IMPACT OF STORAGE AND PACKAGING CONDITIONS ON PHYSICO-CHEMICAL PROPERTIES OF DATE PASTE.

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ABSTRACT

The effect of storage period (12 months) and temperature (room and refrigerated) as well as packaging media (polyethylene bags under vacuum or under atmospheric pressure) on some of the physical and chemical properties of three date varieties (Rezaiz, Barni and Khudari) paste were evaluated. Data indicates that date varieties, storage temperature and period as well as packaging media significantly ($p>0.05$) affected moisture, sugars contents, acidity, color, pH and hardness of date paste. Storage temperature was found to be the most significant ($P>0.05$) parameter effecting the physico-chemical properties of the date paste. In contrast storage media showed a significant ($P>0.05$) effect only on moisture, sucrose contents and acidity of the date paste. Meanwhile storage period showed a significant ($P>0.05$) effect only on moisture content, total solids and acidity of the date paste.

INTRODUCTION

Dates production in the kingdom of Saudi Arabia has bean raised in the recent years due to the increase in the number of date palm planted those reaches 18,2 million trees in 1996. Its annual production is estimated at about 735,000 tons, which qualify it to rank the first among the dates producing countries (Ministry of Agriculture and Water, 2001). The majority of produced dates are consumed at the rutab and tamr stages while a small percentage (9%) is processed into date products by twenty one factories producing approximately 51,000 tons a year (Mustafa, *et al.,* 1983; Al-juhaimi 2001; and Eleid, 2000). Due to the governmental support and subsidy date production is expected to increase subsequently the quantities of processed date should increased. There are several ways by which it might be possible to absorb the increased amount of date production including jam industry, date syrup, beverage drinks, ethyl alcohol and acetic acid industries (Al-juhaimi 2001). In the last few years, date factories in countries, which used to produce packed dates only have increased and diversified their production. Date paste was produced as a new product (Yousif *et al.,* 1986). Processing of date to date paste serves as one way not only to reduce transportation and storage costs but also to provide availability of the fruit paste during the whole year. It facilities to protect the date paste from microbial spoilage and other spoilage changes such as insect infestation by the proper formulation and packaging (Yousif, *et al.,* 1986). Recently, several factories produced the date paste as a semi-processed date material, but no survey has been conducted to determine the use of and attitude towards the date paste in food industry. Several researchers have mentioned the importance of date paste as intermediate product in confectionery, bakery, and other food industry (Barreveld, 1971; Hussein, 1975; Mikki, *et al.*, 1983; Mustafa, *et al.,* 1983 Yousif, *et al.,* 1986 and Eleid, 2000).

Basic knowledge of the storage stability of the date paste is required to develop and increase its utilization in the food industry. Several researches were recorded on the storage stability of date paste. Yousif, *et al.* 1986 studied the storage stability of date paste prepared by four different techniques. Chemical changes associated with American date deterioration were also studied by Maier and Schiller (1961a, b). Norman *et al* (1975) studied the quality changes of dates under various combination of out door and refrigerated storage conditions. Browning reaction in iraqi Zahdi dates was also examined by Mohammad *et al.* (1985). The present study aims to evaluate the effect of storage and packaging conditions on the physio-chemical properties of date paste manufactured from three main date varieties grown in the kingdom of Saudi Arabia.

MATERIALS AND METHODS

Collecting of Date Samples

Fumigated date fruits varieties Rezaiz (predominant at Al-Hassa), Barni (predominant at Madinah) and Khudari (predominant at Riyadh) were obtained from Nadec (National Agriculture Development Company) Date Factory in Al-Hassa.

Date paste preparation

Date fruits were washed and left to dry in plastic containers with plastic net underneath to facilitate dryness and maintain the moisture content then pitted, grounded in a meat mincer and then packed either under vacuum or under atmospheric pressure in half kilo gram plastic bags. The date pastes were stored at 25ºC and 5ºC for 0, 6 and 12 months before analysis were conducted.

Physico-chemical analysis

Moisture and acidity of date pastes were determined by standard methods of AOAC (1995). Total soluble solids expressed as Brixº values were determined with an Abbe Refractometer (Melton Roy). Sugars (reducing and sucrose) contents were determined by lane-eynon method of AOAC (1995) .The pH was measured by a pH Meter (Metrohm pH /millivolt meter, model 744). Date pastes color was determined by spectrophotometry, for this a duplicate of 5g date paste sample was extracted with 100ml of warm water for 2 minutes. Extracts were filtered and optical density at 420nm was measured using UV/VIS spectrophotometer (Milton Roy model spectronic 20). Hardness was

measured at 25ºC using a cone pentrometer model Setic-matic (Starhope Ltd).The yield value (hardness) was expressed as distance of penetration in mm.

