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EFFECT OF SUN DRYING AS PRESERVATION METHOD ON APRICOT COLOR SPACES AND SOME CHEMICAL PROPERTIES

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Abstract

The drying characteristics of apricot were determined usingOpen Sun and three Greenhouse Drying (Black Mesh Shading, white and black poly film plastic in as absorbers plate covering greenhouse. pretreatments (control, sucrose syrup and Sodium bicarbonate) were used before drying conditions at (Open air , White and Black poly film plastic greenhouse). The color values (L, a* and b*),beta carotenoids, total soluble sugar and ascorbic acid content were also measured for the different fresh and dried apricot.The fresh apricot fruit initial moisture content was 80.03% d.b. The color values Lightness (L* was 71.14,) Red/Green Value(a* was 21.36) and Blue/Yellow Value (b* was 70.23), Browning Index (BI, was 223.47)hue angle, Hº was73.08 and chroma, relative saturation(C was 73.41). Results showed that the moisture, beta carotenoids, total soluble sugar and ascorbic acid were highest in sodium bicarbonate blanched sample and color attributes were found maximum in sodium bicarbonate blanched sample, immediately after dehydration. The values of the dried apricot color spaces (L*, was 14.22, a* was 13.17 and b* was 18.04) while chroma, hue angle, and Browning Index was 22.33, 53.87and 390.12 Black Mesh Shading with pretreatments at Sodium bicarbonate) There was not much change on the ascorbic acid contents of fresh and dried apricot .*

Key words**:** *apricot, chemical properties, sun drying, colour, pre-treatments*

INTRODUCTION

Apricot (Prunus armeniaca L.) is a member of the Rosaceae family and is a common fruit due to its special sweetness and color. Annual production exceeds 3.7 million tons [7]**.** Dried apricot is one of the important traditional export products. In 2019, Egypt shipped 242 tons of apricots. In 2019 alone, interest in Egyptian apricots (fruit) increased, with a change of 19.212% compared to 2018. Apricot exports fell -7.98% between 2017 and 2019, bringing the country $8.17 million in 2019 [22]**.**

Apricots provide significant health benefits because of their high content in antioxidants, primarily phenolic compounds and carotenoids [14]**.**

[17] reported that apricots are rich sources of carotenoids, 50% of which consist of β-carotene, and the carotenoid composition of apricots is unique, being quite different from many of fruits.

The drying process aims to prolong shelf life by reducing physical, chemical, microbiological and enzymatic reaction rates through the removal of the water content, to decrease costs of packaging, warehouse and transportation, and to protect nutritional value [16]**.** Dried fruits and vegetables are considered an alternative fat-free snack and have been getting a lot of attention lately [6]**.**

Sun-dried fruits and vegetables are one of the oldest methods of food preservation. The reason is that sun drying is a simple method that requires less capital, simple equipment and less energy input. [5]**.**

Before drying, fruits and vegetables are generally subjected to different pre-treatments, such as blanching, osmotic dehydration in sucrose and salty solutions, and immersion in a sodium bisulphite solution [3]**.**

To decrease the effect of spoilage reactions, to facilitate the drying process, to prevent browning, to ensure colour stability, and to improve the overall product quality, some pretreatments are advised [23]**.**

However, to the best of our knowledge, there are no investigations on the effect of dipping the whole apricot in NaCl, sucrose, and sodium bisulphite solutions [3]**.**

The color, beta-carotene, minerals and antioxidant activity of apricots by microwave and hot air treatment were investigated. The system was set to convection mode with air velocity of 1 m s–1, air temperature of 50 °C and 75 °C, microwave mode set to output power of 90 W and 160 W, and microwave mode set to four different combinations of power levels and temperatures (50°C+90W, 50°C+160W, 75°C+90W, 75°C+160W). The color values (L*, b*, ΔEab, h° and C*ab) of dried fruit decreased, while the a* value increased. Dried apricots have a 1.4 to 3.9-fold increase in beta-carotene ratio based on dry matter increase compared to fresh samples [10]**.** [12] investigate the effect of different hot air-drying temperatures and sun drying on quality (color and b-carotene content) of both sulphurated and non-sulphurated apricot. Darkening of the color of fresh apricot when a process of sun drying was applied, was defined as the decreasing L* values from 70.7 to 42.0 and 30.6, and b* values from 50.0 to 25.4 and 11.3 for sulphurated and no sulphurated apricots, respectively in the sun-dried samples. Hunter a* values increased almost two folds, which also shows the darkening of the color. Other researchers also used the LAB method to measure the color change of various crops including sweet potato. The maximum (L* was 74.62 and a* was 15.7) for sweet potato slices were treated while the maximum yellowness (b*) and Browning Index (BI) were 55.46 and 208.29 for untreated sweet potato slices, respectively [20].Color values and b-carotene content of hot air-dried samples were favorable in comparison to air drying. b-carotene content in dried apricots at sun drying 3.87, 3.38 48mg 100 g^{-1} dry matter for sulphurated and no sulphurated apricots, respectively.

