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EVALUATION OF QUALTY ATTRIBUTES FOR EGYPTIAN APRICOT AND FIG CULTIVARS PRODUCED BY OSMODRYING PROCESS

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ABSTRACT

This study was carried out to assess the quality parameters of osmo-dried apricot and fig pretreated with various type of osmotic sugar syrup i.e. glucose, fructose, sucrose and fructose- glucose mixture comparing with those produced by sun drying. The syrup mixture of glucose- fructose (2:1) had the lowest osmosis time for osmosed apricot followed by syrups of fructose, glucose and sucrose, respectively. However, the reduction time of dehydration for both apricot and fig caused to obtain the higher percentage of solid gain (SG) and total solids (T.S) than that obtained by sun-drying. Furthermore, the dehydration parameters (WL and WC) were strictly related to the type and concentration of the used osmosis solution. The phsico-chemical properties, microbiological assessment and quality attributes of both osmo-dried and sun-dried apricot and fig just after processing and during storage for 9 months were also undertaken. Results indicated that, osmo-dried apricot and fig pretreated with glucose syrup had the highest retention of ascorbic acid followed by sucrose, mixture of glucose- fructose (2:1) and fructose, respectively. Reducing sugar content were ranged between 55.47 to 55.77% and 53.97 to 54.70% for osmos-dried apricot and fig with various pretreatments just after processing. While, the corresponding values of fibers were ranged between 5.4o to 4.64% and 18.11 to 18.20%, respectively. The sun- dried apricot and fig had the highest total microbial contents ($7.4x10^2$ and $8.1x10^2$cfu/g) followed by osmo-dried pretreated with fructose ($2.4x 10^2$ and $3.6x10^2$ cfu/g), mixture of glucose - fructose (2:1) ($2.3x10^2$ and $2.9x10^2$ cfu/g), sucrose ($2.1x10^2$ and $2.8x10^2$ cfu/g) and glucose ($1.9x10^2$ and $2.4x10^2$ cfu/g), respectively. On the other hand, all tested counts of microorganisms either total counts of flora or yeasts and molds showed to be proportional reduction with extending the storage period and reached to the maximum reduction after 9 month of storage. The osmo-dried apricot and fig pretreated with fructose syrup recorded the highest scores of color, texture, taste, flavor and overall acceptability followed by osmo-dried samples pretreated with syrups of glucose – fructose (2:1), glucose , sucrose and sun-dried just after processing and after 3,6 and 9 months of storage at ambient temperature. Therefore, pretreatment of apricot and fig with osmotic sugar solution to produce osmo-dried product play an important role for producing high quality dried apricot and fig than those produced by sun-drying process.

INTRODUCTION

Osmotic dehydration process are widely applied to obtain high quality intermediate moisture foods. Dehydration kinetics and mass transfer mechanisms is very important for understanding and controlling the osmotic dehydration process **(Derossi *et al* 2008).**

Osmotic dehydration is used for partial removal of water from materials such as fruits and vegetables, when immersed in a concentrated solution of

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sugar or salt **(Rastogi *et al* 1997)**. On the other hand, the use of osmotic dehydration like a previous step to drying process could be an interesting option in order to reduce costs or to preserve the characteristics of food material **(Moreira *et al* 2007)**. Also, the osmotic dehydration process is simple, economical and nondestructive with least wastage of fruit during processing (**Sharma *et al* 2006)**.

The earliest uses of food desiccation is consisted simply of exposing fresh foods to sunlight until drying had been achieved. Through this method of drying, which is referred to as sun drying, certain foods may be success fully preserved if the temperature and relative humidity allow. Fruits such as apricot and fig may be dried by sun-drying. This method, which requires a large amount of space for large quantities of the product. Some advantages of the direct osmosis in comparison with other methods during process include minimized heat damage to color and flavor, less discoloration of the fruit by enzymatic oxidative browning **(Ponting *et al* 1966). Contreras and Smyrl (1981)** noted that, osmosis was effective in preventing fruit discoloration by enzymatic oxidative browning, thus precluding the use of sulphur dioxide. **Farkas and Lazar (1969) & Kanner *et al* (1981)** they indicated that, an increased sugar content in the concentrated fruit produces a sweeter flavor in the processed fruits.

Moreover, this type of technology is primary stabilization process such as sterilization or freezing, where, the a_w is not the unique factor affecting the shelf- life of this product and furthermore the most consistent changes in its composition occurred in about two hours of process **(Giangiacomo *et al* 1987)**.

The objective of this investigation was carried out to study the effect of using various osmotic sugar syrups as pretreatments for producing of osmo-dried apricot and fig on dehydration parameters, physicochemical properties and microbial assessment as well as sensory evaluation was undertaken just after both sun-drying and osmo-drying and during the storage for 9 month at ambient temperature.

MATERIALS AND METHODS

Materials

Baladi Apricot (*Prunus armonica*, L) and Conadria Fig (*Ficus carica* L) were obtained from El-Obour market, El- Obour city, Cairo, Egypt, at season 2007.

Glucose and Fructose syrup were obtained from the National Company for maize Products, 10^{th} of Ramadan city, Cairo, Egypt.

