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ORIGINAL RESEARCH PAPER

FATTY ACID COMPOSITION OF OIL OBTAINED FROM IRRADIATED AND NON-IRRADIATED WHOLE FRUIT AND FRUIT FLESH OF OLIVES (*OLEA EUROPAEA* L.)

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This study aimed to investigate the fatty acid profile of olive oil extracted from whole fruit and fruit flesh of "Kaissy cultivar" olives, irradiated with 0, 2 and 3 kGy doses of gamma irradiation, and stored for 0, 6 and 12 months. Results on the fatty acid profile showed that the studied oils contained mostly oleic acid (68.15-70.80%) followed by palmitic acid (14.38-15.89%) and linoleic acid (10.34-12.51%). Generally, there are slight differences in the fatty acid profile between the oil extracted from whole olives and fruit flesh, but sometime significant ($p<0.05$). Also, the storage time influenced to a limited extent the fatty acid profile of both type of oils. Immediately after treatment, irradiation caused a significant ($p<0.01$) gradual decrease in the unsaturated fatty acid content and a significant ($p<0.01$) saturated fatty acid content increased in virgin olive oils.

Keywords: fatty acids, olive oil, gas chromatography, Syria

Introduction

Among vegetable oils, olive oil is the one that has received most attention, chiefly as a source of monounsaturated fatty acids (MUSFA). It has a high biological value and contains antioxidant substances in optimum concentrations (Servili *et al.*, 2009). The fatty acid composition of virgin olive oil has great importance from a health point of view. Several studies have shown the dietary importance of fatty acid composition of lipids (Beltran *et al.*, 2004). The most prevalent compounds in olive oil are the triglycerides (TAGs), which give rise to the main physical properties of the product. While the dominant triglyceride is triolein (with three oleic acid moieties), a number of other fatty acids are presents (Blatchly *et al.*, 2014). Only when the fatty acids are bounded in these small units, are they considered to be good quality oil. A triacylglycerol unit may lose one fatty acid to become a diacylglycerol- or if it loses tow fatty acids it is a monoacylglycerol. The

fatty acid which is lost from the triacylglycerol is then called a free fatty acid (Ghanbari *et al.*, 2012). The oil triglycerides are mainly represented by monounsaturates (oleic acid), along with small amount of saturates and relatively large amounts of polyunsaturates, considerable quantity of polyunsaturates (mainly of linoleic acid) (Aparicio and Aparicio-Ruiz, 2000). It seems suitable to use the olive oil in thermal processes since it contains high amounts of monounsaturated fatty acids (MUFAs), low saturated fatty acids (SFAs), very low linolenic acids, and no trans fatty acids (Farhoosh *et al.*, 2013).

Gamma irradiation is well known as a decontamination method for many foodstuffs and plant materials, being an environment friendly and effective technology to solve technical problems in trade and commercialization (Khattak *et al.*, 2009; Aouidi *et al.*, 2011). Polyunsaturated fatty acids (PUFA) of the phospholipid fraction are the major contributors for the development of rancidity during food storage and so, the most susceptible during irradiation (Alfaia *et al.*, 2007). Therefore, these findings indicate that further studies are necessary to elucidate change of fatty acids by gamma irradiation. Current knowledge of the quality of Syrian olive oil is still incomplete and no consistent database compiling its properties is available. Also, no research concerned the evolution of quality parameters of irradiated and non-irradiated olive oil in Syria is available. The main objective of this work was to identify and quantify the fatty acids in virgin olive oil from Syrian variety, namely "Kaissy cultivar" in order to improve understanding of the oil quality, stability and applicability for human nutrition. Another objective of this study was to assess the effect of gamma irradiation on the fatty acid composition of olive oil obtained from different parts of the olives.

Materials and methods

Materials

The studied olive cultivar was Kaissy, the most widespread in Syria. The olive fruits of good quality and in the mature firm condition were harvested during 2009/2010 growing season, from the trees grown in grove located at Deer Al Hajar research station, southeast Damascus, Syria (33o 21´ N, 36o 28´ E) at 617 m above sea level. Then olive fruits were weighed as in the sampling plan and transferred into polyethylene pouches for irradiation. Each pouch of olive fruits (1 kg) was considered as a replicate. The samples were then divided into three groups: group 1 (control) and groups 2 and 3 were irradiated with 2 and 3 kGy of gamma irradiation.

