Effect of some conservation methods on the physicochemical quality properties of some ecotypes of dry date fruits (*Phoenix dactylifera* L.) in Aswan governorate.

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Abstract

The aim of this research was carried out on three ecotypes of dry date fruits in Aswan (Three ecotypes of dry date fruits were given symbols inside this search ecotype V1, V2 and V3), in order to study the effect of three conservation methods such as: solar drying, oven drying and freeze store on the properties physicochemical quality of date fruit samples during freeze time storage at -18 ± 0.5°C and at room temperature storage (20 ± 4°C). All date samples were stored for 9 months and tested at zero time and the end storage. The results showed that, drying type (solar or oven drying), then storage at room temperature (20 ± 4°C) for 9 months significantly ($p \leq 0.05$) affect physicochemical quality of all date fruit samples. Physical attributes such as fruit weight, length, diameter and edible portion of all dried date samples were significantly ($p \leq 0.05$) reduced at zero time storage, also storage period at room temperature (20 ± 4°C) and freeze store at -18 ± 0.5°C affected physical properties of all date samples. All dried date samples by solar drying method were significantly ($p \leq 0.05$) reduced in fruits weight, length, diameter and edible portion, in the end storage period at room temperature (20 ± 4°C). Also, insect damage percentages were significantly ($p \leq 0.05$) affected by the conservation methods and storage period. While, all freeze date samples were non insect damaged after 9 months of storage at -18 ±0.5°C. On the other side, proximate values (moisture, protein, total sugars and ash) were significantly ($p \leq 0.05$) affected by the conservation methods and storage period. Drying type (solar or oven drying) reduced ($p \leq 0.05$) the moisture values compared with freeze store method at zero time. Total sugar, protein and ash percentage of all dried date samples by oven drying were significantly ($p \leq 0.05$) decreased in the end storage period at room temperature (20 ± 4°C). While, no significantly ($p \leq 0.05$) affected in the

protein values of ecotype V2 with freeze store method after 9 months at -18 ±0.5°C. Freeze storage method able to be aviable alternative, which allows storing the fruits of dry date fruits in the long term and high-quality properties.

Keywords: physicochemical date palm; conservation methods of date palm, date palm storage.

1- NTRODUCTION

Dates are among the most important horticultural crops in Egypt. Seven millions of fruitful date palms representing about 20 varieties are grown over the Nile valley and delta region which yield annually about 615000 tons of fresh, semi-dry and dry native dates (**FAO 1992**). Date palm plays an important role in the economic and social life of the people in date producing regions (**Tang *et al.*, 2013**). The importance of the date in human nutrition comes from its rich composition of carbohydrates, salts and minerals, dietary fiber, vitamins, fatty acids, amino acids and protein (**Walid and Richard, 2003**). When stored at some specific conditions, date fruits can be subject to various quality degradation phenomena. Temperatures which are low, but not low enough to cause chilling-injury, can slow down physiological activity. The Food and Agriculture Organization (FAO) has conducted several activities to prolong the storage of date fruits using refrigeration. The process is mainly based on slowing down of fruit maturity (**Mansouri *et al.*, 2005**).

Because of genetic differences and variable growth conditions, dates show, perhaps more than other fruits, wide variations in their final appearance and quality (**Aleid *et al.*, 2014**). Important quality criteria for producers of dates are not only the ones that lead to consumer satisfaction, but also those that lead to economic profit, as is the case with any producer in the food industry. However, these criteria are only the outcome of many factors, such as chemical composition and physical properties of the date varieties used (**Wills *et al.*, 1998**). Insect infestation and damage caused by insect feeding on the dates is one of the primary causes of postharvest losses in quality and quantity. Heat treatments or freezing can be used for insect disinfestations of organic dates (**Kader and Hussein, 2009**). Since

quality parameters are affected by storage, it is very important to understand the effect of such storage conditions on the different characteristics of the date fruit. Unfortunately, few if any of those studies and reports dealt with the effect of storage conditions on dry date quality parameters. Thus, research is needed to investigate the effect of current methods of storage on different date quality and physical and chemical quality attributes during storage time. Therefore, the aim of this work was to assess some of the quality parameters of dates and their changes during storage conditions (at room temperature (20 ±4°C) and freeze store at -18 ±0.5°C) for 9 months and provide a basic understanding of physical and chemical composition of the fruit as post-harvest technologies will be mainly concerned with slowing down the rate of produce metabolism without inducing abnormal events.