Apricots are rich in carbohydrates and minerals, have an amazing color and distinct flavour. The most abundant minerals are potassium and iron. Apricots are an important source of sugars, fibres, proteins, minerals, vitamins A and C, and beta-carotene. Because of its benefits to human health, there is a growing demand for dried apricots all over the world. Moreover, there is a marked interest in polyphenols and carotenoids in this fruit due to its antioxidant activity and ability to prevent chronic diseases. Apricots are characterized by a short harvest season and limited storage time and to provide the market with a wide range of products, saved by drying The drying process aims to extend the shelf life by reducing physical, chemical, microbiological and enzymatic reaction rates by removing the water content and reducing the costs of packaging, storage and transportation and protecting the nutritional value .

However, different drying methods and pre-treatments significantly influence the quality of dried apricot. Therefore, the aim of study was conducted to study the suitable drying methods and pre-treatments for preserving maximum quality traits (beta carotenoids, total soluble sugar and ascorbic acid) and color of dehydrated apricot.

MATERIALS AND METHODS

The present investigation was carried out in Ras Sadr, Egypt. The aim of the study was to determine the optimum drying conditions for apricots and the optimum initial treatments to obtain better quality.

Experimental set up

Raw Apricot

Apricot was procured during the month of July 2022. Fresh apricots were washed, halved, divided on three trays made of stainless-steel mesh (covered with a plastic) and then dried by direct exposure to sunlight, with an overall maximum daytime air temperature of around 40°C. After that, apricots were pre-treated by, un treated (**T1**control), and treated with blanched with **1) T2** sucrose syrup (5g in 1liter of hot water at 100°C for 1min).

2) T3 in Sodium bicarbonate (5g in1liter of hot water at 100°C for 1min), then it put in Sodium chloride and ascorbic acid (5: 20g in 1liter of cold water). Chemicals were purchased from local market for analysis.

Apricot was spread evenly in a single layer on trays. The trays were placed (open air drying; inside three greenhouses (1- Black Mesh Shading greenhouse, 2- white and black poly film plastic greenhouse covering in as

absorbers plate. Three trays made of stainless-steel mesh (40 cm x 20 cm) were put in inside drying green house)

During the drying process, the relative humidity of the air was 53 % and average wind speed was 17 m/sec. This traditional sun-drying method is a common process applied by the farmers and the families in several regions in Ras Sadr, aiming to preserve the excess of production and make apricots available for longer periods.

Moisture content determination

The moisture content of the dried samples was determined at 78°C during 48 h even weight stability, using an air oven set, three replicates carried out for sample according to the Association of Official Analytical [2].

The moisture content of the samples was calculated on a percent dry basis and the average value of the triplicate samples was used.

$$\text{Percent Moisture} = \frac{W_w - W_d}{W_d} \times 100 \text{.....(1)}$$

where: Ww is the initial weight of sweet potato samples (g); Wd is the dry weight of sweet potato samples (g).

Quality Evaluation of the dried apricot

Color properties determination

The image processing is the conversion of RGB color units to L* a* b* (segment labelling) values necessary for graphics and analysis, respectively. To convert the RGB color space of the image to CIE. Lab color space is necessary to do it in two steps. The first step carries out the RGB to XYZ transformation. And the second step carries out the XYZ → L*a*b* transformation [8].

The color values (CIE) of the fresh and dried apricot (*L**, *a** and *b**) were determined, the total color change (ΔE), chroma, hue angle and Browning Index (BI) were calculated after drying from the L*, a* and b* values using these Equations [9].

$$\Delta E = \sqrt{\Delta L^2 + \Delta a^2 + \Delta b^2} \quad \text{..... (2)}$$

$$\Delta L^* = L^*_{sample} - L^*_{standard} \text{..... (3)}$$

$$\Delta a^* = a^*_{sample} - a^*_{standard} \text{ ..... (4)}$$

$$\Delta b^* = b^*_{sample} - b^*_{standard} \text{ ..... (5)}$$

$$\text{Hueangle } H^\circ = \tan^{-1}\frac{b^*}{a^*} \text{.....(6)}$$

$$C^*_{ample} = \sqrt{a^* + b^*} \quad \text{..... (7)}$$

$$BI = X - 0.31 0.17 * 100\% \text{ ..... (8)}$$

$$X = a^* + 1.75L^* 5.645L^* + a^* - 3.012b^* \text{ ..... (9)}$$

where: L*, a*, and b* sample for the dried sample.

