

## Effect of packaging type and storage temperatures and periods on the microbial count of AL-Deglet Noor and AL-Sagai soft dates

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### Abstract:

This study was carried out to evaluate the safety of **soft dates** ( AL-Deglet Noor and AL-Sagai); packed in carton and plastic containers ) and stored (for nine months)under freezing(-18<sup>0</sup>c), refrigeration (4<sup>0</sup>c)and room temperatures(25<sup>0</sup>c),Samples were taken from a farm in the Qassim area at October 2017 after harvesting, and microbial growth were tested. Resultsshowed the higher value of microbial load in Al-Sagai cultivar while had lower value in Al-Deglet Noor cultivar (1.500 and 1.208 cfu/g) for bacteria and (2.492 and 1.825cfu/g) for yeasts and mould respectively.

**Keywords:** Dates, Al-DegletNoor, Al-Sagai, Microbial Growth, Cultivar, Storage Period, Plastic, Carton

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### 1. INTRODUCTION:

Date Palm is one of the oldest fruit trees in the Arabian Peninsula (AP) and played a key role in the life of its people. Date fruit is marketed all over the world as a high value

confectionery and as a fresh fruit it remains an important subsistence crop in most of the desert areas. It is produced largely in the hot arid regions of the world countries, Many published research works have confirmed the close relationship between quick freezing and high-quality frozen products and the resulting increase shelf life with maximum preservation of initial quality (Sanzet *al.*1999 ؛Sun and Li, 2003; Zhangetal) 2004) .( Microbial spoilage can be caused by yeasts (most important), molds and bacteria, Yeast species of *Zygosaccharomyces* are more tolerant to high sugar content than others found in dates. Yeast-infected dates develop an alcoholic odor (become fermented). *Acetobacter* bacteria may convert the alcohol into acetic acid (vinegar). Yeasty fermentation results in souring of dates (due to accumulation of ethanol and/or acetic acid) with moisture content above 25% when kept at temperatures above 20°C and its severity increases with duration and temperature of storage. Storage at low temperatures reduces incidence and severity of souring, decay or mold. Fungi (*Aspergillus*, *Alternaria*, and *Penicillium*spp) may grow on high-moisture dates, especially when harvested following rain or high humidity period. Growth of *Aspergillus flavus* on dates can result in aflatoxin contamination that would make them unsafe for human consumption and unmarketable (Adelet *al.*2009)

Dates face many problems during storage Such as thinness, stiffness, and infestation of molds and yeast. Therefore, this study was prepared to address the storage conditions and the appropriate packaging materials in terms of temperature, storage period, and type of packaging and its effect on microbial properties during the storage period. This research illustrates deals with the study of the comparison of three storage conditions (freezing, refrigeration, and room temperature) and two packaging materials (plastic and carton) on the microbial load of soft date fruits (*AL-Deglet Noor* and *AL-Sagai* cultivars) by analysis and evaluating during nine months of storage period.

## 2. MATERIAL AND METHODS:

**Samples collected and Treatment:** Fresh mature soft date fruits (*AL-Deglet Noor and AL-Sagai*) were obtained from a commercial farm in AlQassim, Saudi Arabia, preserved in clean containers till to analysis. Dates were packed in two types of containers (Cartons and Plastic cans), the plastic cans were sterilized by alcohol 70% before usage. Fresh date fruits were stored under freezing (-18°C), refrigeration (4°C) and at room temperature (25-30 °C) for nine months. All carton containers and plastic cans that kept on room temperature were taped to prevent environmental pollution.

**Methods:** Twenty-five grams of each sample were homogenized into 225 mL of sterile maximal recovery diluent (AVONCHEM – ACM-2070 – UK) with Stomacher (SMASHER – MA106401 – FRANCE) 450-640 strokes/min, for two min. Decimal dilutions were made into the buffer dilution water to 10<sup>-6</sup>. Two plates were made for each dilution series. 20µ drop it was absorbed in 15 – 20 minutes after surface of plate dryness for each appropriate dilution, and the drop allowed spreading naturally. Total count bacteria were counted onto standard plate count agar (PCA) (MICROGEN - DM 1091 A - India) incubated at 37°C for 18 - 24 h. And the total count of yeasts and moulds were counted on yeasts and mold agar (OXOID - CM0920 - UK) incubated at 28°C for 5 – 7 days. Each sector for observed growth, colonies were counted in the sector where the highest number of full-size discrete colonies were seen (sector containing between 2-20 colonies were counted). The following equation was used to calculate the number of colonies forming unit (CFU) per ml from the original aliquot/sample:

$$CFU \text{ per ml} = \text{Average number of colonies for a dilution} \times 50 \times \text{dilution factor,}$$
  
