Physiochemical, microbiological and sensory evaluation of osmotic dried apricot by date syrup

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Abstract: This study was carried out to assess the quality of osmotic-dried apricot pretreated with various type of osmotic date syrup i.e. 50, 60 and 70% date syrup, compared with those produced by untreated apricot (control). The physiochemical, microbiological and sensory properties of both osmotic-dried and control apricot after processing and during storage for 6 months were also undertaken. Results indicate that, the 70% date syrup had the lowest dehydration time for osmotic apricot followed by 60% and 50% date syrup, respectively. The ascorbic acid content gradually decreased with increasing the storage time for both osmotic dehydrated and control samples by extending the storage periods up to 6 month but the greatest reduction was observed for control samples. The amount of reducing sugars immediately after processing was ranged between 56.12 and 59.42% for osmotic dried apricot samples. The control- dried apricot had the highest total microbial contents followed by the osmotic-dried sample pretreated with date syrup 50%, 60% date syrup and 70% date syrup, respectively. On the other hand, all tested counts of microorganisms either total counts of flora or yeasts and molds showed a proportional reduction with extending the storage period and reached to the maximum reduction after 6 month of storage. The osmotic-dried apricot pretreated with date syrup 70% recorded the highest sensory scores of color, texture, taste, flavor and overall acceptability followed by osmotic-dried samples pretreated with 60 and 50% date syrup and the untreated (control) immediately after processing and during storage at ambient temperature. Therefore, pretreatment of apricot with osmotic date syrup to produce osmotic-dried products played an important role in producing high quality dried apricot than those produced by the control drying process.

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1. Introduction

For its biochemical structure, apricot (Prunus armeniaca) is considered a fruit very suitable for drying. It features high content of provitamin A, vitamin C as well as a complex of other vitamins which are beneficial to human organism. The complex of mineral matter in apricot fruits - especially high contents of potassium, phosphorus, magnesium and iron - improves blood count, blood circulation and regulates blood pressure in humans (**Pavkov, et, al 2009**).

Osmotic dehydration is used for partial removal of water from materials such as fruits and vegetables, when immersed in a concentrated solution of sugar or salt **(Derossi*et al.*, 2008).** 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 also, is a simple, economical and nondestructive process with least wastage of fruit during processing **(Sharma *et al.*, 2006).** Date syrup (locally named Dibis) is probably the most common date product. It is produced by extraction and boiling down the juice. The process consists of extraction, clarification and concentration of the date juice. Date syrup is thick- dark brown syrup. Glucose and fructose sugars are the major sugars presented in the date syrup and total sugar contents reached 88 %. Date syrup contains in addition to sugar, macro and micro elements which may play an important role in, considering the date syrup as rich nourishment (**Al-Hooti, et. al., 2002).**

The earliest uses of dried food desiccation were 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 figs may be dried by sun-drying. This method requires a large amount of space for large quantities of the product. Some advantages of the direct osmosis in comparison with other methods during drying 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 process was effective in preventing fruit discoloration by enzymatic oxidative browning, thus precluding the use of sulphur dioxide. **Farkas and Lazar (1969) and Kanner *et al.* (1981)** indicated that increasing sugar content in the concentrated fruit produces a sweeter flavor in the processed fruits. Osmotic drying by submersion in concentrated solutions is used for partial removal of water from plant tissue. The concentration gradient of water influences extraction of water from the tissue, while conditioning penetration of osmotic solution into the tissue. Extraction of water from the tissues much more intensive than the penetration of osmotic solute into the tissue. Velocity of diffusion of water molecules from biological materials depends on a number of factors such as: temperature and concentration of osmotic solution, solute properties, dimension and geometric shape of submersed material, mass ratio between material and osmotic solution, velocity of solution flow, material preprocessing and other factors (Pavkov, et,al 2009).

The objective of this investigation was to study the effect of using various concentration of date syrups as pretreatments for producing osmotic-dried apricot on dehydration time. Physicochemical, microbial assessments as well as sensory evaluation were undertaken during the storage for 6 month at the ambient temperature.

2. Materials and Methods

Materials

Apricot (*Prunus armonica*, L) were obtained from local market, at season 2016. Date syrup (dibis) were obtained from local market.

