DETERMINATION OF THE SHAPE AND COLOR CHARACTERISTICS IN DIFFERENT DRYING CONDITIONS OF ORANGE (Citrus sinensis)

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Abstract

Drying of agricultural products is one of the most effective methods for extending the market period of the product. Consumers prefer the dried product according to market conditions such as appearance, color, smell and aroma. Some physical changes occur in the product due to water loss during drying. The aim of this study is to determine the change of some physical properties of orange dried under different drying conditions. For this purpose, oranges will be cut cylindrical in different sizes and periodically the diameter, volume, area, thickness and width properties will be measured. Also, the color properties will be compared at the beginning and at the end of the drying.

PORTAKALIN (Citrus sinensis) FARKLI KURUTMA ŞARTLARINDA ŞEKİL ve RENK BİYOKİMYASAL ÖZELLİKLERİNİN BELİRLENMESİ

Keywords
Kurutma, renk, kalınlık, biyokimyasal, portakal

Özet

Tarım ürünlerinin kurutulması ürünün pazar süresinin uzatılmasında en etkili yöntemlerin başında gelmektedir. Tüketiciler, kurutulmuş ürünü pazar koşullarında görünüş, renk, koku ve aroma gibi özelliklerine göre tercih etmektedir. Kurutma sırasında oluşan su kaybı sebebiyle üründe fiziksel bazı değişimler meydana gelmektedir. Bu çalışmanın amacı farklı kurutma şartlarında kurutulan portakalın bazı fiziksel özelliklerinin değişiminin belirlenmesidir. Bu amaçla portakallar silindirik olarak farklı boyutlarda kesilecek ve periyodik olarak çap, hacim, alan, kalınlık ve genişlik gibi özellikleri ölçülecektir. Ayrıca portakalların başlangıçta ve kurutma sonunda renk özellikleri karşılaştırılacaktır.

1. INTRODUCTION

Drying is the process of decreasing the moisture in its structure in order to extend the storage and storage periods of agricultural products (Aktaş et al., 2013).

There are disadvantages such as the loss of nutrient content of the product and long drying time (Alibas Ozkan et al. 2007; Kocabiyik and Tezer 2009; Sorour and El-Mesery 2014). In the food processing industry, drying generally consists of an intensive energy consumption process. Energy costs should be reduced by researching and / or designing new drying methods or dryers for the drying process (Strumillo and Kudra 1986). In terms of nutritional value and quality of the product as well as economic and energy saving of drying method, different types of drying methods are investigated and applied in industrial applications (Güngör and Özbalta 1997, Kartal Kangaloğlu 2011). The aim of this study is to determine the change of some physical properties of orange dried under different drying conditions.

2. MATERIALS and METHODS

2.1 Materials

''Washington'' orange variety constituted the plant material of this study. Oranges were obtained from a orange garden in Antalya province of Turkey. Dimensions were measured with a digital caliper (±0.01 mm) and 20 fruits were used for all dimensional measurements. The weight of the fruit was measured using a digital balance (±0.001 g). Oranges were cut cylindrical in different sizes with product slicer machine and periodically the diameter, volume, area, thickness and width properties were measured. Color measurements were performed with a chroma meter (CR- 400; Konica Minolta, Japan). Drying was carried out in a single unit drying cabinet (ETHK-20M drying cabinet) with a capacity of 1500 kg.

2.2. Methods

The moisture content (wet basis) obtained from the drying experiments was calculated by the following equation. (Yağcıoğlu, 1999).

$$MR(w.b.,\%) = \frac{W_w - W_d}{W_w} \times 100$$

Where MR represents the moisture ratio (w.b.%), W_w, wet weight of product (g), W_d, dry weight of product (g).

Color measured CIE-L*, a*, and b* values were used to calculate color index (CI), hue angle (h*), and chroma (C*) values (McGuire, 1992):

$$c^* = \sqrt{(a^*)^2 + (b^*)^2}$$

$$h^* = \tan^{-1}(b^* / a^*), \qquad (eğer\ a > 0\ \ and\ \ b^* \geq 0)$$

$$h^* = 180 + \tan^{-1}(b^* / a^*), \qquad (eğer\ a^* < 0\ \ and\ \ b^* \geq 0)$$

$$h^* = 180 + \tan^{-1}(b^* / a^*), \qquad (eğer\ a^* < 0\ \ and\ \ b^* < 0)$$

$$h^* = 360 + \tan^{-1}(b^* / a^*), \qquad (eğer\ a^* > 0\ \ and\ \ b^* < 0)$$

$$CI = \frac{1000 \cdot a^*}{L^* b^*}$$

Drying process was carried out at two different product thickness (5 and 7 mm), two different times (9 and 10 hours) and two different temperatures (50 and 60° C).

