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BIOACTIVE COMPONENTS CHANGES DURING PROCESSING METHOD OF TABLE OLIVES.

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ABSTRACT

The aim of this study was to investigate the effect of processing methods on the bioactive components in table Manzanilla olives variety (green and black). Moisture, oil, protein, reducing sugar, fiber, ash, total polyphenols, chlorophyll content (a and b), anthocyanins, minerals pattern by (Atomic absorption) and phenolic composition by (high performance liquid chromatography, HPLC) were determined in olive fruits processed by different methods (in brine, Spanish, Californian and naturally black). PH values, Nacl content, Titratable acidity were also determined in the brine. Results indicated that total polyphenols, anthocyanins and chlorophyll content (a & b) were significantly decreased in case of Spanish and Californian methods of green olives. Also, pH values were significantly decreased during the fermentation period (12 months), whereas titratable acidity and Nacl content were increased.

Tyrosol and hydroxyltyrosol being the main polyphenols in Manzanilla olive fruits (green and black). On the contrary, the results obtained in this work indicate that table olives can be considered as a good source of phenolic compound as natural antioxidants, although their concentration depends on olive variety and processing methods used.

Key words: Polyphenols, Table olive, Manzanilla variety, Spanish-style. Califonian- style. pH values,Nacl content.

INTRODUCTION

Table olives are a commodity of great importance in Mediterranean countries and United States. World production reached 1.832.500 metric tons in the 2006/2007 season. Spain comes in the first the list of producing countries (39 %). Egypt covers 11 % of the world production with average annual production of 400.000 metric tons, approximetly.

There are three main trade preparations of table olives: green or Spanish –style olives (50 % of total production), black ripe or Californian – style olives (25 %of total production) and naturally black or Greek –style olives (25 % of total production). Olives for the Spanish, Californian, and Greek styles are harvested when fruits reach a green –straw, yellow- purple, or black color, respectively, Garrido Fernandez *et al.*, (1997).

An olive industry is rapidly developing in many countries. Table olives are sold whole, stuffed or sliced. Often they are mixed into salads, used in pizzas and breads or turned into pastes. Those specializing in table olives must produce and distribute nutritious and safe marketable products, using environmentally acceptable methods underpinned by quality assurance processes.

Polyphenols are one of the main secondary metabolites in olives and they account for 1 – 2 % of fresh fruit (Amoit *et al.,* 1986 and Lopez- Lopez, *et al*, 2008). The main polyphenol in green olives is the oleuropein, a glucoside ester of 3,4- dihydroxyphenyl ethanol (hydroxytyrosol) and elenolic acid; its concentration decreases with fruit maturation (Romero, *et al.*, 2004 and Ranalli *et al,* 2007).

Other natural phenols that have been identified in olive drupes are verbascoside, ligustroside, salidroside, rutin, luteolin-7-glucoside, anthocyanins cyaniding 3- glucoside and cyaniding 3-rutinoside (Romero *et al.*, 2002; Ryan *et al.,* 2002 and Bastoni *et al* ., 2001).

During olives processing, polyphenols undergo chemical transformations and in general diminish their concentration in olives. One of the main steps in the Spanish- style green method is the debittering of fruits under alkaline condition by which oleuropein is hydrolyzed into hydroxytyrosol and elenolic acid glucoside (Amiot *et al.,* 1990 and Brenes and De Castro, 1998). The subsequent lactic acid fermentation does not modify the phenolic composition (Brenes *et al.,* 1995).

Californian – style black olives processing consists of preserving fruits in brine or an acidified solution and then darkening with air under alkaline conditions. Polyphenols, mainly oleuropein diffuse from olive flesh into the surrounding solution during preservation and their acid hydrolysis accurse (Brenes *et al.,* 1993 and Bravo *et al,* 2007). Greek- style black olives are harvested when they are fully ripe and put directly into brine for yeast fermentation. The main changes in polyphenols are the acid hydrolysis of oleuropein and hydroxytyrosol glucoside and the polymerization of anthocyanins that contributes to the color stabilization (Vlahov and Solinas, 1993 and Romero *et al.,* 2004).