Methods

Osmotic dehydration

Apricot fruits were washed thoroughly with tap water, blanched in the presence of 1% NaOH at 90°C for 30 sec. After that, the apricot was divided into four groups (T1 to T4). T2, T3 and T4 apricot groups were immersed in solutions of 50, 60 and 70% date syrup previously prepared in the presence of 1% calcium chloride at 50°C for 12 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 draining rinsed quickly in a stream of tap water and blotted with tissue to remove the adhering solution. The control samples T1 without immersed in date syrup solutions. The obtained samples (T2, T3, T4 and T1 control) were then weighed and dried in an oven at 50°C for about 22-40 hr. according to type of osmosis solution used for pretreatment.

Packaging and storage

Samples were packed in poly ethylene bags of about 500 g capacities with removing the air. Finally bags were sealed by heat and stored for 6 month at ambient temperature.

Analytical methods

Physiochemical analyses

Moisture content, total solids, ascorbic acid, total acidity, total sugars, (reducing and non-reducing sugars) and ash contents were determined according to **A O A C (2005).**

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 30ºC 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 overall acceptability) of the osmotic dehydration and control dried apricot by 10 will trained panelists, assigned a score of each sensory characteristic according to 10 point category scales.

Statistical analysis

The data set of sensory evaluation was statistically analyzed using the statistical analysis system **SAS (1996)**, and Duncan's multiple range test **Duncan, (1955)** to ascertain the significances among means of the treatments at significance level of $P < 0.05$.

3. Results and Discussion

Physiochemical properties of date syrup (dibis).

Table (1). Physiochemical properties of date syrup in dry weight basis.

Components (%)	Date syrup
Moisture content	17.20
Ash content	6.47
Total solids on dry weight	82.80
T.S.S	79.20
Total sugars	90.80
Total proteins	0.99
Total lipids (fats)	1.74
Total acidity	0.19
pH values	6.90
Ascorbic acid (mg/100 g)	5.40
Iron (mg/100 g)	9.75
Potassium (mg/100 g)	210.40
Calcium (mg/100 g)	350.20
Sodium (mg/100 g)	11.70
Magnesium (mg/100 g)	144.79

Chemical constituents of date syrup are presented in Table (1). It could be noticed that, date syrup contained 17.20 % moisture content, 6.47% ash, 1.74% fat, 0.99% protein, and 90.80% total sugars. On the other hand, total solids, total soluble solids, total acidity and pH values were 82.80%, 79.20%, 0.19% and 6.90, respectively in date syrup. While ascorbic acid, sodium, potassium, iron, magnesium and calcium in date syrup were 5.40, 11.70, 210.40, 9.75, 144.79 and 350.20 mg/100g, respectively.

The effect of immersed apricot with date syrup on the dehydration time

Dehydration of osmotic dried apricot is shown in **Table (2).** The concentrations of solutions used for osmosis were 50, 60 and 70 % just before processing of apricot. However, the concentration of osmoses solutions used for osmotic processing were lowered at the end of osmosis process to become 40, 48 and 55 % for T2, T3and T4 solutions, respectively. The osmosis time changed the driving force of the drying process as the alteration of the type of osmosis solution. Meanwhile, the T4 solution had the lowest drying time for the osmotic apricot followed by T3, T2, and T1, respectively. It is worth to know that, the sugars in the fruits were considered as a distinctively characteristics of the fruit varieties. As the equilibration time increase, the ratios between the various components showed considerable changes **Giangiacomo et al., (1987)**. These results may be explained by **Tedjo et al., (2002).** The osmosis process also reduced the time of dehydration of grapes compared with grapes dried with sun drying. It may be due to the choice of osmosis solution and the addition of NaCl to osmotic solutions which caused an increase in the driving force of the drying process. These results are correlated well with **Lerici et al. (1985).**

Table 2. The effect of immersed apricot with date syrup on the dehydration time

Treatments	Concentration of osmotic solution		Dehydration time
	Before	After	
Control T1			40
T2	50	40	32
T3	60	48	27
T4	70	55	22

T1 control, T2 treated with 50% date syrup, T3 Treated with 60% date syrup, T4Treated with 70% date syrup

Physiochemical properties of osmosis dried apricot during storage periods

Physicochemical properties of both osmotic-dried and untreated apricot during storage period up to 6 months at an ambient temperature are shown in **Table (3).** Results indicated that, the moisture content was 85.30% for fresh apricot. While, the average ratios of moisture contents of osmotic-dried apricot pretreated with different osmosis solutions immediately after processing were 8.10 to 10.0% but it was 10.30% for the control apricot. A little increment in moisture contents were recorded with progress of storage period for all tested samples and reached to the maximum at the end of storage after 6 months of storage at ambient temperature, but still being little than that of T4 control apricot values after 6 months.

