Arab Gulf J. Scient. Res., **15** (1), pp. 99-110 (1997)

Extension of the Shelf Life of Two UAE Date Fruit Varieties at *Khalal* and *Rutab* Stages of Maturity

Suad Al-Hooti, Jiwan S. Sidhu, Hanan Al-Amiri, Jamla Al-Otaibi and Hussain Qabazard[1]

Biotechnology Department, Kuwait Institute for Scientific Research, P.O. Box 24885, Safat-13109, Kuwait
and [1]Palms Agro-Production Company, P.O. Box 1976, Safat-13020, Kuwait

ABSTRACT. The *Khalal*-stage fruits of *Bushibal* and *Lulu* cultivars were stored at three different temperatures to extend their shelf lives. The potassium sorbate treatment of date fruits during storage at 4 °C extended the shelf life of *Bushibal* and *Lulu* cultivars to between 8 and 10 weeks, respectively. The microbial load on date fruits stayed within acceptable limits by this treatment at a level of 0.05%. During storage at temperatures of –2 °C and –20 °C, no coliforms or enterobacteriaceae were detected on the date fruits, while aerobes and mold counts stayed within acceptable limits. The use of subzero temperatures for storage of fresh date fruits retarded the growth of microorganisms naturally present on these fruits. No definite trend was observed in pH values during cold storage. The sensory scores of cold-stored date fruits indicated, that they were slightly to moderately acceptable to the panelists. The fruits of both cultivars matured from the *khalal* to *rutab* stage during the storage period.

The date plam (*Phoenix dactylifera* L.) is an important staple food crop in the Middle East. Most of the dates at the *rutab* and *tamr* stages of maturity are consumed directly by the human population with little or no processing. Although the majority of date fruit produced is consumed in the driest stage, the *tamr* stage with 20% moisture, dates are also consumed in the perishable, immature stages, the *khalal* and *rutab* stages. Very little information is available on the extension of the shelf life of date fruits at different stages of maturity. Mikki *et al.* (1986) studied the suitability of major Saudi date cultivars for commercial handling and packing. They recommended the use of methyl bromide to control insect infestation in date fruits

during packing and storage.

Mikki and Al-Taisan (1993) also reported physicochemical changes occurring during frozen storage (–18 ± 2 °C) of three date cultivars at the *rutab* stage of maturity. During six months of storage at this temperature, the *rutab* fruits increased in moisture content, reducing sugars, and pH, but decreased in tannins. The fruits developed an acceptable sweet taste with the disappearance of astringency. At the end of the storage period, upon thawing, the fruit became soft in texture and darker in color. Similar studies on the chemical composition of Egyptian dates during frozen storage have been reported by Goneum *et al.* (1993). The suitability of fresh Saudi dates at the *rutab* stage for refrigeration and frozen storage has recently been reported (Yousif and Abou-Ali 1993, Al-Mashadi *et al.* 1993).

Date fruits of some of the cultivars are extremely popular for consumption at the *khalal* stage of maturity. But unfortunately, date fruit is available at this stage of maturity for only a short time. The development of techniques to extend the shelf life of date fruits at the *khalal* stage of maturity would enhance the commercial and economic value of this crop, and at the same time, provide a delicious product for consumers.

Considering the importance of date fruit in the dietary patterns of local populations and the scope of date processing industry, this study was carried out to investigate ways to extend the shelf life of fresh date fruits at the *khalal* and *rutab* stages of maturity through manipulative storage techniques.

Materials and Methods

Materials:

Date fruit samples of two date cultivars, *viz. Bushibal* and *Lulu,* were received from United Arab Emirates through the Palms Agro-Production Company (Kuwait), during the date-palm fruiting season (1993 crop). The fruits were picked from the randomly selected (marked) trees for the purpose of this study and transported by air to our laboratories under refrigerated conditions. The *khalal* fruits of these cultivars were used for cold storage studies.