Statistical analysis:

Data were statistically analyzed using SAS (ver. 6.12) computring software as the usual technique of analysis of variance (AOV) for factorial experiment in completely randomized design as published by Gomez and Gomez (1984). Treatment means were compared using the newly Least significant difference (NLSD) at 5% level of probability (Waller and Duncan, 1969). Line chart were drawn for each date paste type to show the relationship between storage period and packaging conditions and the main effects which were taken into consideration in this study which include moisture content, pH, color, hardness, acidity and sugar content.

RESULTS AND DISCUSSION

Effect of date varieties, storage and packaging condition on chemical properties of date pastes

Table 1 and 2 show the overall average values of moisture and sugar contents of date paste during storage as affected by date varieties, storage temperature and packaging conditions. As indicated by the NLSD values, significant differences could be observed between varieties, storage temperature, storage period, packaging conditions and interactions. The data indicate that date variety significantly affected moisture and sugar contents of the evaluated date pastes. Compared to Barne and Ruzaiz date pastes, Khudari date paste showed significantly lower moisture content. Regarding sugar contents, Barni date paste had significantly lower total, sucrose and reducing sugars than the other two varieties. Moreover, Khudari and Rezaiz date pastes did not show significant differences in both total sugar and sucrose content. It is also clear that Khudari date paste contained significantly higher reducing sugars than the other two examined varieties.

Concerning the storage conditions, it is clear that the moisture content of the date pastes was significantly affected by the storage and packaging conditions. The storage temperature significantly affected the moisture content of all date paste samples. The samples stored in the refrigerator showed significantly lower moisture content than those stored at room temperature. With regard to packaging media, the date paste stored under vacuum showed significant higher moisture content than normal packaged date paste at the end of the storage period (12months). The data presented in tables 1 and 2 also reveal that the date paste's moisture content decreased significantly with the advance of storage period. In another words, moisture content in date past was decreased as storage period was increased.

In the other hand, the sugar contents of the date paste samples were significantly affected by the storage period (Tables 1 and 2). Reducing sugar content significantly decreased while total sugar and sucrose contents were significantly increased at the end of the storage period. Date paste samples stored at 5ºC (refrigerated) revealed a significantly lower reducing sugar but a significantly higher total and reducing sugar contents than those stored at room temperature at the end of the storage period. It is also possible to conclude that the date paste sample packed under vacuum exhibited a significantly higher sucrose, total and reducing sugar contents than those normally packed at the end of the storage period.

In general, from the forgoing results it could be concluded that the change in the total sugar content of date paste samples is related to the change in the moisture content. As the moisture content of the date paste decreases the total sugar content increases during storage. Yousif *et al*., (1991) found that the type of pack and the storage time were significantly affected the moisture content of the stored (16 weeks) date paste. The polyethylene-packed date paste lost a considerable amount of moisture compared to the glass-jar and canned date pate because of less effective moisture barrier of the polyethylene (Gilbert 1985). In another study Khatchadourian *et al*. (1986) found that total solid in date products decreased after storing for 90 days at 25ºC. They suggested that this behavior might be attributed to the slight loss of residual moisture from the dates in the pulp to the preserving medium till equilibrium reached in solute concentration.

Table (1). Average values of some chemical properties of date paste as affected by varieties, storage and packaging conditions

Variables	Moisture %	Sugar		
		Total (Brixº)	Reducing %	Sucrose %
Varieties:				
Barni	10.70A	69.25B	67.30C	2.06B
Khudari	10.04C	70.67A	67.91A	2.59A
Rezaiz	11.19A	70.51A	67.62B	2.58A
Storage treatments				
Fresh	12.62a	70.12b	68.41b	2.39 c
Nroom6	11.22b	70.00d	67.78c	2.11 f
Nroom12	10.61d	70.10d	67.00d	2.95 b
Vroom6	11.20b	70.02d	67.88c	2.03 f
Vroom12	10.74c	70.64c	67.66c	3.45a
Nref6	10.33e	68.63e	66.16e	2.24d
Nref12	9.21g	70.95b	68.61b	1.91g
Vref6	10.36e	68.31f	66.00e	2.20d
Vref12	9.53f	71.51a	69.02a	2.43c

Means in the same column bearing different upper case letters are significantly different (p<0.05).
Means in the same column bearing different lower case letters are significantly different (p<0.05).
Nroom6 = packed in air and stored at room temp. for 6 months
Nroom12 = packed in air and stored at room temp. for 12 months
Vroom6= packed under vacuum and stored at room temp. for 6 months
Vroom12 = packed under vacuum and stored at room temp. for 12 months
Nref6 = packed in air and stored at 5ºC for 6 months
Nref12 = packed in air and stored at 5ºC for 12 months
Vref6 = packed under vacuum and stored at 5ºC for 6 months
Vref12 = packed under vacuum and stored at 5ºC for 12 months