Total solids of fresh apricot were 14.70 %. While, the total solids were ranged from 90.0 to 91.90 % for osmotic dehydrated apricot just after processing, respectively. Subsequently, a little increment in total solids for osmotic-dried apricot was found and it was affected by the progressive period of storage up to 6 months and its impact was also affected by the type of the used osmotic solution for pre treating of both apricot before drying.

The content of ascorbic acid was 17.30 mg/100g for fresh apricot as shown in (Table3). Meanwhile, the ascorbic acid contents ranged from 95.20 to 99.11 mg/100g for osmotic-dried apricot immediately after processing, respectively. However apricot pretreated with T4 had the highest ascorbic acid content immediately after processing followed by T3, T2and T1, respectively. The ascorbic acid content gradually decreased with increasing the storage time for both osmotic dehydrated and control samples by extending the storage periods up to 6 month but the greatest reduction was observed for control samples. The reduction of ascorbic acid for osmotic-dried apricot may be due to the native content of ascorbic acid in apricot, the concentration or type of used osmosis solutions, the immersing time in osmosis solution, the temperature of dehydration process and extending shelf life at ambient temperature. These results coincide with **El-Gharably et al., (2003)** who mentioned that, during the first four months of osmotic dehydrated cherries, there was a decrease in ascorbic acid, while in the last two months, further decreases were found.

The initial total acidity of fresh apricot was 0.65%, the values of the osmotic dehydrated apricot pretreated with different tested osmosis solutions were in the range of 1.75-1.86%. However, the control apricot recorded total acidity value of 1.63 %. On the other hand, **Table (3)** shows that, the value of sugar contents in fresh apricot was 8.42 % in which reducing sugars are the predominant sugars recording 6.70 %. Results, also, indicated that, the amount of reducing sugars immediately after processing was ranged between 56.12 and 59.42% for osmotic dried apricot samples. Where, the corresponding values of non reducing sugars were about 14.32 and 14.80% for all osmotic-dried apricot. But, the control apricot had less total sugars than osmotic dehydrated samples. Results showed a little change in total, reducing and non reducing sugars during storage at ambient temperature up to 6 months of storages. These results are similar to that reported by **Torreggiani et al. (1988).**

Microbiological examination

Table (4) shows the assessment of total microbial count and the yeasts and molds count during storage of osmotic-dried apricot pretreated by various osmotic solutions as well as the control-sample during storage up to 6 months at ambient temperature. The behavior of the different groups of microorganisms (total microbial flora, yeast and molds) immediately after osmotic dehydration and control was quite different depending upon the type of pretreatment used before dehydration. Where, the control apricot immediately after processing had the highest total microbial flora (6.4 x 10^3cfu/g) followed by osmotic-dried apricot pretreated by immersing with date syrups of 50, 60% and 70% date syrup (4.6 x 10^3, 3.2 x 10^3 and 1.4 x 10^3 cfu/g), respectively. Results also indicated that, yeast and molds in osmotic dehydrated apricot had markedly lowest counts than the control samples depending upon the type of pretreated with osmosis solution, where the total counts of yeast and molds were ranged between 2.4 x 10^2 to 1.1 x 10^2 cfu/g for osmotic dehydrated apricot samples. 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 T4 for osmotic-dried apricot were more effective and caused the higher reduction in total counts followed by T3 and T2, respectively, immediately after processing of apricot. Meanwhile, osmotic dehydrated and control sample of apricot caused a gradual increment of reductions or eliminated for total viable counts in relation to the extending period of storage. The viable microbial population also gradually decreased during extending the storage period of the tested samples which recorded the lowest total viable counts of total microbial flora and yeast & molds at the end of 6 months of storage. Subsequently, both total counts of flora and yeast & molds flora growth decreased and reached to the lowest level for all samples tested after 6 months of storage at ambient temperature compared with those values immediately 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 6 months of storage. This trend of decreasing for total microbial counts and yeast & molds was well correlated with the type of osmotic solution used in pretreatment before dehydration, and extended storage period.

