

## Quality and Acceptability of Processed Products from Date Fruits Cultivars Grown in the United Arab Emirates

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**ABSTRACT.** A variety of value-added processed products of acceptable quality were prepared in the laboratory from five different date fruit cultivars being grown in the United Arab Emirates. All of the processed products were free from aerobes except for the pickle-in-oil and chutney samples which had very low total plate counts. No molds, coliforms or members of the enterobacteriaceae were detected in any of these products. Among all the products prepared, dates-in-syrup, jam and butter were found to be the most acceptable to the panelists and thus may have commercial potential. All these processed date products had good shelf lives when stored at room temperature.

The date palm (*Phoenix dactylifera* L.) is an important food crop in the Middle East. Although most of the dates at the *rutab* and *tamr* stages are consumed directly by the human population with little or no processing, quantities of processed dates are growing rapidly as a result of encouragement and support being provided to the date processing industry by the governments concerned. The development of new, popular, processed date products would enhance the commercial and economic value of this crop. Due to an increase in production and a decrease in the direct consumption of date fruits, the introduction of new, processed date products is important (Sawaya 1986).

Experimental production of date products has been reported by a number of researchers. The research has indicated the importance of processed date products

like pickles, chutney, jam, butter, dates-in-syrup, beverages, syrup, paste and a host of miscellaneous items (Yousif *et al.* 1993b, Hamad and Yousif 1986, Khatchadourian *et al.* 1986, Sawaya *et al.* 1986b, Yousif *et al.* 1985, Mikki *et al.* 1983, Mustafa *et al.* 1983, Alogaidi *et al.* 1982, Barreveld 1975).

Date paste has been used to replace wheat flour at various levels in the manufacture of bread and cookies (Yousif and Mustafa 1993, Mustafa *et al.* 1986). Dates-in-syrup, a product that resembles fruit preserves, is another feasible product that can be made from dates (Ahmed *et al.* 1993, Mikki and Al-Taisan 1993, Khatchadourian *et al.* 1986).

Cane sugar in cakes can be replaced with date syrup at varying levels of production (El-Samahi *et al.* 1993). Date syrup can be used in a number of other ways too. A few attempts have been made in this direction including the production of date wine (Hassan *et al.* 1982), milk-date drinks (Yousif *et al.* 1986, Yousif *et al.* 1982, Al-Shabibi 1973), soft drinks (Hamad and Al-Beshr 1993, Ali and Hassan 1980), ice cream and frozen deserts (Hamad *et al.* 1993, Hamad *et al.* 1993, Hamad *et al.* 1983), and date juice (Benjamin *et al.* 1982).

Sawaya *et al.* (1986b) prepared glacé dates from the *khalal* fruit of two date cultivars, Hallaw and Kuwaildi. Sawaya *et al.* (1983) and Khalil *et al.* (1984) described a process for preparing date bars fortified with soy protein isolate, single cell protein, or dry milk solids. Recently, Yousif *et al.* (1993a) studied the shelf life of plain and chocolate-coated date candy over six months at  $25 \pm 5^\circ\text{C}$ .

Considering the importance of date fruit in the dietary patterns of local populations and the scope of the date processing industry, this study was carried out to highlight the possibility of producing some important processed products from fruits of some date cultivars (*viz.* *Shahla*, *Bushibal*, *Lulu*, *Gash Habash* and *Gash Gaafar*) grown in the United Arab Emirates.

## Materials and Methods

### *Materials:*

Date fruit samples of five date cultivars *viz.* *Gash Gaafar*, *Gash Habash*, *Shahla*, *Bushibal* and *Lulu*, were received from the United Arab Emirates through the Palms Agro-Production Company (Kuwait), during the date-palm fruiting season (1993 crop). *Kimri* fruits were used to make date pickles and chutney, *khalal* fruits were used to make dates-in-syrup, pickles and chutney, *rutab* fruits were processed into date jam, and *tamr* fruits were processed into date butter. All the spices,

condiments and sugar required for this study were procured from the local cooperative stores.

The samples were sorted, washed in tap water and left to air dry. The fruits were separated from the stalks. For pickle-in-oil, the fruits were pitted, calyxes were removed, and then the fruits were cut into four uniform longitudinal slices. The slices were blanched in boiling water for 2 min, excess water drained off and then the dry slices were used as per the recipe.

The washed date fruits were peeled using a laboratory abrasive peeler (OMUS make, Bologna, Sabatucci-11, Italy). The peeled fruits were pitted manually and each fruit was cut into eight longitudinal slices when being used for making chutney. However, for pickle-in-vinegar, the peeled, pitted fruits were cut into four rings that were uniform in size. For the preparation of dates-in-syrup, the peeled and pitted whole fruits were used.

#### *Processing of date fruit into products:*

*Pickle-in-oil:* The prepared pitted date fruit was cut longitudinally into four pieces. The spices, fenugreek, fennel, nigella and cumin (Table 1) were mixed and fried in mustard oil to a light brown color. After cooling to room temperature, salt, turmeric, red chili powder and date fruit slices were added to the fried spice mixture. Potassium sorbate was dissolved in a small amount of water and added. The pickle was poured into clean dry glass jars and pressed well to squeeze out any trapped air. After capping, the jars were kept daily for six hours during day time in the sun for a week after which the samples were stored at room temperature for further study.