Effect of date varieties, storage and packaging condition on physical properties of date pastes

Tables 3 and 4 illustrate the overall average values of acidity, pH, color and hardness of date paste during storage in response to date varieties, storage temperature and packaging conditions. Data analysis showed that date variety significantly affected acidity, pH, color and hardness of date pastes. Ruzaiz date paste showed significantly the highest acidity, compared to the other two tested date varieties. Khudari and then Barni followed it. Ruzaiz date paste exhibited significantly lower pH values than the other two varieties, while Khudari and Barni date paste did not show significant differences in their pH values. It is also clear that the color values of Ruzaiz date paste were significantly higher than those of the other two varieties, which their color values did not posses significant differences. Regarding the hardness of the date paste samples varieties were found significantly differed in their values. The highest hardness value was observed in Khudari (201mm) date paste while the lowest was observed in Ruzaiz (2.77mm).

The packaging and storage conditions of the date paste were also found to significantly affect its physical properties. Date paste's acidity did not changed significantly when packed under vacuum and stored for 12 months at 5ºC. In the other hand, a significant decrease in date paste acidity was observed in the rest treatments. As shown in table (4), significant decreases in date pastes pH were only observed when the date pastes were packed either under vacuum or in air and stored at 25ºC. The present finding have shown that the color of the date pastes is mainly influenced by storage temperature. Regardless of the packaging medium, date pastes stored at room temperature show significantly higher color values than those stored at 5ºC. Hardness of date pastes was significantly increased with the increase in storage period. The lowest hardness values were observed for those date pastes stored at 5ºC regardless of the packaging media.

Generally, it is possible to conclude that the acidity of the date paste samples were significantly affected by the storage temperature, storage period and storage medium while the pH, color and hardness of the date pastes were only significantly affected by the storage temperature. These results

support earlier research findings of Yousif *et al*. (1986 a&b; 1991) who found that no deleterious changes in quality attributes (color, pH and sugar content) of the date paste when it was stored for 8 weeks at 5ºC or for 16 weeks for 25ºC. They concluded that the storage temperature and period affect color and pH of the date past. Date paste color tends to change (darkening and browning) with the increase of the storage period and or storage temperature as a result of the interaction between the reducing sugars and amino acid. Maire and Schiller (1961a) and Mohammad *et al*. (1985) suggested that the darkening of date paste could be attributed to the effect of both the enzymatic and non-enzymatic browning. The non-enzymatic browning is significant and more dependent on temperature than on moisture content or water activity (aw) level (Al-juhaimi, 2001).

2

Table 3. Average values of physical properties of date paste as affected by varieties, storage and packaging conditions

Variables	acidity	PH	Color Abs at 420nm	Hardness (mm)
Varieties:				
Barni	45.25C	5.56A	0.40B	2.34B
Khudari	46.88B	5.57A	0.39B	2.01C
Rezaiz	56.09A	5.41B	0.60A	2.77A
Storage treatments				
Fresh	53.46a	5.60a	0.42b	10.26a
Nroom6*	51.50c	5.42b	0.43b	1.58b
Nroom12*	52.50b	5.38b	0.59a	1.62b
Vroom6*	53.92a	5.33b	0.44b	1.39c
Vroom12*	53.91a	5.30c	0.62a	1.67b
Nref6*	44.03f	5.66a	0.38c	1.42c
Nref12*	45.08e	5.62a	0.45b	1.17e
Vref6*	44.52f	5.68a	0.38c	1.20d
Vref12*	45.75d	5.65a	0.43b	1.09e

Means in the same column bearing different upper case letters are significantly different ($p<0.05$).
Means in the same column bearing different lower case letters are significantly different ($p<0.05$).
***See foot note under table 1 for details**

As to the pH the present results support earlier observations reported by several authors (Yousif *et al*., 1986 and 1991). Their findings indicated that the date paste pH decrease as the storage period and or temperature increases. The same pattern was also noticed with date paste darkening which indicates that the decrease in pH is a result of the same reaction systems that cause darkening.

The hardness of the date paste was also found by Yousif *et al*., 1991 to be storage period dependent. The present results supported their findings, which indicates that the hardness values of date paste increase with each increment in storage and the maximum increase in hardness was noticed in the polyethylene-packed date paste. Both results are in agreement with the moisture results and confirmed Kapsalis (1967) findings of stored dehydrated foods.