2. MATERIALS AND METHODS

2-1. Materials:

2-1-1. Dates samples: Three ecotypes of dry date fruit samples were obtained from three farm locations (Ekleet, El-edwa and El-rakama villages) at Aswan, Egypt in October, 2013 (Three ecotypes of dry date fruit samples were given symbols inside this search ecotype V1, V2 and V3 ,respectively). All samples transported to Food Science and Technology laboratory Faculty of Agriculture, Al-Azhar University, Assiut.

2-1-2. Reagent: All chemicals used in this study were obtained from El-Gomhoria Company, Assiut, Egypt.

2-2. Methods:

2-2-1. Dates sampling: Date fruit samples were divided into three parts. The first part of samples was solar drying (natural drying) for 3 weeks, then packaged inside cardboard cartons and stored at room temperature (20 ±4°C). Second part of samples was drying at 70 °C for 3 hrs, then packaged inside cardboard cartons and stored at room temperature (20 ±4°C). Third part of samples packaged into bags of polyethylene then preserved in a freeze store at -18 ±0.5°C. Three different parts of date

fruit samples were stored for 9 months, tested at zero time and at the end of storage period.

2-2-2. Physical analysis: Date fruit weight was estimated using a sensitive balance with sensitivity of 0.1 mg fruit weight, length and diameter of date fruits were estimated using a Vernier caliper. Edible portion and insect damage were calculated as the percentage of fruit biomass.

2-2-3. Chemical analyses: Moisture, protein, total sugars and ash were determined according to the **A.O.A.C (1990)**.

2-2-4. Statistical analysis: The experimental data were subjected to an analysis of variance **(ANOVA)** for a completely randomized design using a statistical analysis system **(SAS, 2000)**. (L.S.D) tests were used to determine the differences among means at the level of 0.05%.

3. RESULTS AND DISCUSSION

3-1. Physicochemical properties quality of date fruits:

3-1-1. Physical properties quality:

Physical properties of ecotypes dry date fruit samples such as: Fruit weight, length, diameter, edible portion and insect damage are summarized in Tables (1- 5). The significant differences ($p \leq 0.05$) were observed, especially in fruit weight, length, diameter and edible portion of three ecotypes dry date fruits at zero time. The reasons for these different results could be due to the difference of the collecting origin and cultivar of date fruits (**Aleid *et al.*, 2014).** Physical properties of all date fruit samples were significantly ($p \leq 0.05$) affected by the drying type especially oven drying method compared with freshly date fruit samples trended freeze store at zero time. The results also in Tables (1-5) indicated that storage period at room temperature (20 ± 4°C) and freeze store at -18 ± 0.5°C affected physical properties of all date samples. Fruit weight, length and edible portion, were significantly reduced in the end storage period at room temperature (20 ± 4°C) of all dried date samples by solar drying. The decreasing trend of physical properties of all dried date samples by solar drying might be attributed to