Irradiation treatments

Samples of olive fruits were exposed to gamma radiation at doses of 0, 2 and 3 kGy in a ^{60}Co package irradiator (ROBO, Techsnabexport, Moscow, Russia). Irradiation was carried out in the stationary mode of operation with the possibility of varying dose rate (10.846 to 3.921 kGy h^{-1}), depending on the location and the distance from the source (10 to 40 cm). The samples were irradiated at place (15 cm from source) with a dose rate of 9.571 kGy h^{-1} and the uncertainty less than 5%

according to the certificate of IDAS program (IAEA). The irradiations were carried out at room temperature (20 – 25 °C) and atmospheric pressure. The absorbed dose was determined using alcoholic chlorobenzene dosimeter (Al-Bachir, 2004).

Oil extraction

The samples of each treatment were divided into two groups: group 1 used for extracting the oil from whole fruits and the second group was used for extracting the oil from fruit flesh. The oils from whole fruits and fruit flesh of control and irradiated olive fruits were extracted at the shortest time possible, using a mechanical and physical processes (Blatchly *et al*., 2014). Olive fruits were crushed with hummer crusher and slowly mixed for about 30 min at 27°C. Then, the past mixed was centrifuged at 3000 rpm for 3 min without addition of water to extract the oil. Finally, the oils were decanted and immediately transferred into dark glass bottles and stored at room temperature (20 – 25°C) for analysis. Fatty acid determination analysis of oils extracted from irradiated and non-irradiated olive fruit samples were performed immediately after irradiation, and after 6 and 12 months of storage.

Fatty acids (FAs) determination

The fatty acid methyl esters (FAME) were prepared according to the methods proposed by Al-Bachir and Zeinou (2014). The fatty acids (FAs) profile was determined by gas chromatography in a GC- 17 A Shimadzu chromatograph (Shimadzu Corp., Koyoto, Japan) equipped with a flame ionization detector and a capillary column (CBP20-S25- 050, Shimadzu, Australia). The selected chromatographic conditions were: oven temperature - 190 °C, detector temperature - 250 °C, injector temperature - 220 °C. N_2 was used as a carrier gas with split ratio 29:1, the sample volume injected was 1 µL. Peak areas were integrated and converted to FA percentages (direct area normalization) by means of the CLASS – VP 4.3 program (Shimadzu Scientific Instruments, Inc., Columbia, MD). The FA identification was carried out by retention times and by addition of standards.

Statistical analysis

The four treatments were distributed in a completely randomized design with three replicates. Data were subjected to the analysis of variance test (ANOVA) using the SUPERANOVA computer package (Abacus Concepts Inc, Berkeley, CA, USA; 1998). The p value of less than 0.05 was considered statistically. The degree of significance was denoted as: $p<0.05$*, $p<0.01$** (Snedecor and Cochran, 1988).

Results and discussion

Fatty acid profile of olive oil extracted from whole fruit and fruit flesh

The olive oils under study were subject to a fatty acid analysis using gas chromatographic methods in order to evaluate the effect of the oil source (extracted from whole fruits or fruit flesh) on fatty acid composition. The fatty acid compositions of olive oils extracted from whole fruit and fruit flesh were: palmitic acid (C16:0) (15.2 and 15.73%), palmitoleic acid (C16:1) (0.95 and 1.15%), stearic acid (C18:0) (1.74 and 1.75%), oleic acid (C18:1) (70.61 and 68.15%), linoleic