As for olive oil, the main simple phenolic compounds in table olives are hydroxy- tyrosol and tyrosol and the beneficial properties for human health found in olive oil could also be supposed in table olives (Brenes., *et al.,* 1992 and Brenes *et al.*, 1995). Phenols present in olive exert a protective effect against oxidative stress in human cells and low density lipoprotein oxidation (Manna, *et al.,* 2002 and Leenen, *et al.,* 2002). Hydroxytyrosol, tyrosol and lignans also possess antioxidant properties (Gordon, *et al.,* 2001).

Despite the great importance that phenolic compounds of table olives may have from a nutritional point of view, few data are available on the phenolic composition of table olives (Bravo *et al.,* 2007). Therefore, this work was carried out to study the effect of processing method on the contents of polyphenols in Manzanilla olive fruits and physico- chemical properties of table olives were determined. Phenolic compounds, chlorophyll (a & b) content and anthocyanins were extracted and evaluated in table olive (fresh and pickled).

MATERIALS AND METHODS

Source of olive fruits: Olive fruits (*Olea europaea*) namely: Manzanilla variety (20 kg) was obtained from Alexandria, Egypt during 2006 season.

Solvent, reagents and standard: All solvent were distilled before use, Folin Ciocalteau reagent was obtained from Gerbsaure Chemical Co. Ltd Germany and Standard phenolic compounds were obtained from Koch-light Laboratory. Ltd Colubrook, Buckingham, Shira, England.

Salt: Sodium chloride, food grade was purchased from El-Nasr Salt Company, Alexandria, Egypt.

Procedures used for processing of various types of table olives:

1- Green olive (in brine):

The collection of olives took place when they reached a stage of so called industrial maturity (first days of September), when the fruits development had been accomplished, the skin color was greenish-yellow and the flesh hardness was normal. After sorting, with regard to their size, the olives were washed with water and put into plastic containers of 3 kg capacity containing brine (Nacl 8 %). A month later, the salt concentration was gradually increased in the brine up to 10 % ((Bravo, 1990).).

2- Green table olive (Spanish – style):

After sorting, olives were processed with NaOH solution (0.5 – 1.0 %) in plastic containers 3 kg capacity for 6 - 8 hours. When the NaOH solution penetrated in a depth corresponding 2 / 3 of flesh thickness, three rinsing with tap water were followed with the next 16 hours (Bravo, 1990).

3- Oxidation table olive (Californian –style):

After sorting, olives were processed with NaOH solution (1.0 – 2.0 %) in plastic containers 3 kg capacity. The concentration used for the first treatment is 1.5 – 2.0 % NaOH (4 -6 hours and the olives were oxidized in air for 24 hours), and the olives are left in this solution until the lye has penetration the skin only. In the remaining treatments the proportion of sodium hydroxide is 1.0 – 1.5% NaOH (4 -6 hours and the olives were oxidized in air for 24 hours); the alkali first penetration 1 mm into the flesh, then reaching through to the stone in the last immersion. After treatments the olives were washed with tap water were followed with the next 16 hours. After washing the olives are placed in a solution containing iron salts (ferrous gluconate 0.1%) to fix the color (Bravo, 1990).

4- Black olives (in brine):

The olive collection started when the black color of the flesh reached the stone. The olives, after being –well washed with water, were sorted with regard to their size and put into plastic containers 3 kg capacity containing brine (Nacl 8 %). A month later the brine salt concentration was gradually increased up to 11 % (w /w). Under these

condition the olive flesh bitterness disappeared and lactic fermentation took place, to some extent (Frazier; 1967).

Chemical composition of olive fruits: Moisture, Lipid, crude protein, fiber and ash were determined according to A. O. A. C. (2000), and reducing sugars of fresh fruits were determined according to Fernandez Diez (1983).

Physico - chemical analysis: Titratable acidity (as lactic acid), sodium chloride content according to (Garrido Fernandez et al., 1997) and pH values were measured using pH meter (VWR Scientific model 8015, Orion, USA) in brine.

Total phenolic contents: Total phenols were extracted from olive fruits and determined calorimetrically using the Folin-Ciocaltea reagent according to Gutfinger (1981) and were expressed in milligram per kilogram as caffeic acid.

Analysis of sugars: Sugar were analyzed by high performance liquid chromatography (HPLC) according to Duran and Roncero(1976).