(Miles and Misra, 1938)

**Statistical analysis:** The Least Significant Difference test (LSD test) was used to separate the means for each replicate of each sample, and the analysis of variance was performed to analyze the significant influence in all parameters (Peterson, 1985).

### 3. RESULTS:

#### 1.0 Effect of different packaging materials and Storage temperatures on total viable count of bacteria (cfu/g) during storage periods in soft dates (*Al-Deglet Noor variety*).

As shown in (Table 1), the results showed that the total viable count of bacteria (cfu/g) of soft dates wasn't growth in *Al-Deglet Noor variety* on control samples. The results showed that the packaging materials (plastic & carton), preservation condition (temperatures) and storage periods was affected on bacterial growth by increased the results at some months of storage. Results showed there was a colonies growth on the samples starting up from first month of storage at room temperature for all types of packaging materials, and in second month at refrigerator, while there had no growth of colonies in freezer for all type of packages. The study showed there was a significant different ( $P \leq 0.05$ ) between packaging materials by increased total count of bacteria (cfu/g) on *Al-Deglet Noor variety* during storage periods, and there was a significant different ( $P \leq 0.05$ ) between preservation temperatures also the storage periods affected on total count of bacteria by increased significantly. The last month of storage (9th month) at room temperature for plastic packed and last two months on same condition for carton packed the results were appeared too high because there was too high contaminated and insect infestation and there was a significant different ( $P \leq 0.05$ ).

#### 2.0 Effect of different packaging materials and preservation temperatures on total viable count of bacteria (cfu/g) during storage periods in soft dates (*Al-Sagai variety*)

As shown in (Table 2), the results showed that the total viable count of bacteria (cfu/g) of soft dates (*Al-Sagai variety*) wasn't growth as control samples. The results showed that the packaging materials affected on total count of bacteria by appeared some colonies on some samples during storage, for plastic package the study showed that some positive results on 1<sup>th</sup>, 5<sup>th</sup> and 7<sup>th</sup> months of storage when preserved on freezer, while the

results was negative when the samples stored on refrigerator and room temperature except last month of storage was appeared colonies and there was a significant difference ( $p \leq 0.05$ ). In packaging material (carton) all preservation condition was affected on total count of bacteria by appeared colonies on some months of storage significantly.

### **3.0 Effect of different packaging materials and preservation temperatures on total yeasts and moulds (cfu/g) during storage periods in soft dates (*Al-Deglet Noor* variety)**

As shown in (Table 3), the results showed that the total yeasts and moulds (cfu/g) of soft date (*Al-Deglet Noor cultivar*) was found to be 0.0 as control samples. The results showed that the packaging materials was affected on total yeasts and moulds growth on samples during storage significantly ( $p \leq 0.05$ ). for plastic package the study showed there was contaminated by yeasts and moulds on samples when were packaged and preserved on freezer and room temperature during storage for some months, while the samples had no colonies (Nil) appeared when to be preserved on refrigerator during storage except the last month of storage was contaminated. The study showed that the samples were contaminated when to be packaged on carton and stored at room temperature, while the samples were free of contaminated when to be preserved on freezer and refrigerator. it is also showed there was a significant different ( $p \leq 0.05$ ) between type of packaged and preservation condition, also showed there was a significant different ( $p \leq 0.05$ ) between types of storage for affected on total count of yeasts and moulds during storage periods.

### **4.0 Effect of different packaging materials and preservation temperatures on total yeasts and moulds (cfu/g) during storage periods in soft dates (*Al-sagai* variety)**

As shown in (Table 4), the results showed that the total yeast and mould (cfu/g) of soft date (*Al-sagai cultivar*) was found to be 0.0 as control samples. The results showed that the packaging materials was affected on total yeasts and moulds growth on samples during storage by increased result of contaminated significantly ( $p \leq 0.05$ ). The results

showed there was a significant different ( $p \leq 0.05$ ) between type of packaged and preservation condition, also showed there was a significant different ( $p \leq 0.05$ ) between types of storage for affected on total count of yeasts and moulds during storage periods. The study showed that the preservation conditions (freezer, refrigerator and room temperature) for all packaging materials (plastic & carton) were affected on colonies of yeasts and moulds by increased in some months with significant different ( $p \leq 0.05$ ) during storage periods.

