https://dergipark.org.tr/tr/pub/food
OPEN ACCESS JOURNAL

ISSN 2667-5803

FHTI Journal of Food Health and Technology Innovations
December Vol 6, No 13 (2023)

DergiPark AKADEMİK

Research Article

The effect of color fixation with ferrous lactate on the color and sensory criteria of canned 'Gemlik' olives

Yasin OZDEMIR[1]*, Aysun OZTURK[1], Mehmet OZKAN[2]

Abstract

Black olives may lose their color after their bitterness has been removed with alkali and sterilized in brine. Customers demand that canned black olives have a shiny black surface. 'Gemlik' olives were used as material in this research. 'Gemlik' olive is the most grown olive in Turkey. However, in Turkey, the method of removing the bitterness of olives with caustic and sterilizing them is rarely used. In the research, 'Gemlik' olives were harvested at 3 different maturities. Bitter removal with standard alkali was carried out using the standard method. To fix the color of the olives, they were kept in brine containing 0.05 % iron with blower application (6 h and 20°C). The change in the colors of the olives was determined by color measuring device and sensory analysis. By applying ferrous lactate to the samples at all three maturity levels, a stable shiny black color was obtained throughout storage. Brighter black color value was measured in the samples applied with ferrous lactate. Sensory color and appearance scores were also higher for samples treated with ferrous lactate.

Keywords: Black Olive, Canned Olive, Color Fixation, Olive Color

TÜBİTAK ULAKBİM

1Ataturk Horticultural Central Research Institute, Yalova, Türkiye
2Tekirdag Food Control Laboratory, Tekirdag, Türkiye
*Corresponding author: Telephone: +90 2268142520, Fax: +90 2268141146, e-mail: gidaciyasin@hotmail.com

INTRODUCTION

The black oxidizing or alkaline debittering or Californian style processing is one of the main methods of black table olive production in USA and European countries. These three methods have similar step for bitterness removing which contain keeping olives in dilute alkaline (0,4-1,5%NaOH) to break down oleuropein and related bitter phenols. During these processes phenol composition of olives were highly lost. After that if olives were canned and stored more than 3 or 6 moths olive may lost their black color. If ferrous gluconate or ferrous lactate is not used to fix the color of black olives, color loss may occur [4]. Therefore, the use of ferrous gluconate and lactate to stabilize the color of black olives throughout storage is legally permitted for canned olives [11, 15].

In a study using different rates of ferrous gluconate, it was reported that the color parameters were the same for olives that were color fixed with 1 g/L and 0.5 g/L ferrous gluconate. It has been reported that the amount of 0.5 g/L ferrous gluconate used for color fixation is sufficient [9]. In a study using 0.5–1.5 g L−1 ferrous gluconate solution to fix the black color of olives, olives processed with an initial pH adjusted to 4 units had a darker color than those without pH correction [6]. Both iron salts are effective in fixing color. However, iron gluconate is more widely used worldwide [7]. The iron-phenol complexes are very stable and can ensure that the black color of olives remains stable for 3 years [8].

Natural brine processing is widely used method and alkaline debittering is lessly used in Türkiye [5]. However, alkaline debittering method can be advantageous in the production of low-salt olives [3]. This research aimed to determine the effects of ferrous lactate application before and after canned storage on ‘Gemlik’ olives which have different maturation index. Since color loss is significant in canned black olives and iron lactate application to ‘Gemlik’ olives is not common in Turkey, this research was done to give some information about color and sensory characteristics of these olives.

MATERIAL AND METHOD

‘Gemlik’ olives were harvested from a producer's orchard in Bozova district (Şanlıurfa, Türkiye). Olives were harvested by hand at the 3th, 4th and 5th maturity indexes. The harvested olives were put into production trials the next day at the latest. Olives were processed according to methods of [10]. Bitterness of ‘Gemlik’ olives was removed by alkali application. 1 kg of olive was kept in 1% NaOH (2 L) until to allow the NaOH reach to the approximately 2/3 of the olives. Olives were washed 4 times by keeping tap water at least 30 minutes. After that olives were put in brine and its pH adjusted to 4,5 by addition of acetic acid. Then the olives were divided into two groups. One group was kept in 3% brine (pH 4,5) containing 0.05 % ferrous lactate, and the other group was considered as control group. All samples were pu in 3% brine which contain 1% apple cider vinegar (5% acetic acid). Each olive sample group were placed in 2 glass jars (850 mL) with their brine and heat treated (121^{o}C for 15 minutes).

Olives were analyzed after canning production, without waiting and after being kept for 6 months. After the olives were removed from the jars, they were filtered and analyzed without waiting. 30 olives were randomly taken from each sample jar for color measurement and sensory analysis. First, color analysis was performed, then sensory analysis was done. Surface color of olives was measured by color measuring device (Konica Minolta, Japan). Color measurements were taken from three different places of each olive. Color values were reported as L* (brightness), a* (red-green), and b* (yellow-blue). Sensory scores for brightness, color and appearance of olives were determined by trained and six well experienced food engineers in sensory analysis of table olives. Five scale-test (5: very high, 4: high, 3: normal, 2: low, 1: very low) form was used for sensory panel. Samples and sensory panel room well lighted and at 20^{o}C temperature [1]. Two factorial (maturity level and color fixation step) completely randomized design was used. Statistical analyses were done with JMP statistical program.

