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EFFECT OF THE MANUFACTURING PROCESS OF OLIVE JAM ON QUALITY OF LIPIDS AND ANTIOXIDANTS.

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ABSTRACT

Olives used in Egypt for the production of table olives and olive oil. We saw in this study can be used for the production of jam and study the effect of manufacturing process and storage on the quality and content of antioxidants and unsaturated fatty acids (oleic acid), its nutritional value and important therapeutic. Olive fruits jam manufacturing from treated and untreated olive fruits (green and black) with (1.5%w/v) NaOH to eliminate bitterness. We Found that the total solids soluble (TSS) and saturated fatty acids increased gradually in all treatments during storage. While, pH, total phenols and unsaturated fatty acids decreased during storage. Results revealed that linolenic acid ($C_{18:3}$) completely disappeared after jam processing. In sensory evaluation (overall acceptability) all treatments were acceptable especially alkali treatment.

INTRODUCTION

The olive tree (*Olea europaea* L) is widely grown in the Mediterranean area and represents one of the most important crops in this zone. Its fruit is a drupe that is used for both oil extraction and table olive purposes (Beltran et *al.,* 2004).

The olive drupe, in fact, contains high concentration of phenolic compounds that can range between 1 and 3% of the fresh pulp weight (Garrido *et al.*, 1997). Phenolic compounds constitute an important group of naturally occurring compounds in plants. They are secondary plant metabolites, with a great structural diversely and a wide phytogenetic distribution (Harbone, 1989)**.** In contrast to other crude oils, virgin olive oil (VOO) produced from olive of good quality is consumed unrefined. Thus, VOO contain phenolic compounds that are usually removed from other edible oils in various refining stages.

In ancient times, the Mediterranean people considered olive oil not only an excellent food but also a healing agent. During the past four decades a renewed interest in the nutritional and health aspects of olive oil has been generated. Olive oil is a key component of the traditional Mediterranean diet, which is believed to be associated with a relatively long life in good health. Virgin olive oil is unique among other vegetable oils because of the high level of particular phenolic compounds, to which, together with the high content of unsaturated fatty acids, the health benefits of olive oil are attributed (Kiritsakis and Markasis, 1984; Visioli and Galli, 1998).

Olive oil phenols also contribute to the characteristic taste and the high stability of olive oil against oxidation (Tsimidou, 1999). The most important classes of phenolic compounds in olive fruit include phenolic acids, phenolic alcohols, flavonoids and secoiridoids (Vinha *et al*., 2005).

Oleic acid is less prone to lipid peroxidation than linoleic acid and is incorporated as a major long chain fatty acid in cellular membranes when consumption is high. Thus, the Mediterranean diet, with its favorable fatty acid composition and relatively high levels of polyphenolic antioxidants, provides greater resistance to oxidative stress, which is regarded to be a major a etiologic factor for many cancers (Bartsch *et al*., 1999, 2002) and heart disease (Keys and Keys, 1975; Keys *et al*., 1981).

Moreover, some studies (Ficarra *et al.*, 1991 and Le Tutor and Guedon, 1992) have shown a hypocholesterolemic and hypoglycemic activity of the oleuropein, (the main secoiridoid present in the olive fruits, as well as the olive oil, as an aglycon). It appears that the minor polar compounds of virgin olive oil play an important role in human nutrition as preventive agents against several diseases.

Phenols have a multifunctional activity and can act as reducing agents; hydrogen donating antioxidant, and singlet oxygen quenchers. Furthermore, some of them also have the possibility of chelating metal ions and preventing ion- and copper catalyzed formation of initiating radical species (Gennaro *et al.*, 1998).

There is a considerable demand for fresh fruits as well as their products. Since many types of fruit are seasonal and their shelf life is limited, they must be processed to keep the quality (Ocibisz and Mitek, 2007). Processing may include preservation by several methods, such as the addition of sugar to make a jam. Jam processing is a fruit preservation method (Kansci *et al*., 2003). It is usually produced as a result of cooking fruits with sugar and other additions such as pectin and citric acid (Abers and Worlstad, 1979).

Jam is a means of preserving fruits, the high sugar content of jam does not allow bacteria, yeast and moulds to grow and also, prevent other spoilage. This means that the nutritional qualities of the fruits can be maintained at the same time as providing tasty products (Ashaye and Adeleke, 2009).

Due to the nutritional and healthy benefits of olive fruit and olive oil composition. This study aimed to evaluate the effect of jam processing of olive fruits on quality of lipids and antioxidants.

MATERIALS AND METHODS

Materials:

Green and black olives (*Olea europaea*) were purchased from local market, Egypt. Sugar was obtained from super market. All chemicals used were purchased from El Naser Pharmaceutical Chemical Company, Egypt.

