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Physical, Sensorial, Color and Rehydration Properties of Dried Green Olive Slices

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Abstract: The physical, sensorial and color properties of Memecik olive slices were evaluated in fresh and dried samples. The olive samples were dried by a tray dryer with hot air. The moisture of fermented green olive slices was 81.41 % (wet basis) and was reduced to 2.15 % after drying. The dehydration process was performed at 65 ^{o}C with an air velocity of 1 m/s. There were changes in some physical characteristics of olives during drying, such as changing in diameters. Inner and outer diameters of olives decreased 20.6 % and 23.2 % respectively. Color components (***L****, ***a****, ***b****) were measured with a Minolta colorimeter and ***h****, ***ΔC****, ***ΔE**** values were calculated using color coordinates. There were reductions in ***L**** (51.46 - 32.35) and ***b**** values (31.65-17.03) of olive samples by drying process. An increase was observed for ***a**** values from -0.62 to 1.95. Dried olive slices rehydrated slower than other dried foods because of their salt content. Also, dried olive slices were compared for fresh ones by sensorially with visual, aroma, taste, texture properties and general acceptibility.

Key words: Olive, drying, color, physical properties, rehydration properties, sensory.

Kurutulmuş Yeşil Zeytin Dilimlerinin Fiziksel, Duyusal, Renk ve Rehidrasyon Özellikleri

Özet: Memecik çeşidi zeytin dilimlerinin fiziksel, duyusal ve renk özellikleri taze ve kurutulmuş örneklerde değerlendirilmiştir. Zeytin örnekleri tepsili kurutucuda sıcak hava ile kurutulmuştur. Başlangıç nem değeri 81.41 g/100 g olarak tespit edilen fermente edilmiş yeşil zeytin dilimlerinin kurutma sonrasında nem değeri 2.15 g/100 g 'e düşürülmüştür. Kurutma işlemi 65^{o}C' de 1 m/s hava hızı ile gerçekleştirilmiştir. Kurutma işlemi sırasında, zeytinlerin çap gibi bazı fiziksel özelliklerinde değişimler meydana gelmiştir. Örneklerin iç ve dış çapları sırası ile % 20.6 ve % 24.0 oranında azalmıştır. Renk bileşenleri (***L****, ***a****, ***b****) Minolta kolorimetresi ile ölçülmüş ve renk koordinatları kullanılarak ***h****, ***ΔC****, ***ΔE**** değerleri hesaplanmıştır. Kurutma işlemi ile birlikte örneklerin ***L**** (51.46 - 32.35) ve ***b**** (31.65-17.03) değerlerinde azalma bulunmaktadır. ***a**** değerinde ise -0.62'den 1.95 değerine bir artış gözlenmiştir. Kurutulmuş zeytin dilimleri tuz içeriğinden dolayı diğer kurutulmuş gıdalardan daha yavaş rehidre olmuştur. Ayrıca, kurutulmuş zeytin dilimleri duyusal analiz ile de görsel, tat, tekstür ve genel kabuledilebilirlik özellikleri bakımından taze örneklerle karşılaştırılmıştır.

Anahtar kelimeler: Duyusal analiz, fiziksel özellikler, kurutma, rehidrasyon oranı, renk, zeytin.

Introduction

The production of olives is 17 356 447 tonnes in the world (Anonymous, 2007a). Amount of olive production in Turkey is 1 075 854 tonnes in total, 455 385 tons for table olives and also 620 469 tonnes for oil olives (Anonymous, 2007b). The countries of the Mediterranean area including Turkey have approximately 80 % of the world production for table olives. It was reported that nearly 45 % of this production consisted of green table olives (Marsilio et al., 2000, Öngen et al., 2005; Sağlam and Aktaş, 2005).

Among the dehydration techniques, hot air drying is the most widely applied method for fruits and vegetables (Nicoleti, 2001). Olive fruit is used for oil or consumed and characterized by rich flavour, aroma and non-intensive residual bitterness (Panagou, 2006; Sakouhi et al., 2008). Olive fruits are used for pizza, salad and sauces as an ingredient (Öngen et al., 2005). Dried olives have a high potential which can be consumed as a snack with its natural aromatic taste. Also, it can be used as an instant product with a long shelf life and an ingredient after rehydration in different products, fast foods etc.

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Memecik is an important variety of olive in Turkey, which is suitable for drying. It has high olive oil content and is used for both table olive and olive oil production.

In this study, the differences in physical and color properties of fresh and dried samples were measured for green olive slices. Rehydration rates of dried olives were determined and sensory properties of the olive samples, such as appearance, aroma, texture properties and general acceptability were determined.

Materials and Methods

Material

The samples used in this study were fermented green olive slices (Memecik variety) and were supplied by Orhanoğlu Food Company from Aydın, Turkey.