### 3. DISCUSSION:

The results showed that the stored soft date on freezer had a positive effect on the total viable count for *Al-DeglatNoor* cultivar without significantly, while the stored in room temperature had a negative effect on the results for all types of packaging materials. The study showed there had a significant difference ( $p \leq 0.05$ ) between packaging materials, also preservation temperatures and storage periods affected on total viable count for *Al-Sagai* cultivar significantly. The obtained total viable count of bacteria (cfu/g) results were agreed with Salah *et al.*, (2014) who reported total viable count of bacteria for unpressed - unpitted dates ( $2.0 - 2.1 \times 10^3$  /cfu/g) for different size of AL-Deglet Noor and AL-Sagai cultivars during some months of storage period. And was disagreed with Abekhti *et al.*, (2013) who mentioned total viable count of bacteria was ( $3.5 \times 10^2$ ). Some results difference is due to samples cultivars, handling, and other reactions. For Al-Sagai variety the obtained results of total yeasts and moulds were agreed with Salah *et al.*, (2014) who reported total yeasts and mould for unpressed – unpitted dates (0.0 - 900 cfu/g) for different size of packaged for soft dates (*AL-Deglet Noor* and *AL-Sagaic* cultivars). Some results were appeared positive due to samples cultivars and handling and other reactions like high contaminated by yeasts and moulds, weathers storage condition and samples treatment.

**Table (1): Effect of different packaging materials and preservation temperatures on total viable count of bacteria (cfu/g) during storage periods in soft dates (*Al-Deglet Noor variety*)**

Overall mean storage period	Packaging material						Storage period (month)
	Carton			Plastic			
	Storage temperature						
	Room temp.	Refrigerator	Freezer	Room temp.	Refrigerator	Freezer	
No growth	No growth						Control
0.6667 <sup>BC</sup>	2.00±1.41 <sup>e</sup>	0.00±0.00 <sup>f</sup>	0.00±0.00 <sup>f</sup>	2.00±0.00 <sup>e</sup>	0.00±0.00 <sup>f</sup>	0.00±0.00 <sup>f</sup>	1 <sup>st</sup> month
1.333 <sup>B</sup>	2.00±2.83 <sup>e</sup>	2.00±1.41 <sup>e</sup>	0.00±0.00 <sup>f</sup>	2.00±2.83 <sup>e</sup>	2.00±0.00 <sup>e</sup>	0.00±0.00 <sup>f</sup>	2 <sup>nd</sup> month
5.833 <sup>A</sup>	0.00±0.00 <sup>f</sup>	0.00±0.00 <sup>f</sup>	0.00±0.00 <sup>f</sup>	0.00±0.00 <sup>f</sup>	35.00±7.07 <sup>a</sup>	0.00±0.00 <sup>f</sup>	3 <sup>rd</sup> month
1.083 <sup>BC</sup>	0.00±0.00 <sup>f</sup>	0.00±0.00 <sup>f</sup>	0.00±0.00 <sup>f</sup>	6.50±2.12 <sup>c</sup>	0.00±0.00 <sup>f</sup>	0.00±0.00 <sup>f</sup>	4 <sup>th</sup> month
0.00 <sup>D</sup>	0.00±0.00 <sup>f</sup>	0.00±0.00 <sup>f</sup>	0.00±0.00 <sup>f</sup>	0.00±0.00 <sup>f</sup>	0.00±0.00 <sup>f</sup>	0.00±0.00 <sup>f</sup>	5 <sup>th</sup> month
0.00 <sup>D</sup>	0.00±0.00 <sup>f</sup>	0.00±0.00 <sup>f</sup>	0.00±0.00 <sup>f</sup>	0.00±0.00 <sup>f</sup>	0.00±0.00 <sup>f</sup>	0.00±0.00 <sup>f</sup>	6 <sup>th</sup> month
1.083 <sup>BC</sup>	0.00±0.00 <sup>f</sup>	0.00±0.00 <sup>f</sup>	0.00±0.00 <sup>f</sup>	0.00±0.00 <sup>f</sup>	0.00±0.00 <sup>f</sup>	6.50±4.9 <sup>c</sup>	7 <sup>th</sup> month
1.25 <sup>BC</sup>	7.50±2.12 <sup>b</sup>	0.00±0.00 <sup>f</sup>	0.00±0.00 <sup>f</sup>	0.00±0.00 <sup>f</sup>	0.00±0.00 <sup>f</sup>	0.00±0.00 <sup>f</sup>	8 <sup>th</sup> month
0.8333 <sup>BC</sup>	TNTC	2.00±2.83 <sup>e</sup>	0.00±0.00 <sup>f</sup>	3.00±1.41 <sup>d</sup>	0.00±0.00 <sup>f</sup>	0.00±0.00 <sup>f</sup>	9 <sup>th</sup> month
	0.52 <sup>B</sup>			1.90 <sup>A</sup>			Overall mean packaging materials
	1.25 <sup>B</sup>		2.05 <sup>A</sup>		0.325 <sup>C</sup>		Overall