*Date chutney:* Mustard oil was heated in a frying pan. The spices (Table 1) were mixed with the sliced date fruit (kimri) which was then lightly fried in mustard oil being constantly stirred until the fruit became soft. Vinegar was added, and the mixture was heated on a medium flame for another 10 min, constantly being stirred. The chutney was then removed from the fire, and sugar was mixed thoroughly into the contents. Potassium sorbate was dissolved in a small amount of water and stirred into the mixture. While still hot, the chutney was poured into clean dry glass jars and then capped. The product was ready for immediate use. Date chutney from *khalal* stage fruits was made in the same manner.

*Date pickle-in-vinegar:* The pitted, peeled date fruit rings were packed into glass jars and filled with hot packing liquid (85-90°C), capped and pasteurized at 71°C for 15 min in a water bath. The jars were then cooled, labelled and stored at

**Table 1.** Recipes for pickle-in-oil, *kimri*-stage chutney and *khalal*-stage chutney

Ingredients	Pickle-in-oil	<i>Kimri</i> chutney	<i>Khalal</i> chutney
Date fruit peeled/sliced	1000 g	1000 g	1000 g
Table salt	200 g	100 g	100 g
Fenugreek seeds	50 g	25g	05g
Fennel seeds	50 g	–	–
Nigella ( <i>Kalaunji</i> )	20 g	25 g	05 g
Red chili powder	20 g	06 g	09 g
Turmeric powder	20 g	–	–
Cumin seeds	25 g	25 g	05 g
Mustard seeds	20 g	–	–
Cloves, coarsely ground	–	03 g	01 g
Black pepper	–	10 g	03 g
Big cardamom seeds	–	01 g	0.5 g
Vinegar	–	400 ml	160 ml
Glacial acetic acid	–	–	011 ml
Mustard oil	100 ml	060 ml	060 ml
Sugar	–	500 g	400 g
Potassium sorbate	0.5 g	0.5 g	0.5 g

room temperature for further study. The packing liquid consisted of 3 table salt, 20% sugar, 2% acetic acid and 0.05% potassium sorbate.

*Other Products:* The jam and butter samples were prepared according to the procedures described by Khatchadourian *et al.* (1986). However, to prepare dates-in-syrup, the peeled, pitted date fruits were poured into glass jars. Sugar syrup of 50° Brix was prepared in a cooking pot. Solid citric acid was added to adjust the pH of the syrup to 2.8 and then boiled until the total soluble solids reached 80° Brix. This hot syrup (230°F) was immediately poured into the jars containing the fruits. The jars were capped and stored for further study.

*Analysis:* The prepared samples were analyzed for their chemical, microbiological and sensory characteristics at zero time and after three/four months during storage at room temperature ( $20 \pm 1^\circ\text{C}$ ).

*Chemical Analyses:* The pH, titrable acidity (as % citric acid) and sodium chloride contents of the pickle-in-vinegar, pickle-in-oil, and chutney were determined, in duplicates, according to the methods reported by Ruck (1969). The date fruit jam and butter, and dates-in-syrup were analyzed for acidity (as % citric acid) and pH according to the procedures reported by Ruck (1969) and for total soluble solids ( $^\circ\text{Brix}$ ) with an Abbe refractometer calibrated to  $20^\circ\text{C}$ . The water activity ( $a_w$ ) of pickle-in-oil and chutney samples was measured using a water activity probe (Vaisala make, Finland, model HMI 31). Approximately 50 g of the sample was poured into a conical flask having a rubber bung for water activity probe insertion. The water activity probe was inserted through this bung and allowed to equilibrate until the reading became constant. The equilibrium relative humidity (ERH) value and temperature were read directly from the dial. The ERH value divided by 100 gave the water activity value.

*Microbiological examinations:* The total plate, mold, coliform and enterobacteriaceae counts of all samples were determined at filling and during storage by standard procedures (ICMSF 1978).

*Sensory Analysis:* The products were evaluated by fifteen semi-trained panelists from the Kuwait Institute for Scientific Research, at zero time and at suitable intervals. A nine-point hedonic scale (1 = disliked extremely, 2 = disliked very much, 3 = disliked moderately, 4 = disliked slightly, 5 = neither disliked nor liked, 6 = liked slightly, 7 = liked moderately, 8 = liked very much and 9 = liked extremely) was used. Each judge was asked to evaluate the products for color, appearance, texture, flavor and overall acceptability (Larmond 1994, Meiselman 1978).

*Statistical Analysis:* The research data obtained in this project were analyzed for analysis of variance, taking cultivars as replicates, and the mean values were compared for statistical significance by Duncan's New Multiple Range Test using the ANOVA procedure of the Statistical Analysis System (SAS Program, Window Version 6.08).