partially the evaporation of moisture from stored date samples at room temperature (20 ± 4°C) (Table 6). Meanwhile, physical properties of all dried date samples by oven drying were significantly increased at the end storage period at room temperature (20 ± 4°C). The increasing trend of weight, length, diameter and edible portion values at the end storage period of all dried date samples by oven drying might be attributed to the increasing in the moisture (Table 6). Diameters of freeze date samples at -18 ±0.5 °C of ecotype V1 and V2 were no significantly reduced during storage period (Table 3). These results are in agreement with those obtained by **Ismail *et al.* (2008)** whose reported that, this decrease in some physical characteristics was counter balanced by an increase in some chemical attributes. On the other side, insect damage percentage was significantly ($p \leq 0.05$) affected by the conservation methods and storage period. The highest insect damage percentage was observed in dried date samples especially that treated by solar drying. Ecotype V2 was dried by solar drying method had the highest percent of insect damage (32 %), chack by ecotype V3 and V1 (29 and 20 % respectively). The highest value in insect damage percentage of dried date samples treated by solar drying method could be attributed to the method used which was not enough to kill the insect eggs inside date fruits. On the other hand, all freeze date samples showed non insect damage after 9 months of storage period (Table 3). These results were similar with the results reported by **Kader and Hussein (2009)** whose reported that freezing at -18°C or lower (from the time when the fruit temperature reaches -18°C or lower) is enough to kill all life stages of stored products insects.

Table (1): Effect of conservation methods (solar drying or oven drying or freezing) and storageperiod (9 months) at either room temperature (20 ± 4 °C) or -18 ± 0.5 °C on fruit weight (g) (100 fruits) of three different ecotypes date fruits.

Conservation methods		Ecotype V1		Mean	Ecotype V2		Mean	Ecotype V3		Mean
		Zero time	After 9 months		Zero time	After 9 months		Zero time	After 9 months	
Solar drying		717.56	702.23	709.90	672.54	658.12	665.33	487.00	456.23	471.62
Oven drying		706.00	728.25	717.13	608.22	643.14	625.68	411.34	485.41	448.38
Freezing		756.78	755.89	756.34	745.82	738.00	741.91	566.21	577.11	571.66
Mean		726.78	728.79	-	675.53	679.75	-	488.18	506.25	-
L.S.D 0.05	A	0.654			1.35 •			1.78		
	B	0.801			1.65			2.17		
	AB	1.133			2.34			3.08		

Table (2): Effect of conservation methods (solar drying or oven drying or freezing) and storage period (9 months) at either room temperature (20 ± 4 °C) or -18 ± 0.5 °C on fruit length(cm) of three different ecotypes date fruits.

Conservation methods		Ecotype V1		Mean	Ecotype V2		Mean	Ecotype V3		Mean
		Zero time	After 9 months		Zero time	After 9 months		Zero time	After 9 months	
Solar drying		4.70	4.63	4.67	3.67	3.59	3.63	3.20	3.18	3.19
Oven drying		4.69	4.71	4.70	3.40	3.42	3.41	3.13	3.10	3.12
Freezing		4.75	7.70	6.22	3.75	3.74	3.75	4.72	4.69	4.71
Mean		4.72	5.68	-	3.61	3.58	-	3.68	3.66	-
L.S.D 0.05	A	0.025			0.031			0.013		
	B	0.031			0.037			0.016		
	AB	0.036			0.053			0.023		

Table (3): Effect of conservation methods (solar drying or oven drying or freezing) and storage period (9 months) at either room temperature (20 ± 4 °C) or -18 ± 0.5 °C on fruit diameter (cm) of three different ecotypes date fruits.

Conservation methods		Ecotype V1		Mean	Ecotype V2		Mean	Ecotype V3		Mean
		Zero time	After 9 months		Zero time	After 9 months		Zero time	After 9 months	
Solar drying		2.13	2.04	2.08	2.17	2.12	2.15	1.80	1.76	1.78
Oven drying		1.92	2.12	2.02	1.51	1.57	1.54	1.70	1.74	1.72
Freezing		2.18	2.18	2.18	2.22	2.21	2.22	2.17	2.14	2.16
Mean		2.07	2.11	-	1.97	1.97	-	1.89	1.88	-
L.S.D 0.05	A	0.009			0.011			0.007		
	B	0.012			0.013			0.009		
	AB	0.016			0.019			0.013		

Table (4): Effect of conservation methods (solar drying or oven drying or freezing) and storage period (9 months) at either room temperature (20 ± 4 °C) or -18 ± 0.5 °C on edible portion (%) of three different ecotypes date fruits.