				<b>mean storage temp.</b>
0.001**				<b>P-value</b>
1.751				<b>Lsd<sub>0.05</sub></b>
0.726				<b>SE±</b>

Mean±SD values having different superscripts are significantly different ( $P \leq 0.05$ ).

**Table (2): Effect of different packaging materials and preservation temperatures on total viable count of bacteria (cfu/g) during storage periods in soft dates (*Al-Sagai variety*)**

Overall mean storage period	Packaging material						Storage period (month)
	Carton			Plastic			
	Storage temperature						
	Room temp.	Refrigerator	Freezer	Room temp.	Refrigerator	Freezer	
No growth	No growth						Control
0.6667 <sup>C</sup>	0.00±0.00 <sup>g</sup>	0.00±0.00 <sup>g</sup>	0.00±0.00 <sup>g</sup>	0.00±0.00 <sup>g</sup>	0.00±0.00 <sup>g</sup>	4.00±2.83 <sup>d</sup>	1 <sup>st</sup> month
0.00 <sup>D</sup>	0.00±0.00 <sup>g</sup>	0.00±0.00 <sup>g</sup>	0.00±0.00 <sup>g</sup>	0.00±0.00 <sup>g</sup>	0.00±0.00 <sup>g</sup>	0.00±0.00 <sup>g</sup>	2 <sup>nd</sup> month
5.00 <sup>A</sup>	2.00±2.83 <sup>f</sup>	0.00±0.00 <sup>g</sup>	28.00±2.83 <sup>a</sup>	0.00±0.00 <sup>g</sup>	0.00±0.00 <sup>g</sup>	0.00±0.00 <sup>g</sup>	3 <sup>rd</sup> month
1.00 <sup>C</sup>	6.00±5.66 <sup>c</sup>	0.00±0.00 <sup>g</sup>	0.00±0.00 <sup>g</sup>	0.00±0.00 <sup>g</sup>	0.00±0.00 <sup>g</sup>	0.00±0.00 <sup>g</sup>	4 <sup>th</sup> month
0.75 <sup>C</sup>	0.00±0.00 <sup>g</sup>	0.00±0.00 <sup>g</sup>	2.50±0.71 <sup>f</sup>	0.00±0.00 <sup>g</sup>	0.00±0.00 <sup>g</sup>	2.00±1.41 <sup>f</sup>	5 <sup>th</sup> month
0.00 <sup>D</sup>	0.00±0.00 <sup>g</sup>	0.00±0.00 <sup>g</sup>	0.00±0.00 <sup>g</sup>	0.00±0.00 <sup>g</sup>	0.00±0.00 <sup>g</sup>	0.00±0.00 <sup>g</sup>	6 <sup>th</sup> month
3.833 <sup>B</sup>	3.00±0.00 <sup>e</sup>	8.50±0.71 <sup>b</sup>	3.00±2.83 <sup>e</sup>	0.00±0.00 <sup>g</sup>	0.00±0.00 <sup>g</sup>	8.50±4.95 <sup>b</sup>	7 <sup>th</sup> month
0.00 <sup>D</sup>	0.00±0.00 <sup>g</sup>	0.00±0.00 <sup>g</sup>	0.00±0.00 <sup>g</sup>	0.00±0.00 <sup>g</sup>	0.00±0.00 <sup>g</sup>	0.00±0.00 <sup>g</sup>	8 <sup>th</sup> month
3.75 <sup>B</sup>	6.00±1.41 <sup>c</sup>	8.00±1.41 <sup>b</sup>	0.00±0.00 <sup>g</sup>	2.50±0.71 <sup>f</sup>	6.00±2.83 <sup>c</sup>	0.00±0.00 <sup>g</sup>	9 <sup>th</sup> month

