Egypt. J. Agric. Res., 80 (2), 2002.

COMPARATIVE STUDIES ON THE EFFECT OF BLANCHING AND DRYING METHODS ON THE OSMOTIC PARTIAL DEHYDRATED PEAR SLICES

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(Manuscript received 18 November 2001)

Abstract

Pear fruits were cored, cut into slices then blanched. Both blanched and unblanched fruit slices were immersed in 65% sucrose solution for different periods at room temperature, then dried by different methods of drying.

The results indicate that blanching caused much more migration of osmotic medium into fruits and reduced the time of immersion. It could be recommended that solar drying is suitable for pear fruits grown in Egypt. It was also recommended that final dried products produced by osmosis at 0.15-0.16 moisture ratio could be suitable for dry form consumption, but at 0.1 moisture ratio or lower the products became unsuitable for dry form consumption, hence it should be rehydrated.

INTRODUCTION

Drying of food has long been utilized as a food preservation method. Osmotic dehydration is used for the partial dehydration of food, usually as an upstream processing step before subjected to further processing such as freezing or drying (Ponting, 1973; Raoult-Wack, 1994).

Rastogi and Raghavarao (1994) stated that osmotic dehydration in sugar syrup reduces both moisture content of fruit and the drying time, as well as, it prevents enzymatic browning, increases sugar contents, nutrient retention and intensifies sweetness of the processed fruits, while minimizes damage of color and flavor, reduces refrigeration energy also dehydrated fruits are suitable for consumption directly in the dry state. On the other hand it could be considered as cost-effective alternative compared to freeze-drying (Flink, 1975).

The rate of water removal and weight loss in osmotic dehydrated fruits depend upon many factors such as the concentration and temperature of osmotic solution, immersion time, solution to food ratio, specific surface area of the food and the vacuum level if applied. Considerable amount of information is available in the literature describing the influence of these variables (Rastogi and Raghavarao 1996). Blanching has been successfully applied in food dehydration, but it has not been so far studied as available for osmotic dehydration.

The quality of food dehydration depends not only on its original state but also on the involving factors such as the used method, temperature, time, light, etc. as well as the extent of changes that take place during processing. Sun drying is the most economical method of drying, but it is not suitable for dehydration of some fruits such as apple and pear fruits. Recent efforts to improve sun drying have led to solar drying (Bhide *et al.*, 1987).

Solar drying uses the sun as a heat source, but a specially designed drier increases the dehydration air temperature. Egypt has a suitable climate for solar drying, where solar energy is 900-1000 w/m^2 and ambient temperature is relatively high 30-40°C during the harvesting seasons of most fruits and vegetables ; i.e. from May to September (Khattab, 1994).

The aim of this project was to investigate the effect of blanching on the characteristics of the osmotic dehydrated products and to determine the effect of different drying methods on the attribute of final products.

MATERIALS AND METHODS

Materials:

Pear fruits were obtained from Dokki, Giza, local market. Commercial sucrose was used in this study, sodium benzoate and other chemicals were of analytical grade from EL-Gomhoria company.

Methods:

Fresh pear fruits were washed, cored, hand peeled then cut into slices, blanched in water at 100 ºC for 2 min. Unblanched samples were used as control. For osmotic drying the pear slices were immersed in (65% total soluble solids) sugar solution containing one gram of sodium benzoate which was added per kilogram sugar to prevent microbiological growth. Fruits /sugar ratio was 1:20. Samples were held at room temperature for the respective time (33 hrs). At the end of the immersion period, the osmosed products were dried by different methods as follow:

1. Oven dryer at 50 ºC.
2. Solar dryer constructed by the Food Engenering Dept, Food Tech. Res. Inst., Agri. Res. Center, Giza.
3. Hot air dryer with a circulating air speed of about 4m/sec.

In each method the samples were placed in a single layer on perforated trays in the dehydrator.