Methods

Osmotic dehydration

Apricot and fig fruits were washed thoroughly with tap water, blanched in the presence of 1% NaOH at 90°C for 30 sec, then sulphurized with 0.5% sodium meta bisulfite. After that, the fruits of each were divided into 4 groups and immersed in solutions of 72° Brix sucrose solution, 72° Brix glucose syrup, 70° Brix fructose syrup and mixture of 72° Brix glucose and 70° Brix fructose syrup (2:1) at 65°C for 5 hr. At the end of immersion the syrups were drained, and can be re-concentrated and re-used as osmotic agent for another osmotic process. While, the samples after drained rinsed quickly in a stream of tap water and blotted with tissue to remove the adhering solution. The obtained osmosis samples were then weighed and dried in a vacuum oven at 50°C for about 23-32hr. according the type of osmosis solution used for pretreatment.

Sun-drying

Another samples of apricot and fig blanched in 1% NaOH were dried in sun-drying for 6 days under atmospheric conditions to obtain the sun-dried apricot and fig and used for comparing between osmotic dehydration and sun-dried samples. All experiments were done in 3 replicates and average values were recorded.

Packaging and storage

Samples packed in poly ethylene bags of about 500g capacity with removed air. Finally bags were sealed by heat and stored for 9 month at ambient temperature.

Analytical methods

The following variables were determined as described by **Lerici *et al* (1985)** for each sample: % water content (WC), water loss (WL), solid gain (SG) as g/100g fresh product, weight reduction (WR) and total solids% (T.S).

Physico-chemical analyses

Moisture content, total solids, ascorbic acid, titratable acidity, total sugars, (reducing and non-reducing sugars), ash and crude fibers contents were determined according to **A.O.A.C. (1995)**.

Microbial analysis

Samples were serially diluted and plated on total count agar for total flora counts and on acidified (10% tartaric acid) potato dextrose agar for mold and yeast counts. Plates were incubated for 48 hr at 30°C for total flora, and for 5 days for molds and yeasts **(APHA, 1992)**.

Sensory evaluation

The method of **Aparicio-Cuesta *et al* (1992)** was carried out by using five sensory characteristics (color, texture, taste, flavor and general acceptability) of the osmotic dehydration and sun-dried apricot and fig samples were performed by 10 trained panelists, assigned a score of each sensory characteristic according to 10 point category scales.

Statistical analysis

Statistical analysis was done by using the SAS statistical program **(SAS, Statistical analysis system 1996)** for sensory evaluation was expressed as the mean values. To ascertain the significance among means of the treatments Duncan's multiple range test at significant level of $P < 0.05$.

RESULTS AND DISCUSSION

Dehydration parameters of osmotic dehydration and sun-dried apricot are shown in **Table (1).** The Brix concentration of glucose, fructose, sucrose syrup and glucose- fructose syrup (2:1) solutions which used for osmosis were 72,70,72 and 72 Brix just before processing of apricot at temperature 65°C. However, the concentration of osmoses solutions used for osmotic processing were lowered at the end of osmosis to become 64, 63, 59 and 64 Brix for glucose, fructose, sucrose and glucose - fructose (2:1) syrups, respectively. This phenomenon presumably owing to the reduction water diffusion coefficient in the product- solution interface as explained by **(Lerici, *et al* 1985).** The osmosis time changes the driving force of the drying process as the alteration of the type of osmosis solution. Meanwhile, the mixture of glucose- fructose (2:1) syrup had the lowest osmosis time for osmosed apricot followed by fructose, glucose and sucrose syrup, respectively. Its worth to know that, the sugars in the fruits considered as a distinctively characteristics of the fruit varieties. As the equilibration time increase, the ratios between the various components showed considerable changes **(Gianglacomo *et al* 1987 and Salem and Hegazi 1973).** On the other hand, the changes in the ratios between osmosed solutions of fructose, glucose and sucrose and glucose-fructose mixture (2:1) in the presence of NaCl used for pretreating of apricot reflect the predictable gain in osmosis solutions, which showed considerable penetration.

Consequently, the higher weight reduction of osmosed- dehydrated apricot was obtained with fructose-glucose mixture (70.1%), followed by glucose syrup (69.8%) fructose (69.2%) and sucrose (68.8%), respectively compared with 75.6% for sun- dried apricot product. However, dehydration parameters WL and WC were strictly related to the type and concentration of the osmotic solution used. The weight loss of osmosed apricot with fructose-glucose mixture recorded the lowest one followed by sucrose, fructose and glucose, respectively but a reversible trend was observed between the values of WC and osmotic solutions used for processing of osmosed dried apricot. It is interesting to observe that under the investigated conditions of osmotic conditions, the reduction time for dehydration can give a higher percent of T.S in the final products of osmosed dried apricots depending on the type of osmotic solutions used. Results also indicated that, the pretreated osmosed dried apricot with osmosis syrups before drying caused to increase the obtained solid gain than that for untreated samples (sun drying samples). Furthermore, the osmosed dried apricot pretreated with sucrose syrup had the highest solid gain followed by fructose mixture of, glucose-fructose (2:1) and sucrose syrup, respectively. These results may be explained by **Rastogi and Raghavarao (1994), Taiwo *et al* (2001) and Tedjo *et al* (2002)** they mentioned that, solid uptake during osmotic dehydration (OD) may not necessarily be a function of permeabilized cells alone but may also depend on the type of chemical and structural changes caused by the pretreatments. Also, the osmosis process reduced the time of dehydration of grapes compared with grapes dried with sun drying may be due to the choice of osmosis solution and the addition of NaCl to osmotic solutions which caused to increase the driving force of the drying process. These results are correlated well with **(Lerici *et al* 1985).**