Methods:

Sample preparation. Date fruits of two varieties, *Lulu* and *Bushibal,* at the *khalal* stage of maturity were stored at 4 ± 1 °C, –2 ± 1 °C and –20 ± 1 °C. At 4 °C-storage, half of the fruit was stored untreated (control), while to the other half, 0.05% potassium sorbate was added. The potassium sorbate was dissolved in a few

milliliters of water and uniformly sprinkled over the fruit with constant mixing. The other date fruit samples stored at –2 °C and –20 °C temperature, were not treated with potassium sorbate. The samples were removed from storage periodically and analyzed for chemical, microbiological and sensory characteristics.

Before proceeding with cold storage experiments, the samples were sorted to remove damaged, insect infested fruits *etc.,* then washed in tap water and left to drain excess water. The fruits were then separated from the stalks. Water drops adhering to the fruits were removed with blotting paper.

Analyses. Chemical, microbiological and sensory analysis of the prepared samples were conducted, in duplicates, at zero time and at suitable intervals during storage. The pH of the cold-stored fruit samples was determined with a pH meter at suitable intervals according to the method reported by Ruck (1969).

Mold, coliform, enterobacteriaceae and total plate counts of all the samples were determined initially and during storage by standard procedures (ICMSF 1978).

The fruits were evaluated using a nine-point hedonic scale ranging from "disliked extremely" (1) to "liked extremely" (9) by fifteen semi-trained panelists from the Kuwait Institute for Scientific Research at zero time and at regular intervals (Larmond 1994, Meiselman 1978). Each judge was given samples and asked to evaluate the products for color, appearance, texture, flavor and overall acceptability (score greater than 5 means acceptable). Whenever any sample showed visible growth of molds, its sensory analysis was discontinued at that time.

Statistical Analysis:

The research data obtained were analyzed for analysis of variance taking cultivars as replciates, 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

Chilling temperature storage:

The results are presented in Tables 1 and 2. The pH of the date-fruit pulp ranged from 4.6 to 7.2 for the control group and from 4.9 to 6.9 for the sorbate-treated samples. No definite trend was noticed in the pH values of date fruits during the period of storage. The total plate counts on the control as well as sorbate-treated *Bushibal* samples did not increase significantly till six and nine weeks of storage,

respectively. Under 4 °C storage conditions, the sorbate treatment was more effective in prolonging the shelf life of *Lulu* cultivar fruits than the *Bushibal* cultivar fruits. Total mold counts for *Bushibal* control fruits increased significantly at six weeks of storage, and when on seventh week a visible mold growth appeared, the sensory analysis on these fruits was discontinued. However in case of sorbate treated *Bushibal* fruits, the mold counts did not vary significantly during the storage period. The presence of a lower initial microbial load (lower total plate count) on *Lulu* fruits may be one of the reasons for the longer shelf life of this cultivar under these storage conditions. Total mold counts for *Lulu* control fruits also increased significantly at six weeks of storage, and when on eleventh week a visible mold growth appeared, the sensory analysis on these fruits was also discontinued. However in case of sorbate treated *Lulu* fruits, the mold counts did not vary significantly from the second week onwards till the entire storage period of eleven weeks. The mold growth on these date fruits was, therefore, kept under check by the sorbate treatment during the storage period. The slow increase in the mold count figures presented in Table 1 supports this observation. The aerobe, mold, coliform and enterobacteriaceae counts on control samples of *Bushibal* and *Lulu* cultivars remained within acceptable limits (ICMSF 1986, log value of 7 for aerobes and molds, and log value of 3 for coliforms and enterobacteriaceae), for up to six and ten weeks of storage respectively. However, in the case of the sorbate-treated samples, the microbial loads on *Bushibal* and *Lulu* cultivars remained within acceptable limits for up to nine and eleven weeks respectively.