Analytical methods:

Moisture content of fresh and treated samples were determined by drying at 60ºC until constant weight (A.O.A.C, 1995). Moisture and weight-loss were determined according to the following equations (Bolin *et al.*, 1983, Viberg *et al.*, 1998).

$$\text{Moisture loss} = \frac{\text{Moisture content (Initial - Final)}}{\text{Initial moisture content}} \times 100$$

$$\text{Weight loss} = \frac{\text{Initial weight - Final weight}}{\text{Initial Weight}} \times 100$$

The concentration of osmotic medium was adjusted initially and throughout examination using an Apple refractometer (Mavroudis *et al.*, 1998): Color index in dehydrated sample was determined by blending 50 gm of samples in waring blender with 150 ml ethanol, filtrated, diluted and optical density was recorded at 420 nm in spectrophotometer (Shimidzul, UV 120).

The texture of dehydrated samples as firmness was measured by using Magness and Baulauf tester pressure equipped with a plunger 3/16. Ascorbic acid was extracted from 0.5 gm samples using 25 ml of 2% oxalic acid, then filtrated. The supernatant was used for the determination of ascorbic acid according to Anonymous, 1966. Total and reducing sugars were determined by the dinitrosalycilic acid method (Miller, 1959) at 540 um using spectrophotometer (Shimidzul, UV 120). Dehydration ratio is the ratio of weight sample before dehydration and after osmosis and drying. Moisture ratio was calculated as moisture content/ solid phase (Kim and Toledo, 1987). Sensory attributes in samples were investigated. Ten panel members were used to evaluate the dried fruit slices, according to the methods of Schadle *et al.*, (1983) with some modification. Samples were directly used in sensory evaluation in the dry form without rehydration in water.

Sensory evaluation were statistically analyzed according to SPSS(1987). Calculations were done by means of statistical software package.

RESULTS AND DISCUSSION

1. Osmotic dehydration

During the process of osmotic dehydration, weight loss, moisture loss, total soluble solids and dehydration ratio as well as total soluble solids of osmotic solution were determined.

A. Effect of blanching as shown from the curve of weight loss of pear slices and total soluble solids of osmotic solution within different immerison times:

Weight of pear slices dropped to 50% of its original weights within 18hrs in blanched samples and 25 hrs in unblanched samples, then the weight was constant (Fig. 1). This may be due to the flow of the water from fruits to solution. The highest drop value was observed in blanched sample at the first time of immersion. This could be explained by the degradation and breakdown of pectin and structural texture, thus increase water liberation (Parrott and Thrall, 1978).

In addition, blanching causes much more osmotic migration into the fruits and could reduce total soluble solids of the osmotic medium (Fig.1), thus, the lowest weight loss was in the final products subjected to blanching. These results are similar to those obtained by Simal *et al.*, 1998 when apple cubes were subjected to osmosis in 70% TSS sucrose solution as well as ultrasound energy treatment. They concluded that ultrasound treatment affected both water loss from fruits and increased migration of osmotic medium into fruits.

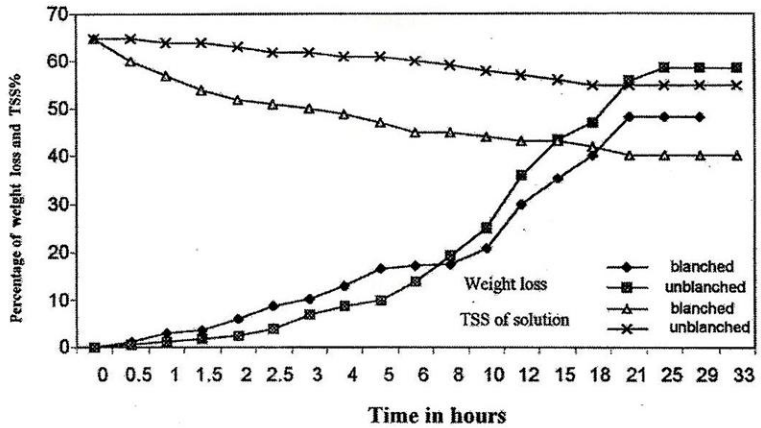

Fig 1. Effect of blanching on weight loss percentage of pear slices and total soluble solids percentage of solution within osmosis dehydration