Ascorbic acid measurements

Ascorbic acid content was determined as follows [19].

$$\text{Amount of ascorbicacid of sample} \frac{\text{mg}}{100\text{g}} = \frac{0.5\text{mg} \times V2 \times 100\text{ml}}{V1\text{ ml} \times V1\ 5\text{ ml} \times \text{Weight of the sample}} \times 100$$

.....(10)

Determination of total soluble sugar

Total soluble sugars: TSS were determined by Anthrone reagent. Briefly 8 mg of Anthron reagent was taken in 250 mL beaker and then 40mL H_2SO_4 was added to make reaction mixture. After preparing reaction solution, 1 mL from the above prepared solution was taken and mixed with 100 µl samples. Test tubes containing reaction mixture were kept in water bath for 1 hour. Samples were cooled and then absorbance was read at 630 nm [21].

Measurement of beta carotenoids

The extraction method followed was as described in the literature with slight modifications [18].

The fruits and vegetables were cut separately and 10g of each fruit and vegetable was weighed and kept separately. The same extraction procedure was followed for all the fruits and vegetables. 10g of the fruit or vegetable was placed in a mortar and crushed with a pestle. A mixture of hexane and acetone in the ratio of 1:1was added into the mortar and the sample was crushed. About 5 ml of acetone was added slowly at regular intervals. The solvents were collected separately and the process was repeated with the sample again for double extraction. The solvents containing carotenoids were filtered through a filter paper and then transferred into a separating funnel. 20ml of distilled water was added along with 20 ml of 10% NaCl solution. The mixture was shaken vigorously

and kept aside for the layers to separate. The upper layer contained carotenoids and it was collected separately after the removal of the water and NaCl solution. The extract was collected in tubes. The extraction procedure was repeated thrice for reproducible values and by using a colorimeter, the absorbance of carotenoid was noted at 630 nm.

RESULTS AND DISCUSSIONS

Quality of fresh apricot

Physicochemical properties of fresh apricot fruit were indicated in table 1. The average initial moisture content was 80.03% on a dry basis. These findings were consistent with previous studies by [13] who reported the initial moisture content of 85.66 %.

CIE* color values of apricot were in close agreement with a range of L*, 70.7; a*, 6.4; b*, 50.0; C*, 49.3; and h*, 82.7 for [12]**.**

The total soluble sugar content, and beta carotenoidscontent of fresh apricot were **0.474mg/ml and 7.213mg/100g,** respectively. The values of beta carotenoid were quite comparable with the results of [4] who reported 173.2 ± 0.50 and 29.5- 33.5 mg/100 g, respectively for carrot and apricot.

The results of total soluble solids were in close agreement with [1]**,** who reported ranged from 12.67 to 20.00 ◦Brix, for apricot.

The total vitamin C content in the fresh apricot samples was 17 mg/100 g. The finding of this study was not in agreement with values reported by [11] and [17] of 17 and 22.02 mg/100 mL, respectively for apricot.

Table 1. Color space CIELABfor fresh apricot fruit

Drying methods	Fresh apricot
Moisture (d. b.%)	
L*	71.14
a*	21.36
b*	70.23
C	73.41
Hº	73.08
Bi	223.47

Source: Authors' determination.

Quality of physical properties dehydrated apricot

The effects of pre-treatment on physical properties of dried apricot**.** Color values of L *, a*, b* and total color change for apricot Chroma, hue angle and browning index was measured as illustrated in Table 2.

The color parameters of dried samples are presented in Table 2. The color values of all dried samples are less than the fresh samples. The highest value of lightness (L*) when using for treated with sucrose syrup while was 28.64 at these conditions (Black poly film plastic greenhouse) while at untreated there was 25.09 the maximum value of lightness (L*). Pre-treatment by blanching in sucrose syrup solution results in prevention of enzymatic browning of apricot and it had higher L* (lightness) value; lower Hue, and browning index. This implies that the pretreatment. The Sodium bicarbonate pretreated apricot recorded the highest value of redness (a*) value among the pretreatment methods while was 27.68 while at the untreated apricot of apricot was 26.85 at these conditions (Black poly film plastic greenhouse). The Sodium bicarbonate pretreated apricot recorded the lowest b* value among the pretreatment methods. The values for chroma and hue angle of the dried apricot decreased as compared with fresh samples. Lastly, the values for change color of open air drying higher than the other drying methods**.**

Quality of chemical properties dehydrated apricot

The influence of drying methods on quality of dehydrated apricot (beta carotenoid, total soluble sugar and ascorbic acid).