The sensory scores of *Bushibal* and *Lulu* fruits stored at 4 °C are presented in Table 2. The color, appearance, texture, flavour and overall acceptability scores indicate, that control and sorbate-treated *Bushibal* fruits stayed acceptable for six and eight weeks, respectively. Compared with the *Bushibal* variety, the control and sorbate-treated *Lulu* fruits, however, remained acceptable for longer periods of ten and eleven weeks, respectively. No significant decrease in the color, appearance and texture scores was observed among these two cultivars during the entire period of storage. The *Lulu* cultivar fruits obtained higher average sensory scores (5 or higher) for overall acceptability most of the times during the storage period than did the *Bushibal* fruits. During storage, the date fruits matured from *khalal* to *rutab* stage. As the sorbate-treated fruit matured, the flavor score increased significantly after two and three weeks of storage for *Lulu* and *Bushibal* cultivars, respectively. The overall acceptability scores did not vary for control as well as for sorbate-treated samples of both the cultivars during the entire period of storage. As the visible mold growth was observed in control and sorbate-treated *Bushibal* samples after six and eight weeks of storage, respectively, the sensory analysis of these samples was discontinued at this stage. The use of potassium sorbate for extending the shelf life of date fruits

stored at chilling temperatures has not been reported earlier.

Storage at sub-zero temperatures:

The date fruits stored at subzero temperatures were also analyzed for pH, microbial counts and sensory quality at monthly intervals. The results are presented in Tables 3 to 6. The pH of the date fruits stored at these temperatures were comparable to the pH values obtained for fruits stored at 4 °C. The microbial counts on the fruits were lower in both the samples when stored at –2 °C and –20 °C than when stored at 4 °C. The aerobes and mold counts were within acceptable limits during the storage period. The coliforms and enterobacteriaceae were not detected in date fruits stored at subzero temperatures. The fruits kept at –20 °C were still free of any visible growth of molds even after eight months of storage (Table 4). Even after eight months of storage at –20 °C, the total plate counts and mold counts were quite low in the date fruits of *Lulu* cultivar.

The various sensory scores for the date fruits of these cultivars stored at –2 °C did not vary significantly till one month of storage. However, mold growth became visible after two months of storage at –2 °C, at which point the sensory analysis was discontinued. Hence, Table 5 contains storage data up to one month only. At –20 °C storage temperature, the *Bushibal* cultivar fruits remained acceptable for a period of only two months. However, the *Lulu* date fruits stored at –20 °C maintained acceptable sensory quality up to eight months. The date fruits at –20 °C developed a soft texture upon thawing. The development of a soft texture upon thawing was also observed by Mikki and Al-Taisan (1993). Goneum *et al.* (1993) have suggested the use of freezing temperature storage for the ripening of freshdate fruits. Yousif and Abou-Ali (1993) have found the use of –20 °C better than 5 °C for the storage of *rutab* stage date fruits. Al-Mashadi *et al.* (1993) have also used freezing temperature storage for extending the shelf life of *rutab* stage date fruits up to one year and reported an increase in the total as well as reducing sugars during this storage period.

Although these researchers have mostly used *rutab* stage fruits, but their finding support most of the observations made on the storage of *khalal* stage date fruits in this study. Some of the chemical changes occurring in the date fruits of these cultivars at different stages of maturity have been reported earlier by Al-Hooti *et al.* (1995). The increase in total sugars and decrease in tannin contents of *Lulu* date fruits as these matured from *khalal* to *rutab* stage during freezing storage (–20 °C), may be responsible for their higher overall acceptability scores (Table 6). Throughout the storage period, the date fruits of both cultivars gradually matured from the *khalal* stage to the *rutab* stage. However the extent of ripening differed between the cultivars. Sorbate-treated *Bushibal khalal*-stage fruits matured to the

rutab stage slower than the control group, but the pattern was reversed in the case of *Lulu* cultivar fruits. *Khalal*-stage date fruits matured much faster to the *rutab* stage at –20 °C than at the other temperatures employed in this study.