B. Some physical changes in osmotic dehydrated pear slices

Table (1) shows that the reduction in water content was not concomitant with reduction in weight loss (Fig. 1). Total soluble solids in previously blanched samples were high, which indicate the higher solute transfer from the solution into the fruits. Ponting, (1973); found that blanching and freeze/thawing are all conductive to the uptake of solids and to the water loss. The same data revealed that the samples without any pretreatment had low ratio of dehydration of 2.7:1 . Blanching process caused an increased ratio of dehydration which had reached 2.3:1. The results also indicate that blanching caused more reduction in the time of immersions from 25 hrs. to 18 hrs. This would lead to preserve the natural flavor and color. These results are in good agreement with those obtained by (Simal *et al.*, 1998).

2. Effect of osmotic treatment and different drying methods on final products:

A. Drying rate:

The drying rate of osmotic and non-osmotic dehydrated pear slices are shown in Figs. (2&3). The rate of drying in air forced by ventilation was very rapid compared to oven and solar driers. After 2.30 hrs time of forced air drying, moisture ratio was reduced from 1.1 to 0.15 in osmotic dehydrated pear slices (Fig. 2). On the other hand, the decrease of moisture ratio from 5.2 to 0.1 of non-osmotic dehydrated ones in solar driers required 27hrs. Suitivan *et al.*, (1982), stated that by reduction of dehydration to moisture ratio of 0.1 or below, the products will be too hard and woody when eaten in the dry form.

Table 1. Effect of blanching on some physical changes in osmotic dehydrated pear slices

Treatment / Parameter	Fresh	Unblanched	Blanched
Moisture content %	84.3	60.2	53.3
Total soluble solids %	11.3	18.1	28.7
Dehydration ratio	-	(2.7 :1)	2.3 :1
Osmosis time in hours	-	25	18

B. Some chemical and physical properties of final dehydrated pear slices

The sugar content and the chemical changes which occur during drying played a very important role in the qualities of the products. From the data given in table (2), it is observed that osmosis treatment had increased sugar content, this could be attributed to penetration of sugar solution into pear slices. The oven dried samples contained the lowest total and reducing sugar content among samples dried by the three drying methods. The relatively lower level of sugar content in oven dried samples was probably due to Maillard type reaction for sugar and amino acids. This reaction is very sensitive to thermal condition of the methods during drying. Ascorbic acid content of solar dried samples was higher than that of oven and forced air dried samples. Ascorbic acid is known to be sensitive to processing temperature of the methods (Rajas and Gerschenson, 1997).

Both color index and texture highly influence the market acceptability of food products. Color index value of osmotic dehydrated pear slices was less as compared to the control (table 2). This could be due to the reduction of active enzymes causing browning in the case of osmosis treatment. The same pattern was observed by (Dixon and Jen, 1977). The combination of osmotic dehydration followed by rapid drying method such as using the forced air flow method, resulted the lowest darkening rate.