## Results and Discussion

*Pickle-in-oil.* Date fruits from all the five cultivars at the *Kimri* stage were used in the preparation of pickle-in-oil. Two of the cultivars, *Gash Gaafar* and *Gash*

*Habash*, were also used at the *khalal* stage for making pickle-in-oil to compare the quality of this product prepared from the two stages of date fruit. After three months of storage at room temperature, the product was analyzed for pH, moisture, titrable acidity and salt content. The results are shown in Table 2. The moisture content,

**Table 2.** Moisture, acidity, pH and salt content of pickle-in-oil made from date fruits at different stages of maturity after three months of storage at room temperature

Stage of maturity	Cultivar	Moisture content (%)	Titrable acidity (as % citric acid)	Salt content (as % NaCl)	pH
<i>Kimri</i>	<i>Gash Gaafar</i>	55.5 <sup>a</sup>	0.22 <sup>b</sup>	12.7 <sup>c</sup>	4.9 <sup>d</sup>
	<i>Lulu</i>	58.9 <sup>a</sup>	0.26 <sup>b</sup>	14.9 <sup>c</sup>	5.2 <sup>d</sup>
	<i>Shahla</i>	55.5 <sup>a</sup>	0.13 <sup>b</sup>	14.0 <sup>c</sup>	4.9 <sup>d</sup>
	<i>Bushibal</i>	57.7 <sup>a</sup>	0.13 <sup>b</sup>	14.1 <sup>c</sup>	5.0 <sup>d</sup>
	<i>Gash Habash</i>	54.8 <sup>a</sup>	0.20 <sup>b</sup>	13.6 <sup>c</sup>	5.1 <sup>d</sup>
<i>Khalal</i>	<i>Gash Gaafar</i>	40.4 <sup>a</sup>	0.24 <sup>b</sup>	14.5 <sup>c</sup>	5.1 <sup>d</sup>
	<i>Gash Habash</i>	61.3 <sup>a</sup>	0.45 <sup>b</sup>	6.8 <sup>c</sup>	3.8 <sup>d</sup>

Means with same superscripts do not differ significantly ( $P = 0.05$ ) for a parameter in a column.

titrable acidity, salt content and pH ranged from 54.8 to 61.3%, 0.1 to 0.5%, 6.8 to 14.9% and 3.8 to 5.2 respectively. The water activity ( $a_w$ ) for pickle-in-oil samples ranged between 0.729 and 0.751 with a standard deviation of  $\pm 0.011$  for these values. For comparison, a commercial sample of pickle-in-oil made from mango was tested for moisture content, titrable acidity, salt content and pH. These values were found to be 60.9%, 1.8%, 25.7%, and 2.7 respectively. The commercial sample of mango pickle was found to be higher in acidity and salt contents than the date fruit pickle.

The sensory analysis of pickle-in-oil is presented in Table 3. This product was not acceptable (*i.e.*, an average score of less than 5 in most samples), initially or after three months of storage. The panelists found no differences in the sensory quality of pickle-in-oil samples made from *kimri* or *khalal* fruits. After storage, the acceptance of *kimri* pickle was significantly lowered, but no significant decrease in average sensory scores was observed in pickle made from *khalal* fruits of *Gash Gaafar*. The

**Table 3.** Sensory quality (average score) of pickle-in-oil made from date fruits at the *kimri* and *khalal* stages of maturity

Stage of maturity	Cultivar	Color		Appearance		Texture		Flavor		Overall acceptability	
		Storage Period, months									
		0	3	0	3	0	3	0	3	0	3
<i>Kimri</i>	<i>Bushibal</i>	4.9 <sup>a</sup>	3.9 <sup>b</sup>	4.2 <sup>a</sup>	3.7 <sup>b</sup>	4.2 <sup>a</sup>	3.0 <sup>b</sup>	3.8 <sup>a</sup>	2.4 <sup>b</sup>	4.2 <sup>a</sup>	2.6 <sup>b</sup>
	<i>Shahla</i>	5.3 <sup>a</sup>	4.0 <sup>b</sup>	5.0 <sup>a</sup>	3.6 <sup>b</sup>	4.5 <sup>a</sup>	3.2 <sup>b</sup>	4.4 <sup>a</sup>	2.5 <sup>b</sup>	4.8 <sup>a</sup>	2.8 <sup>b</sup>
	<i>Lulu</i>	5.1 <sup>a</sup>	3.6 <sup>b</sup>	4.6 <sup>a</sup>	3.0 <sup>b</sup>	4.6 <sup>a</sup>	2.2 <sup>b</sup>	4.3 <sup>a</sup>	2.0 <sup>b</sup>	4.4 <sup>a</sup>	2.0 <sup>b</sup>
	<i>Gash Gaafar</i>	6.0 <sup>a</sup>	4.4 <sup>b</sup>	6.0 <sup>a</sup>	4.3 <sup>b</sup>	5.2 <sup>a</sup>	3.9 <sup>b</sup>	4.8 <sup>a</sup>	3.6 <sup>b</sup>	5.0 <sup>a</sup>	3.9 <sup>b</sup>
	<i>Gash Habash</i>	5.5 <sup>a</sup>	4.6 <sup>b</sup>	5.8 <sup>a</sup>	4.5 <sup>b</sup>	5.0 <sup>a</sup>	4.1 <sup>b</sup>	5.2 <sup>a</sup>	3.6 <sup>b</sup>	5.0 <sup>a</sup>	4.0 <sup>b</sup>
<i>Khalal</i>	<i>Gash Gaafar</i>	5.0 <sup>a</sup>	4.5 <sup>a</sup>	4.6 <sup>a</sup>	4.4 <sup>a</sup>	4.4 <sup>a</sup>	3.6 <sup>a</sup>	3.9 <sup>a</sup>	3.3 <sup>a</sup>	4.1 <sup>a</sup>	3.5 <sup>a</sup>
	<i>Gash Habash</i>	5.5 <sup>a</sup>	8.0 <sup>a</sup>	5.4 <sup>a</sup>	7.0 <sup>a</sup>	5.5 <sup>a</sup>	6.0 <sup>a</sup>	4.5 <sup>a</sup>	6.0 <sup>a</sup>	5.1 <sup>a</sup>	6.0 <sup>a</sup>