Conclusions

The results presented in this report indicate that the shelf life of date fruits of *Bushibal* and *Lulu* cultivars at the *khalal* or *rutab* stages of maturity can be extended with a 0.05% potassium sorbate treatment by additional two to three weeks (*i.e.* eight to nine weeks as opposed to six weeks of control samples) at a storage temperature of 4 °C. The use of a lower storage temperature (–20 °C) was even more effective in extending the shelf life of (up to eight months) *Lulu* cultivar fruits. These manipulative techniques, if adopted by the date packing industry, would make date fruits (at the *khalal* and *rutab* stages of maturity) available for consumption for an extended period. Moreover, the storage of fresh date fruit at subzero temperatures retarded the growth of microorganisms naturally present on these fruits.

Acknowledgements

The authors acknowledge and express their gratitude to the Palms Agro-Production Company and the Kuwait Foundation for the Advancement of Science for their partial funding and continued support of this project, and to the Management of the Kuwait Institute for Scientific Research (KISR) for its continued support and guidance. The help rendered by Ms. Shoushanik Jombanian and Ms. Amani Al-Othman of the Division of Information Systems (KISR) for carrying out the statistical analysis of research data is duly acknowledged.

Table 1. Physiochemical and microbiological quality of date fruits (*khalal* stage) of *Bushibal* (BB) and *Lulu* (LL) varieties stored at 4 °C

Storage (weeks)	Treatment	pH		Total plate count, (Log_{10} CFU/ml rinse)		Mold (Log_{10} CFU/ml rinse)		Coliform (Log_{10} CFU/ml rinse)		Entero-bacteriaceae (Log_{10} CFU/ml rinse)	
		BB	LL	BB	LL	BB	LL	BB	LL	BB	LL
0	Control	6.2	5.6	4.91^{a}	2.95^{b}	3.57^{a}	3.07^{c}	0.0^{a}	0.0^{c}	1.69^{a}	0.0^{b}
