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Studies on the Physio-chemical Characteristics of Date Fruits of Five UAE Cultivars at Different Stages of Maturity

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ABSTRACT. Date fruit (*Phoenix dactylifera* L.) samples of five cultivars *viz. Shahla, Gash Gaafar, Gash Habash, Lulu* and *Bushibal,* were evaluated for their physical and chemical composition. All the cultivars were green at the *kimri* stage, but after reaching the *khalal* stage, they each attained a distinctive color of their own. The *Shahla* and *Bushibal* varieties were red, the *Gash Gaafar* and *Lulu* varieties yellow, and the *Gash Habash* variety yellow-scarlet. The *Lulu* fruit was nearly round while fruit from the other four cultivars was cylindrical in shape. The fruit weights ranged from 4.6 to 7.6 and from 6.5 to 10.6 g at the *kimri* and *khalal* stages, respectively. These cultivars can, therefore, be classified as small-fruit varieties. The pulp: seed ratios centered around 90:10 in most of the cultivars. They were slightly lower (84:16) in the *Gash Habash* and *Bushibal* varieties. At the *kimri*-stage, the fruits had a moisture content between 84 and 85.5%, which decreased to between 48.7 and 59.9% at *khalal*. The moisture content decreased further at *rutab* (between 38 and 49%) and *tamr* (between 13.7 and 27.7%).

As the fruits matured from *kimri* to *tamr,* their chemical composition changed considerably. Moisture, protein, ash, fat, tannin and crude fiber contents decreased progressively from *kimri* to *tamr,* but total sugars, glucose and fructose increased. At the *tamr* stage, glucose and fructose were the main sugars present; but sucrose was not detected in these cultivars. The date cultivars were found to be reasonably good sources of some important minerals like calcium, magnesium, phosphorus, potassium, iron, copper and zinc, but extremely low in sodium content.

From time immemorial dates (*Phoenix dactylifera* L.) have been an important crop in the desert region of Middle Eastern countries and formed the basis of survival for

many ancient nomads. Information on the physiocochemical characteristics of some of the date cultivars commercially grown in the United Arab Emirates (UAE) is scanty. Visualizing the vast potential for expansion of the date-fruit industry, this study was carried out in collaboration with the Palm Agro-Production Company (Kuwait), to determine the physicochemical characteristics of five cultivars of commercial importance in UAE.

Materials and Methods

Materials: Date fruit samples (about 25 kg of each cultivar at each stage of maturity) of five date cultivars, *viz. Shahla, Gash Gaafar, Gash Habash, Lulu* and *Bushibal* were received from the United Arab Emirates, through the Palms Agro-Production Company (Kuwait), during the date-palm fruiting season (1993 crop). Fruit samples were obtained from randomly selected trees at each of the four maturity stages, *i.e., kimri, khalal, rutab*, and *tamr* (Hussein 1970), for all cultivars, except for the *rutab* stage of the *Shahla* cultivar. The *khalal*-stage fruits were stored at ambient temperature in the laboratory and matured to the *rutab* stage, when they were analyzed chemically.

Methods: About 3 kg of representative sample was taken from the freshly received date fruits. These were washed thoroughly in running tap water and subsequently air-dried. The fruits were separated from the stalks, and calyxes and seeds were removed. The flesh was cut into small pieces using a blender, mixed well and sampled for moisture content and pH. The seeds were also cut into small pieces using a blender. Both the pulp and seeds were then freeze-dried separately, powdered and stored in a deep freezer for further chemical analysis.

Physical measurements: After removing the calyxes, the length and diamter of 100 fruits for each sample group were measured using a micrometer. The weight of 100 fruits was recorded; then the average value for a single fruit was calculated and recorded. The seeds were manually removed from these fruits with a knife, and the weight of the flesh (pulp) as well as that of the seeds were separately recorded. Fruits at the *kimri* and *khalal* stages of maturity were photographed to record their color, appearance and shape.

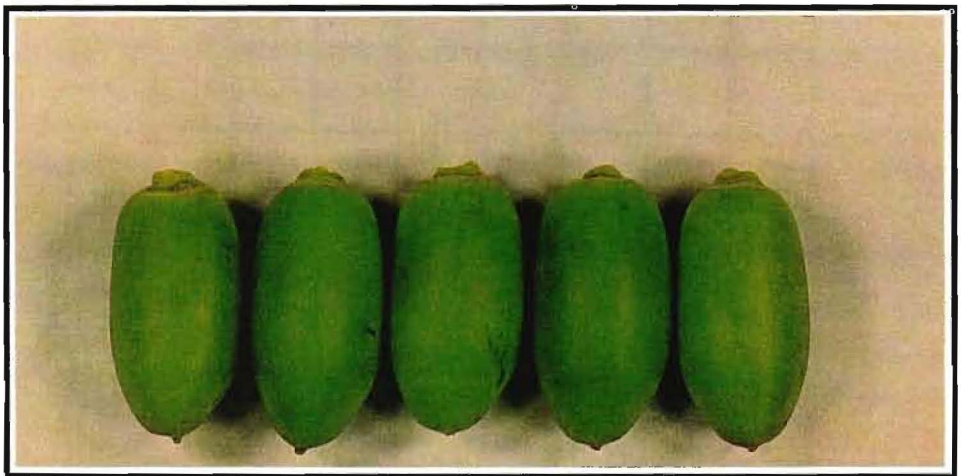
Chemical analysis: Moisture, ash, crude protein, and crude fibre contents were determined according to the methods of the Association of Official Analytical Chemists (1990). About 5 kg of random sample of date fruits was collected from each cultivar at every stage of development, stones removed, macerated into pulp and freeze dried. The freeze dried material was thoroughly mixed to obtain uniform