Drying Method

Fermented green olive slices (Memecik variety) were dried by using tray dryer at 65 ^{o}C with air velocity of 1 m/s (Renewable Energy Research and Implementation

Center in Süleyman Demirel University). The drying period was continued for 9 h when samples reached to the constant moisture content of 2.15 %. 667.4 g of fresh olives sices were dried in the tray dryer.

Moisture Analysis

Moisture content of fresh and dried samples were determined by drying weighed samples at 105 ^{o}C in an oven for 24 h (Öngen et al., 2005).

Physical Properties

Inner and outer diameters were measured for fresh and dried olive slices. The diameter measurements of samples were performed at four directions by composing stick (Mitutoya, Japan) with an accuracy of 0.01 mm (Walde et al., 2006).

Color Properties

The ***L**** (whiteness), ***a**** (greenness or redness) and ***b**** (blueness or yellowness) color values of fresh and dried olive samples were measured with Konica Minolta CR 400 Colorimeter (Czapski and Szudyga, 2000; Jaworska et al., 2008). Choroma difference (**Δ*C****), color differences (**Δ*E****) and hue (***h****) were calculated for fresh and dried olive slices for storage time using the following formulas (Ergüneş ve Tarhan, 2006; Taser et al., 2007);

$$\Delta C^* = [(a^* - a^*_{fresh})^2 + (b^* - a^*_{fresh})^2]^{1/2}$$

$$\Delta E^* = [(L^* - L^*_{fresh})^2 + (a^* - a^*_{fresh})^2 + (b^* - b^*_{fresh})^2]^{1/2}$$

$$h^* = \tan^{-1}(b/a)$$

Rehydration Properties

Rehydration experiments were carried out in distilled water at 80 ^{o}C. The dried olive slices were rehydrated. For this, approximately 0.23-0.27 g of olives were added to 150 ml of water. Water was drained from the surface by a paper towel. For 15 min time intervals, the weight was measured. After rehydration, the moisture content of rehydrated slices was determined. All the measurements were carried out in quadripartite and the averages were taken (Singh et al., 2006).

Sensory Evaluation

The sensory evaluation was performed by 10 panelists who were either faculty members or undergraduate students in the Departmet of Food Engineering, within the age group of 18-55. They evaluated the appearance, aroma, taste, texture and general acceptabilities of fresh and dried samples by rating within the 10 points on a 0 to 10 scale. The panelists were trained and guided by descriptive sensory analysis methods (Lawless and Heymann, 1999).

Results and Discussion

The moisture of fermented green olive slices were reduced from 81.41 % (wet basis) to 2.15 % by a tray dryer with hot air. During drying, the changes in the diameter of olives were observed. Inner and outer diameters of olive slices slightly changed during the drying process. On the average, outer diameters of olives changed from 1.69 to 1.34 (cm) and inner diameters changed from 0.421 to 0.32 (cm). The inner and outer diameters decreased 20.56 % and 23.99 % respectively. The effect of hot air drying on the quality properties of fermented green olive slices is represented on the figures.

The results of color measurements (***L****, ***a****, ***b****) values for fresh and dried olive slices are shown in figure 1. ***L**** value was determined to be relatively low (32.35) compared with the fresh slices (51.46). As a result of the dehydration process, a decrease in their lightness was noted (***L****) from 32.35 to the level of 51.46 as well as in others except the ***a**** value. In addition, the red color value (***a****) increased (from -0.62 to 1.95), while the yellowing value (***b****) showed a decrease from 31.65 to the level of 17.03.

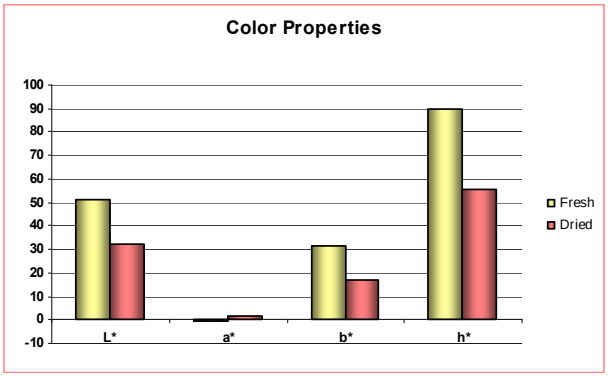

Figure 1. *Some color values of fresh and dried fermented olive slices.*

A number of browning reactions occurred during the dehydration process and caused color changes on dried olive slices. However; ***L****, ***a****, ***b**** color components do not enough to represent the the colour change on inhomogeneous materials. The different combinations of these values are used to present the color changing in foods. Literatures have shown that hue angles have a better correlation with visual estimation than chroma and total color difference for inhomogeneous materials. Thus, browning was expressed as hue angles for this type of foods (Heimdal et al., 1995; Öngen et al., 2005).
Hue angles were calculated as 89.98 and 55.56 for fresh and dried olives slices respectively (Figure 1). When hue angle value of fresh samples were slightly different from the yellow value (90.00), dried samples had a closer range with yellow.