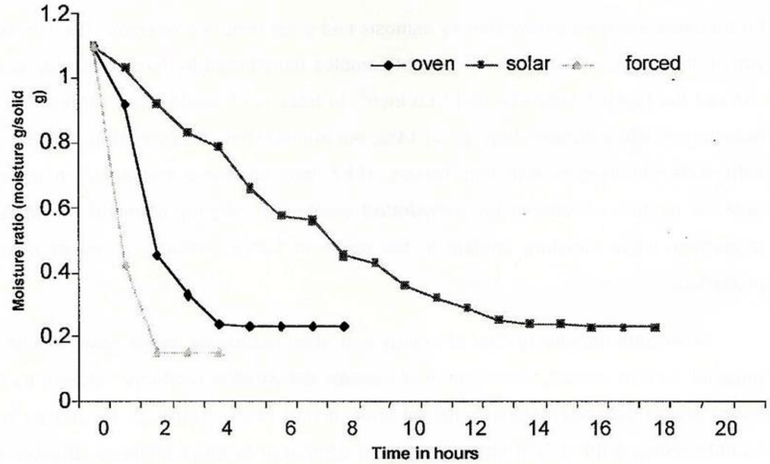

Fig. 2. Drying curve of osmotic dehydrated pear slices.

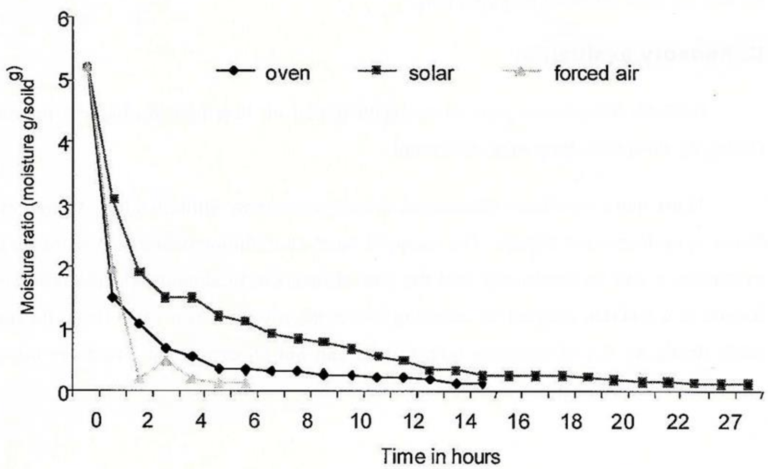

Fig. 3. Drying curve of non-osmotic dehydrated pear slices.

Furthermore samples dehydrated by osmosis had good texture properties. The firmness was in the range of 6-7 Lb/Inch^2 except samples dehydrated by forced air flow which showed the highest firmness 10-11 Lb/Inch^2. In table (2) it could be observed that by reducing moisture content from 19 to 14%, the firmness increased sharply. Similar results were obtained by Kim and Toledo, 1987, who observed that moisture content from 20 to 30% of osmotically dehydrated blueberries slightly changed the texture properties, while moisture content in the range of 10-15% sharply changed texture properties.

Now, with increasing cost of energy and other resources, these costs should be reduced. In this context, combination of osmotic dehydration products followed by different drying methods caused different short drying times (Table 2). Forced air flow method reduced the drying time much more compared to other methods. Blueberries treated with osmotic dehydration followed by high temperature fluidized bed drying reduced drying time from 21.50 to 1.17 hrs (Kim and Toledo, 1987). Although forced air drying method apparently reduced drying time, solar drying method was less expensive as well as quite different in drying time.

C. Sensory evaluation:

Osmotic dehydrated pear slices using forced air flow had the highest firmness (Table 2), therefore, they were discarded.

There were significant differences among all sensory attributes (Fig.4), for color, flavor, sweetness and texture. The rating of each attribute increased with osmosis dehydration. It can be concluded that the use of osmosis treatment before final drying, results in a suitable product for consumption in the dry form at 0.15 % moisture ratio, while drying at 0.1 % moisture ratio or less can not be consumed directly in the dry state. Therefore, this product should be rehydrated.

Table 2. Effect of osmosis treatment and methods of drying on some physiochemical properties of dehydrated pear slices.