acid (C18:2) (10.98 and 12.51%%) and linolenic acid (C18:3) (0.55 and 0.71%), respectively (Table 1). The overall fatty acid composition of Syrian Kaissy cultivar olive oil (SKOO) was similar to that of the oils reported previously (Beltran *et al*., 2004; Jiang *et al*., 2005; Bajoub *et al.*, 2015). Generally, virgin olive oil contains 9.48-15.60% palmitic acid (C16:0), 0.67-1.40% palmitoleic acid (C16:1), 1.71-3.63% stearic acid (C18:0), 67.43-78.44% oleic acid (C18:1), 4.67-15.10% linoleic acid (C18:2), 0.03-1.15% linolenic acid (C18:3) and 0.17-0.90% arachidic acid (C20:0) (Sakar *et al.*, 2014). Olive oil differs from the other vegetable oils by its high content in monounsaturated fatty acids (palmitoleic acid (C16:1) and oleic acid (C18:1)) and relatively low polyunsaturated acids (linoleic acid (C18:2) and linolenic acid (C18:3)) (Spangenberg *et al*., 1998). The fatty acids of olive oil have a great importance from people's health point of view. Olive oil, among various cooking oils, is unique because it has high oleic acid content 55-80% (Owen *et al.*, 2000). The abundance of oleic and linoleic acids in these oils makes them good oils for reducing serum cholesterol and low density lipoprotein LDL and increasing high density lipoprotein HDL levels; they could also be good oils for the fight against cardiovascular illnesses. The oil extracted from whole fruit and that extracted from fruit flesh have the ratio of saturated fatty acids (TSFAs), total unsaturated fatty acids (TUSFAs) and the ratio of TUSFAs to TSFAs which vary between 17.02 - 17.81%, 82.20 - 83.08%, and 4.62 - 4.88 respectively (Table 2). The ratio of total unsaturated (TUFA) to saturated (TSFA) (TUFA/TSFA) is important in projecting the detrimental effects of dietary fats. The higher the TUFA/TSFA ratio, the more nutritional potentials the oil has (Ogungbenle and Afolayan, 2015). The high UFA/SFA ratio is an indication of unsaturation level of oils and fats, and also indicates the high tendency of oil towards oxidative stability. Therefore, the lowest oxidative stability in terms of fatty acid structure can be attributed to processed olive oil (Najafi *et al.*, 2015).

Effect of the oil source and storage time on the fatty acid profile of olive oil

Table 1 shows the results obtained for each fatty acid identified in the olive oil extracted from whole fruits and fruit flesh of Kaissy cultivar during storage. ANOVA results showed that differences on individual fatty acids composition between oil extracted from whole olive fruits and from fruit fleshes were significant ($p<0.05$) for palmitic acid (C16:0), palmitoleic acid (C16:1), oleic acid (C18:1) and linoleic acid (C18:2). The content of palmitic acid (C16:0), palmitoleic acid (C16:1), and linoleic acid in olive oil obtained from fruit flesh was higher, while the oleic acid (C18:1) was lower comparing to oil obtained from whole fruits. An increase ($p<0.01$) of stearic acid (C18:0) as saturated fatty acid, and a decrease ($p<0.05$) of linoleic acid (C18:2) as unsaturated fatty acid were observed in virgin olive oil after 12 months of storage.

Table 2 shows total saturated fatty acids (SFA), total unsaturated fatty acids (USFA), and the ratio of unsaturated to saturated fatty acids (USFA/SFA) of the olive oil extracted from whole fruits and fruit flesh of Kaissy cultivar during storage. The analysis of the oil extracted from whole olive fruits indicated significant ($p<0.05$) lower mean value of SFA (17.02%) and significant ($p<0.05$)

higher mean value of UFA (83.08%). On the other hand, the oil extracted from fruit flesh of olive fruits showed a significant ($p<0.05$) higher mean value of SFA (17.48%) and significant ($p<0.05$) lower mean value of UFA (82.52%). The ratio USFA/SFA of oil extracted from total olive fruit (4.88) was significantly ($p<0.05$) higher than those extracted from fruit flesh (pulp) (4.72).

Table 1. Effect of oil source and storage time on fatty acids content (%) of olive oil

Storage period/Months	0 Month	6 Months	12 Months	P-Value
Type		**C16:0**		
Whole Fruits	15.27±0.09bB	15.72±0.03aA	14.38±0.07cB	**
Fruit flesh	15.73±0.12aA	15.68±0.02aA	15.89±0.22aA	NS
P-Value	**	NS	**	
		C16:1		
Whole Fruits	0.95±0.60bA	1.28±0.19aA	1.12±0.04abA	*
Fruit flesh	1.15±0.12aA	1.15±0.03aA	1.10±0.07aA	NS
P-Value	*	NS	NS	
		C18:0		
Whole Fruits	1.74±0.03cA	1.86±0.01bB	2.75±0.08aA	**
Fruit flesh	1.75±0.13bA	1.97±0.06aA	1.92±0.03aB	*
P-Value	NS	*	**	
		C18:1		
Total Fruits	70.61±0.22abA	70.23±0.17bA	70.80±0.27aA	*
Whole Fruits	68.15±0.21aB	68.83±0.51aB	68.63±0.63aB	NS
Fruit flesh	**	**	**	
		C18:2		
Total Fruits	10.98±0.15aB	10.34±0.35bB	10.39±0.28bB	*
Whole Fruits	12.51±0.09aA	11.75±0.05bA	11.89±0.49bA	*
Fruit flesh	**	**	**	
		C18:3		
Whole Fruits	0.55±0.01aA	0.55±0.01aB	0.57±0.09aA	NS
Fruit flesh	0.71±0.34aA	0.61±0.01aA	0.58±0.04aA	NS
P-Value	NS	**	NS	

[abc] Means values in the same column not sharing a superscript are significantly different. [ABC] Means values in the same row not sharing a superscript are significantly different. NS: not significant. * Significant at $p<0.05$. ** Significant at $p<0.01$.