sample for chemical analysis. Total tannins were determined by the procedures reported by Ruck (1969). Sugars were extracted with 75% ethanol, and by sonication for 30 min, followed by filtration. The extracts were analyzed for glucose, fructose and sucrose by high performance liquid chromatography using acetonitrile: water (80:20) as the mobile phase with a 1 ml/min flow rate. An amino silica column (250 mm long and 4.6 mm internal diameter) and a refractive index detector were utilized for sugars separation and detection respectively. For the estimation of minerals (Ca, Mg, P, K, Na, Cu, Zn and Fe), 1 g of sample was wet digested using a nitric acid: perchloric acid mixture (3:1). After making up the volume, the extract was analyzed for the minerals with the inductively coupled plasma technique using a Jobin Yvon Atomic Emission Spectrophotometer (model JY-24). All analyses were conducted in duplicates, and the average results are expressed on a moisture-free basis. The standard deviation and coefficient of variation in these chemical analyses are reported.

Results and Discussion

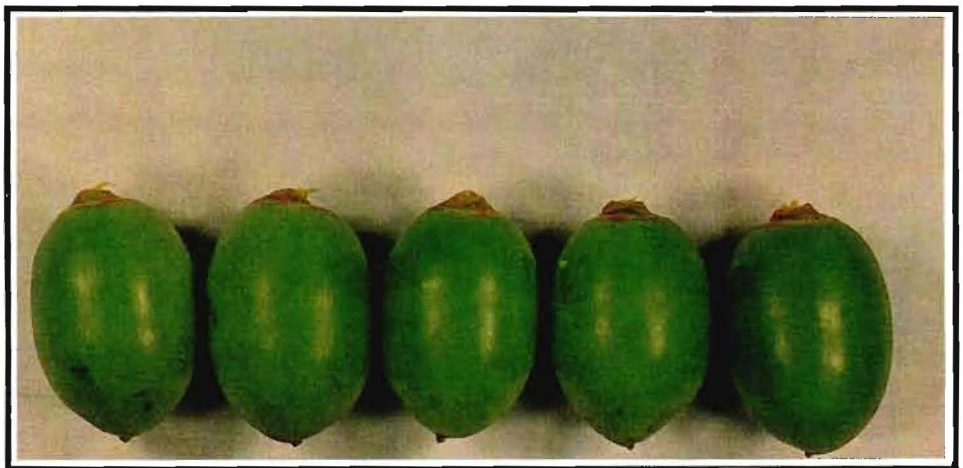
The color and appearance of all cultivars at the *kimri* and *khalal* stages in Plates 1 and 2 respectively. All the cultivars were green at the *kimri* stage but by the *khalal* stage, each cultivar had developed a distinctive color. At the *khalal* stage, *Shahla* and *Bushibal* fruits were red, *Gash Gaafar* and *Lulu* were yellow, and *Gash Habash* fruits were yellow-scarlet (Plate 2). As the date fruits matured to the next stage (*i.e. rutab*) their color and texture changed considerably. The date fruits at *rutab* stage had turned a dull brown, starting from the distal red (Plate 3).

The fruit weight, pulp: seed ratio, and dimensional measurements of the date fruits at the *kimri* and *khalal* stages of maturity are presented in Table 1. At the *kimri* stage, the *Bushibal* fruits were cylindrical in shape (29.1 mm length and 16.1 mm diameter), with an average fruit weight of 4.6 g and a pulp: seed ratio of 86:14. The *Gash Habash* and *Shahla* fruits were less cylindrical than the *Bushibal* fruits at the *kimri* stage. The length and diameter for *Gash Habash* fruits at this stage were 24.2 mm and 18.1 mm respectively The *Gash Habash* average fruit weight was 4.6 g and it had a pulp:seed ratio of 84:16. The dimensional values for *Shahla* fruits at this stage were quite similar, *i.e.*, 24.1 mm in length, 18.8 mm in diameter and a fruit weight of 4.6 g. The *Shahla* fruits did have a slightly higher pulp:seed ratio (91:9). The *Gash Gaafar* fruits were cylindrical in shape at the *kimri* stage (34.3 mm in length, 12.7 mm in diameter) and had a fruit weight of 7.6 g and a pulp:seed ratio of 90:10. The *Lulu* fruit was nearly round in shape (26.0 mm length; 23.2 mm diameter) at the *kimri* stage, with a fruit weight of 7.5 g and a pulp:seed ratio of 91:9.