Table (2) shows the changes in osmotic solutions, water contents, and yields percent of osmo-dried and sun-dried fig. The initial °Brix of osmosed solution were 72, 70, 72 and 72 for glucose, fructose, sucrose and mixture of glucose-fructose (2:1) syrups, respectively. While the corresponding

Table 1. Initial concentration of osmotic solution (°Brix) as well as conditions applied for drying and characteristics of osmotic apricot

Osmotic solutions	°Brix for treatment		Characteristics of osmosed dried apricot							
	Before	After	Temp.°C for osmotic solution	Immersion time (hrs) of osmosis	WL (%)	WR (%)	WC (%)	SG	Dehydrate time (hrs)	WL+SG (%)
Glucose syrup	72	64	65	5	48.2	69.8	8.70	28.3	25	76.5
Fructose syrup	70	63	65	5	50.4	69.2	8.69	26.6	24	77.0
Sucrose syrup	72	59	65	5	52.7	68.8	8.72	24.9	27	77.6
Fructose glucose (1:2)	72	64	65	5	53.1	70.1	8.60	25.2	23	78.3
Sun drying	-	-	-	-	-	75.6	8.67	18.4	120	-

WL: water loss; WR: weight reduction; WC: water content; SG: solid gain.

Table 2. Initial concentration (°Brix), applied condition for drying in relation to characteristics of osmotic dehydration of fig

Osmotic solutions	°Brix for treatment		Temp.°C for osmotic solution	Characteristics of osmosed dried fig						
	Before	After		Immersion time of osmosis (hrs)	WL (%)	WR (%)	WC (%)	SG	Dehydrated Time (hrs)	WL+SG (%)
Glucose syrup	72	62	65	6	46.8	69.5	10.2	27.3	29	74.1
Fructose syrup	70	62	65	6	48.3	69.0	10.0	26.4	28	74.3
Sucrose syrup	72	58	65	6	50.0	67.3	10.4	26.5	32	76.5
Fructose glucose (1:2)	72	63	65	6	50.3	70.0	9.90	26.4	27	76.7
Sun drying	-	-	-	-	-	74.8	9.93	18.7	144	-

* WR: weight reduction; WL: water loss; WC: water content; SG: solid gain.
** Values are the mean of three independent determinations.

values of osmosed syrups at the end of processing were 62, 62, 58 and 63 °Brix after immersing time for 6 hr, respectively. On the other hand, results indicated that, glucose and mixture of glucose-fructose (2:1) syrups would seems to be the best choice osmotic syrup for immersion process. These results are agreement with **(Bolin *et al* 1983)** they reported that, syrup penetration rate into a fruit was faster by using high fructose corm syrup (HFCS) than sucrose. Results also indicated that, the dehydration parameters (WL and WC) were not strictly related to the concentration of the used osmotic solutions, but high values of yield% for weight loss (WL) in the osmo-dried figs pre-treated with osmosis syrups of fructose and glucose-fructose (2:1) was observed. These results are similar with obtained by **(Lerici *et al* 1985 and El-Gharably *et al* 2003)**.

It is worth to note that, the yield % and the time of osmo--dried fig obtained from thus investigation were correlated well with the type of osmotic syrup used. Fore instance, these results indicated that, the pretreatments of apricot and/or fig with osmotic sugar solution before drying caused to reduce the time of dehydration and lead to obtain much higher final yield% of matter. Where, the time used to obtain osmo-dried apricot was ranged between 23 to 32hr compared with 120 to 144 hr with that dried by sun-drying. Moreover, withdrawn osmotic syrups can be re-concentrated and reused. Also, the obtained osmo-dried fig and apricot may be expecting more safety and best quality properties.

Effect of storage period on physico- chemical properties of osmosed dried apricot and fig for 9 month at ambient temperature

Effect of storage period up to 9 month at ambient temperature on physicochemical properties of both osmo-dried and sun-dried apricot and fig are shown in **Table (3).** Results indicated that, The moisture content was 85.30 and 72.32% for fresh apricot and fig. While the average ratios of moisture contents of osmo-dried apricot and fig pre-treated with different osmosis syrups just after processing were 8.51to 9.11% and 15.30 to 15.88% but it was 9.03 and 15.11% for sun dried apricot and fig, respectively. Also, it could be noticed a little incremental in moisture contents were recorded with progress of storage period for all tested samples up to 6 months at ambient temperature and reached to the maximum at the end of storage after 9 months of storage at ambient temperature, but still little than that in sun-dried apricots and figs after 9 months.

Total solids of fresh apricot and figs were 14.7 and 27.68%. While, the total solids were ranged from 90.89 to 91.49 and 84.12 to 84.89% for osmodehydrated apricot and fig just after processing, respectively. Our results showed a good correlation betwe :n the type of osmosis solution used in pretreatment before dehydration process and the total solids in the final products. While, the total solids recorded 90:97 and 84.25% for both sun-dried apricot and fig just after processing. Subsequently, a little incremental in total solids for osmo-dried apricots and fig were found affecting with the progressive period of storage up to 9 months and its impacts by the type of osmotic solution used for retreating of both apricot and/or fig before drying.