When the oils from the different storage time are compared, there is a trend showing higher total saturated fatty acid and lower total unsaturated fatty acids at the end of storage period, and significant differences for both oils (from whole fruit and from flesh fruit). A possible explanation for the difference in observed effect between oleic acid (as MUSF) and palmitoleic acid and linoleic acid (as PUFA) is

that the linoleyl radical could be implicated in initiation of the degradation, as suggested by Kamal- Eldin *et al*. (2003) and Gomez-Alonso *et al*. (2003). It has been suggested that the loss of PUFA in the course of oxidation is not sensitive enough to serve as an index of oxidative degradation of oils (Gordon, 2001). Besides, the variation of the ratio monounsaturated/ polyunsaturated fatty acids may affect the oil shelf-life. The effect of fatty acids on stability depends mainly on their degree of unsaturation and, to a lesser degree, on the position of the unsaturated functions within the triacylglycerol molecule (Kamal- Eldin, 2006). Oils that have high levels of monounsaturated oleic acid are considered to be of highest nutritive value (oleic acid is named after olive 'olea'), which is the major saturated fat. The higher levels of linoleic acid, although nutritionally acceptable, are also likely to contribute to reduced storage stability in the oil (Ghanbari *et al*., 2012).

Table 2. Effect of Type and storage time on total saturated fatty acids (SFA) and unsaturated fatty acids (USFA) of Olive oil

Type	**Storage period/Months**			
	0 Month	**6 Months**	**12 Months**	**P-Value**
		SFA		
Whole Fruits	17.02±0.07bB	17.59±0.03aA	17.12±0.10bB	**
Fruit flesh	17.48±0.15bA	17.66±0.07abA	17.81±0.20aA	*
P-Value	**	**NS**	**	
		USFA		
Whole Fruits	83.08±0.15aA	82.40±0.04bA	82.88±0.10cA	**
Fruit flesh	82.52±0.16aB	82.35±0.07abA	82.20±0.20bB	**NS**
P-Value	**	**NS**	**	
		USFA/SFA		
Whole Fruits	4.88±0.02aA	4.69±0.01bA	4.84±0.03aA	**
Fruit flesh	4.72±0.05aB	4.66±0.02abA	4.62±0.06bB	*
P-Value	**	**NS**	**	

[abc] Means values in the same column not sharing a superscript are significantly different. [ABC] Means values in the same row not sharing a superscript are significantly different. NS: not significant. * Significant at $p<0.05$. ** Significant at $p<0.01$

Effect of the oil source and irradiation on the fatty acid profile of olive oil

Compositions and differences, related to irradiation exposure doses, in terms of contents of palmitic, palmitoleic, stearic, oleic, linoleic, linolenic fatty acid, total saturated, total unsaturated fatty acids and the ratio of unsaturated to saturated fatty acids (USFA/SFA) were statically analyzed (Tables 3, 4 and 5). Significant ($p<0.01$) effects of irradiation exposure doses on some fatty acid composition of olive oils (at 0 and 6 months of storage) were determined, including palmitic, oleic

and linoleic fatty acid, and total saturated and total unsaturated fatty acids and the ratio of unsaturated to saturated fatty acids (USFA/SFA).