Bushibal بوشيبال

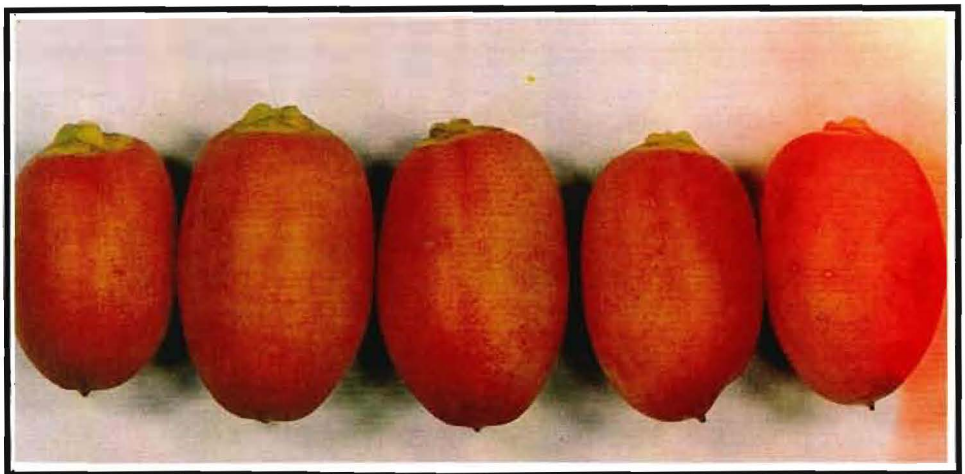
Kimri كمري



Shahla شهلة

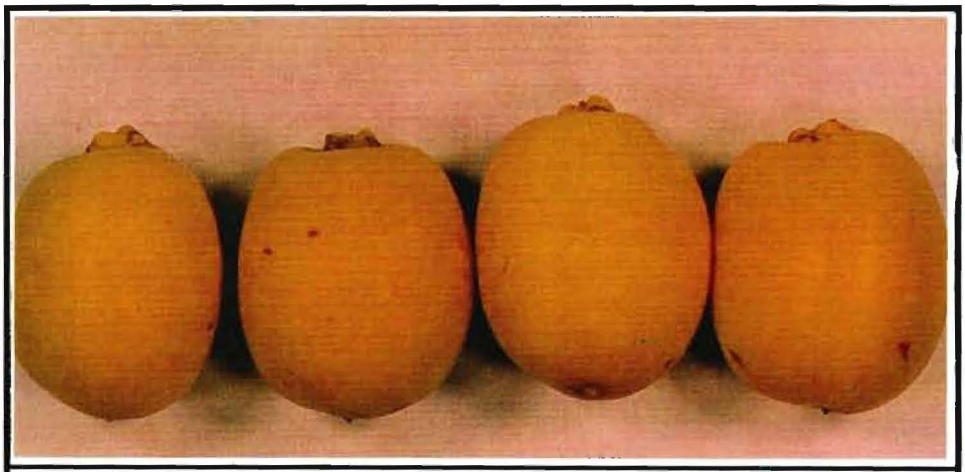
Kimri كمري

Plate 1. Date Fruits of *Bushibal* and *Shahla* Cultivars at the *Kimri* Stage.



Gash Habash جش حبش

Khalal خلال



Lulu لولو

Khalal خلال

Plate 2. Date Fruits of *Gash Habash* and *Lulu* Cultivars at the *Khalal* Stage.

