 1990, the expected annual yield by 1992 would be about 16,000 tons of date fruits, 850 tons of date seeds or nearly 70 tons of date seed oil in Israel.

Date seed oil was used to replace the portions of "other vegetable oils," coconut/palm oils, coconut oil and coconut oil/tallow in well-known body creams, shampoos and shaving soap formulations, respectively. Thus, three types of cosmetic cream, three types of liquid shampoo (called "date seed oil shampoo") and one type of bar shaving soap were prepared from the date seed oil. The cosmetic samples were given to selected persons in the cosmetics business for trial use and comments. In general, their comments as to the quality of the cosmetic formulations were encouraging. Considering that date seeds are available at low or no cost, a small plant to extract the oil may be feasible and worth consideration.

ACKNOWLEDGMENTS

This work was supported by research grant from MASHAV, the Israeli Foreign Affairs Ministry, Division for International Cooperation.

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[Received August 16, 1991; accepted March 12, 1992]