Means with different superscripts differ significantly ( $P = 0.05$ ) for a sensory attribute in a column.

pickle made from *khalal*-stage fruit of the *Gash Habash* cultivar was found to be more acceptable after three months of storage. The characteristic smell of the mustard oil used in the recipe, and stronger blend of spices were cited by the panelists as main reasons for lower sensory scores. In order to produce an acceptable quality product, these recipes need to be modified by reducing the spices and the mustard oil.

The microbiological quality data on the freshly prepared pickle-in-oil samples as well as after four months of storage at room temperature are presented in Table 6. As can be seen from these data, the pickle samples from all the date cultivars studied were free from molds, coliforms and enterobacteriaceae. Moreover, the total plate counts were also low and only an insignificant increase was recorded after four months of storage.

*Date chutney*: Two types of sweet chutney were prepared from the *kimri* and *khalal* stages of date fruits using the recipe given in Table 1. Moisture content, acidity, salt content and pH values (Table 4) ranged between 24.9 to 54.4%, 0.7 to 1.2%, 3.3 to 8.4% and 3.7 to 3.9, respectively. The water activity of chutney samples ranged between 0.688 and 0.759 with a standard deviation of  $\pm 0.037$  for these values. The sensory analysis scores (Table 5) indicated that initially the product was

**Table 4.** Moisture content, acidity, pH and salt content of chutney stored for three months at room temperature, made from date fruits at different stages of maturity

Stage of maturity	Cultivar	Moisture content (%)	Titration acidity (as % citric acid)	Salt content (as % NaCl)	pH
<i>Kimri</i>	<i>Gash Gaafar</i>	40.0 <sup>a</sup>	0.97 <sup>b</sup>	3.3 <sup>c</sup>	3.1 <sup>d</sup>
	<i>Shahla</i>	49.0 <sup>a</sup>	1.00 <sup>b</sup>	5.8 <sup>c</sup>	3.3 <sup>d</sup>
	<i>Gash Habash</i>	24.9 <sup>a</sup>	0.99 <sup>b</sup>	8.1 <sup>c</sup>	3.9 <sup>d</sup>
	<i>Lulu</i>	54.4 <sup>a</sup>	1.01 <sup>b</sup>	6.1 <sup>c</sup>	3.3 <sup>d</sup>
<i>Khalal</i>	<i>Gash Gaafar</i>	34.3 <sup>a</sup>	1.19 <sup>b</sup>	7.9 <sup>c</sup>	3.8 <sup>d</sup>
	<i>Shahla</i>	36.4 <sup>a</sup>	0.66 <sup>b</sup>	8.4 <sup>c</sup>	3.7 <sup>d</sup>

Means with same superscripts do not differ significantly ( $P = 0.05$ ) for a parameter in a column.



**Table 5.** Sensory quality (average score) of chutney made from date fruits at the *kimri* and *khalal* stages of maturity after three months of storage at room temperature

Stage of maturity	Cultivar	Color		Appearance		Texture		Flavor		Overall acceptability	
		Storage Period, months									
		0	3	0	3	0	3	0	3	0	3
<i>Kimri</i>	<i>Lulu</i>	6.0 <sup>a</sup>	4.7 <sup>a</sup>	5.0 <sup>a</sup>	4.3 <sup>b</sup>	5.0 <sup>a</sup>	4.6 <sup>b</sup>	4.0 <sup>a</sup>	4.1 <sup>a</sup>	4.5 <sup>a</sup>	4.3 <sup>a</sup>
	<i>Gash Gaafar</i>	5.4 <sup>a</sup>	4.3 <sup>a</sup>	5.3 <sup>a</sup>	3.9 <sup>b</sup>	5.6 <sup>a</sup>	4.0 <sup>b</sup>	5.5 <sup>a</sup>	3.5 <sup>a</sup>	5.5 <sup>a</sup>	3.5 <sup>a</sup>
	<i>Shahla</i>	6.0 <sup>a</sup>	7.6 <sup>a</sup>	5.0 <sup>a</sup>	4.8 <sup>b</sup>	5.0 <sup>a</sup>	4.1 <sup>b</sup>	5.0 <sup>a</sup>	3.9 <sup>a</sup>	5.0 <sup>a</sup>	4.2 <sup>a</sup>
	<i>Gash Habash</i>	5.3 <sup>a</sup>	4.9 <sup>a</sup>	4.6 <sup>a</sup>	4.4 <sup>b</sup>	4.3 <sup>a</sup>	4.1 <sup>b</sup>	4.1 <sup>a</sup>	4.2 <sup>a</sup>	4.1 <sup>a</sup>	4.6 <sup>a</sup>
<i>Khalal</i>	<i>Shahla</i>	5.7 <sup>a</sup>	5.5 <sup>a</sup>	5.1 <sup>a</sup>	5.0 <sup>a</sup>	5.3 <sup>a</sup>	4.8 <sup>a</sup>	5.3 <sup>a</sup>	5.1 <sup>a</sup>	5.3 <sup>a</sup>	5.2 <sup>a</sup>
	<i>Gash Gaafar</i>	6.0 <sup>a</sup>	5.2 <sup>a</sup>	6.0 <sup>a</sup>	4.9 <sup>a</sup>	5.0 <sup>a</sup>	4.7 <sup>a</sup>	5.0 <sup>a</sup>	4.6 <sup>a</sup>	5.0 <sup>a</sup>	4.7 <sup>a</sup>