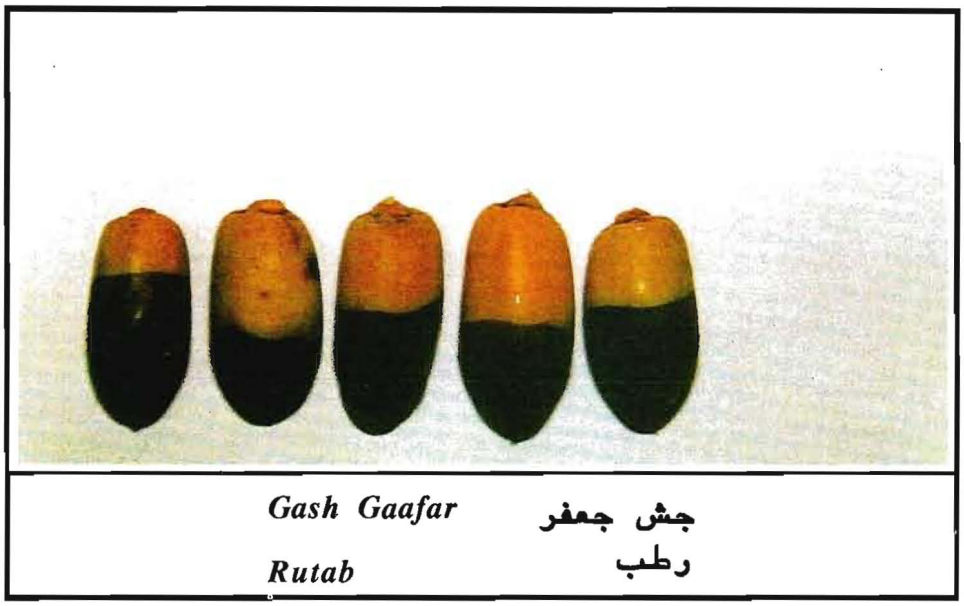


Plate 3. Date Fruits of *Gash Gaafar* Cultivars at the *Rutab* Stage.

At the *khalal* stage, the *Bushibal* fruits retained their cylindrical shape (34.4 mm length and 17.2 mm diameter) and increased in fruit weight to 6.5 g, but maintained the same pulp:seed ratio. The *Gash Habash* fruits were cylindrical in shape (31.0 mm length, 20.5 mm diameter), and had an average fruit weight of 7.6 g. Their pulp:seed ratio increased to 86:14. The *khalal* fruits of the *Shahla* variety were 32.0 mm in length and 23.1 mm in diameter and had a higher average fruit weight (9.7 g) and a higher pulp:seed ratio (91:9). The *Gash Gaafar* fruit became plumper at the *khalal* stage (38.8 mm length, 20.8 mm diameter), and had fruit weight of 10.6 g and a pulp:seed ratio of 90:10. The *Lulu* fruit retained the same rounded shape at the *khalal* stage, but the weight increased to 9.2 g with the pulp:seed ratio of 90:10. The literature reports values for individual *khalal*-stage fruit weights for 25 date cultivars grown in Saudi Arabia ranging from 5.8 to 26.8 g (Sawaya 1986). The five date cultivars investigated in this study, with fruit weights of 6.5 to 10.6 g, can be classified as small-fruit varieties.

Fresh whole-fruit weights and dimensions at the *kimri* stage were quite different from those at the *khalal* stage of development. The range of values for fruits at the *kimri* stage were 24.1 to 34.3 mm length, 12.7 to 23.2 mm diameter, and 4.6 to 7.6 g.

The fruits at the *khalal* stage significantly increased in weight as compared to *kimri*-stage fruits (from 6.5 to 10.6 g). The length and diameter values for the various cultivars at the *khalal* stage ranged from 26.5 to 38.8 mm and from 17.2 to 23.5 mm, respectively. The pulp:seed ratios for the different cultivars, did not change considerably from the *kimri* stage to the *khalal* stage, which shows that as the fruit matured, both pulp and seed increased in weight in much the same proportions. The fruit flesh as a percentage of total fruit weight at the *kimri* and *khalal* stages ranged from 84 to 91% and from 86 to 91% respectively. It was lowest for the *Gash Habash* variety, both at *kimri* (84%) and *khalal* (86%) stages, mainly because of the large seed weight of this variety. This measurement was the highest (91%) for the *Shahla* cultivar at both of these stages of development. *Gash Gaafar* was the longest, whereas *Lulu* fruit was the largest in diameter among these cultivars. As the fruits matured to *khalal* stage, the length, diameter and weight tended to increase considerably.

The pH values for the fruit flesh of the different cultivars at the *kimri* and *khalal* stages ranged from 5.4 to 5.6 and from 5.1 to 6.1 respectively (Table 1). The pH value of fruits is one of the important attributes which affects their processing and storage quality.

Chemical composition of date fruits: The results of proximate composition analysis of the five date cultivars at different stages of maturity are presented in Table 2. Throughout the fruit development, the moisture content decreased drastically, and consequently, the total solids increased. The moisture contents of the fruit pulp of the different cultivars at the *kimri* stage ranged between 84.0 and 85.5%, and decreased considerably at the *khalal* stage of maturity (from 48.7 to 67.2%) due to the accumulation of total soluble solids (primarily sugars like fructose, glucose and sucrose). In contrast to dates grown in the United States (Rygg 1946), the majority of the date cultivars in the current study had a higher moisture content at the *khalal* stage, which is characteristic of soft date cultivars. The moisture content of these cultivars, decreased progressively as the fruit advanced through the various developmental stages, and ranged between 13.7 and 27.7% at the *tamr* stage.