Methods:

Lye Treatment (Treated Olives);

Green and black olives (3 kg each) were separately placed in glass vessels and covered with 3 L of 1.5 % (w/v) NaOH solution. The lye treatment lasted 7 hours for green olives and 4.5 hours for black olives at 25±1° C until the lye penetrated two-thirds of the distance to the pit, tested with ph.ph

solution every one half hour according to Garrido, *et al*. (1997). The NaOH solution was then poured off, and the olives were washed in running water for 32 h (4 times/8 h) for that treated green olives and 24 h (3 times/8 h) for that treated black olives.

Jam processing:

After washing, fresh and treated olives, the olives were pitted. jam samples were prepared in the laboratory, according to a traditional procedure, by boiling in an open kettle, with manual stirring, the fleshes were boiled in water (1:1 w/v) , 1000 g of olives flesh with 1000 g of sugar, and 1 g citric acid . Samples were cooked till required (68 - 70 °Brix). The jam was hot-packed in glass jars, closed tightly and stored in the dark at room temperature for 6 months.

Jam samples were taken every 2 months for physiochemical and sensory analysis. Each analysis was carried out in triplicate.

Physiochemical analysis:

1. Weight of fruit:

Fresh olive fruits (100 fruits) from each cultivar were weighed and weight of a fruit was calculated (g) (Garrido, *et al.,* 1997).

2. Size of fruits (fruit/kg):

Fresh olive fruits (1 kg) from each cultivar were weighed and number of fruits was counted as fruits/ kg weight and as fruit/pound (1 kg =2.20459 pound) (Garrido, *et al.,* 1997).

3. Size grades:

Size grades for fresh olives were determined according to Balatsouras *et al*. (1996).

4. Maturity Index:

The maturity index was determined as described by Estacion de Olivicultura of Jaen; Spain (Uceda and Frias, 1975) .This method is based on colour changes of peel and pulp. Samples of olives, 100 fruits for each variety, were taken at random and classified into eight groups or categories: green intense (group *A* = 0), yellow or yellowish green (group *A* = 1), green with reddish spots (group *A* = 2), reddish or light violet (group *A* = 3), black with white pulp (group *A* = 4), black with <50% purple flesh (group *A* = 5), black with ≥50% purple flesh (group *A* = 6) and black with 100% purple flesh (group *A* = 7). The ripening index was calculated as $\sum(Aini)$ / 100, where *A* is the group number and *n* is the number of fruits in the group. Ripening index values are between 0 and 7.

5- Total soluble solids (TSS):

TSS was determined by measuring the °Brix at 20 °C with portable refractometer model (Hand held refractometer REF 101/111).

6- pH:

pH was determined with a pH meter, Model accumet® Fisher Scientific pH meter 25 (USA), according to the instruction manual of the apparatus.

7- Total phenols:

Total phenols content, expressed as (mg/kg) , was determined at 725 nm using Folin-Ciocalteau reagent as described by Gamez- Meza *et al*., 1999).

8-Fatty acid methyl ester preparation:

Fatty acid methyl ester (FAME) was prepared from olive oil using a cold saponification method. Olive oil (0.25g) was transferred into a test tube; 5 ml hexane and 0.5 ml of 2 N methanolic potassium hydroxide solutions were added. The mixture was centrifuged at 3500 rpm for 2 min (Stefanoudaki *et al.*, 1999). The upper layer (1 µL) was analyzed by (Shimadzu, GC-4CM-PET) equipped with stainless steel column packed with 3% diethylene glycol succinate on chromosorb W 80/100 mesh and a flame ionization detector (FID). The oven and detector temperatures were 180°C, isothermal and 270°C, respectively. The injection part temperature was 240°C. N2 was used as carrier gas at flow rate of 20 ml/min. The fatty acid methyl esters (FAMEs) were identified using the reference standard mixture analyzed under the same operational conditions.

9- Sensory evaluation:

Sensory evaluation was carried out on the jam samples as described by Larmond (1977) using 10 panelists to asses the quality of olive jam with regard to their bitterness, colour, taste and overall acceptability. Sensory attribute scores were 1-5 where, 1 is the lowest sensory properties while 5 is the highest sensory properties except for bitterness. Taste evaluated by the 9-point hedonic scale test.

RESULTS AND DISCUSSION

Data in Table (1) shows the Physical Parameters of fresh green and black olives. Size fruit, weight of fruit, size grade and maturity index of black olives was higher than those in green olives.

Table (1): Physical Parameters of fresh green and black olives.