Table 3. Effect of gamma irradiation and storage period on palmitic (C16:0) and stearic (C18:0) acid content (%) on olive oil

Treatments		Control	2 kGy	3 kGy	P-Value
Type			**C16:0**		
Whole fruit	**0 months**	15.27±0.09bB	15.70±0.08aA	15.71±0.11aA	**
	6 months	15.72±0.03bA	15.74±0.17bA	16.02±0.07aA	*
	12 months	14.38±0.07aC	14.06±0.09aB	14.44±0.48aB	NS
	P-Value	**	**	**	
Fruit flesh	**0 months**	15.72±0.12aA	15.94±0.17aA	15.86±0.12aA	NS
	6 months	15.68±0.02bA	15.90±0.08aA	15.88±0.08aA	*
	12 months	15.89±0.22aA	15.90±0.02aA	15.75±0.06aA	NS
	P-Value	NS	NS	NS	
			C18:0		
Whole fruit	**0 months**	1.74±0.03aC	1.75±0.03aC	1.78±0.04aC	NS
	6 months	1.86±0.01aB	1.97±0.16aB	1.91±0.01aB	NS
	12 months	2.75±0.08aA	2.68±0.03bA	2.69±0.08abA	NS
	P-Value	**	**	**	
Fruit flesh	**0 months**	1.75±0.13aB	1.76±0.24aA	1.88±0.02aB	NS
	6 months	1.97±0.06aA	1.88±0.03bA	1.96±0.03aA	*
	12 months	1.92±0.03aA	1.94±0.05aA	1.96±0.05aA	NS
	P-Value	**	NS	*	

[abc] Means values in the same column not sharing a superscript are significantly different. [ABC] Means values in the same row not sharing a superscript are significantly different NS: not significant. * Significant at $p<0.05$. ** Significant at $p<0.01$

The effect of irradiation on fatty acid composition (after 12 months) was non-significant ($p>0.05$). Irradiation caused a significant ($p<0.01$) gradual decrease in the unsaturated fatty acid content and a significant ($p<0.05$) increase in saturated fatty acid content of olive oils. Similar results were reported in sesame seed oils (Zoumpoulakis *et al.*, 2012). The present findings agree with previous studies, where it was found that gamma irradiation had some effects on the physical and chemical composition of soybean fatty acids (Mahrous, 2007), peanut and sesame seeds oil (Afify *et al.*, 2013), black cumin seed oils (Arici *et al.*, 2007). Many research works have reported the irradiation-induced fatty acid compositional changes (Yilmaz and Gecgel, 2007; Hong *et al.*, 2010; Olotu *et al.*, 2014).

Table 4. Effect of gamma irradiation and storage period on palmitoleic (C16:1), oleic (C18:1), linoleic (C18:2) and Linolenic (C18:3) acids content (%) on olive oil

Treatments		Control	2 kGy	3 kGy	P-Value
Type		**C16:1**			
Whole fruit	**0 months**	0.95±0.55abB	0.99±0.04aB	0.91±0.04aB	**NS**
	6 months	1.28±0.19aA	1.13±0.05aA	1.17±0.05aA	**NS**
	12 months	1.12±0.04aAB	1.09±0.01aA	1.06±0.12aA	**NS**
	P-Value	**	**	**	
Fruit flesh	**0 months**	1.15±0.12aA	1.11±0.04aA	1.13±0.04aA	**NS**
	6 months	1.15±0.03aA	1.18±0.08aA	1.14±0.06aA	**NS**
	12 months	1.10±0.07aA	1.14±0.02aA	1.11±0.02aA	**NS**
	P-Value	**NS**	**NS**	**NS**	
		C18:1			
Whole fruit	**0 months**	70.61±0.22aAB	69.11±0.28bC	68.40±0.13cB	**
	6 months	70.23±0.17aB	69.19±0.20bB	68.35±0.13cB	**
	12 months	70.80±0.27aA	71.34±0.15aA	70.40±0.92aA	**NS**
	P-Value	*	**	**	
Fruit flesh	**0 months**	68.15±0.21aA	68.12±0.58aA	67.25±0.90bB	**
	6 months	68.83±0.05aA	68.61±0.10aA	67.87±0.17bAB	**
	12 months	68.63±0.61aA	68.70±0.35aA	68.57±0.58aA	**NS**
	P-Value	**NS**	**NS**	*	
		C18:2			
Whole fruit	**0 months**	10.98±0.15cA	11.88±0.16bA	12.55±0.05aA	**
	6 months	10.34±0.35cB	11.37±0.17bB	11.92±0.04aB	**
	12 months	10.39±0.28abB	10.24±0.09bC	10.80±0.26aC	*
	P-Value	*	**	**	
Fruit flesh	**0 months**	12.51±0.09bA	12.48±0.09bA	13.23±0.16aA	**
	6 months	11.75±0.05bB	11.79±0.22bB	12.32±0.26aB	**
	12 months	11.89±0.49aB	11.79±0.41aB	12.06±0.44aB	**NS**
	P-Value	**	**	**	
		C18:3			
Whole fruit	**0 months**	0.55±0.01aA	0.57±0.08aA	0.65±0.04aA	**NS**
	6 months	0.55±0.01bA	0.61±0.02aA	0.63±0.04aA	*
	12 months	0.57±0.09aA	0.59±0.04aA	0.60±0.05aA	**NS**
	P-Value	**NS**	**NS**	**NS**	
Fruit flesh	**0 months**	0.71±0.34aA	0.59±0.08aA	0.64±0.04aAB	**NS**
	6 months	0.61±0.01aA	0.65±0.09aA	0.66±0.07aA	**NS**
	12 months	0.58±0.04aA	0.54±0.02aA	0.56±0.04aB	**NS**
	P-Value	**NS**	**NS**	*	