	Sorbate	5.9	5.0	4.04_{A}	2.0_{B}	0.0	2.0_{C}	0.0_{A}	0.0_{C}	0.0_{A}	0.0_{B}
1	Control	6.5	5.2	5.34^{a}	3.04^{b}	4.50^{a}	3.20^{c}	0.0^{a}	0.0^{c}	2.0^{a}	0.0^{b}
	Sorbate	6.2	5.3	4.76_{A}	2.85_{B}	3.30_{A}	3.17_{D}	0.0_{A}	0.0_{C}	0.0_{A}	0.0_{B}
2	Control	6.5	5.1	5.75^{a}	3.78^{b}	4.62^{a}	3.36^{c}	2.0^{b}	0.0^{c}	2.30^{a}	0.0^{b}
	Sorbate	6.9	5.8	4.86_{A}	3.20_{B}	3.0_{A}	3.43_{D}	0.0_{A}	0.0_{C}	0.0_{A}	0.0_{B}
3	Control	7.2	6.4	5.75^{a}	4.49^{b}	4.62^{a}	4.47^{c}	2.39^{b}	1.69^{d}	2.74^{a}	2.0^{c}
	Sorbate	6.9	4.9	5.43_{A}	3.46_{B}	3.43_{A}	3.56_{D}	0.0_{A}	0.0_{C}	0.0_{A}	0.0_{B}
4	Control	5.4	4.6	5.77^{a}	4.90^{b}	4.69^{a}	4.88^{c}	2.04^{b}	2.0^{d}	3.11^{a}	2.30^{c}
	Sorbate	5.9	5.0	6.51_{A}	3.63_{B}	4.23_{A}	3.68_{D}	0.0_{A}	0.0_{C}	0.0_{A}	0.0_{B}
5	Control	7.0	5.3	6.14^{a}	5.34^{b}	4.78^{a}	5.38^{c}	3.49^{b}	2.17^{d}	3.27^{a}	2.74^{c}
	Sorbate	6.0	5.0	5.54_{A}	3.69_{B}	4.27_{A}	3.74_{D}	0.0_{A}	1.69_{D}	0.0_{A}	1.69_{C}
6	Control	5.8	4.9	6.95^{a}	5.69^{b}	5.43^{b}	5.65^{d}	3.61^{b}	2.60^{d}	3.36^{a}	3.14^{c}
	Sorbate	6.9	6.8	5.62_{A}	3.74_{B}	4.68_{A}	3.90_{D}	0.0_{A}	0.0_{C}	0.0_{A}	0.0_{B}
7	Control	–	5.6	–	5.69^{b}	–	5.66^{d}	–	2.17^{d}	–	2.17^{c}
	Sorbate	5.7	5.0	5.77_{A}	2.95_{B}	4.97_{A}	4.14_{D}	0.0_{A}	0.0_{C}	1.69_{A}	0.0_{B}
8	Control	–	5.2	–	5.74^{b}	–	5.79^{d}	–	2.47^{d}	–	2.39^{c}
	Sorbate	5.8	6.7	6.51_{A}	4.20_{B}	5.36_{A}	4.23_{D}	3.60_{B}	0.0_{C}	2.65_{A}	0.0_{B}
9	Control	–	6.6	–	6.0^{b}	–	6.14^{d}	–	2.65^{d}	–	2.65^{c}
	Sorbate	6.4	5.9	6.67_{A}	4.34_{B}	5.46_{A}	4.27_{D}	3.0_{B}	0.0_{C}	2.95_{A}	0.0_{B}
10	Control	–	5.0	–	6.23^{b}	–	6.34^{d}	–	2.65^{d}	–	2.74c
	Sorbate	–	–	–	4.41_{B}	–	4.36_{D}	–	0.0_{C}	–	0.0_{B}
11	Control	–	–	–	–	–	–	–	–	–	–
	Sorbate	–	6.7	–	4.46_{B}	–	4.43_{D}	–	0.0_{C}	–	0.0_{B}