Area and volume of the product were calculated by the following equations:

$$Area = 2\pi r(r + h)$$

$$Volume = \pi r^2 h$$

Where, r represents the diameter (mm) and h, thickness of product.

3. RESULTS

Some physical parameters before drying are given in Table 1. The highest moisture (% w.b.) value was determined as 5 mm 9 hour at 60° C and the lowest moisture (% w.b.) at 5 mm 9 hour at 50° C.

Table 1. Some physical parameters before drying

Parameters	First Weight (g)	Diameter (mm)	Moisture (% w.b.)
5 mm 9 hour 50° C	26,90	82,30	54,77
7 mm 10 hour 50° C	32,83	80,32	56,14
5 mm 9 hour 60° C	17,35	72,73	83,19
7 mm 10 hour 60° C	33,92	82,59	71,70

When investigated some physical parameters after drying the highest diameter was measured as 73,93 mm in 7 mm 10 hour 60° C (Table 2). It was determined that the highest weight change in 7 mm 10 hour 60 ° C conditions.

Table 2. Some physical parameters after drying

Parameters	Final Weight (g)	Diameter (mm)	Final Thickness (mm)
5 mm 9 hour 50° C	12,17	73,76	3,87
7 mm 10 hour 50° C	14,40	68,60	4,52
5 mm 9 hour 60° C	2,92	61,75	3,81

7 mm 10 hour 60° C	9,60	73,93	4,29

The highest area difference between the initial and final measurements occurred at 7 ° C for 10 hours at 50 ° C. The lowest volume difference was found at 5 mm 9 hour 60° C (Table 3).

Table 3. Area and volume values

Parameters	Initial Area (mm^2)	Initial Volume (mm^3)	Final Area (mm^2)	Final Volume (mm^3)
5 mm 9 h 50° C	11925,26	26583,01	9437,19	16513,85
7 mm 10 h 50° C	11894,89	35452,85	8362,75	16699,31
5 mm 9 h 60° C	9446,62	20761,89	6725,29	11395,55
7 mm 10 h 60° C	12523,53	37478,96	9575,35	18390,42

Color properties before and after drying given in Table 4 and 5. In the study, it was observed that a* values decreased except 5 mm 9 hour 60° C and b* values inreased except for 5 mm 9 hour 50 ° C.

Table 4. Color properties before drying

Parameters	L*	a*	b*
5 mm 9 h 50° C	47,25	2,52	29,88
7 mm 10 h 50° C	44,72	1,64	26,51
5 mm 9 h 60° C	35,56	1,76	22,78
7 mm 10 h 60° C	37,98	2,13	21,89

Table 5. Color properties after drying

Parameters	L*	a*	b*
5 mm 9 h 50° C	36,77	1,75	25,73
7 mm 10 h 50° C	44,95	1,62	28,46
5 mm 9 h 60° C	47,70	3,10	31,48
7 mm 10 h 60° C	44,81	1,87	31,93

Chroma, hue angle and color index before and after drying given in Table 6 and 7. It was found that hue angle values did not change significantly and chroma and color index values changed in different amounts.

Table 6. Chroma, Hue angle and Color index before drying

Parameters	Chroma	Hue Angle	Color Index
5 mm 9 hour 50° C	29,99	1,49	1,79
7 mm 10 hour 50° C	26,56	1,51	1,38
5 mm 9 hour 60° C	22,84	1,49	2,17
7 mm 10 hour 60° C	22,00	1,47	2,57

Table 7. Chroma, Hue angle and Color index after drying

Parameters	Chroma	Hue Angle	Color Index
5 mm 9 hour 50° C	25,79	1,50	1,85
7 mm 10 h 50° C	28,51	1,51	1,27
5 mm 9 h 60° C	31,63	1,47	2,07
7 mm 10 h 60° C	31,98	1,51	1,31

4. CONCLUSION

In the present study, the physical changes of the orange samples in different thicknesses (5-7 mm), durations (9-10 hours) and temperatures (50-60° C) were investigated in the cabinet type dryer.

It was observed that drying time, product thickness and drying temperature directly effect the drying characteristics and, determining the optimum drying parameters are important in the quality and the storage time of the dried product.

In addition, due to the fact that some measurements take more time, it is necessary to use new technologies (image processing, forecasting methods etc.) in the similar studies.

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