Olives / Parameters	Green olives	Black olives
Size (fruit/kg) **(fruit/pound)**	231 104	124 56
Weight of fruit (g)	4.33	8.06
Size grade	Medium	Giant
Maturity Index	2.18	2.55

Table (2) shows the total soluble solids (TSS) of green and black olives, in black olives had higher concentration (68.3°Brix) of TSS compared to green olives (68°Brix). These results agreed with Islam *et al*. (1996), who studied quality characteristics of tomato at various ripening stage. The total soluble solids of all treatments were in range of 68°Brix which near of 65.03°Brix, which is default value typically used by industries in the preparation of fruit jams added with sugar (Albuquerque, 1997).

TSS of olive jam were increased gradually in all treatments during storage for 6 months. The obtained results agreed with Hussain and Shaker (2010) and Anjam *et al*. (2000).

Table (2): Effect of storage time of olive jam on total soluble solids (TSS).

T.S.S Treatments		Olive Jam Storage Time (month)			
		0	2	4	6
Green	I	68.0	68.8	68.9	69.2
	II	68.9	69.3	69.6	69.8
Black	I	68.3	68.9	69.2	69.5
	II	68.8	69.3	69.8	69.9

I= Untreated (No lye treatment).
II= Treated (lye treatment).

Results in Table (3) showed the effect of jam processing and storage time on pH. Treated green and treated black olives had the highest pH values (8.86, 6.32), respectively, followed by green olives (5.85) and black olives (6.10). Generally, the pH of stored olive jam decreased as the period of storage increased. These results agreed with Rababah *et al*. (2011) and Hussain and Shaker (2010).

Table (3): Effect of jam processing and storage time on pH.

pH Treatments		Fresh flesh olive fruit	Olive Jam Storage Time (month)			
			0	2	4	6
Green	I	5.85	5.21	5.11	5.05	4.99
	II	8.86	6.85	5.96	5.50	5.41
Black	I	6.10	5.19	5.08	5.05	5.05
	II	6.32	5.69	5.61	5.58	5.54

I= Untreated (No lye treatment).
II= Treated (lye treatment).

Table (4) shows the effect of jam processing and storage time on total phenols of the olives. Results revealed that the untreated fresh green olives contained the highest total phenols percentages followed by untreated fresh black olives as compared to lye treated olive samples. Total phenols of olive jam were decreased gradually in all treatments during storage for 6 months. The obtained results agreed with Rababah *et al*. (2011).

Table (4): Effect of jam processing and storage time on total phenols (%).

Treatments		Fresh flesh olive fruit	Olive Jam Storage Time (month)			
			0	2	4	6
Green	I	1.03	0.87	0.84	0.81	0.78
	II	0.65	0.60	0.57	0.54	0.53
Black	I	0.84	0.71	0.64	0.62	0.60
	II	0.55	0.52	0.50	0.49	0.46

I= Untreated (No lye treatment).
II= Treated (lye treatment).

Fatty acid composition of the olive oils extracted from the fresh olives, treated olives and their jam are shown in Table (5).

Table (5): Fatty acids composition of extracted olive oil from fruits and jam.

Component	Fresh Olive Fruits				Olive Jam							
	Green		Black		Green				Black			
	I	II	I	II	I		II		I		II	
					Storage Time (month)							
					0	6	0	6	0	6	0	6
$C_{16:0}$	16.67	17.04	15.64	16.02	17.78	17.98	18.12	18.85	16.87	17.14	17.53	18.10
$C_{16:1}$	0.85	0.79	1.01	0.76	0.93	0.90	0.87	0.79	0.92	0.84	0.79	0.67
$C_{18:0}$	2.95	3.41	3.24	3.68	4.78	4.90	4.85	4.97	4.02	4.75	4.69	5.02
$C_{18:1}$	66.07	66.52	68.85	68.69	64.89	65.30	65.05	64.50	67.17	67.43	66.12	66.48
$C_{18:2}$	13.32	12.13	13.61	11.23	11.62	10.92	11.11	10.89	11.03	9.84	10.87	9.73
$C_{18:3}$	0.14	0.11	0.11	0.08	-	-	-	-	-	-	-	-
Σ SFA	19.62	20.45	18.88	19.70	22.56	22.88	22.97	23.82	20.89	21.89	22.22	23.12
Σ USFA	80.38	79.55	81.12	80.30	77.44	77.12	77.03	76.18	79.11	78.11	77.78	76.88
USFA /SFA	4.10	3.89	4.30	4.08	3.43	3.37	3.35	3.20	3.79	3.57	3.50	3.33
$C_{18:1}/C_{18:2}$	4.96	5.48	5.06	6.12	5.58	5.98	5.86	5.92	6.09	6.85	6.08	6.83

I= Untreated (No lye treatment).
II= Treated (lye treatment).
FA = Saturated Fatty Acids.
USFA = Unsaturated Fatty Acids.