Means with different subscripts and superscript differ significantly (P = 0.05) for each parameter in a column. To compare statistical significance for each parameter in a column, the superscripts should be used for control samples and subscripts for sorbate treated samples for comparisons between weeks of storage.

Table 2. Sensory quality (average score) of date fruits of *Bushibal* and *Lulu* varieties stored at 4 °C

Storage (weeks)	Treatment	Colour		Appearance		Texture		Flavor		Overall acceptability		*Rutab* stage fruit (%)	
		BB	LL	BB	LL	BB	LL	BB	LL	BB	LL	BB	LL
0	Control	6.7^{a}	6.6^{b}	6.0^{a}	6.5^{b}	5.6^{a}	6.1^{b}	5.0^{a}	5.0^{c}	6.0^{a}	6.4^{b}	–	–
	Sorbate	5.0_{A}	6.0_{B}	6.0_{A}	5.5_{B}	6.0_{A}	5.0_{B}	5.0_{A}	5.1_{E}	6.0_{A}	5.6_{B}	–	–
1	Control	5.3^{a}	6.4^{b}	5.8^{a}	6.1^{b}	5.9^{a}	5.2^{b}	5.4^{a}	4.9^{c}	6.1^{a}	5.3^{b}	–	–
	Sorbate	6.6_{A}	6.1_{B}	6.1_{A}	6.2_{B}	5.8_{A}	5.3_{B}	5.2_{A}	5.6_{E}	5.7_{A}	5.8_{B}	24.0	–
2	Control	6.8^{a}	6.3^{b}	6.4^{a}	6.4^{b}	5.4^{a}	5.4^{b}	4.3^{a}	5.3^{c}	5.2^{a}	5.1^{b}	37.9	–
	Sorbate	5.5_{A}	6.1_{B}	5.3	6.1_{B}	5.0_{A}	6.8_{B}	5.0_{A}	5.9_{F}	5.3_{A}	6.2_{B}	28.0	31.8
3	Control	6.0^{a}	6.8^{b}	5.7^{a}	6.3^{b}	4.5^{a}	6.2^{b}	4.4^{a}	5.4^{c}	4.8^{a}	6.2^{b}	54.3	4.3
	Sorbate	6.1_{A}	6.8_{B}	6.3_{A}	6.2_{B}	7.1_{A}	6.5_{B}	7.2_{B}	6.6_{F}	7.4_{A}	6.9_{B}	46.2	42.9
4	Control	6.1^{a}	6.8^{b}	5.8^{a}	6.7^{b}	6.1^{a}	6.7^{b}	6.9^{b}	6.7^{d}	6.0^{a}	6.8^{b}	58.8	35.0
	Sorbate	4.9_{A}	6.1_{B}	5.3_{A}	6.2_{B}	5.0_{A}	6.8_{B}	4.9_{A}	6.9_{F}	5.4_{A}	6.9_{B}	52.6	72.2
5	Control	4.9^{a}	6.1^{b}	5.2^{a}	6.1^{b}	5.3^{a}	6.2^{b}	5.3^{a}	5.9^{d}	5.6^{a}	6.1^{b}	69.4	43.8
	Sorbate	6.0_{A}	6.3_{B}	6.9_{A}	6.4_{B}	5.8_{A}	7.8_{B}	6.2_{B}	7.9_{F}	6.8_{A}	6.9_{B}	65.8	76.2
6	Control	5.0^{a}	6.8^{b}	5.0^{a}	6.8^{b}	5.3^{a}	6.9^{b}	5.3^{a}	6.6^{d}	5.5^{a}	6.7^{b}	79.4	50.0
	Sorbate	6.2_{A}	5.1_{B}	5.8_{A}	6.2_{B}	6.8_{A}	6.2_{B}	6.8_{B}	6.5_{F}	6.6_{A}	6.7_{B}	71.0	77.3
7	Control	–	6.1^{b}	–	6.2^{b}	–	6.8^{b}	–	6.6^{d}	–	6.9^{b}	–	59.1
	Sorbate	6.3_{A}	5.2_{B}	6.1_{A}	5.2_{B}	5.6_{A}	6.1_{B}	6.3_{B}	6.1_{F}	5.9_{A}	6.1_{B}	81.6	81.0
8	Control	–	5.1^{b}	–	6.8^{b}	–	6.1^{b}	–	6.2^{d}	–	6.2^{b}	–	63.2
	Sorbate	5.8_{A}	5.2_{B}	6.2_{A}	5.6_{B}	6.3_{A}	6.8_{B}	5.9_{B}	6.7_{F}	6.7_{A}	6.4_{B}	96.8	83.0
9	Control	–	6.0^{b}	–	6.1^{b}	–	5.4^{b}	–	5.9^{d}	–	6.0^{b}	–	63.6
	Sorbate	–	5.7_{B}	–	6.0_{B}	–	6.5_{B}	–	6.9_{F}	–	6.8_{B}	100.0	85.0
10	Control	–	6.1^{b}	–	6.1^{b}	–	6.5^{b}	–	6.5^{d}	–	6.8^{b}	–	84.2
	Sorbate	–	5.4_{B}	–	6.1_{B}	–	5.8_{B}	–	5.7_{F}	–	5.9_{B}	–	87.0
11	Control	–	–	–	–	–	–	–	–	–	–	–	–
	Sorbate	–	5.6_{B}	–	5.6_{B}	–	6.3_{B}	–	6.5_{F}	–	6.4_{B}	–	100

Means with different subscripts and superscript differ significantly (P = 0.05) for each parameter in a column. To compare statistical significance between storage time periods for each parameter in a column, the superscripts should be used for control samples and subscripts for sorbate treated samples for comparisons between weeks of storage.