Means with different superscripts differ significantly ( $P = 0.05$ ) for a sensory attribute in a column.

neither liked nor disliked (the overall acceptability score ranged from 4.1 to 5.5). These average scores decreased significantly only for appearance and texture of chutney samples made from *kimri* fruits, but no significant differences were observed for any of the other sensory attributes after three months of storage at room temperature. The panelists found no differences in the sensory quality of chutney made from *kimri* or *khalal* fruits, except in appearance and texture of *kimri* chutney after three months of storage. The panelists suggested the level of salt and spices be lowered to make the chutney samples acceptable. The chutney made from *khalal*-stage fruit was much softer in texture than chutney from *kimri*-stage fruit. Moreover, the higher level of sugars present in the date fruit neutralized the strong flavor of salt and spices in the recipe. Sawaya *et al.* (1986a) also prepared a date fruit chutney, but they used *rutab*- and *tamr*-stage date fruits and included carrots, onion and raisins in their recipe. But in the present study, the date fruit chutney was developed to resemble the mango chutney, as no such attempt is reported earlier.

The microbiological examination of the date chutney samples was carried out immediately after preparation as well as after four months of storage at room temperature. The results are presented in Table 6. All the date chutney samples were found to be free of molds, coliforms and enterobacteriaceae. Total aerobes (TPC) in chutney made from *Gash Gaafar* (*kimri*), *Gash Habash* (*kimri*) and *Shahla* (*khalal*) were not detected. No significant increase in the total plate counts of these samples was observed during four months of storage at room temperature. The total plate counts did not differ significantly among the samples made from *kimri* and *khalal* stage date fruits.

*Pickle-in-vinegar*: Acidity, salt and pH values ranged from 1.2 to 1.6%, 1.7 to 2.2% and 3.1 to 3.6 respectively (Table 7). No significant differences were observed for any of these chemical analyses among the samples made from different cultivars. Most of these pickle samples were not disliked initially by the panelists (overall acceptability score of 5 or above), but the sensory scores decreased significantly after three months of storage. However, no differences in sensory scores were found among the samples made from *kimri* or *khalal* stage date fruits. Hamad and Yousif (1986) prepared similar pickles from two date cultivars at the *kimri* stage. The physiochemical characteristics reported for their products are comparable to those reported in this study. However, Alogaidi *et al.* (1982) suggested the use of 15% salt and 2% acetic acid for making pickles from date fruits at the *kimri* stage, which is much higher than the concentrations used in this study. For comparison, a commercial cucumber pickle sample procured from the local market was analyzed for titrable acidity, salt content and pH. The corresponding values were 1.1%, 3.3% and 3.2. This indicates that the date pickles were higher in salt content and lower in

acidity. Microbiological examination indicated the pickle-in-vinegar samples to be free from aerobes, molds, coliforms and enterobacteriaceae.

**Table 6.** Total plate counts ( $\text{Log}_{10}\text{CFU/g}$ ) of pickle-in-oil and chutney samples made from date fruits at different stages of maturity, stored for four months at room temperature