The stabilization of ascorbic acid during processing is important not only from the nutritional point of view but also because ascorbic acid degradation accelerates nonenzymatic browning reaction, which not only cause changes in color but can affect flavor adversely **(Kanner *et al* 1981 and Paakkonen and Mattiala 1991).** According to **Rumm-Kreuter and Demmel (1990)**, the main mechanisms of vitamin C losses appear to be due to water solubility and mass transfer, heat sensitivity, and enzymatic oxidation.

The content of ascorbic acid was 17.30 and 12.17 mg/100g on fresh weight basis for apricot and fig (as shown in Table3). Meanwhile, the ascorbic acid contents were ranged from 90.12 to 97.31 and 59.18 to 60.71 mg/100g on dry basis for osmo-dried apricot and fig immediately after processing, respectively. However apricot and fig pre-treated with glucose syrup had the highest ascorbic acid content immediately after processing followed by syrups fructose, glucose-fructose (2:1) and fructose, respectively. But sun dried apricot had the higher ascorbic acid content compared that in osmadehydrated apricot immediately after processing. The ascorbic acid content reduced gradually with increasing the time of storage for both osmodehydrated and sun-dried samples by extending the storage periods up to 9 month but the greatest reduction was observed for sun-dried samples. The reduction of ascorbic acid for osmo-dried apricot and fig may be due to the native content of, ascorbic acid in apricot and fig, the type of osmosis solution's used, the immersing time in osmosis solution, the temperature of dehydration process and extending shelf life at ambient temperature. These results are coincide with **Torreggiani *et al* (1987) and Shastry and Hartel (1996)** they mentioned that, during the first four months of osmodehydrated cherries there was a decrease in ascorbic acid, while in the last two months, a further decreases was found.

Table 3. Effect of storage period up to 9 month at ambient temperature on physico-chemical properties of osmo-dried apricot and fig treated with various osmotic solution as well as sun- dried apricot and fig

Storage period (month)		Constituent	Moisture %	Total Solids %	Ascorbic acid (mg/100g)	Total Acid-ity %	Total sugars %	Reducing sugars %	Non-reducing sugars %	Ash %	Crud fiber %
		Fresh apricot	85.30	14.70	17.30	0.65	8.42	6.70	1.72	0.60	1.33
	Initial period	I	8.72	91.28	97.31	1.78	70.14	55.77	14.37	1.45	5.61
		II	9.11	90.89	90.12	1.70	70.01	55.66	14.35	1.50	5.64
		III	8.89	91.11	93.41	1.81	69.80	55.50	14.30	1.40	5.62
		IV	8.51	91.49	92.30	1.79	69.77	55.47	14.30	1.38	5.57
		V	9.03	90.97	98.90	1.63	65.11	51.68	13.43	1.34	5.40
	After 3 month	I	9.02	90.98	90.03	1.70	69.85	55.53	14.32	1.40	5.57
		II	9.30	90.70	83.70	1.63	69.65	55.37	14.28	1.47	5.58
		III	9.07	90.93	87.15	1.72	69.60	55.30	14.30	1.38	5.57
		IV	8.80	91.20	87.18	1.71	69.51	55.25	14.26	1.33	5.50
		V	9.16	90.84	90.19	1.58	64.70	51.40	13.30	1.30	5.40
	After6 month	I	9.15	90.85	86.19	1.62	69.15	55.03	14.12	1.36	5.49
		II	9.47	90.53	75.90	1.58	68.90	54.76	14.14	1.40	5.47
		III	9.23	90.77	77.83	1.67	68.71	54.37	14.34	1.35	5.46
		IV	9.09	90.91	80.14	1.64	68.45	54.11	14.34	1.30	5.40
		V	9.31	90.69	82.70	1.51	64.17	50.07	14.10	1.28	5.38
	After 9 month	I	9.23	90.77	77.11	1.53	68.80	54.85	13.95	1.31	5.47
		II	9.51	90.49	65.50	1.50	68.60	54.60	14.00	1.30	5.40
		III	9.40	90.60	66.18	1.60	68.41	54.27	14.14	1.27	5.41
		IV	9.17	90.83	70.10	1.50	68.22	54.09	14.13	1.25	5.33
		V	9.53	90.47	70.02	1.43	63.72	50.02	13.70	1.30	5.35
		Fresh fig	72.32	27.68	12.17	0.54	8.31	6.60	10.71	1.16	4.71
	Initial period	I	15.30	84.70	60.71	1.50	69.33	54.70	14.63	3.42	18.11
		II	15.88	84.12	59.18	1.47	69.17	54.27	14.90	3.50	18.20
		III	15.42	84.58	59.60	1.56	68.78	54.03	14.75	3.39	18.15
		IV	15.11	84.89	59.33	1.52	68.70	53.97	14.73	3.36	18.08
		V	15.75	84.25	51.70	1.44	65.90	50.19	15.71	3.30	17.91
	After 3 month	I	15.83	84.17	57.07	1.43	67.80	53.25	14.55	3.40	18.02
		II	16.01	83.99	55.03	1.40	67.25	53.07	14.18	3.47	18.13
		III	15.80	84.20	55.70	1.52	67.00	53.00	14.00	3.35	18.09
		IV	15.40	84.60	55.40	1.49	77.92	52.90	14.02	3.31	18.00
		V	15.97	84.03	49.15	1.40	63.79	50.01	13.78	3.27	17.83
	After 6 month	I	15.91	84.09	50.17	1.40	66.14	53.00	13.14	3.32	17.90
		II	16.30	83.70	47.00	1.35	65.90	52.90	13.00	3.34	17.93
		III	15.88	84.12	48.11	1.46	65.70	52.93	12.77	3.30	17.85
		IV	15.70	84.30	48.00	1.41	65.30	52.70	12.60	3.25	17.50
		V	16.12	83.88	45.70	1.33	63.50	49.90	13.60	3.21	17.71
	After 9 month	I	16.11	83.89	47.50	1.35	66.00	52.80	13.20	3.25	17.80
		II	16.50	83.50	44.11	1.31	65.71	52.71	13.00	3.27	17.81
		III	16.07	83.93	44.27	1.40	65.20	52.73	12.47	3.22	17.75
		IV	16.00	84.00	44.03	1.39	65.07	52.60	12.47	3.20	17.41
		V	16.30	83.70	42.17	1.30	63.42	49.71	13.41	3.17	17.35