The crude protein content in all these cultivars was highest at the *kimri* stage (5.5 to 5.8%), and gradually but significantly decreased as the fruit matured to the *tamr* stage (1.7 to 2.5%). Although dates are not a rich source of protein, they are reported to contain high quantities of some of the essential amino acids (Salem and Hegazi 1971). The date fruits, at all stages of development, were very low in crude fat content (0.05 to 0.6%). The crude fat content consistently decreased or remained constant as the fruit passed through the different stages of maturity from *kimri* to

Table 1. Physicochemical characteristics of the fresh fruit of different cultivars

Cultivar	Length*(mm) Mean ± S.D.		Diameter*(mm) Mean ± S.D.		Fruit* weight (g)		Pulp:seed ratio*		pH of Pulp		Pulp moisure (%) Mean ± S.D.	
	Kimri	*Khalal*	*Kimri*	*Khalal*	*Kimri*	*Khalal*	*Kimri*	*Khalal*	*Kimri*	*Khalal*	*Kimri*	*Khalal*
Shahla	24.1 ± 0.3	32.0 ± 3.3	18.8 ± 0.1	23.1 ± 1.3	4.6	9.7	91:9	91:9	5.6	6.1	84.0 ± 0.4	48.7 ± 0.1
Gash Gaafar	34.3 ± 0.2	38.8 ± 0.6	12.7 ± 0.2	20.8 ± 0.3	7.6	10.6	90:10	90:10	5.5	5.2	84.7 ± 0.1	59.8 ± 0.1
Gash Habash	24.2 ± 0.1	31.0 ± 0.5	18.1 ± 0.1	20.5 ± 0.3	4.6	7.6	86:14	86:14	5.5	5.5	84.2 ± 0.2	67.2 ± 0.3
Lulu	26.0 ± 0.1	26.5 ± 0.2	23.2 ± 0.4	23.5 ± 0.1	7.5	9.2	90:10	90:10	5.5	5.4	85.5 ± 0.2	55.4 ± 0.3
Bushibal	29.1 ± 0.3	34.4 ± 1.3	16.1 ± 0.2	17.2 ± 0.2	4.6	6.5	87:13	87:13	5.4	5.1	85.3 ± 0.2	59.9 ± 0.1

* Means of 100 fruits; Coefficient of Variation (C.V.) in other observations was less than 5%.

Table 2. Chemical composition of freeze-dried fruit pulps of different date cultivars (% dry basis, n = 2)

Cultivar	Stage of Maturity and Moisture content (%) Mean ± S.D.		Protein	Fat	Ash	Tannin	Crude Fiber
*Shahla**	*Kimri*	84.0 ± 0.4	5.6	0.5	4.2	1.8	6.2
	Khalal	48.7 ± 0.1	2.3	0.2	2.9	1.5	5.0
	Tamr	27.7 ± 0.3	1.7	0.2	1.9	0.5	2.4
Gash Gaafar	*Kimri*	84.7 ± 0.1	5.5	0.4	3.4	2.5	13.4
	Khalal	59.8 ± 0.1	2.6	0.3	2.3	1.7	8.5
	Rutab	49.0 ± 0.2	2.3	0.2	2.6	1.3	3.8
	Tamr	15.0 ± 0.1	2.4	0.1	2.0	0.6	2.9
Gash Habash	*Kimri*	84.2 ± 0.2	5.8	0.6	4.3	2.0	11.8
	Khalal	67.2 ± 0.3	3.0	0.4	3.8	1.7	6.7
	Rutab	38.0 ± 0.4	2.0	0.4	3.6	0.9	5.1
	Tamr	25.0 ± 0.1	2.1	0.4	2.4	0.6	3.0
Lulu	*Kimri*	85.5 ± 0.2	5.7	0.5	2.6	1.4	5.1
	Khalal	55.4 ± 0.3	3.0	0.3	2.2	1.4	2.8
	Rutab	47.5 ± 0.4	3.0	0.2	2.1	1.0	2.4
	Tamr	13.7 ± 0.2	2.5	0.1	1.8	0.5	2.1
Bushibal	*Kimri*	85.3 ± 0.2	5.6	0.4	3.8	1.9	11.1
	Khalal	59.9 ± 0.1	2.7	0.4	2.6	1.4	5.7
	Rutab	47.9 ± 0.1	3.0	0.2	2.1	0.5	3.9
	Tamr	14.5 ± 0.1	2.3	0.1	1.7	0.4	2.6

**Rutab* stage fruit could not be obtained; C.V. in other observations was less than 5%.

tamr. These findings are compatible with the trends of results for other soft-date cultivar studies reported by Hussein *et al.* (1976). The ash content of the fruit pulp was highest (2.6 to 4.3%) at the *kimri* stage, and lowest (1.7 to 2.4%) at the *tamr* stage.

Tannins: The tannins content was the highest at the *kimri* stage for all five date cultivars. The tannins contents ranged between 1.4 and 2.5% at the *kimri* stage, but decreased considerably to its lowest level (0.4 to 0.6%) at the *tamr* stage, again in all five cultivars. The *Lulu* and *Bushibal* varieties had the lowest levels of tannins at the *tamr* stage of maturity. The *Lulu* variety also had the lowest tannin content at the *khalal* stage. Such a trend of decreased levels of tannins present in dates at advanced stages of maturity has also been reported by Sawaya *et al.* (1982).