RESULTS AND DISCUSSION

In this study average of L*, a* and b* values of olive samples were determined between 20.27 - 25.73, -4.45 - -1.98, and -2.80 - -2.13 respectively. Color measurement results of olive surface were given in Table 1. Statistically important interaction was determined between maturity level and color fixing step application. Higher brightness (L*) and a* and b* values were determined for color fixing step applied sampled than control group for each maturity level. L*, a* and b* values of black olives which was employed ferrous gluconate (0,5%) was reported as 20.1, 1.6 and 0.8 [9]. When black olives were kept in ferrous gluconate solution to fix the color, canned olives had homogenous black color, with, low salt content (2–4 %) and good textural characteristics [6,13].

Average of brightness and appearance sensory scores of color fixed samples were higher than control sample. On the other hand, statistically important difference was not detected for average sensory color score of color fixed sample and control samples. Sensory scores for brightness, color and appearance of olive samples were given in Table 2. According to Turkish Food Codex allowed maximum level of ferrous gluconat (E-579) and ferrous lactat (E-585) for olives darkened with oxidation was 150 mg/ kg olive as total iron content [15].

[6] reported that color fixation process of olives with initial pH adjusted to 4 units had a darker colour than those without pH correction. Appearance score of black olives were reported between 6.3-6.9 by using a 10-point scale (0 = none, 10 = extremely strong) [14]. Sensory scores for black olive color were reported as 4 using the form 1-5 scale form (1: lowest and 5: highest) [12]. The oxidation of phenolic compounds found in ripe black olives is stabilized by the addition of iron salts (such as ferrous gluconate or lactate). In this way, olives have a bright black color [6]. Attractive bright color is reported as a factor that increases consumers' appreciation of table olives [2].

CONCLUSION

This study evaluated the response of ‘Gemlik’ olive at different maturations to color fixation steps before and after storage periods. Measured color values L*, a* and b* and sensory evaluation results for brightness and appearance showed that 0.05 % ferrous lactate should be applied before canning processing of black olives. Ferrus lactate prevented or reduced black color and bright appearance of olive samples during storage. Color fixing step applied on different maturation levels showed similar color and sensory responses after storage. The bright black color of the olive is a quality feature that has a great impact on the consumer's purchasing decision. So that keeping olives in ferrous lactate solution is advisable for production canned black olives from ‘Gemlik’ variety.

References

1. Aponte, M., Ventorino, V., Blaiotta, G., Volpe, G., Farina, V., Avellone, G., Moschetti, G., (2010). Study of green Sicilian table olive fermentations through microbiological, chemical and sensory analyses. Food Microbiology, *27*(1), 162-170.
2. Ataollahi Eshkour, M., Ghorbani-HasanSaraei, A., Rafe, A., Shahidi, S. A., Naghizadeh Raeisi, S., (2023). Effect of calcium salts on the firmness and physicochemical and sensorial properties of Iranian black olive cultivars. Foods, *12*(15), 2970.
3. Conte, P., Fadda, C., Del Caro, A., Urgeghe, P. P., Piga, A., (2020). Table olives: An overview on effects of processing on nutritional and sensory quality. Foods, *9*(4), 514.
4. Delgado, A.M., Vaz Almeida, M.D., Parisi, S., Delgado, A.M., Parisi, S., Vaz Almeida, M.D., (2017). Olive oil and table olives. Chemistry of the Mediterranean diet, 33-57.
5. Demir, C., Yildiz, E., Gurbuz, O., (2023). Profile phenolic compounds in Spanish-style and traditional brine black olives (‘Gemlik’Cv.) provided from different regions of Türkiye. Processes, *11*(8), 2412.
6. García, P., Romero, C., Brenes, M., (2018). Influence of iron redox state on black ripe olive processing. Journal of the Science of Food and Agriculture, *98*(12), 4653-4658.
7. García, P, Brenes, M, Romero, C., Garrido, A., (2001). Colour fixation in ripe olives: effects of type of iron salt and