Conservation methods		Ecotype V1			Ecotype V2			Ecotype V3		
		Zero time	After 9 months	Mean	Zero time	After 9 months	Mean	Zero time	After 9 months	Mean
Solar drying		86.63	78.91	82.77	77.02	73.23	75.13	79.81	77.90	78.86
Oven drying		82.55	86.46	84.50	76.56	81.43	79.00	75.99	80.86	78.43
Freezing		88.23	88.12	88.17	86.51	88.27	87.39	87.28	85.35	86.32
Mean		85.80	84.50	-	80.03	80.98	-	81.03	81.37	-
L.S.D 0.05	A	0.075			0.115			0.074		
	B	0.092			0.141			0.09		
	AB	0.131			0.20			0.127		

Table (5): Effect of conservation methods (solar drying or oven drying or freezing) and storage period (9 months) at either room temperature (20 ± 4 °C) or -18 ± 0.5 °C on insect damage (%) of three different ecotypes date fruits.

Conservation methods		Ecotype V1			Ecotype V2			Ecotype V3		
		Zero time	After 9 months	Mean	Zero time	After 9 months	Mean	Zero time	After 9 months	Mean
Solar drying		0	20.00	10.00	0	32.00	16.00	0	29.00	14.50
Oven drying		0	11.00	5.55	0	17.00	8.50	0	13.00	6.50
Freezing		0	0	0	0	0	0	0	0	0
Mean		0	10.33	-	0	16.33	-	0	14.00	-
L.S.D 0.05	A	0.227			0.375			0.332		
	B	0.278			0.459			0.407		
	AB	0.393			0.649			0.576		

3-1-1. Chemical properties quality:

Proximate analysis of ecotypes dry date fruits samples such as: moisture, protein, total sugar and ash percentages are presented in Tables (6- 9). Proximate values were significantly ($p \leq 0.05$) affected by the conservation methods and storage period. Drying type especially treated by oven drying at 70 °C for 3 hrs reduced ($p \leq 0.05$) the moisture values of all dried date fruit samples compared with freeze store method at zero time (Table 6). All dried date samples by oven drying method showed variable increases ($p \leq 0.05$) in the moisture values at the end storage period (Table 6). The increasing trend of moisture content during storage

of all dried date samples by oven drying method might be attributed to the higher hygroscopic capacity of dried date samples by oven drying method which absorbs moisture from the surrounding atmosphere. These results were agreement with the results reported by **Kader and Hussein (2009)** whose reported that, dates will absorb moisture from the room air unless they are packaged in moisture-proof containers. On the other side, all dried date samples by solar drying method showed variable decreases ($p \leq 0.05$) in the moisture values at the end storage period. No significantly ($p \leq 0.05$) affected in the moisture values of ecotype V1 and V2 with freeze store method after 9 months (Table 6). On the other hand, total sugar, protein and ash percentages of all dried date samples by oven drying were significantly ($p \leq 0.05$) decreased at the end storage period (Tables 7- 9). The decreasing trend of total sugar, protein and ash percentages of all dried date samples by oven drying might be attributed to partially increasing of moisture content during storage of stored date samples at room temperature (20 ± 4°C). No significantly ($p \leq 0.05$) affected in the protein values of ecotype V2 with freeze store method (at -18 ± 0.5°C) after 9 months (Table 6).

Table (6): Effect of conservation methods (solar drying or oven drying or freezing) and storage period (9 months) at either room temperature (20 ± 4 °C) or -18 ± 0.5 °C on moisture of three different ecotypes date fruits.