4

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تأثير بعض ظروف التعبئة والتخزين على الخواص الفيزيو -كيميائية لعجينه التمور

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تم دراسة وتقييم تأثير كلا من فترة (١٢ شهر) ودرجة حرارة (٥ درجات و٢٥ درجه) التخزين ووسط التعبئة (أكياس البولي ايثيلين تحت الضغط العادي أو تحت التفريغ) على بعض الصفات الفيزيو – كيميائية لثلاثة أصناف سعودية (الرزيز –

الخضري – البرني) من عجائن التمور. تم تعبئة (٥٠٠جرام) العجائن في أكياس بلاستيكية (بولي اثيلين) ثم خزنت العينات على درجة حرارة الغرفة (٢٥ درجة) أو في الثلاجة (٥ درجات) لمدة ٦ اشهر أو ١٢ شهر أجريت خلالها تحليلات فيزيو – كيميائية على العينات لمعرفة التغيرات في نسبة الرطوبة, السكريات الكلية, السكريات المختزلة, السكروز, الحموضة الكلية, درجة تركيز أيون الهيدروجين (pH), اللون, الصلابة. أظهرت نتائج التحليل التأثير المعنوي (p>٠,٠٥) لصنف التمر و درجة حرارة التخزين ووسط التعبئة على كلا من رطوبة ,محتوى السكريات,حموضة, لون, pH وصلابة العجينة. وكانت اكثر هذه العوامل تأثير على الخصائص الفيزيو – كيميائية للعجين درجة حرارة التخزين أما وسط التعبئة فلم يكن له تأثير معنوي (p>٠,٠٥) إلا على رطوبة وحموضة ومحتوى السكروز في العجينة في حين كان تأثير فترة التخزين معنويا (p>٠,٠٥) على حموضة ومحتوى العجينة من الرطوبة و السكريات الكلية.

Table 2. Effect of storage and packaging conditions on chemical properties of the three date varieties pastes

Storage conditions	Moisture(%)						Sugars					
				Total (Brixº)			Reducing (%)			Sucrose(%)		
	Rezaiz	Khudari	Barni	Rezaiz	Khudari	Barni	Rezaiz	Khudari	Barni	Rezaiz	Khudari	Barni
Fresh	13.00	12.01	12.86	71.44	71.84	70.07	69.43	67.46	68.35	1.41	4.11	1.64
Nroom6*	11.58	10.36	11.71	70.36	70.07	69.57	67.88	67.85	67.61	2.36	2.11	1.86
Nroom12*	10.87	10.48	10.47	10.87	71.41	67.83	66.90	68.41	65.69	3.96	2.85	2.03
Vroom6*	11.47	10.51	11.63	70.40	69.81	69.85	68.42	67.36	67.88	1.88	2.33	1.87
Vroom12*	11.46	10.53	10.22	71.75	69.72	70.45	66.51	67.01	69.47	4.98	2.57	2.81
Nref6*	10.88	9.30	10.82	68.76	68.70	68.42	66.28	66.52	65.55	2.06	2.07	2.58
Nref12*	10.12	8.88	8.62	71.52	71.79	69.53	68.41	69.35	68.08	2.17	2.18	1.38
Vref6*	10.91	9.33	10.84	67.65	69.36	67.92	65.51	66.93	65.55	2.03	2.31	2.25
Vref12*	10.45	8.98	9.16	71.67	73.29	69.58	69.32	70.36	67.39	2.41	2.78	2.09
NLSD(0.05)	1.8			0.48			0.68			1.8		

***See foot note under table 1 for details**

Table 4. Effect of storage and packaging conditions on physical properties of the three date arieties pastes

Storage conditions	Acidity Meq./kg			PH			Color (Abs. at 420nm)			Hardness (mm)		
	Rezaiz	Khudari	Barni	Rezaiz	Khudari	Barni	Rezaiz	Khudari	Barni	Rezaiz	Khudari	Barni
Fresh	60.99	50.05	49.33	5.46	5.63	5.72	0.56	0.35	0.34	13.33	8.07	9.37
Nroom6*	60.69	45.87	47.95	5.40	5.47	5.38	0.56	0.37	0.36	1.73	1.46	1.56
Nroom12*	61.69	46.87	48.95	5.38	5.42	5.33	0.75	0.52	0.50	1.50	1.52	1.83
Vroom6*	61.82	52.13	44.75	5.21	5.40	5.39	0.58	0.37	0.37	1.47	1.22	1.47
Vroom12*	62.86	52.04	46.82	5.19	5.38	5.34	0.76	0.38	0.60	1.76	1.54	1.70
Nref6*	47.81	42.49	41.79	5.51	5.75	5.71	0.52	0.51	0.31	1.50	1.29	1.47
Nref12*	49.44	43.98	41.83	5.48	5.71	5.68	0.60	0.37	0.38	1.20	1.00	1.30
Vref6*	48.90	43.78	40.87	5.57	5.70	5.78	0.49	0.33	0.33	1.30	0.99	1.30
Vref12*	50.62	44.75	41.87	5.53	5.67	5.74	0.54	0.36	0.40	1.17	1.00	1.10
NLSD(0.05)	0.84			0.18			0.6			0.18		

*** See foot note under table 1 for details**