* I Glucose syrup II Fructose syrup III Sucrose syru IV Fructose + Glucose syrup (1:2) V Sun-drying (Control)

**Values are the mean of three independent determi ations

The initial % titratable acidity of fresh apricots and figs were 0.65 and 0.54. Whereas, the titratable acidity of osmodehydrated apricots and figs pretreated with different tested osmosis solutions were in the range of 1.70-1.81% and 1.47 – 1.56%, respectively. just after processing depends on the choice osmosis solution for pretreatment before drying. However, sun-dried apricots and figs recorded titratable acidity of 1.63 and 1.44%, respectively.

On the other hand, findings in **Table (3)** showed that, the values of sugar contents in fresh apricot and fig were 8.42 and 8.31% in which reducing sugars are the predominant sugars in both cultivars recorded 6.70 and 6.50%, respectively. Results also indicated that, both these categories of samples were little changes in total sugars in spite of using different types of osmosis solution for pretreatment before drying process. Meanwhile, the amount of reducing sugars just after processing was ranged between 55.47 to 55.77% for osmosed dried apricot samples and 53.97 to 54.70% for fig samples. Where, the corresponding values of non reducing sugars were about 14.30 and 14.63% for all osmo-dried apricot and fig samples, respectively. But, sun-dried apricot and fig had less total sugars than osmodehydrates samples. Results showed a little changes in total, reducing and non reducing sugars during storage at ambient temperature up to 9 months of storages. These results are similar with that reported by **Torreggiani *et al* (1987).**

From **Table (3)** it could be also observed that, the values of ash and crude fibers were higher in fig (1.16 and 4.71%) than apricot (0.60 and 1.33%). The ash content for osmosed dried apricot and fig pretreated with various osmotic solutions just after processing which were recorded about 1.34 – 1.50% and 3.30 – 3.50 for all samples, respectively and greater decreased during storage of all samples up to 9 months was observed. While crude fibers were ranged between 5.40 – 5.64% and 18.11 –18.20% for osmo-dried apricot and fig samples, respectively, but it was 5.4 and 8.08 for sun-dried apricot and figs. On the other hand, a little gradual reduction of crude fibers was noticed with extending the shelf-life of both osmo-dried and sun-dried apricot and fig up to 9 months of storage at ambient temperature.

Microbiological assessment

Table (4) shows the assessment of total microbial flora and the yeast and molds during storage for asmo-dried apricot and fig pretreated with various osmotic solutions as well as sun-dried both the two cultivars during storage period up to 9 months at ambient temperature. The behavior of the different groups of microorganisms (total microbial flora and yeast and molds) immediately after osmodehydration and sun drying was quite different depending on the type of pretreatment used before dehydration. Where, the sun dried apricot just after processing had the highest total microbial flora (7.4 x 10^2 cfu/g) followed by (2.4 x 10^2 , 2.3 x 10^2, 2.1 x 10^2 and 1.9 x 10^2 cfu/g),for osmo-dried apricot pretreated by immersing with syrups of fructose, combined glucose- fructose (2:1), sucrose and glucose, respectively. However, these values were 8.1 x 10^2 cfu/g for sun-dried fig followed by 3.6 x 10^2, 2.9 x 10^2, 2.8 x 10^2 and 2.4 x 10^2 cfu/g for osmo-dried fig pretreated with syrups of fructose, combined glucose-fructose (2:1), sucrose, and glucose, respectively. Results, also indicated that, yeast and molds in osmodehydrated apricot and fig had markedly lowest counts than sun dried samples depending on the type of pretreated with osmosis solution, where the total counts of yeast and models microflora were ranged between 0.81 x 10^2 to 0.86 x 10^2 cfu/g and 0.79x 10^2 to 0.80 x 10^2 cfu/g for samples of osmodehydrated apricot and fig, respectively. Thus, the pretreatment with osmosis solution before dehydration was more efficient for reduction either for total microbial flora or total counts of yeasts and molds. However, pretreatment with glucose for osmo-dried fig and fructose for osmo-dried apricots were more effective and caused the higher reduction of total counts followed by fructose, combined glucose-fructose (2:1) and sucrose immediately after processing of apricot and fig. Meanwhile, osmodehydrated and sun dried of apricot and fig caused gradual incremental reductions or eliminated for total viable counts in relation to the extending period of storage. Also, the viable microbial population gradually reduced during storage of tested samples by extending the time of storage which recorded the lowest total viable counts of total microbial flora and yeast and molds at the end of 9 months of storage. Subsequently, both total counts of flora and yeast and molds flora growth decreased and reached to the lowest level for all tested samples after 9 months of storage at ambient temperature compared with that values just after processing. In other words, the inactivation and/or the death of all tested counts of microorganisms showed to be proportional with extending the storage time and reached to the maximum reduction after of 9 months of storage. This trend of decreasing for