Storage time (months)	Stage of maturity	Cultivar	Pickle-in-oil	Chutney	
0	Kimri	<i>Gash Gaafar</i>	4.39 <sup>a</sup>	N.D.	
		<i>Gash Habash</i>	4.77 <sup>a</sup>	N.D.	
		<i>Lulu</i>	4.93 <sup>a</sup> <sub>C</sub>	1.69 <sup>b</sup> <sub>D</sub>	
		<i>Shahla</i>	4.94 <sup>a</sup> <sub>C</sub>	2.00 <sup>b</sup> <sub>D</sub>	
		<i>Bushibal</i>	4.94 <sup>a</sup>	*	
	Khalal	<i>Gash Gaafar</i>	5.30 <sup>a</sup> <sub>C</sub>	3.83 <sup>b</sup> <sub>D</sub>	
		<i>Shahla</i>	*	N.D.	
		<i>Gash Habash</i>	4.44 <sup>a</sup>	*	
	4	Kimri	<i>Gash Gaafar</i>	5.83 <sup>a</sup>	N.D.
			<i>Gash Habash</i>	4.88 <sup>a</sup>	N.D.
<i>Lulu</i>			5.20 <sup>a</sup> <sub>C</sub>	1.69 <sup>b</sup> <sub>D</sub>	
<i>Shahla</i>			5.00 <sup>a</sup> <sub>C</sub>	3.36 <sup>b</sup> <sub>D</sub>	
<i>Bushibal</i>			5.04 <sup>a</sup>	*	
Khalal		<i>Gash Gaafar</i>	5.32 <sup>a</sup> <sub>C</sub>	3.88 <sup>b</sup> <sub>D</sub>	
		<i>Shahla</i>	*	1.69 <sup>b</sup> <sub>D</sub>	
		<i>Gash Habash</i>	4.49 <sup>a</sup>	*	

\*Pickle-in-oil and/or chutney were not prepared from these cultivars.

Means with same superscripts do not differ significantly ( $P = 0.05$ ) for a parameter in a column.

Means with different subscripts differ significantly ( $P = 0.05$ ) for a product across in a row.

N.D. = Not Detected.

*Date Fruit Jam:* Acidity, pH and total soluble solids of these samples ranged from 0.5 to 1.0%, 3.4 to 3.7 and 68.6 to 73.3°Brix, respectively (Table 9). The average sugar:acid ratio was 97:1 for the jam samples. These values fall within the normal range for commercial jam samples. By definition, jam must have a minimum total soluble solids content of 65°Brix or above (Anon. 1980). All the jam samples were found by the panelists to be fairly acceptable (Table 10). All these samples

**Table 7.** Acidity, pH and salt content of pickle-in-vinegar made from date fruits at different stages of maturity, after three months of storage at room temperature

Maturity	Cultivar	Titration acidity (as % citric acid)	Salt content (as % NaCl)	pH
<i>Kimri</i>	<i>Gash Gaafar</i>	1.2 <sup>a</sup>	1.9 <sup>b</sup>	3.2 <sup>c</sup>
	<i>Shahla</i>	1.6 <sup>a</sup>	2.2 <sup>b</sup>	2.9 <sup>c</sup>
	<i>Gash Habash</i>	1.2 <sup>a</sup>	1.7 <sup>b</sup>	3.1 <sup>c</sup>
<i>Khalal</i>	<i>Gash Gaafar</i>	1.3 <sup>a</sup>	1.9 <sup>b</sup>	3.4 <sup>c</sup>

Means with same superscripts do not differ significantly ( $P = 0.05$ ) for a parameter in a column.

**Table 8.** Sensory quality (average score) of pickle-in-vinegar made from date fruits at the *kimri* and *khalal* stages of maturity during storage at room temperature

Stage of maturity	Cultivar	Color		Appearance		Texture		Flavor		Overall acceptability	
		Storage Period, months									
		0	3	0	3	0	3	0	3	0	3
<i>Kimri</i>	<i>Gash Gaafar</i>	6.3 <sup>a</sup>	4.6 <sup>b</sup>	6.3 <sup>a</sup>	4.4 <sup>b</sup>	5.3 <sup>a</sup>	4.3 <sup>b</sup>	4.9 <sup>a</sup>	3.7 <sup>b</sup>	4.9 <sup>a</sup>	4.0 <sup>b</sup>
	<i>Shahla</i>	6.1 <sup>a</sup>	4.6 <sup>b</sup>	5.9 <sup>a</sup>	4.4 <sup>b</sup>	5.8 <sup>a</sup>	3.6 <sup>b</sup>	5.5 <sup>a</sup>	3.4 <sup>b</sup>	5.7 <sup>a</sup>	3.7 <sup>b</sup>
	<i>Gash Habash</i>	6.5 <sup>a</sup>	4.4 <sup>b</sup>	5.9 <sup>a</sup>	4.6 <sup>b</sup>	5.1 <sup>a</sup>	3.9 <sup>b</sup>	4.5 <sup>a</sup>	3.4 <sup>b</sup>	5.5 <sup>a</sup>	3.8 <sup>b</sup>
<i>Khalal</i>	<i>Gash Gaafar</i>	6.1 <sup>a</sup>	4.6 <sup>b</sup>	6.3 <sup>a</sup>	4.9 <sup>b</sup>	5.6 <sup>a</sup>	4.3 <sup>b</sup>	5.3 <sup>a</sup>	3.9 <sup>b</sup>	5.5 <sup>a</sup>	4.2 <sup>b</sup>

Means with different superscripts differ significantly ( $P = 0.05$ ) for a given sensory attribute between the storage periods.