Crude fiber: The crude fiber content of the fruit pulp of all five varieties was the highest at the *kimri* stage. It varied from 5.1 to 13.4%. The crude fiber content decreased rapidly as the fruit matured and was lowest at the *tamr* stage (2.1 - 3.0%). Dates are, therefore, a good source of crude fiber content for humans. Similar results have been reported for soft date cultivars by Hussein *et al.* (1976).

Sugars: Sugars are the most prevalent compounds in dates and have been widely studied. The results of the sugar content analysis of these cultivars are presented in Table 3. Among the cultivars tested, the total sugars ranged from 41.0 to 54.15% at the *kimri* stage and increased progressively to between 81.67 and 88.39% at the *tamr* stage. Fructose, glucose and sucrose were the major sugars detected in these varieties. The sucrose contents increased rapidly as the fruits matured from *kimri* to *khalal* stage, but decreased to a nondetectable level at the *tamr* stage. At the *tamr* stage fructose and glucose were the only sugars to be detected. The fructose content increased consistently from the *kimri* to the *tamr* stage. Although the glucose contents were higher at the *tamr* stage than at the *kimri* stage, no definite trend was observed. The glucose: fructose ratio was approximately 1.5:1 at the *kimri* stage but decreased to 1:1 at the *tamr* stage. From the *kimri* to the *tamr* stage, the fructose content increase 2.5 times and is responsible for the characteristically sweet taste of date fruit. Since fructose is much sweeter than glucose, it imparts greater sweetness to dates at the *tamr* stage.

Nutritionally, the invert sugars are the most important constituents, because they provide readily available energy to the human system. The sweetness contributed by fructose is probably the chief reason for the immense popularity of dates enjoy in dietary patterns. The low sucrose contents reported in all cultivars, especially at the *rutab* and *tamr* stages, and the fact that fructose and glucose dominate, are typical features of soft date cultivars. Similar findings on other soft date cultivars have been reported in the literature (Hussein *et al.* 1976, Sawaya 1986).

Table 3. Sugar contents of date fruit cultivars by developmental stage (% dry basis, n = 2)

Cultivar	Stage	Fructose	Glucose	Sucrose	Total sugar
Shahla *	*Kimri*	15.40	19.80	6.30	41.00
	Khalal	26.96	33.07	25.18	84.94
	Rutab	37.12	35.00	12.30	84.43
	Tamr	44.74	43.65	N.D.	88.39
Gash Gaafar	*Kimri*	15.52	24.17	7.28	46.97
	Khalal	29.84	21.68	13.20	64.72
	Rutab	28.83	34.70	19.97	83.50
	Tamr	39.70	41.97	N.D.	81.67
Gash Habash	*Kimri*	14.97	26.66	4.32	45.95
	Khalal	17.79	22.95	28.84	69.58
	Rutab	26.28	28.46	20.39	74.13
	Tamr	44.81	43.83	N.D.	88.64
Lulu	*Kimri*	15.40	27.40	2.00	44.80
	Khalal	26.65	27.07	23.02	76.74
	Rutab	27.39	29.50	24.23	81.13
	Tamr	41.00	42.06	N.D.	83.06
Bushibal	*Kimri*	18.16	26.81	9.18	54.15
	Khalal	22.60	24.81	13.14	60.56
	Rutab	34.30	23.55	13.31	81.16
	Tamr	44.69	43.40	N.D.	88.10

N.D.: None detected

**Rutab* stage fruits of the *shahla* variety obtained in the laboratory from fruits at the *khalal* stage; C.V. in these observations was less than 5%.

Minerals: As the fruit matured from *kimri* to *tamr* stage, the changes in mineral composition can be considered to be small when compared with other constituents such as sugars. Dates even at the *tamr* stage, can supply nutritionally significant levels of important minerals to the diet. The results of analyses for various minerals like calcium, magnesium, phosphorus, sodium, potassium, iron, copper and zinc are presented in Table 4. The various mineral contents decreased progressively, as the fruits matured from the *kimri* to the *tamr* stages of development. The date cultivars were found to be richer in most of the macro-elements, but were comparatively low in micro-elements. Interestingly, all the cultivars were extremely low in sodium (2.2 to 17.4 mg%) but high in potassium (107.4 to 752.6 mg%). This low sodium: potassium ratio makes the date fruit a desirable food for people suffering from hypertension. The macro-element contents of date fruit at the *tamr* stage ranged between 36 and 48 mg of calcium, 43 and 53 mg of magnesium, 53 and 59 of phosphorus, 2 and 7 mg of sodium and 107 and 386 mg of potassium per 100 g dry weight. Among the micro-elements studied, their contents at tamr stage ranged between 0.88 and 6.76 mg of iron, 0.19 and 0.94 of copper, and 0.31 and 0.41 mg of zinc per 100 g dry weight. Similar results with four other soft date cultivar have been reported by Minessy *et al.* (1975). A few researchers have also reported the various physicochemical changes that take place in Iraqi, Saudi and Egyptian date varieties during different stages of ripening (Shabana *et al.* 1981, Mohammed *et al.* 1983, Sawaya *et al.* 1982, Al-Rawi *et al.* 1967, Amin *et al.* 1969). According to their findings, moisture, total nitrogen, fat, crude fiber, ash, tannin, vitamin C, beta-carotene and ten nutritionally important minerals were highest in the early stages of development, but decreased during maturation. On the other hand, the reducing sugars - especially glucose and fructose - increased progressively during ripening.