Table 4. Population of total microbial flora and yeasts & molds for sun-dried and Osmo-dried apricot and fig pretreated with various osmotic solutions during storage for 9 month at ambient temperature

Parameter			Apricot		Fig	
			Total count (cfu/g)	Yeast& mold count (cfu/g)	Total count (cfu/g)	Yeast & mold count (cfu/g)
Storage period (month)	Initial period	I	1.9×10^2	0.81×10^2	2.4×10^2	0.72×10^2
		II	2.4×10^2	0.84×10^2	3.6×10^2	0.74×10^2
		III	2.1×10^2	0.86×10^2	2.8×10^2	0.80×10^2
		IV	2.3×10^2	0.85×10^2	2.9×10^2	0.75×10^2
		V	7.4×10^2	2.70×10^2	8.1×10^2	2.10×10^2
	After 3 month	I	1.6×10^2	0.73×10^2	2.2×10^2	0.70×10^2
		II	2.1×10^2	0.80×10^2	3.2×10^2	0.71×10^2
		III	1.9×10^2	0.82×10^2	2.5×10^2	0.77×10^2
		IV	2.1×10^2	0.81×10^2	2.7×10^2	0.70×10^2
		V	6.5×10^2	2.40×10^2	7.6×10^2	1.90×10^2
	After6 month	I	1.3×10^2	0.65×10^2	2.1×10^2	0.68×10^2
		II	1.7×10^2	0.77×10^2	3.0×10^2	0.69×10^2
		III	1.6×10^2	0.78×10^2	2.3×10^2	0.71×10^2
		IV	1.7×10^2	0.75×10^2	2.4×10^2	0.64×10^2
		V	6.1×10^2	2.10×10^2	7.3×10^2	1.70×10^2
	After 9 month	I	1.1×10^2	0.56×10^2	1.9×10^2	0.65×10^2
		II	1.5×10^2	0.68×10^2	2.7×10^2	0.66×10^2
		III	1.3×10^2	0.70×10^2	1.8×10^2	0.64×10^2
		IV	1.4×10^2	0.69×10^2	1.9×10^2	0.60×10^2
		V	5.8×10^2	1.80×10^2	7.0×10^2	1.40×10^2

* I Glucose syrup II Fructose syrup III Sucrose syrup IV Fructose + Glucose syrup (1:2) V Sun-drying (Control)
Values are the mean of three independent determinations * cfu = colony forming unit

total microbial counts and yeast and molds was correlated well with the type of osmotic solution used in pretreatment before dehydration, and extended of storage period.

Sensory evaluation of osmo-dried apricot and fig

The analysis of variance for color, texture, taste, flavor and overall acceptability for the processed apricot and fig just after processing and during storage up to 9 month at ambient temperature are shown is **Table (5)**. Analysis of variance indicated that a significant difference in color, texture, taste, flavor and overall acceptability between a dehydrated tested samples correlated well with the type of osmotic syrups used for pretreatment of osmo-dried apricot. Also, a little significant difference between samples pretreated with syrups of fructose and combined glucose-fructose (2:1) syrups just after processing and by extending the shelf life up to 9 months. Osmo-dried apricot pretreated with fructose syrup recorded the highest values of sensory attributes followed by combined glucose-fructose (2:1), sucrose and glucose syrup, respectively compared with sun dried apricot which

Table 5. Mean scores of sensory evaluation of sun dried and osmo-dried of apricots and figs during storage for 9 month at ambient temperature