Table 3. Physicochemical and microbiological quality of date fruits (*khalal* stage) of *Bushibal* and *Lulu* varieties stored at –2 °C

Storage (months)	pH of date fruits		Total plate count, (Log_{10} CFU/ml rinse)		Mold (Log_{10} CFU/ml rinse)	
	BB	LL	BB	LL	BB	LL
0	5.5	6.1	3.07[a]	2.00[a]	2.00[a]	2.60[a]
1	5.4	5.7	3.17[a]	2.97[a]	2.69[a]	2.81[a]

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

Table 4 Physicochemical and microbiological quality of date fruits (*khalal* stage) of *Bushibal* and *Lulu* varieties stored at –20 °C

Storage (months)	pH of date fruits		Total plate count, (Log_{10} CFU/ml rinse)		Mold (Log_{10} CFU/ml rinse)	
	BB	LL	BB	LL	BB	LL
0	6.1	6.5	3.00[a]	2.47[a]	1.69[a]	2.30[a]
1	5.4	6.0	3.49[a]	2.97[a]	2.30[a]	2.39[a]
2	6.9	*	3.52[a]	*	2.30[a]	*
8	–	6.2	–	3.30[a]	–	3.24[a]

Means with same superscript do not differ significantly (P = 0.05) for each parameter in a column.
* The *Lulu* date fruit samples were not analyzed at this time of storage period.

Table 5. Sensory quality (average score) of date fruits of *Bushibal* and *Lulu* varieties at the *khalal* stage of maturity cold-stored at –2 °C

Storage (months)	Color		Appearance		Texture		Flavor		Overall acceptability		Fruits turned to *rutab* stage (%)	
	BB	LL	BB	LL	BB	LL	BB	LL	BB	LL	BB	LL
0	6.0^a	6.1^a	6.0	6.3^a	5.8^a	6.4^a	5.4^a	5.9^a	6.2^a	5.6^a	–	–
1	6.1^a	6.1^a	5.5^a	6.6^a	5.3^a	6.8^a	5.1^a	6.6^a	5.5^a	6.7^a	28.6	31.8

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

Table 6. Sensory quality (average score) of date fruits of *Bushibal* and *Lulu* varieties at the *khalal* stage of maturity cold-stored at –20 °C

Storage (months)	Color		Appearance		Texture		Flavor		Overall acceptability		Fruits turned to *rutab* stage (%)	
	BB	LL	BB	LL	BB	LL	BB	LL	BB	LL	BB	LL
0	6.7^a	6.1^a	6.5^a	6.0^a	6.2^a	6.0^a	6.0^a	6.0^a	6.4^a	6.0^a	–	–
1	6.3^a	5.2^a	6.2^a	4.9^a	5.1^b	5.1^b	5.8^a	4.7^a	5.9^a	4.9^a	100	100
2	4.9^a	–	8.8^a	–	4.2^b	–	4.0^b	–	4.2^b	–	100	–
8	–	6.6^a	–	7.3^a	–	7.1^c	–	7.1^c	–	7.6^c	–	100

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

References

Al-Hooti, S., Sidhu, J.S. and **Qabazard, H.** (1995) Studies on the Physico-chemical Characteristics of Date Fruits of five UAE Cultivars at Different Stages of Maturity, *Arab Gulf J. Sci. Res.* **13**(3): 553-569.

Al-Mashadi, A., Al-Shalhat, A. and **Fawal, A.K.** (1993) Storage and preservation of date in rutab stage. Presented at the Third Symposium on Date Palm in Saudi Arabia, King Faisal Univ., Al-Hassa, Saudi Arabia, Abstr. No. I-16.

Goneum, S.I., El-Samahy, S.K., Ibrahim, S.S., El-Fadeel, M.G.A. and **Mohamed, S.M.** (1993) Compositional changes in the date fruits during ripening by freezing. Presented at the Third Symposium on Date Palm in Saudi Arabia, King Faisal Univ., Al-Hassa, Saudi Arabia, Abstr. No. I-14.

ICMSF (International Commission on the Microbiological Specifications of Foods) (1978) *Microorganisms in Foods. I. Their Significance and Methods of Enumeration.* University of Toronto Press, Toronto, Canada.

ICMSF (International Commission on the Microbiological Specifications of Foods) (1986) *Microorganisms in Foods. II. Sampling for Microbiological Analysis: Principles and Specific Applications.* 2nd Ed. University of Toronto Press, Toronto, Canada.