**Table 9.** Acidity, pH and total soluble solids (°Brix) of jam, butter and dates-in-syrup made from date fruits at different stages of maturity after three months of storage at room temperature

Product	Cultivar	Stage of maturity	Titration acidity (as % citric acid)	Total soluble solids (°Brix)	pH
Jam	<i>Gash Gaafar</i>	<i>Rutab</i>	0.48 <sup>a</sup>	70.6 <sup>c</sup>	3.7 <sup>f</sup>
	<i>Shahla</i>	<i>Rutab</i>	0.95 <sup>a</sup>	73.3 <sup>c</sup>	3.4 <sup>f</sup>
	<i>Gash Habash</i>	<i>Rutab</i>	0.77 <sup>a</sup>	68.6 <sup>c</sup>	3.6 <sup>f</sup>
Butter	<i>Gash Gaafar</i>	<i>Tamr</i>	0.27 <sup>b</sup>	67.3 <sup>d</sup>	4.6 <sup>f</sup>
	<i>Bushibal</i>	<i>Tamr</i>	0.33 <sup>b</sup>	65.8 <sup>d</sup>	4.4 <sup>f</sup>
	<i>Lulu</i>	<i>Tamr</i>	0.31 <sup>b</sup>	64.0 <sup>d</sup>	4.1 <sup>f</sup>
	<i>Gash Gaafar</i>	<i>Tamr</i>	0.17 <sup>b</sup>	66.0 <sup>d</sup>	4.8 <sup>f</sup>
Dates-in-syrup	<i>Lulu</i>	<i>Khalal</i>	0.55 <sup>b</sup>	58.0 <sup>e</sup>	3.5 <sup>f</sup>
	<i>Shahla</i>	<i>Khalal</i>	0.19 <sup>b</sup>	62.1 <sup>e</sup>	4.5 <sup>f</sup>
	<i>Gash Habash</i>	<i>Khalal</i>	0.14 <sup>b</sup>	60.6 <sup>e</sup>	5.1 <sup>f</sup>

Means with same superscripts differ significantly ( $P = 0.05$ ) for a parameter in a column.

fully met this total soluble solids requirement. On microbiological examination, the date fruit jam samples were found to be free from aerobes, molds, coliforms and enterobacteriaceae. The date jam prepared by Yousif *et al.* (1993b) had similar total soluble solids contents, but the pH in their jam was slightly higher (4.14). Similar studies on date jam making from Saudi date cultivars have also been reported by Mustafa *et al.* (1983) and Khatchadourian *et al.* (1986).

*Date Fruit Butter:* Acidity, pH and total soluble solids for the date butter samples ranged from 0.2 to 0.3%, 4.1 to 4.8 and 64.0 to 67.3°Brix, respectively (Table 9). The average sugar:acid ratio was 244:1 for the date butter samples. An average score for overall acceptability of 6.9 was obtained for the date butter samples (Table 10), possibly due to its sugar:acid ratio. All the date fruit butter samples reported in the present study were found to be free from aerobes, molds, coliforms and enterobacteriaceae. Khatchadourian *et al.* (1986) also studied five Saudi date cultivars for the production of date butter. These workers suggested using orange, banana or almond flavoring to obtain butter of an acceptable quality.

**Table 10.** Sensory quality (average score) of jam, butter and dates-in-syrup made from date fruits at different stages of maturity after three months of storage at room temperature

Product	Cultivar	Stage of Maturity	Color	Appearance	Texture	Flavor	Overall acceptability
Jam	<i>Gash Gaafar</i>	<i>Rutab</i>	5.2 <sup>a</sup>	5.4 <sup>b</sup>	5.4 <sup>c</sup>	5.1 <sup>c</sup>	5.3 <sup>g</sup>
	<i>Shahla</i>	<i>Rutab</i>	6.4 <sup>a</sup>	6.5 <sup>b</sup>	5.1 <sup>c</sup>	6.0 <sup>e</sup>	6.1 <sup>g</sup>
	<i>Gash Habash</i>	<i>Rutab</i>	6.5 <sup>a</sup>	6.3 <sup>b</sup>	6.1 <sup>c</sup>	6.2 <sup>e</sup>	6.3 <sup>g</sup>
Butter	<i>Gash Gaafar</i>	<i>Tamr</i>	6.0 <sup>a</sup>	5.8 <sup>b</sup>	6.2 <sup>cd</sup>	6.8 <sup>ef</sup>	6.7 <sup>gh</sup>
	<i>Lulu</i>		6.4 <sup>a</sup>	6.5 <sup>b</sup>	6.8 <sup>cd</sup>	6.6 <sup>ef</sup>	6.9 <sup>gh</sup>
	<i>Bushibal</i>		6.5 <sup>a</sup>	6.4 <sup>b</sup>	6.9 <sup>cd</sup>	6.9 <sup>ef</sup>	7.1 <sup>gh</sup>
	<i>Gash Gaafar</i>		8.5 <sup>a</sup>	6.4 <sup>b</sup>	6.6 <sup>cd</sup>	6.7 <sup>ef</sup>	6.8 <sup>gh</sup>
Dates-in-syrup	<i>Gash Habash</i>	<i>Khalal</i>	5.7 <sup>a</sup>	7.9 <sup>b</sup>	8.3 <sup>d</sup>	8.7 <sup>f</sup>	8.8 <sup>h</sup>
	<i>Shahla</i>		6.9 <sup>a</sup>	5.6 <sup>b</sup>	6.8 <sup>d</sup>	6.9 <sup>f</sup>	6.8 <sup>h</sup>

Means with different superscripts differ significantly ( $P = 0.05$ ) for a given sensory attribute among these products.