Quality attributes during storage of osmodried apricots and figs	Osmotic solution used before dehydration process	Glucose syrup	Fructose syrup	Sucrose syrup	Fructose + Glucose (1:2)	Sundried
Apricot						
Initial period	Color	7.0^{C}	6.8^{c}	7.3^{c}	8.4^{b}	6.1^{d}
	Texture	7.2^{C}	7.2^{c}	7.0^{c}	8.1^{b}	6.2^{d}
	Taste	7.4^{C}	7.0^{c}	7.1^{c}	8.2^{b}	6.0^{d}
	Flavor	7.0^{C}	6.9^{c}	6.9^{c}	8.0^{b}	5.9^{d}
	Overall acceptability	7.2^{C}	6.7^{c}	6.8^{c}	7.8^{bc}	6.1^{d}
After 3 month	Color	6.8^{c}	6.5^{c}	7.0^{c}	7.7^{bc}	6.0^{d}
	Texture	6.9^{c}	7.7^{c}	6.8^{c}	7.0^{c}	5.9^{d}
	Taste	6.7^{c}	6.4^{cd}	6.7^{c}	7.7^{bc}	5.8^{d}
	Flavor	6.8^{c}	6.6c	6.5^{c}	7.5b^{c}	5.9^{d}
	Overall acceptability	6.7^{c}	6.4^{cd}	6.6^{c}	7.6b^{c}	5.8^{d}
After 6 month	Color	6.6^{c}	6.3^{cd}	6.8^{c}	7.4^{c}	5.8^{d}
	Texture	6.5^{cd}	6.4^{cd}	6.7^{c}	7.2^{c}	5.7^{d}
	Taste	6.3^{c}	6.2^{cd}	6.5^{c}	7.1^{c}	5.7^{d}
	Flavor	6.2^{d}	6.1^{d}	6.4^{cd}	7.3^{c}	5.8^{d}
	Overall acceptability	6.5^{c}	6.2^{cd}	6.3^{cd}	7.4^{c}	5.6^{d}
After 9 month	Color	6.3^{c}	6.0^{d}	6.5^{c}	7.2^{c}	5.5^{d}
	Texture	6.2^{d}	6.1^{d}	6.3^{cd}	7.0^{c}	5.4^{d}
	Taste	6.0^{d}	6.0^{d}	6.1^{d}	6.9^{c}	5.3^{d}
	Flavor	5.8^{d}	5.9^{d}	5.9^{d}	6.7^{c}	5.0^{d}
	Overall acceptability	5.9^{d}	5.8^{d}	5.9^{d}	6.8^{c}	5.1^{d}
Fig						
Initial period	Color	6.8^{c}	8.1^{b}	6.9^{c}	8.0^{b}	5.7^{d}
	Texture	7.2^{c}	7.9^{b}	7.0^{c}	7.7^{bc}	5.8^{d}
	Taste	7.0^{c}	7.3^{c}	6.8^{c}	7.0^{c}	5.4^{d}
	Flavor	6.9^{c}	7.3^{c}	6.7^{c}	7.1^{c}	5.4^{d}
	Overall acceptability	6.7^{c}	7.0^{c}	6.5^{c}	6.8^{c}	5.5^{d}
After 3 month	Color	6.5^{c}	7.7^{b}	6.4^{cd}	7.5b^{c}	5.6^{d}
	Texture	7.7^{c}	7.2^{c}	6.6^{c}	7.0^{c}	5.3^{d}
	Taste	6.4^{cd}	7.1^{c}	6.2^{cd}	6.8^{c}	5.2^{d}
	Flavor	6.6c	6.8^{c}	6.4^{cd}	6.6^{c}	5.1^{d}
	Overall acceptability	6.4^{cd}	6.9^{c}	6.2^{cd}	6.5^{c}	5.2^{d}
After 6 month	Color	6.3^{cd}	7.5^{bc}	6.0^{d}	7.0^{c}	5.3^{d}
	Texture	6.4^{cd}	7.0^{c}	6.1^{d}	6.7^{c}	5.2^{d}
	Taste	6.2^{cd}	6.7^{c}	6.0^{d}	6.5^{c}	5.1^{d}
	Flavor	6.1^{d}	6.1^{d}	5.9^{d}	5.8^{d}	5.1^{d}
	Overall acceptability	6.2^{cd}	6.4^{cd}	5.9^{d}	6.1^{d}	5.0^{d}
After 9 month	Color	6.0^{d}	7.1^{c}	5.7^{d}	6.7^{c}	5.1^{d}
	Texture	6.1^{d}	6.8^{c}	5.6^{d}	6.5^{c}	5.0^{d}
	Taste	6.0^{d}	6.5^{c}	5.7^{d}	6.3^{cd}	5.1^{d}
	Flavor	5.9^{d}	6.0^{d}	5.7^{d}	5.9^{d}	5.0^{d}
	Overall acceptability	5.8^{d}	6.1^{d}	5.6^{d}	5.8^{d}	5.2^{d}

* Mean with different symbols in the horizontal columns significantly different at $P \leq 0.05$

was recorded the lowest sensory scores. Consequently, there were a significant differences between osmo-dried apricot samples stored for 3, 6 and 9 months at ambient temperature depends on the type of pretreatment used and extending the shelf life. On the other hand, the osmo-dehydrated apricot pretreated with fructose had the highest scores of all tested sensory parameters followed by that pretreated with fructose - glucose, pretreated with sucrose and glucose, respectively after 6 and/or 9 months storage. But, sundried apricot recorded the lowest scores for all osmo-dried apricot samples. Therefore, it seems the decline of sensory scores were pronounced for sun-dried samples stored for 9 months compared with those for osmo-dried apricots.

The analysis of variance for color, texture, taste, flavor and overall acceptability for osmo-dried fig are seen in table (5). A significant difference for sensory attributes as observed with extending the storage time correlated well with the type of pretreatment used for processing of fig. There were a significant differences in sensory scores between fig at initial time of storage and through storage up to 9 months owing to the type of used osmosis solution before drying. There were a little difference in color and overall acceptability for osmo-dried fig pretreated with glucose and / or glucose-fructose (2:1) syrups stored for zero,3,6 and 9 Whereas, osmo-dried figs pretreated with, fructose had the highest sensory attributes scores for color, texture, taste, flavor and overall acceptability followed by that pretreated with glucose and sucrose, respectively after 3,6 and 9 months of storage at ambient temperature. But, sun dried fig recorded the lowest scores after any period of storage. Therefore, it seems that, the pretreatment of apricot and fig with osmotic sugar solution plays an important roll for producing valuable nutrition, best sensory attributes and high quality of osmo-dried apricot and fig than producing them by sun-drying.