The data reported in this table indicates that date fruit is a good source of some of the important minerals for humans. Mineral content in date fruit may be influenced by soil fertility as well as the amount of fertilizer used (Sawaya *et al.* 1982). Thus, variations observed in the mineral contents of date fruits during this study can be explained on their findings.

Table 4. Mineral composition of date fruit pulp (mg/100 g, dry weight basis, n = 2)

Maturity	Cultivar	Macro-element					Macro-element		
		Ca	Mg	P	Na	K	Fe	Cu	Zn
Kimri	*Shahla*	218.9	151.5	131.8	15.0	706.2	2.02	0.85	1.70
	Gash Gaafar	154.0	104.5	106.7	7.6	739.7	2.64	0.32	1.27
	Gash Habash	167.8	124.1	101.8	10.3	710.1	3.31	0.88	1.96
	Lulu	38.7	132.7	152.2	9.7	633.2	4.21	0.42	1.58
	Bushibal	142.4	121.0	117.2	7.0	752.6	8.09	0.32	1.00
Khalal	*Shahla*	49.0	54.4	58.8	4.6	459.8	0.69	0.28	0.41
	Gash Gaafar	102.4	64.2	71.2	5.5	479.3	1.45	0.10	0.93
	Gash Habash	88.9	83.3	76.4	6.8	584.6	2.01	0.59	0.53
	Lulu	48.6	59.0	67.4	5.9	484.2	1.24	0.53	0.37
	Bushibal	75.4	74.9	132.4	17.4	510.1	1.55	0.21	0.52
Rutab	*Gash Gaafar*	74.5	55.5	58.0	6.5	517.1	1.35	0.42	1.04
	Gash Habash	73.1	73.1	83.5	7.0	542.8	0.94	0.53	0.56
	Lulu	74.3	74.3	84.9	4.6	350.3	1.06	0.45	0.66
	Bushibal	76.3	65.4	87.2	10.9	338.1	0.98	0.39	0.76
Tamr	*Shahla*	40.2	46.0	58.0	7.6	215.0	1.79	0.19	0.35
	Gash Gaafar	48.1	43.5	59.7	5.1	152.3	1.46	0.35	0.40
	Gash Habash	46.8	45.3	59.0	2.2	386.4	1.28	0.28	0.31
	Lulu	36.3	46.1	53.9	5.4	128.8	6.76	0.94	0.32
	Bushibal	37.8	53.2	53.3	2.5	107.4	0.88	0.31	0.41

C.V. in these analyses was less than 5%.

Conclusions

The physical measurements and chemical analyses of the date fruits of five cultivars showed that while the fruits differed in color and shape, all are small-fruit varieties. Due to differences in seed weight, the flesh accounted for 84 to 91% of the total fruit weight. At the *tamr* stage, the absence of sucrose and the presence of higher concentrations of reducing sugars, especially fructose and glucose, characterize these cultivars as soft dates. As the fruit matured from the *kimri* to the *tamr* stages, the sugar content increased, while all other constituents - such as moisture, crude protein, crude fat, ash, crude fiber and tannins decreased. Date fruits were found to be a reasonably good source of most of the macro- and a few of the micro-elements.

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References

Al-Rawi, N., Markakis, P. and **Bauer, D.H.** (1967) Amino acid composition of Iraqi dates, *J. Sci. Food Agric.* **18:** 1-2.

Association of Official Analytical Chemist (1990) Methods of Analysis. 15th Edition, Method nos. 934.06, 940.26, 920.152, 930.10, Washington, D.C.

Amin, El. S., Awad, O., Abd El-Samad, M. and **Iskander, M.N.** (1969) Isolation of estrone from moghat roots and from pollen grains of Egyptian date palm, *Phytochemistry* **8:** 295-297.

Hussein, F. (1970) Fruit growth and composition of two dry date cultivars grown in Asswan, *Tropical Agriculture (Trinidad)* **47**(2): 157-162.

Hussein, F., Moustafa, S., El-Samiraea, F. and **Al-Zeid, A.** (1976) Studies on physical and chemical characteristics of eighteen date cultivars grown in Saudi Arabia, *Indian J. Horticulture* **33:** 107-113.