	2.23 <sup>A</sup>		0.77 <sup>B</sup>		<b>Overall mean packaging materials</b>
	0.98 <sup>B</sup>	1.13 <sup>B</sup>		2.40 <sup>A</sup>	<b>Overall mean storage temp.</b>
0.003 <sup>**</sup>					<b>P-value</b>
0.6253					<b>Lsd<sub>0.05</sub></b>
0.4122					<b>SE±</b>

Mean±SD values having different superscripts are significantly different ( $P \leq 0.05$ ).

Overall mean storage period	Packaging material						Storage period (month)
	Carton			Plastic			
	Storage temperature						
	Room temp.	Refrigerator	Freezer	Room temp.	Refrigerator	Freezer	
No growth	No growth						<b>Control</b>
2.50 <sup>C</sup>	Nil	Nil	Nil	13.00±2.83 <sup>a</sup>	Nil	2.00±1.41 <sup>l</sup>	<b>1<sup>st</sup> month</b>
0.50 <sup>E</sup>	3.00±1.41 <sup>j</sup>	Nil	Nil	Nil	Nil	Nil	<b>2<sup>nd</sup> month</b>
2.42 <sup>C</sup>	12.00±2.83 <sup>b</sup>	Nil	Nil	2.50±0.71 <sup>k</sup>	Nil	Nil	<b>3<sup>rd</sup> month</b>
3.00 <sup>B</sup>	4.00±0.0 <sup>i</sup>	Nil	Nil	6.50±2.12 <sup>f</sup>	Nil	7.50±1.061 <sup>e</sup>	<b>4<sup>th</sup> month</b>
0.50 <sup>E</sup>	3.00±0.00 <sup>j</sup>	Nil	Nil	Nil	Nil	Nil	<b>5<sup>th</sup> month</b>
1.00 <sup>D</sup>	Nil	Nil	Nil	6.00±1.41 <sup>g</sup>	Nil	Nil	<b>6<sup>th</sup> month</b>
3.75 <sup>A</sup>	12.00±0.00 <sup>b</sup>	4.00±5.66 <sup>i</sup>	Nil	4.50±3.54 <sup>h</sup>	Nil	2.00±0.00 <sup>l</sup>	<b>7<sup>th</sup> month</b>
1.25 <sup>D</sup>	TNTC	Nil	Nil	7.50±3.54 <sup>e</sup>	Nil	Nil	<b>8<sup>th</sup> month</b>
3.33 <sup>AB</sup>	11.50±0.71 <sup>c</sup>	Nil	Nil	Nil	8.50±2.12 <sup>d</sup>	Nil	<b>9<sup>th</sup> month</b>

	1.65 <sup>B</sup>		2.00 <sup>A</sup>		<b>Overall mean packaging materials</b>
	4.28 <sup>A</sup>	0.63 <sup>B</sup>	0.58 <sup>B</sup>		<b>Overall mean storage temp.</b>
	0.018*				<b>P-value</b>
	0.479				<b>Lsd<sub>0.05</sub></b>
	0.136				<b>SE±</b>

**Table (3): Effect of different packaging materials and preservation temperatures on total yeast and mould (cfu/g) during storage periods in soft dates (*Al-Deglet Noor* variety)**

Mean±SD values having different superscripts are significantly different (P≤0.05).