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حوليـــات العلــوم الزراعية
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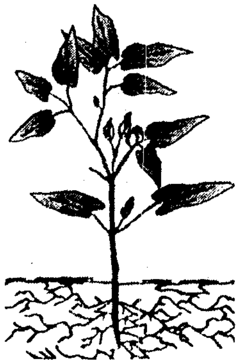
مجلد(٥٤)، عدد (٢)، ٣٥٩-٣٧١، ٢٠٠٩



تقييم جودة المشمش والتين المصري المنتج بالتجفيف الاسموزي

[٢٨]

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الموجـــز

أجريت هذه الدراسة بهدف تقييم عينات المـــشمش والتين المنتج بالتجفيف الأسموزي والمعامل بـــأنواع مختلفة من المشروبات الـــسكرية الاســـموزية مثـــل الجلوكوز، الفركتوز، السكروز، مخلوط الجلوكـــوز- الفركتوز (١:٢) ومقارنتها بتلك التـــي تـــم إنتاجهـــا بالتجفيف الشمسي. هذا وقد أوضحت لدراسة أن أقل وقت لإتمام الاســـموزية كـــان باســـتخدام مخلـــوط الجلكوز-الفركتوز (١:٢) كمعاملة ابتدائية لتجفيـــف المشمش تلاه الفركتوز ثم الجلوكوز وشراب السكروز علي التوالي. هذا ولقد أدي اختزال وقت التجفيف إلي إمكانية الحصول علي نسبة عالية منالمـــادة المجففـــة لكلا المشمش والتين المجفف وكـــذلك كميـــة المـــادة الصلبة مقارنة بتلـــك المتحـــصل عليهـــا بـــالتجفيف الشمسي. والأكثر من ذلـــك فقـــد لـــوحظ أن دلالات التجفيف مثل فقد الرطوبة والمحتوي الرطوبي كان ذو ارتباط واضح بنوعية وتركيز المحاليـــل الاســـموزية المستخدمة للحصول علي المنتجات المجففة اسموزيا بعد المعاملة مباشرة وكذلك أثناء التخـــزين لمـــدة ٩ شهور علي درجة حرارة الغرفة يضاف إلي ذلك أنه قد أخذ في الاعتبـــار دراســـة الخـــواص الطبيعيـــة والكيماوية والتقيـــيم الميكروبيولـــوجي وخـــصائص الجودة للعينات المجففة ومباشرة بعد التصنيع وكـــذلك أثناء تخزينها علي درجة حـــرارة الغرفـــة لمـــدة ٩ شهور.

هذا وقد بينت الدراسة أن المشمش والتين المجفف اسموزيا والمعامل ابتدائيا بـــالجلوكوز كـــان أكثـــر احتفاظا بمحتواه من فيتامين ج تلاه ذلك الذي عومـــل ابتـــدائيا بالـــسكروز ثـــم مخلـــوط الجلوكـــوز- الفركتوز(١:٢) ثم الفركتوز علي التوالي. هذا وقـــد تراوح محتوي المشمش والتين المجفف اسموزيا مـــن السكريات المختزلة من ٥٥,٤٧- ٥٥,٧٧، ٥٣,٩٧- ٥٤,٧٠% مباشرة بعد التجفيـــف الاســـموزي بينمـــا تراوحت تلك النسبة لكلاهما من الألياف علي ٥,٤٠- ٥,٦٤% للمـــشمش، ١٨,١١- ١٨,٢٠ % للتـــين المجفف اسموزيا باستخدام الأنـــواع المختلفـــة مـــن المحاليل الاسموزية. هذا وقد كانت نتائج العد الكلـــي للميكروبات عالية في المشمش والتين المجفف شمسيا (7.4×10^{2} - 8.1×10^{2} خلية مكونة لمستعمرة / جم) ثم كانت 2.4×10^{2} ، 3.6×10^{2} للعينات المجففة اسموزيا والمعاملة ابتدائيا بالفركتوز ثـــم 2.3×10^{2} ، 2.9×10^{2} خلية مكونـــة لمـــستعمرة/ جـــم للمعاملة ابتدائيا بمخلوط الجلوكوز- الفركتوز(١:٢) ثم 2.1×10^{2} ، 2.8×10^{2} خلية مكونة لمـــستعمرة / جم لعينات المشمش والتين المجفف اسموزيا والمعامل

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أ.د عبد الرحمن محمد عطية

ابتدائيا بالجلوكوز. ومن ناحية أخري فلقد لوحظ من الدراسة حدوث انخفاض تدريجي في المحتوي الميكروبي الكلي وكذلك الفطر والخميرة بزيادة فترة التخزين حيث وصلت إلي أقل معدلاتها بعد ٩ شهور من التخزين علي درجة حرارة الغرفة.

هذا ولقد سجل التقييم الحسي للمشمش والتين المجفف اسموزيا والذي عومل ابتدائيا بالفركتوز أعلي القيم لخواص اللون، القوام ، والطعم ، النكهة والقبول العام تلاه ذلك الذي عومل ابتدائيا بمخلط الجلوكوز-الفركتوز(١:٢) ثم الجلوكوز ثم السكروز بعد التصنيع مباشرة وكذلك بعد التخزين لمدة ٣، ٦، ٩ شهور علي درجة حرارة الغرفة مقارنة بالذي تم تجفيفه شمسيا والذي سجل أقل القيم في خصائص التقييم الحسي.

وعلي ذلك فقد أوضحت الدراسة أن المعاملة الابتدائية بالمحاليل السكرية الاسموزية لإنتاج منتجات مجففة اسموزيا تلعب دورا هاما في الحصول علي مشمش وتين مجفف اسموزيا ذو خصائص جودة عالية مقارنة بذلك الذي تم إنتاجه بالتجفيف الشمسي.