[abc] Means values in the same column not sharing a superscript are significantly different. [ABC] Means values in the same row not sharing a superscript are significantly different. NS: not significant
* Significant at p<0.05. ** Significant at p<0.01

Table 5. Effect of gamma irradiation and storage period on total saturated fatty acids (SFA) and unsaturated fatty acids (USFA) of Olive oil

Treatments		Control	2 kGy	3 kGy	P-Value
Type			**SFA**		
Whole fruit	**0 months**	17.02±0.07bB	17.45±0.04aB	17.49±0.10aAB	**
	6 months	17.59±0.03cA	17.70±0.02bA	17.93±0.08aA	**
	12 months	17.12±0.10aB	16.74±0.11aC	17.13±0.55aB	NS
	P-Value	**	**	*	
Fruit flesh	**0 months**	17.48±0.15aB	17.70±0.37aA	17.74±0.13aA	NS
	6 months	17.66±0.07bAB	17.77±0.05abA	17.84±0.06aA	*
	12 months	17.81±0.20aA	17.84±0.06bA	17.71±0.10aA	NS
	P-Value	*	NS	NS	
			USFA		
Whole fruit	**0 months**	83.08±0.15aB	82.56±0.05bA	82.51±0.11bAB	**
	6 months	82.70±0.04aC	82.30±0.02aB	82.07±0.15bB	**
	12 months	82.88±0.10bA	83.26±0.11aC	82.87±0.55bA	NS
	P-Value	**	**	*	
Fruit flesh	**0 months**	82.52±0.16aA	82.30±0.38aA	82.26±0.12aA	NS
	6 months	82.35±0.07aAB	82.23±0.06abA	81.99±0.23bA	*
	12 months	82.20±0.20aB	82.16±0.05aA	82.29±0.20aA	NS
	P-Value	NS	NS	NS	
			USFA/SFA		
Whole fruit	**0 months**	4.88±0.02aA	4.73±0.02bB	4.72±0.03bAB	**
	6 months	4.68±0.01cB	4.65±0.01aC	4.58±0.03bB	**
	12 months	4.84±0.03aA	4.97±0.04aA	4.84±0.19aA	NS
	P-Value	**	**	*	
Fruit flesh	**0 months**	4.72±0.05aB	4.65±0.12aA	4.64±0.04aA	NS
	6 months	4.66±0.02aA	4.63±0.02bA	4.60±0.00cA	**
	12 months	4.62±0.06aA	4.61±0.02aA	4.65±0.03aA	NS
	P-Value	*	NS	NS	

[abc] Means values in the same column not sharing a superscript are significantly different. [ABC] Means values in the same row not sharing a superscript are significantly different. NS: not significant

* Significant at $p<0.05$. ** Significant at $p<0.01$

Conclusions

Fatty acid (FA) composition of gamma irradiated Syrian Kaissy cultivar olive fruit (SKOF) and stored up to 12 months was compared. Gamma irradiation and storage caused alteration of the unsaturated and saturated fatty acids compositions of SKOO, which showed an increase in the relative amount of saturated fatty acids and decrease in the unsaturated fatty acids. The ratio between total unsaturated

fatty acids and saturated ones (TU/TS) decreased gradually in parallel with the irradiation doses.

The fatty acid composition of olive oil obtained from SKOF contains a healthy mixture of all the types of saturated (S), mono-unsaturated (MUS) and poly-unsaturated fatty acids PUSFA). These oil is very rich in essential fatty acids. The value of USFA//SFA index which is associated to the impact in the human health is also high, ranging from 4.58 to 4.88, which makes them the most suitable edible oils for mass consumption.

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