**Table (4): Effect of different packaging materials and preservation temperatures on total yeast and mould (cfu/g) during storage periods in soft dates (*Al-Sagai* variety)**

Overall mean storage period	Packaging material						Storage period (month)
	Carton			Plastic			
	Storage temperature						
	Room temp.	Refrigerator	Freezer	Room temp.	Refrigerator	Freezer	
No growth	No growth						<b>Control</b>
4.83 <sup>C</sup>	Nil	Nil	Nil	Nil	11.00±1.41 <sup>d</sup>	18.00±2.83 <sup>c</sup>	<b>1<sup>st</sup> month</b>
1.50 <sup>D</sup>	Nil	Nil	Nil	4.50±0.71 <sup>i</sup>	4.50±0.71 <sup>i</sup>	Nil	<b>2<sup>nd</sup> month</b>
0.33 <sup>E</sup>	Nil	Nil	Nil	2.00±0.00 <sup>m</sup>	Nil	Nil	<b>3<sup>rd</sup> month</b>
1.67 <sup>D</sup>	TNTC	Nil	2.50±2.12 <sup>l</sup>	2.50±0.71 <sup>l</sup>	5.00±4.24 <sup>h</sup>	Nil	<b>4<sup>th</sup> month</b>
6.17 <sup>B</sup>	19.50±4.95 <sup>b</sup>	2.50±0.71 <sup>l</sup>	3.00±1.41 <sup>k</sup>	Nil	2.50±0.71 <sup>l</sup>	9.50±9.19 <sup>e</sup>	<b>5<sup>th</sup> month</b>
1.50 <sup>D</sup>	Nil	Nil	Nil	7.50±3.54 <sup>f</sup>	Nil	Nil	<b>6<sup>th</sup> month</b>

1.42 <sup>D</sup>	1.50±0.71 <sup>n</sup>	3.00±0.00 <sup>k</sup>	Nil	Nil	Nil	4.00±0.00 <sup>j</sup>	<b>7<sup>th</sup> month</b>
Nil	Nil	Nil	Nil	Nil	Nil	Nil	<b>8<sup>th</sup> month</b>
7.50 <sup>A</sup>	35.50±7.78 <sup>a</sup>	Nil	2.00±2.83 <sup>m</sup>	2.00±0.00 <sup>m</sup>	5.50±2.12 <sup>g</sup>	Nil	<b>9<sup>th</sup> month</b>
	2.32 <sup>B</sup>			2.62 <sup>A</sup>			<b>Overall mean packaging materials</b>
	3.75 <sup>A</sup>		1.70 <sup>B</sup>		1.95 <sup>B</sup>		<b>Overall mean storage temp.</b>
							<b>P-value</b>
0.392							<b>Lsd<sub>0.05</sub></b>
							<b>SE±</b>

Mean±SD values having different superscripts are significantly different ( $P \leq 0.05$ ).

## CONCLUSION:

From the facts cited in this study it could be established that, the stored soft date on freezer had a positive effect on the total viable count for Al-Deglat Noor cultivar, while the stored in room temperature had a negative effect on the results for all types of packaging materials. Keeping that in mind, according to (Zamir, Islam et al. 2018) the following is recommended: (i) treating the packaged samples with  $\gamma$  irradiation before storage and transportation as an effective way to mitigate the possible microbial risks is required; (ii) washing the dates with food grade sanitizers before consumption is advised to assure further safety.

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## تأثير نوع التغليف ودرجات حرارة التخزين وفتراته على العدد الميكروبي لتمر الدجلة نور والصقعي الطرية

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### المستخلص:

أجريت هذه الدراسة لتقييم سلامة التمر الرطبة (دجلة نور والصقعي) المعبأة في مواد تعبئة مختلفة (الكرتون والبلاستيك) و مخزنة (لمدة تسعة أشهر) تحت درجات حرارة مختلفة (التجميد -١٨ درجة مئوية، التبريد ٤ درجة مئوية وحرارة الغرفة ٢٥ درجة مئوية). أخذت العينات من مزرعة بمنطقة القصيم وأجريت لها التحاليل الميكروبية (البكتيريا الكلية (cfu/g) والفطريات والخمائر الكلية) فقد وجد أعلى متوسط معنوي لصنف الصقعي وأقل متوسط معنوي لصنف دجلة نور (١,٥٠٠، ١,٢٠٨، ٢,٤٩٢، ١,٨٢٥) (cfu/g) للبكتيريا و الخمائر والفطريات على التوالي.

**الكلمات المفتاحية:-** التمر، دجلة النور، الصقعي، نمو ميكروبي، أنواع، دورة التخزين، بلاستيك، كرتون

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