Chemical properties of dried apricot were evaluated and the results indicated in Figures 1, 2 and 3.

The changes in total soluble sugar and Ascorbic acid of apricot samples before and after the drying processes as shown in Figures 1 and 2, respectively.

Table 2. Effect pretreatments and drying methods on physical properties of dried apricot

Drying methods	Pretreatments	L*	a*	b*	C	H°	Bi	ΔE
Open air drying	**T1**	7.14	8.09	6.74	10.53	39.79	248.66	91.12
	T2	11.24	16.69	14.32	21.99	40.62	395.20	82.07
	T3	11.87	13.15	14.02	19.22	46.83	343.85	82.10
Black Mesh Shading	**T1**	25.09	27.55	36.07	45.39	53.33	511.81	57.67
	T2	27.15	23.81	37.21	44.17	57.39	463.08	55.05
	T3	19.42	16.79	25.08	30.18	56.21	404.92	68.81
White poly film plastic greenhouse	**T1**	11.65	13.40	14.80	19.97	48.74	392.66	81.70
	T2	24.25	24.34	34.17	41.95	54.53	491.21	59.23
	T3	28.11	27.68	37.29	46.44	53.41	428.43	54.56
Black poly film plastic greenhouse	**T1**	8.27	12.87	11.29	17.12	41.27	447.22	86.59
	T2	28.64	26.85	38.32	46.79	54.98	436.97	53.43
	T3	14.22	13.17	18.04	22.33	53.87	390.12	77.66

T1 control - **T2** sucrose syrup (5g in 1liter of hot water at 100 °C for 1min).**T3** in Sodium bicarbonate (5g in1liter of hot water at 100 °C for 1min), then rinsing with Sodium chloride and ascorbic acid (5: 20g in 1liter of cold water).
Source: Own design and results.

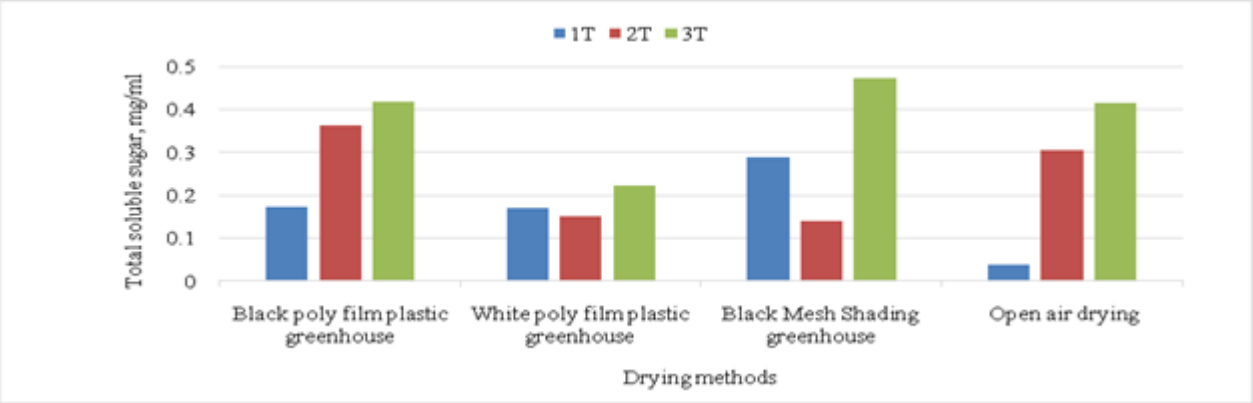

Fig. 1. Effect of pre-treatment methods on Total soluble sugar of dried apricot
Source: Own design and results.

Total soluble sugar ranged from 0.038 to 0.474 mg/ml. The maximum value of Ascorbic acid 8.0108 mg/100g for treated by Sodium bicarbonate, while the minimum value 2.708 mg/100g for treated by sucrose syrup. Beta Carotenoids was assessed before and after the drying processes as illustrated in Figure 3. Pretreatment conditions resulted in reduction in beta carotene content in all cases.