Conservation methods		Ecotype V1			Ecotype V2			Ecotype V3		
		Zero time	After 9 months	Mean	Zero time	After 9 months	Mean	Zero time	After 9 months	Mean
Solar drying		20.53	19.22	19.88	23.16	19.86	21.51	21.70	20.06	20.88
Oven drying		16.23	19.89	18.06	18.82	21.18	20.00	17.77	20.09	18.93
Freezing		25.26	25.30	25.28	26.88	26.84	26.86	24.66	25.13	24.89
Mean		20.67	21.47	-	22.95	22.63	-	21.38	21.76	-
L.S.D 0.05	A	0.113			0.096			0.251		
	B	0.138			0.117			0.31		
	AB	0.196			0.166			0.438		

Table (7): Effect of conservation methods (solar drying or oven drying or freezing) and storage period (9 months) at either room temperature (20 ± 4 °C) -18 ± 0.5 °C on total sugar of three different ecotypes date fruits. (on dry weight basic)

Conservation methods		Ecotype V1			Ecotype V2			Ecotype V3		
		Zero time	After 9 months	Mean	Zero time	After 9 months	Mean	Zero time	After 9 months	Mean
Solar drying		70.16	72.02	71.09	65.46	68.65	67.o5	68.86	69.51	69.19
Oven drying		74.33	69.26	71.97	69.80	68.33	69.07	72.61	69.85	71.23
Freezing		66.05	67.61	66.83	62.77	64.12	63.45	67.49	68.13	67.81
Mean		70.18	69.63	-	66.01	67.03	-	69.65	69.16	-
L.S.D 0.05	A	0.118			0.057			0.518		
	B	0.145			0.070			0.635		
	AB	0.205			0.099			0.897		

Table (8): Effect of conservation methods (solar drying or oven drying or freezing) and storage period (9 months) at either room temperature (20 ± 4 °C) or -18 ± 0.5 °C on protein of three different ecotypes date fruits. (on dry weight basic)

Conservation methods		Ecotype V1			Ecotype V2			Ecotype V3		
		Zero time	After 9 months	Mean	Zero time	After 9 months	Mean	Zero time	After 9 months	Mean
Solar drying		2.50	2.54	2.52	2.38	2.40	2.39	2.88	2.91	2.90
Oven drying		2.61	2.57	2.59	2.84	2.36	2.60	2.92	2.89	2.91
Freezing		2.47	2.41	2.44	2.43	2.42	2.43	2.34	2.38	2.36
Mean		2.53	2.51	-	2.55	2.39	-	2.71	2.73	-
L.S.D 0.05	A	0.020			0.014			0.009		
	B	0.025			0.017			0.011		
	AB	0.035			0.024			0.015		

Table (9): Effect of conservation methods (solar drying or oven drying or freezing) and storage period (9 months) at either room temperature (20 ± 4 °C) or -18 ± 0.5 °C on ash of three different ecotypes date fruits. (on dry weight basic)

Conservation methods		Ecotype V1			Ecotype V2			Ecotype V3		
		Zero time	After 9 months	Mean	Zero time	After 9 months	Mean	Zero time	After 9 months	Mean
Solar drying		1.38	1.47	1.43	1.16	1.22	1.19	0.96	0.99	0.98
Oven drying		1.96	1.88	1.92	1.21	0.87	1.04	1.08	0.97	1.02
Freezing		1.12	0.94	1.03	1.09	1.17	1.13	0.87	0.88	0.88
Mean		1.49	1.43	-	1.15	1.09	-	0.97	0.95	-
L.S.D 0.05	A	0.009			0.005			0.017		
	B	0.010			0.006			0.014		
	AB	0.015			0.008			0.019		

4- CONCLUSION

The results of this research showed that, drying type (solar and oven drying), then storage at room temperature (20 ± 4°C) for 9 months significantly ($p \leq 0.05$) affect physicochemical quality of all date fruits. Freeze storage method is capable of being a viable alternative that allows for long term storage of dry date fruits. Further research on other date fruit quality parameters such as appearance, texture, and sensory evaluation is recommended.