other processing factors. J Sci Food Agric *81*: 1364–1370.
8. García, P., Sánchez, A.H. Garrido, A., (2014). Changes of physicochemical and sensory characteristics of packed ripe table olives from Spanish cultivars during shelf-life. Int J Food Sci Technol *49*: 895–903.
9. García-Serrano, P., Brenes-Álvarez, M., Medina, E., García-García, P., Romero, C., Brenes, M. (2023). Study of the processing of dehydrated black olives from oxidized black olives. *LWT*, *180*, 114681.
10. Fernández, A.G., Adams, M.R., Fernandez-Diez, M.J., (1997). Table olives: production and processing. Springer Science & Business Media.
11. IOC 2004. International Olive Council (IOC), Unified qualitative standard applicable for table olives in international trade. Madrid, Spain (2004).
12. Irmak, Ş., Sefer, F., Güngör, F.Ö., Susamci, E., Güloğlu, U., Yildirim, A., Gönül, T., (2022). Determination of table olive characteristics of new olive varieties obtained by crossbreeding of Gemlik and Memecik variety. Journal of Ege University Agriculture Faculty, *59*(2), 195-208.
13. Martin-Vertedor, D., Rodrigues, N., Marx, I.M.G., Veloso, A.C.A., Peres, A.M., Pereira, J.A., (2020). Impact of thermal sterilization on the physicochemical-sensory characteristics of Californian-style black olives and its assessment using an electronic tongue. Food Control, *117*, 107369.
14. Repajić, M., Grudenić, A., Levaj, B., (2019). Functional and sensory properties of olives fortified spreadable cheese. Mljekarstvo/Dairy, *69*(2), 125-137.
15. TFC 2008, Turkish Food Codes – Communique of other food substances except from colorant and sweeteners. Communıque No: 2008/22.

Table 1. Color Measurement Results of Olive Surface

Color Value	Maturation Segree	Storage Status	Color fixed Sample	Control Sample	Average	CV
L*	3. Maturation	Before	22.35±0.35cd	20.57±0.75ef	21.46B	2.69
		After	22.71±0.42cd	17.27±0.19h	19.99C	
	4. Maturation	Before	26.75±1.06b	22.75±0.01cd	24.75A	
		After	23.00±0.92cd	19.70±0.57fg	21.35B	
	5. Maturation	Before	28.20±0.28a	23.25±0.35c	25.73A	
		After	21.80±0.42de	18.74±0.86g	20.27C	
	Average		24.13A	20.38B		
a*	3. Maturation	Before	-3.70±0.14f	-1.10±0.14b	-2.40B	4.77
		After	-3.25±0.07df	-0.70±0.14a	-1.98A	
	4. Maturation	Before	-3.55±0.07df	-3.15±0.21d	-3.35D	
		After	-3.20±0.01de	-2.05±0.07c	-2.63B	
	5. Maturation	Before	-4.75±0.35h	-4.15±0.07g	-4.45E	
		After	-4.25±0.07g	-3.15±0.06d	-3.70D	
	Average		-3.78B	-2.38A		
b*	3. Maturation	Before	-3.05±0.07f	-2.55±0.07d	-2.80C	2.40
		After	-2.70±0.02e	-2.15±0.06c	-2.43B	
	4. Maturation	Before	-2.55±0.02d	-2.25±0.07c	-2.40B	
		After	-2.20±0.05c	-2.05±0.07b	-2.13A	
	5. Maturation	Before	-2.85±0.06e	-2.20±0.05c	-2.53B	
		After	-2.55±0.01d	-1.80±0.02a	-2.18A	
	Average		-2.65B	-2.17A		

Values expressed as the mean ± standard deviation. Different letters indicate statistical difference for each raw group. CV: coefficients of variation.

Table 2. Sensory Scores for Brightness, Color and Appearance of Olives

Sensory Sharacters	Maturation	Storage Status	Color fixed Sample	Control Sample	Average	CV
Brightness	3. Maturation	Before	4.55±0.07ab	4.30±0.02bc	4.43A	3.04
		After	4.50±0.14ab	3.55±0.07f	4.03C	
	4. Maturation	Before	4.50±0.14ab	4.20±0.14c	4.35A	
		After	4.21±0.01c	3.75±0.07ef	3.98C	
	5. Maturation	Before	4.70±0.11a	4.15±0.08c	4.43A	
		After	4.61±0.27a	3.90±0.13de	4.25B	
	Average		4.51A	3.98B		
Color	3. Maturation	Before	4.23±0.13cd	4.73±0.02a	4.48AB	3.20
		After	4.19±0.12cde	3.77±0.05fg	3.93C	
	4. Maturation	Before	4.57±0.23a	4.72±0.16a	4.65A	
		After	3.91±0.01efg	3.94±0.07def	3.92C	
	5. Maturation	Before	4.49±0.17ab	4.57±0.23ab	4.55AB	
		After	4.30±0.08bc	3.63±0.13g	3.96C	
	Average		4.28A	4.23A		
Appearance	3. Maturation	Before	4.41±0.07bc	4.02±0.03ef	4.22B	2.98
		After	4.32±0.07cd	3.32±0.09h	3.82C	
	4. Maturation	Before	4.59±0.14ab	4.26±0.11cde	4.43AB	
		After	4.14±0.03de	3.60±0.01g	3.87C	
	5. Maturation	Before	4.76±0.19a	4.33±0.18bcd	4.54A	
		After	4.48±0.24bc	3.76±0.05fg	4.12B	
	Average		4.45A	3.88B		

Values expressed as the mean ± standard deviation. Different letters indicate statistical difference for each raw group. CV: coefficients of variation.