Table 3. Physiochemical properties of osmotic-dried apricot prepared with date syrup during storage period up to 6 months at ambient temperature

Constituents			Moisture %	Total Solids %	Ascorbic acid (mg/100g)	Total Acidity %	Total sugars %	Reducing sugars%	Non-reducing sugars%
		Fresh apricot	85.30	14.70	17.30	0.65	8.42	6.70	1.72
Storage period (month)	Zero time	T1 control	10.30	89.70	92.30	1.63	69.79	55.65	14.14
		T2	10.00	90.00	95.20	1.75	70.26	56.12	14.32
		T3	9.30	90.70	97.44	1.82	71.80	57.30	14.50
		T4	8.10	91.90	99.11	1.86	74.22	59.42	14.80
	After 3 month	T1 control	10.60	89.40	80.13	1.60	68.30	54.22	14.08
		T2	10.20	89.80	85.40	1.70	69.80	55.09	14.11
		T3	9.40	90.60	88.34	1.78	70.70	56.37	14.33
		T4	8.50	91.50	91.13	1.81	73.21	58.56	14.65
	After6 month	T1 control	10.90	89.10	67.10	1.58	67.92	54.00	13.92
		T2	10.50	89.50	73.14	1.66	68.32	54.30	14.02.
		T3	9.70	90.30	79.40	1.74	69.42	55.27	14.15
		T4	8.80	91.20	83.14	1.79	72.10	57.77	14.33

T1 control, T2 treated with 50% date syrup, T3 Treated with 60% date syrup, T4Treated with 70% date syrup

Sensory evaluation of osmotic-dried apricot

The analysis of variance for color, texture, taste, flavor and overall acceptability for the processed apricot immediately after processing and during storage up to 6 months at an ambient temperature is shown in **Table (5).** Analysis of variance for the processed apricot immediately after processing and during storage up to 6 months at an ambient temperature indicated that a significant difference in color, texture, taste, flavor and overall acceptability was found among dehydrated samples and well correlated with the concentration of osmotic syrups used for pretreatment of osmotic-dried apricot. Osmotic-dried apricot pretreated with 70% date syrup recorded the highest values of sensory attributes followed by 60 and 50 % date syrup, respectively compared with the control dried apricot which recorded the lowest sensory scores. Consequently. On the other hand, the osmotic-dehydrated apricot pretreated by 70% date syrup had the highest scores of all tested sensory parameters followed by that pretreated with 60% and 50% date syrup and the control respectively. Therefore, it seems that the decline of sensory scores was pronounced for control-dried samples stored for 6 months compared with those for the osmotic-dried apricot.

Table 4. total microbial counts for osmotic-dried apricot pretreated with date osmotic solutions during storage for 6 month at ambient temperature

Microorganisms	Treatments	Storage periods (month)		
		0-time	3 month	6 month
Total bacterial count (cfu/g)	Control	6.4×10^3	4.2×10^3	2.1×10^3
	T1	4.6×10^3	3.1×10^3	1.4×10^3
	T2	3.2×10^3	1.6×10^3	7.4×10^2
	T3	1.4×10^3	8.5×10^2	5.3×10^2
Yeast & mold count (cfu/g)	Control	3.2×10^2	2.5×10^2	1.9×10^2
	T1	2.4×10^2	1.8×10^2	1.3×10^2
	T2	1.7×10^2	1.2×10^2	9 x 10
	T3	1.1×10^2	6 x 10	4 x 10

T1 control, T2 treated with 50% date syrup, T3 Treated with 60% date syrup, T4Treated with 70% date syrup

Table(5). Sensory evaluation of osmotic-dried apricot prepared with date syrup during storage period up to 6 months at ambient temperature

Properties	Treatment	Storage time (days)		
		Zero time	3 month	6 month
Color	Control T1	6.10^d	5.40^d	5.20^d
	T1	7.20^c	6.60^c	6.30^c
	T2	8.40^b	8.10^b	7.60^b
	T3	9.80^a	9.20^a	8.80^a
Flavor	Control T1	6.50^d	6.10^d	5.30^d
	T1	7.40^c	7.20^c	6.60^c
	T2	8.70^b	8.30^b	8.00^b
	T3	9.60^a	9.20^a	8.90^a
Texture	Control T1	6.4^d	6.1^d	5.80^d
	T1	7.80^c	7.40^c	6.80^c
	T2	9.10^a	8.60^b	8.10^b
	T3	9.70^a	9.20^a	9.00^a
Overall acceptability	Control T1	6.20^d	5.80^d	5.00^d
	T1	7.70^c	7.20^c	6.70^c
	T2	9.20^a	8.60^b	8.20^b
	T3	9.80^a	9.30^a	9.00^a

Values with different letters in the same raw are significantly different at $P< 0.05$
T1 control, T2 treated with 50% date syrup, T3 Treated with 60% date syrup, T4Treated with 70% date syrup

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