Chlorophyll determination: Chlorophyll contents were determined according to Wensttein (1957). Samples were measured at 644 nm and 663 nm, chlorophyll was calculated using the following equations:
Chlorophyll (a) = $(9.78 \times 0.D_{663}) - (0.59 \times 0.D_{644})$ V/ W × 0.1
Chlorophyll (b) = $(21.426 \times 0.D_{644}) - (4.65 \times 0.D_{663})$ V / W × 0.1
Where: 0.D = optical density, W = weight of sample, V= volume of ethyl alcohol used.

Total anthocyanins: Total anthcyanins were determined by the bisulfite procedure (Ribereou-Gayon, 1968) and were expressed in milligrams per kilograms of cyaniding 3- rutinoside.

Identification and quantification of phenolic compounds:

Phenolic compounds were analyzed by solid phase extraction and identified by reversed –phase HPLC using a diode arrange Uv detector (Mateos et al., 2001). A Hewlett-Packard series 1,100 liquid chromatographic system (Waldbronn, Germany) loop 20 ml equipped with a diode arraye detector and a lichrosorb Rb 18 column (4.0 nm id C 250 nm; particle size 5 nm) (Merck, Darmstadt) was used. Elution was performed at a flow rate of 1.0 ml / min. with Mobil phase of water / acetic acid (48: 2 v/v, solvent A) and methanol / acetonitril (50:50, v/v, solvent B) starting with 5 % B and increasing B to 40

min., levels of 30% at 25 min., 40 % at 35 min., 52 % at 40 min., 70 % at 50 min., 100 % at 55 min., and kept at this stage for 5 min. A re-equilibration time of 15 min. was then required. Quantification of phenolic compounds was carried out at 280 nm using p-hydroxy benzoic acid as an internal standard.

Statistical analysis; Analysis of variance (ANOVA) was carried out on all data. A 5 % level of least significant difference (LSD), calculated by Duncanc's multiple range test, was used to establish differences between the mean values (Snedecor and Cochran, 1973).

RESULTS AND DISCUSSION

Chemical composition of table olives:

Data in Table (1) show that the chemical composition of table olive fruits of Manzanilla green olives (fresh, in brine, Spanish method and Californian method) and Manzanilla black olives (fresh and pickled) are moisture, crude protein, oil, reducing sugar, ash and fiber. Moisture content plays an important role in table olives processing because all processing methods used require a series of exchanges between substances in the flesh and the surrounding solutions (Garrido Fernandez et al., 1997). There was a significant decrease in moisture of the fruit flesh by processing in both green and black Manzanilla olive variety, which almost related to the significant increase of oil content due to processing. Data in table (1) clearly show that oil content of black Manzanilla olives was much higher than that of green Manzanilla. A slight increase in the oil content was initial oil content was 17.91 % increased to 18.81%, 18.43 % and 18.25 % in the case of olive pickled in brine, Spanish and Californian Manzanilla olives was 19.11 % increased to 19.45 % in the case of pickling in brine. It is interesting to note that higher oil content was observed in black Manzanilla olives.

Protein content of fresh and processed olives is recorded in Table (1). A very slight difference was observed between protein content of green and black Manzanilla olives either fresh or processed. A decrease of protein content was noticed in all of the processed samples. It is of great importance to note that a part of olive flesh protein being diffused into the brine, supports growth of lactic acid bacteria (Blatsouras, 1980). Soluble reducing and non-reducing sugars are the most important components with respect to the fermentation and preservation stages in all types of table olive processing. In

general, reducing sugars are the most important of the olive flesh sugars (90- 95%), with slight differences due to maturation degree **(Garrido Fernandez et al., 1997)**. Data showed that soluble reducing sugars content of olive flesh of the green and black Manzanilla olives were 4.67 % and 4.25 %, respectively. The sugars significantly reduced during the preparation processes, washing or lye treatment with subsequent washings, as well as during fermentation which converted sugars to lactic, acetic and formic acids.

Data in Table (1) show that crude fiber significant decreased by processing of both green and black Manzanilla olives. Crude fiber is an important constituent of pickled olives, because of its effect on the texture of the produced (Fernandez –Diez, 1980).

Table (1): Chemical composition of Manzanilla table olive (fresh and after pickled).