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تأثير بعض طرق الحفظ المختلفة على خواص الجودة الطبيعية والكيميائية لبعض الطرز البينية من ثمار البلح الجاف فى محافظة أسوان

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الملخص العربى

الهدف من هذا البحث الذى تم إجراءه على ثلاثة طرز بينية من ثمار البلح الجاف فى محافظة أسوان (أعطيت الطرز البينية الثلاثة رموزاً داخل هذا البحث: طرز بينية V1 ، V2، V3) وذلك لدراسة تأثير ثلاث طرق للحفظ هى: التجفيف الشمسي، التجفيف باستخدام فرن التجفيف وكذلك التخزين بالتجميد على خواص الجودة الطبيعية والكيميائية لثمار البلح خلال فترة التخزين بالتجميد (- ١٨± ٠,٥°م) وأيضاً عند درجة حرارة الغرفة (٢٠± ٤°م) لمدة ٩ أشهر واختبارها عند بداية التخزين وكذلك نهاية مدة التخزين. أظهرت النتائج أن نوع التجفيف (الشمسي أو فرن التجفيف) ثم التخزين على درجة حرارة الغرفة (٢٠ ± ٤ °م) لمدة ٩ أشهر لها تأثيراً معنوياً ($P \leq 0.05$) على جودة الخواص الطبيعية والكيميائية لجميع عينات ثمار البلح. كانت الخواص الفيزيائية مثل الوزن والطول والقطر ونسبة الجزء الصالح للإستهلاك فى جميع عينات البلح منخفضة بشكل معنوى ($P \leq 0.05$) عند زمن الصفر من فترة التخزين، أيضاً التخزين على درجة حرارة الغرفة (٢٠ ± ٤°م) وكذلك مدة التجميد على -١٨ ± ٠,٥°م كان لهما تأثير على الخواص الفيزيائية لجميع عينات البلح. فجميع عينات البلح المجففة بطريقة التجفيف الشمسي سجلت انخفاض معنوى ($P \leq 0.05$) في وزن ، وطول وقطر الثمار وكذلك الجزء الصالح للاستهلاك عند نهاية فترة التخزين على درجة حرارة الغرفة (٢٠ ± ٤ °م). سجلت أقطار ثمار البلح المجمد (الطرز البينية V1 وكذلك V2) انخفاضات غير معنوية ($P \leq 0.05$) خلال فترة التخزين على - ١٨± ٠,٥ °م. طريقة الحفظ وكذلك فترة التخزين كانت لهما أيضاً تأثيرات معنوية ($P \leq 0.05$) على نسبة الإصابة الحشرية فى الثمار. أعلى نسبة إصابة حشرية كانت فى العينات المجففة وبخاصة المعاملة بطريقة التجفيف الشمسى . في حين، كانت جميع عينات البلح المجمدة خالية تماما من أى إصابة حشرية بعد ٩ أشهرمن التخزين على - ١٨± ٠,٥ °م.

على الجانب الآخر، تأثرت قيم التركيب الكميائى (الرطوبة والبروتين والسكريات الكلية والرماد) بشكل معنوى سواءً بطريقة الحفظ أو فترة التخزين. نوع التجفيف (الشمسي أو فرن التجفيف) كان له تأثير معنوى فى خفض قيم الرطوبة مقارنة مع طريقة التخزين بالتجميد عند زمن

الصفر من فترة التخزين . جميع العينات المجففة بطريقة استخدام أفران التجفيف أظهرت ارتفاع في قيم الرطوبة في نهاية فترة التخزين على درجة حرارة الغرفة (٢٠ ± ٤°م). فى حين أن قيم الرطوبة للطرز البيئية V1 وكذلك V2 لم تتأثر بشكل معنوى عند نهاية فترة التخزين بالتجميد. نسب السكريات الكلية وكذلك البروتين والرماد لجميع عينات البلح المجففة بواسطة فرن التجفيف انخفضت بشكل معنوى في فترة نهاية فترة التخزين على درجة حرارة الغرفة (٢٠ ± ٤°م). بينما لم تتأثر قيم البروتين بشكل معنوى ($P \leq 0.05$) لعينات الطراز البيئي V2 بعد ٩ أشهر من التخزين على - ١٨± ٠,٥ °م. طريقة التخزين بالتجميد قادرة على أن تكون بديلا مجديا والتي تسمح بتخزين ثمار البلح الجاف على المدى الطويل وبخواص جودة عالية.