Results, generally, revealed that fatty acid composition of green and black fresh fruits showed the same fatty acids and were typical of olive oil composition. Oil from green untreated fruits (Table 5) is characterized by lower percentage of oleic acid $C_{18:1}$ and linoleic acid $C_{18:2}$ (66.07 and 13.32%), respectively compared to oil from black untreated fruits, however, contained (68.85 and 13.61%), respectively.

Results in Table (5) showed that, oil from black untreated fruits showed higher total saturation percentage (19.62%) than, those from green untreated fruits (18.88%). On the contrary, Oil from black untreated fruits revealed that it had a higher total unsaturation (81.12%) than those from untreated green fruits (80.38%). The favorable oleic acid/linoleic acid ratio of untreated (fresh) fruits was 5.06 for black fruits and 4.96 for green fruits.

Fatty acid composition of oils extracted from treated olive fruits were slightly affected by the lye treatment (Table 5). The total saturation, generally, increased as compared to the total saturation of untreated olives in two cases. On the other hand, the total unsaturation decreased due to lye treatment in two cases. $C_{18:1}$ / $C_{18:2}$ ratio increased in treated green and black olive fruits as compared to those untreated olive fruits.

Regarding the effect of olive jam processing and storage period for 6 months on the fatty acid composition of oils, results in Table (5) revealed that, linolenic acid $C_{18:3}$ completely disappeared after jam processing in two cases and a decrease in linoleic acid $C_{18:2}$ concentrations. The total saturation also increased with increasing the storage time for 6 months as compared to their initial values. On the other hand, the total unsaturation gradually decreased.

Data in Table (6) showed that, the bitterness attribute of treated green olive jam had the lowest score 1.1 at 0 time and 0.8 score after 6 months of storage at room temperature. On the other hand, green olive jam had the highest score 3.4 at zero time and 2.9 after 6 months of storage at room temperature. Treated olives had lower scores than other not treated with NaOH. This is due to lye treatment which removes the oleuropein, one of the bitter glucosides naturally present in olive-flesh (Marsilio *et al*., 2001).

Table (6): Effect of jam processing and storage time on sensory attributes of olive jam.

Sensory attributes*	Green olives				Black olives			
	I		II		I		II	
	0	6	0	6	0	6	0	6
Bitterness	3.4	2.9	1.1	0.8	3.0	2.4	2.6	2.0
Taste	3.8	4.1	7.2	7.7	4.1	4.7	6.0	6.5
Color	2.8	3.0	4.0	4.2	3.4	3.6	3.6	3.8
Overall acceptability	3.0	3.0	4.0	4.1	3.2	3.4	3.8	3.9

*** Score values = Mean value of ten panelists**
I= Untreated (No lye treatment).
II= Treated (lye treatment).

The 9-point Hedonic Scale Test for taste rated from like moderately to like very much for treated green olive jam at 0 time and after 6 months of storage at room temperature by the panelists and rated from dislike slightly to neither like nor dislike for green olive jam at 0 time and after 6 months of storage at room temperature. Treated black olive jam ranged from 6.0 at 0 time to 6.5 at 6 months of storage.

Overall acceptability of treated green olive jam had the highest score 4.0 at 0 time and 4.1 at 6 months of storage. On the other hand, overall acceptability untreated green olive jam had the lowest score 3.0 at 0 time and 6 months of storage.

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تأثيرعملية تصنيع مربى الزيتون على جودة الليبيدات و مضادات الأكسدة.

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تستخدم ثمار الزيتون فى مصر لإنتاج زيتون المائدة و زيت الزيتون. ونحن فى هذه الدراسة رأينا إمكانية إستخدامها لإنتاج المربى و دراسة تأثير عمليات التصنيع والتخزين على جودتها وما تحتويه من مضادات أكسدة وأحماض دهنية غير مشبعة (حامض الاوليك) لها قيمة غذائية وعلاجية هامة. حيث تم تصنيع مربى الزيتون من ثمار زيتون خضراء وسوداء (معاملة أو غير معاملة) بـ ١,٥٪ هيدروكسيد صوديوم لإزالة المرارة الموجودة بالزيتون . أوضحت النتائج المتحصل عليها زيادة نسبة المواد الصلبة الذائبة ونسبة الاحماض الدهنية المشبعة بزيادة فترة التخزين, وعلى الجانب الأخر لوحظ انخفاض رقم pH ومحتوى الفينولات الكلية ونسبة الأحماض الدهنية الغير مشبعة بزيادة فترة التخزين لمدة ٦ شهور على درجة حرارة الغرفة. كما أوضحت الدراسة أيضا أن نتائج التقييم الحسى (القبول العام) أنها كانت مقبولة لدى المحكم خصوصاً الثمار المعاملة بالقلوى.

بتحكيم البحث

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