Treatment / Physiochemical properties	Fresh	Without osmosis			With osmosis		
		Solar energy	Oven method	Forced air	Solar energy	Oven method	Forced air
Moisture %	48.3	12.2	12.03	11.3	20.01	20.1	13.85
Total sugar %	9.65	75.10	70.29	73.52	83.22	79.50	78.34
Reducing sugar %	6.67	57.91	50.32	55.17	59.37	51.90	65.13
Ascorbic acid mg/100 g	7.81	6.5	4.2	3.5	9.3	6.71	7.61
Color index 420 um	0.031	0.53	0.61	0.63	0.41	0.51	0.60
Texture Lb/Inch^2	6	7	9	9	6	6	11
Drying time (hr)	-	27	14	5	13	5	2.30

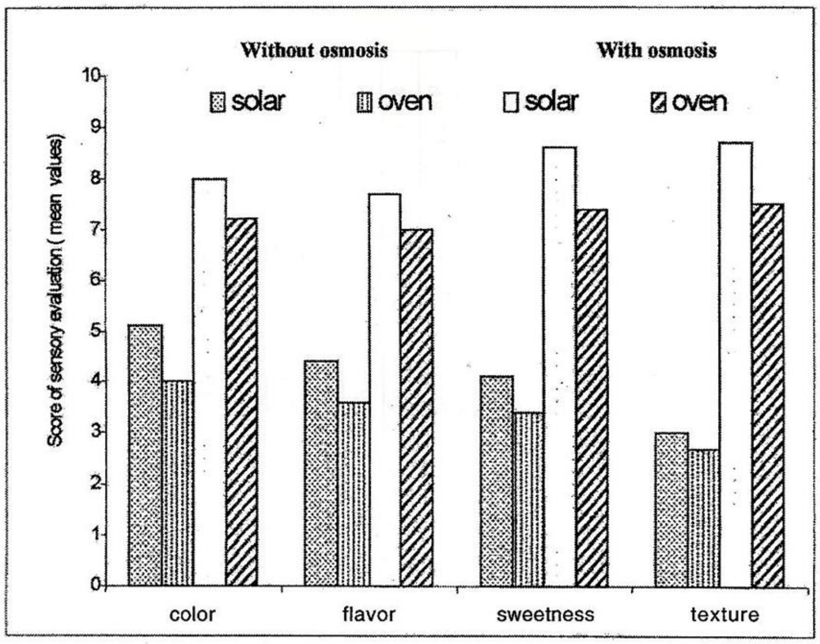

Fig. 4. Effect of osmosis treatment and methods of drying on sensory attributes of dehydrated pear slices.

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دراسات مقارنة عن تأثير السلق وطرق التجفيف على شرائح الكمثرى المجففة جزئيا بالأسموزية

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تم دراسة تأثير عمليات السلق الأولية على بعض الخصائص الكيميائية والطبيعية لشرائح الكمثرى المغمورة فى محلول سكرى ٦٥٪ لمدة ٣٢ ساعة على درجة حرارة الغرفة. وكذلك تم دراسة تأثير طرق التجفيف بإستخدام الطاقة الشمسية وأفران التجفيف العادية وأفران التجفيف المزودة بتيارات هوائية على الخواص الكيميائية والطبيعية والحسية للمنتجات المجففة لأختيار أفضل طريقة للتجفيف.

فقد وجد أن أستخدام السلق الأولى قبل عملية التجفيف الجزئى بالأسموزية يؤدى إلى زيادة أنتقال المحلول السكرى إلى شرائح الكمثرى مع أقل وقت للغمر فى المحلول السكرى.

وأيضاً وجد أن طريقة التجفيف بالطاقة الشمسية تكون مناسبة وأفضل لتجفيف الكمثرى المنزرعة فى مصر. ومن الدراسة وجد أن منتجات شرائح الكمثرى المجففة والمعاملة بالسلق والتجفيف الجزئى بالأسموزية صالحة للأكل على حالتها المجففة عند نسبة رطوبة ١٥,٠ أما عند نسبة رطوبة ١,٠ أو أقل تكون صالحة للأكل بعد استرجاعها بالماء ولا يمكن تناولها على الحالة الجافة.