*Dates-in-syrup:* Acidity, total soluble solids and pH values ranged from 0.14 to 0.55%, 58.0 to 62.1°Brix and 3.5 to 5.1, respectively (Table 9). The dates-in-syrup were also evaluated for their sensory quality (Table 10). This product had a sugar:acid ratio of 208:1. The dates-in-syrup prepared from the *Gash Habash* cultivar appeared strongly preferred (on average score of 8.8) to that made from the *Shahla* cultivar. All the dates-in-syrup samples in the present study were found to be free from aerobes, molds, coliforms and enterobacteriaceae even after three months of storage. The sample from the *Shahla* cultivar prepared by the method suggested by Khatchadourian *et al.* (1986), obtained lower average scores than that from the *Gash Habash* cultivar prepared by a modification of the Khatchadourian *et al.* (1986) method. The modified method preserved the shape, texture and flavor of the fruit better, which made it more acceptable to the panelists. Khatchadourian *et al.* (1986) also prepared dates-in-syrup from three Saudi date cultivars. Their data showed that an acceptable product can be prepared with or without the addition of various synthetic flavors.

Most of the processed date products reported in this study had attractive appearance (Plate 1). The date fruit slices maintained their natural texture in dates-in-syrup, pickle-in-oil, pickle-in-vinegar and chutney. The development of brown color in jam, butter, pickles and chutney samples may be attributed to a set of complex chemical reactions involving sugar caramelization and/or Maillard reactions. The presence of sugars, acid, pectins etc. in the date fruits may enhance these chemical reactions. The caramelization reaction is autocatalytic and increasing temperatures not only increase the reaction rate but also alter the qualitative nature of the pigments (Doss and Ghosh 1949). The Maillard reaction comprises of a series of reactions, starting with the free amino group of amino acids and free aldehyde or keto group of reducing sugars (Namiki 1988). Dulkan and Friedemann (1956) and Deuel and Stutz (1958) have been shown that both reductic acid (derived from pectins) and ascorbic acid, in acid or buffered solutions, can undergo browning reactions analogous to those occurring in stored or heat processed foods (Mudahar *et al.* 1986), ultimately leading to the development of brown color. Ascorbic acid has also been shown to be the most reactive component in browning systems containing ascorbic acid, amino acids and sugars (Joslyn 1957). In another study, Singh *et al.* (1948) have also suggested that ascorbic acid alone in aqueous solutions undergoes browning on heating at 98°C or above. In the present study, no artificial coloring or flavoring were added to either the jam, butter or dates-in-syrup, because the color of the date jam and date butter were acceptable in their natural form. However, the artificial colors may have to be added to control the uniformity of color of jam and butter if produced on a commercial scale.

Date Fruit Products



Dates in Syrup



Date Chutney



Date Pickle in Oil



Date Jam



Date Pickle in Vinegar



Date Butter

**Plate 1.** Physical appearance of various prepared date fruit products.



### Conclusions

From the results presented in this paper, there seems to be a good possibility of preparing value-added date fruit products especially dates-in-syrup, jam, and butter. To produce pickle-in-oil, pickle-in-vinegar, and chutney, the recipes need to be refined by reducing the level of spices to make these products bland in taste for greater acceptability. These processed date products had good shelf lives when stored at  $20 \pm 1^\circ\text{C}$ . Of the products prepared in this study, dates-in-syrup, date fruit jam and date fruit butter appears the most acceptable to consumers and may have commercial potential.

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## دراسة نوعية ومدى تقبل منتجات معالجة من ثمار النخيل المزروعة في دولة الإمارات العربية المتحدة

سعاد الحوطي و جوان سيدهو و حنان العميري  
و جملا العتيبي و احسين قبازد

دائرة التكنولوجيا الحيوية - معهد الكويت للأبحاث العلمية - ص.ب (٢٤٨٨٥) صفاة ١٣١٠٩ - الكويت  
و اشركة النخيل للانتاج الزراعي - ص.ب (١٩٧٦) - صفاة ١٣٠٢٠ - الكويت

تم تحضير خمسة أنواع من منتجات التمور مضافة القيمة من خمسة أصناف لثمار النخيل المزروعة في دولة الإمارات العربية . ومن بين كافة المنتجات التي تم تحضيرها ، كانت منتجات البلح المنقوع في السائل الحلو ، ثم المربى فالزبدة هي الأكثر قبولاً واستحسانا للمذاق من قبل المحكمين ، بينما حصلت عينات الجيتني والمخلل على درجة قبول متدنية جداً . وقد خلقت هذه المنتجات من الميكروبات الجيهوائية باستثناء عينات الجيتني والمخلل بالزيت ، كما لم يتم الكشف عن أي تعفونات أو فطريات أو بكتريا أو جراثيم قولونية في أي من هذه المنتجات .

لذا فإنه يمكن القول أن لهذه المنتجات قابلية وإمكانات تجارية جيدة بالإضافة إلى فترة صلاحية طويلة نسبياً عند تخزينها في درجة حرارة الغرفة .