Color differences (***ΔE****) and color intensity (**Δ*C****) were calculated as 35.24 and 16.11 for dried olive slices respectively, using ***L****, ***a****, ***b**** color components measured by reflectance colorimeter (Figure 2).

Kumcuoğlu et al. (2008) also dried Memecik olive slices at 3 different temperatures (40 ^{o}C, 50 ^{o}C and 65 ^{o}C) and at constant air velocity of 1.3 m/s. They evaluated to changes in color and water activity of dried samples. It was pointed out that higher drying tempereatures

promoted browning in dried olives. Comparing the results (for 65 °C), it is clearly seen that there were differences among ***L***, ***a***, ***b***, ***h***, Δ***C*** and Δ***E*** values. These differences may be caused by temperature and air flow rate difference. On the other hand, there were also differences for diameters and moisture contents of samples. Their samples had higher inner (14 mm) and outer (7.5 mm) diameters for fresh olive slices and higher moisture content (4 %).

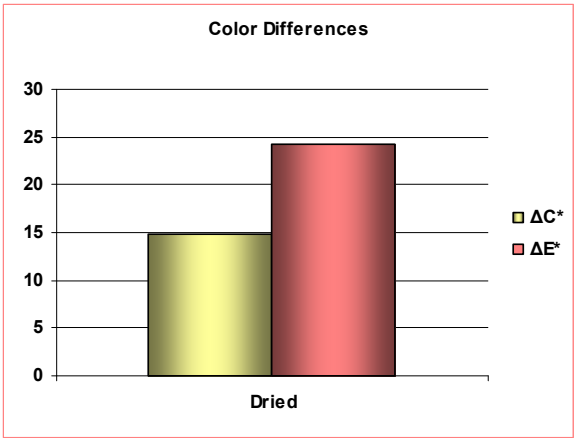

Figure 2. *h*, ΔC*, ΔE* values of fresh and dried fermented olive slices.*

Öngen et al. (2005) dried olives at 40 °C, 50 °C, 60 °C and 70 °C and they evaluated ***L***, ***a***, ***b*** values. The results of the 70 °C are similar with ours for fresh and dried samples. However, there were differences for Δ***C***, Δ***E*** and hue angle values. Their hue angles were greater than our samples, so browning degree of our samples was higher then others.

The quality of dried green fermented olives was also evaluated with rehydration ability. Rehydration ability is the most important characteristic for dried food. It is aimed to show that capability of dried material for win former properties (Krokida and Philippopoulos, 2005; Singh et al., 2006). Dried foods must be have rapid and complete rehydration ability (Singh et al., 2006).

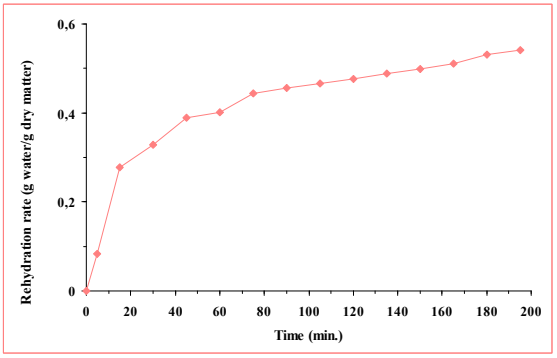

Figure 3. *Rehydration properties of dried olive samples.*

The water temperature influences the rehydration ability of dried food (Krokida and Philippopoulos, 2005). It was necessary that high temeperature for rehydration of dried olive slices owing to the salty content. The rehydration ratio is significantly affected by osmotic pretreatment (Singh et al., 2007). Rehydration at high temperatures improves rehydration due to the effect of temperature on cell wall and tissue (Singh et al., 2006). The temperature (80 °C) was determined with preliminary tests in the light of the literature (Singh et al., 2006; Singh et al., 2007). In the first 15 minutes, it was observed that this was the highest capacity for rehydration, whereas the rehydration rates of samples were lower between the 15th and 75th minutes and there were remarkable decreases after the 75th minutes (Figure 3).