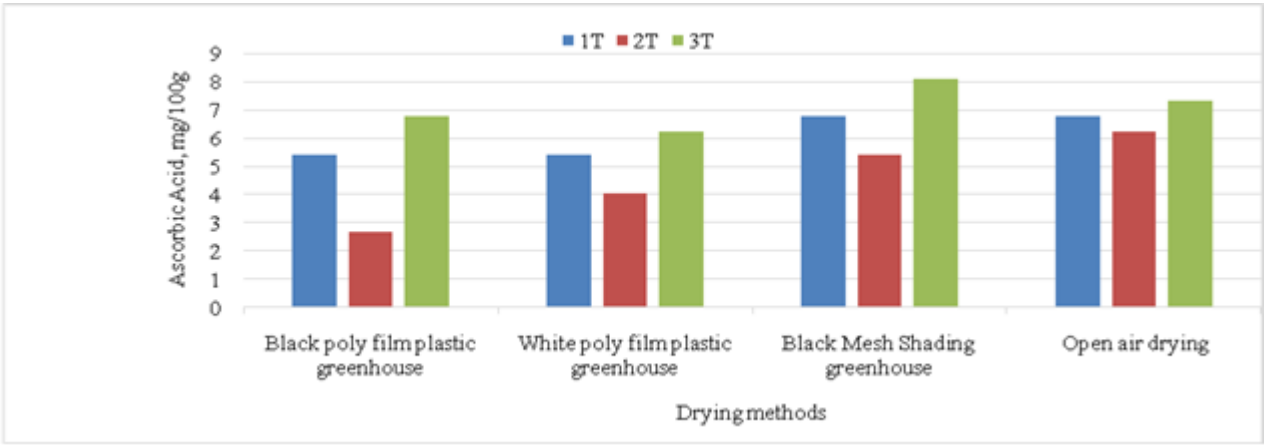

Fig. 2. Effect of pre-treatment methods on Ascorbic Acid of dried apricot
Source: Own design and results.

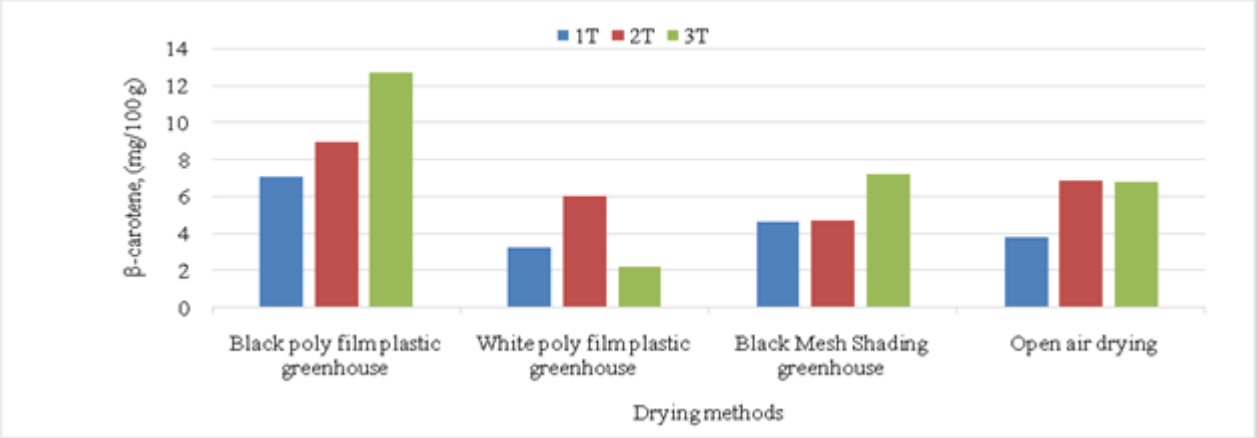

Fig. 3. Effect of pre-treatment methods on β-carotene of dried apricot
Source: Own design and results.

CONCLUSIONS

Drying of apricots is the preservation method which is highly suitable for Ras Sadr because of the plenty of available sunshine accompanied by low humidity. It is economical and easy as compared with the other methods of preservation as well as there is good quality retention. The different types of solar dryers which are used in Ras Sadr though improved the preservation technique has a tremendous influence on the economy of the small growers. The pre-treated and control apricot were dried with Open air and Greenhouse Drying methods. The apricot was pre-treating with Sodium bicarbonate solution. The pre-treatments and drying methods and their combination had a significant effect on the chemical composition and quality of apricot. Black Mesh Shading greenhouse method had a significant effect on the nutrient retention and a best.

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