Minessy, F.A., Bacha, M.A.A. and **El-Azab, E.M.** (1975) Changes in sugars and nutrient elements content in fruit of four soft date varieties in Egypt, Alexandria *J.Agric. Res.* **23:** 301-306.

Mohammed, S., Shabana, H.R. and **Mawlod, E.A.** (1983) Evaluation and identification of Iraqi date cultivars: Fruit characteristics of fifty cultivars, *Date Palm J.* **2**(1): 27-55.

Ruck, J.A. (1969) *Chemical Methods for Analysis of Fruit and Vegetable Products,* Publication No. SP 50, Research Station, Canadian Department of Agriculture, Summerland, B.C.

Rygg, G.L. (1946) *Compositional Changes in the Date Fruit during Growth and Ripening,* Technical Bulletin No. 910, US.D.A., Washington, D.C.

Salem, S.A. and **Hegazi, S.M.** (1971) Chemical composition of the Egyptian dry dates, *J. Sci. Food Agric.* **22:** 632-633.

Sawaya, W.N., Khatchadourian, H.A., Khalil, J.K., Safi, W.M. and **Al-Shalhat, A.** (1982) Growth and compositional changes during the various development stages of some Saudi Arabian date cultivars, *J. Food Sci.* **47:** 1489-1493.

Sawaya, W.N. (1986) Overview in Dates of Saudi Arabia, Safir Press, Riyadh, Saudi Arabia. p 1.

Shabana, H.R., Benhamin, N.D. and **Mohammed, S.** (1981) Pattern of growth and development in date palm fruit, *Date Palm J.,* **1**(1): 31-42.

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دراسات حول الخصائص الفيزيوكيميائية لثمار البلح من خمسة أصناف اماراتية خلال مراحل نضوجها المختلفة

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[1] *شركة النخيل للإنتاج الزراعي - الكويت*

تم تقييم عينات من خمسة أصناف لثمار البلح هي شهلة وجش جعفر وجش حبش ولولو وبوشيبال ، وذلك لتحديد خواصها التركيبية الفيزيائية والكيميائية . وقد جمعت هذه العينات في مرحلة الكمري حيث كانت جميعها خضراء اللون ، ولكن بعد تجاوزها مرحلة الخلال اكتسب كل نوع لونا خاصا مميزاً . فكان لون نوعي شهلة والبوشيبال أحمرا ، ولون الجش جعفر واللولو أصفرا ، والجش حبش أصفرا قرمزياً ، وكانت ثمرة بلح اللولو مستديرة الشكل تقريبا ، بينما أخذت الأنواع الأربعة المتبقية شكل اسطوانياً . ومن حيث الوزن ، تباينت أوزان ثمار الأنواع الخمسة ، وتراوحت مابين ٦ , ٤ - ٦ , ٧ إلى ٥ , ٦ - ٦ , ١٠جرام في مرحلتي الكمري والخلال ، ولهذا السبب يمكن تصنيف هذه الأنواع من البلح على أنها ذات ثمرة صغيرة الحجم . (على صعيد اخر ، تمركزت نسب وزن أنوية البلح إلى لب الثمار حول ١٠ :٩٠ في معظم الأنواع ، الا أنها كانت أقل بقليل (١٦ :٨٤) في نوعي الجش حبش والبوشيبال . وارتفعت نسبة الرطوبة في ثمار البلح خلال مرحلة الكمري لتصل مابين ٨٤ - ٥ , ٨٥٪ ، في حين انخفضت إلى ٧ , ٤٨ - ٩ , ٥٩٪ خلال مرحلة الخلال .

وازداد انخفاض نسبة الرطوبة في مرحلتي الرطب والتمر ، فوصلت إلى ٣٨ - ٤٩٪ و ١٣,٧ - ٢٧,٧٪ على التوالي . هذا وقد اختلف التركيب الكيماوي لثمار هذه الأنواع من البلح خلال فترة نضوجها من مرحلة الكمري إلى مرحلة التمر اختلاف بالغاً ، حيث انخفض محتواها من الرطوبة والبروتين والرماد والدهن والألياف باضطراد خلال فترة انتقالها من مرحلة الكمري إلى مرحلة التمر ، في حين زاد اجمالي محتواها من السكريات ، كسكر الغلوكوز وسكر الفركتوز . وكان سكر الغلوكوز وسكر الفركتوز نوعي السكر الرئيسيين المتواجدين في مرحلة التمر ، بينما لن تبين التحاليل وجود سكر السكروز في هذه الأنواع من البلح عند هذه المرحلة . كذلك كشفت التحاليل أن هذه الأنواع من البلح هي مصدر جيد لبعض أهم المعادن كالكالسيوم والماغنيسيوم والفوسفور والبوتاسيوم والحديد والنحاس والزنك ، الا أن محتواها من الصوديوم كان قليلا جداً .