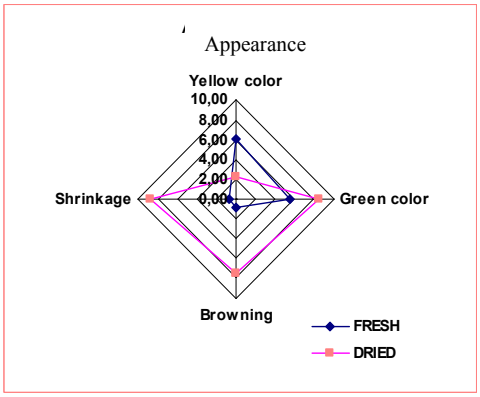

Figure 4. *Taste properties of olive slices with sensorial analysis.*

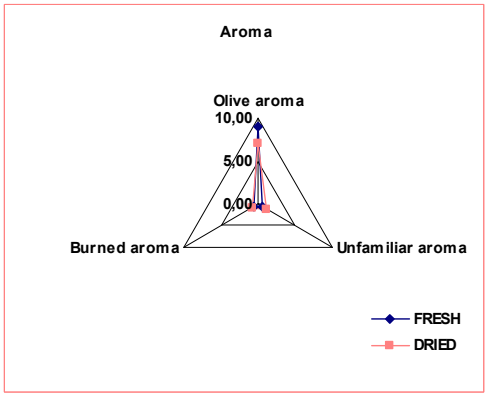

Figure 5. *Texture properties and general acceptibility of olive slices with sensorial analysis.*

The greatest change in taste was indicated in salty taste from 5.60 to 8.00 (Figure 6). It was shown that less salty fermented olives should be used for dried snack olives because there was a sharp increase in salt concentration with drying. Other taste descriptors are sour (5.60-5.20), rancid (1.20-1.40), pungent (4.40-5.80), dated (0.60-1.30), burned (0.30-0.60) and unfamiliar (0.60- 1.20) tastes that had been slightly affected with drying.

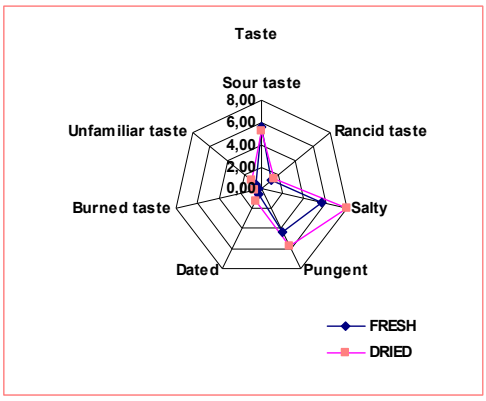

Figure 6. *Taste properties of olive slices with sensorial analysis.*

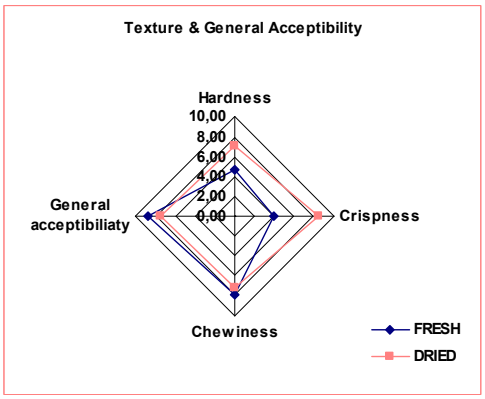

Figure 7. *Texture properties and general acceptibility of olive slices with sensorial analysis.*

Two marked differences were the textural properties, hardness (4.70-7.10) and crispiness (3.90-8.40) (Figure 7). The increased texture scores were expected for the dried olive slices because it was intended to obtain a snack food like olive chips. Also, chewiness had slight differences with drying (7.90-7.20). The panelists signed lower acceptability for dried olive slices (7.40) than fermented olive slices (8.80). However, dried olive slices must be interpreted alone because fermented olives and dried olives are different products from each other.

It was concluded that calculated color properties have similarity with sensorial color values. When positive ***b**** values define to the yellow color, negative values express to the blue color. Yellow color have decreasing with drying process according to both sensorial (yellowness) and colorimeter analysis (***b****). Also, browning point and hue angle have similar results. According to the sensorial analysis, dried olives have higher browning point than fresh slices. So, hue angle have a decrease with drying process.

Conclusion

This research indicates that dried fermented green olives had high visual quality and final product acceptibility which is proven by sensory analysis. Present work constitutes an attempt to improve the quality of dried-fermented olive slices with both sensorial and colorimeter. According to the sensorial evaluation, a decrease was determined for olive flavor of dried olive slices. However; a new aroma which is determined like a sour and fatty olive aroma was specified. The panelists were also emphazied that this new aroma incereased the attractiveness of dried olive slices. In addition, according to the different interpretations; initial salt content should be adjusted because it is concentrated by drying process. So, the last dried product can be having too pungent aroma because of its salt content.

Dried olive slices include high salt content had lower rehydration properties than some other dried products. Because of this reason, olives are not capable of effective rehydration at low temperatures. The rehydration rate is observed within the initial period of first 75th min.

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