Larmond, E. (1994) Is sensory evaluation a science? *Cereal Foods World,* **39**(11/12): 804-806.

Meiselman, H.L. (1978) 'Scales for measuring food preferences' *In:* **Petersen, M.S.** and **Johnson, A.H. eds.,** *Encyclopedis of Food Science,* AVI, Westport, Conn. 675-678 pp.

Mikki, M.S., Hegazi, A.H., Abdel-Aziz, A.A. and **Al-Taisan, S.M.** (1986) Suitability of major Saudi date cultivars for commercial handling and packing. *Proceedings, Second Symposium on the Date Palm in Saudi Arabia,* King Faisal Univ., Al-Hassa, Saudi Arabia, **II:** 9-24.

Mikki, M.S. and **Al-Taisan, S.M.** (1993) Physico-chemical changes associated with freezing storage of date cultivars at their *Rutab* stage of maturity. Presented at the Third Symposium on Date Palm in Saudi Arabia, King Faisal Univ., Al-Hassa, Saudi Arabia. Abstr. No. I-11.

Ruck, J.A. (1969) *Chemical Methods for Analysis of Fruits and Vegetable Products,* Publication No. SP 50, Canadian Department of Agriculture, Research Station, Summerland, British Columbia, 5 and 40 pp.

Yousif, A.K. and **Abou-Ali, M.** (1993) Suitability of fresh Saudi dates (*rutab*) for refrigeration and freezing storage. Presented at the Third Symposium on Date Palm in Saudi Arabia, King Faisal Univ., Al-Hassa, Saudi Arabia. Abstr. No. I-15.

(Received 30/07/1994;
in revised form 26/11/1995)

اطالة فترة صلاحية نوعان من ثمار البلح المنتج في دولة الامارات العربية في مرحلتي الخلال والرطب

سعاد الحوطي و جيوان سيدهو و جملا العتيبي
و حنان العميري و حسين قبازرد [1]

دائرة التكنولوجيا الحيوية - معهد الكويت للأبحاث العلمية - ص .ب (٢٤٨٨٥) - صفاة ١٣١٠٩ - الكويت
و [1] شركة النخيل للانتاج الزراعي - ص .ب (١٩٧٦) - صفاة ١٣٠٢٠ - الكويت

تم تخزين ثمار البلح من صنف البوشيبال ، واللولو أثناء مرحلة الخلال تحت ثلاث درجات حرارة مختلفة وذلك لاطالة فترة صلاحيتها . وقد كشفت النتائج ان استخدام ومعالجة الثمار بسوربات البوتاسيوم بنسبة ٠,٠٥ ٪ خلال فترة التخزين وتحت درجة حرارة ٤° درجة مئوية قد أطال فترة صلاحية ثمار البوشيبال واللولو لمدة ٨-١٠ أسابيع على التوالي . وقد ظل مستوى الحمل الميكروبي في ثمار البلح ضمن الحدود والمستويات المقبولة باستعمال هذه الطريقة . وعند تخزين البلح تحت درجات حرارة -٢° و -٢٠° درجة مئوية لم يحدث أي نمو للبكتيريا القولونية أوالامعائيات البكتيرية ، في حين ظلت مستويات الاصابة في الميكروبات الجيهوائية ، أو العفونة ضمن الحدود والمستويات المقبولة . وقد أدى تخزين الثمار في درجة حرارة ما دون الصفر إلى تأخير نمو الكائنات الدقيقة التي عادة ما توجد في مثل هذه الثمار . ولم يلاحظ أي توجه محدد في قيم الحموضة (pH) خلال فترة التخزين البارد . وقد أشارت نتائج اختبارات التذوق الحسية للثمار المخزنة بالتبريد ، تفاوتاً بسيطاً إلى معتدل في معدلات القبول كما أن ثمار هذين النوعين من الخلال تم انضاجها لمرحلة الرطب وخلال فترة التخزين .