Processing methods	Composition (%)					
	Moisture	Crude protein	Oil	Reducing sugar	Ash	Fiber
Green olive (fresh)	69.80	1.76	17.91	4.67	0.95	4.91
Green olive (in brine)	67.60	1.68	18.81	0.00	8.91	3.81
Green olive (Spanish-style)	67.23	1.65	18.43	0.00	9.01	2.60
Oxidation olive (Californian- style)	67.18	1.50	18.25	0.00	9.6	2.25
Black olive (fresh)	68.95	1.71	19.11	4.25	1.00	4.33
Black olive (in brine)	66.92	1.63	19.45	0.00	9.65	1.90
LSD value at p > 0.05	1.55	0.60	1.00	1.00	0.67	0.90

Sugar analysis:

Data in Table (2) show the sugar analysis by high performance liquid chromatography (HPLC) in both green and black Manzanilla olives. The obtained results show that very destroyed in all sugars by processing methods of both green and black Manzanilla olives.

Table (2): Sugar analysis of Manzanilla table olive (fresh and after pickled).

Processing methods	Sugar (%)				
	Glucose	Fructose	Sucrose	Xylose	Raminose
Green olive (fresh)	2.06	0.95	0.07	Trace	0.40
Green olive (in brine)	1.01	0.00	0.00	0.00	0.00
Green olive (Spanish-style)	0.00	0.00	0.00	0.00	0.00
Oxidation olive (Californian- style)	0.00	0.00	0.00	0.00	0.00
Black olive (fresh)	2.00	0.90	0.05	0.00	0.38
Black olive (in brine)	0.95	0.00	0.00	0.00	0.00
LSD value at p > 0.05	0.00	0.00	0.00	0.00	0.00

Minerals content:

The amount of minerals in the flesh of green and black Manzanilla olives is presented in Table (3). It was noticed that sodium, potassium and iron predominated over all the other minerals, where they constituted more that 90 % of the total minerals. These minerals followed distantly by calcium, phosphorus, Magnesium and sulfur. Trace minerals (manganese, zinc and copper) were found in minute quantities. All minerals non-significant decrease by processing methods of both green and black Mnazanilla olives.

Generally, it can be concluded that the flesh of table olives is rich in important minerals, most of then of great importance to human feeding.

Total polyphenols:

Table (4) shows the effect of processing methods on the total polyphenols of green and black Manzanilla olives. Results revealed that the fresh olives contained the highest total polyphenols content in both green and black Manzanilla olives. Also, polyphenols content of green Manzanilla olives was much higher than that of black Manzanilla olives. In general, phenols in olives are hydrolyzed during lye treatment and are partially lost during this operation and in subsequent washings. A decrease of polyphenol content was noticed

in all of the processed samples, especially Spanish and Californian methods. Also, the total polyphenols significant decrease as the fermentation process continued up to 12 months in all cases.

Table (3): Minerals content of Manzanilla table olive (fresh and after pickled).

Processing methods	Minerals (ppm)									
	P	K	Ca	Mg	Na	S	Fe	Mn	Zn	Cu
Green olive (fresh)	0.029	283	0.051	0.014	0.008	0.04	39.0	1.80	5.3	4.2
Green olive (in brine)	45.00	360	0.400	20.00	650	18.00	1.8	0.30	0.30	0.6
Green olive (Spanish-style)	39.00	266	33.0	16.00	999	15.30	1.30	0.25	0.21	0.45
Oxidation olive (Californian- style)	36.00	241	30.00	13.00	1150	13.00	1.20	0.20	0.20	0.40
Black olive (fresh)	0.030	0.285	0.060	0.016	0.009	0.060	39.50	1.080	5.35	4.30
Black olive (in brine)	44.00	350	38.00	18.00	670	16.00	1.80	0.30	0.3	0.6
LSD value at p > 0.05	2.50	1.30	1.20	5.50	3.10	4.20	2.41	0.1	0.02	0.03

Table (4): Total polyphenol, anthocyanins and pigment contents of Manzanilla table olive (fresh and after pickled).

Processing methods	Total polyphenol (ppm)	Anthocyanins (ppm)	Chlorophyll (a)	Chlorophyll (b)
Green olive (fresh)	800.00	35.17	43.11	22.50
Green olive (in brine)	600.00	31.00	36.00	17.30
Green olive (Spanish-style)	250.00	15.50	21.00	10.50
Oxidation olive (Californian- style)	180.00	22.90	32.00	14.60
Black olive (fresh)	765.00	37.30	35.00	16.00
Black olive (in brine)	655.00	30.13	30.30	11.30
LSD value at p > 0.05	10.50	1.50	2.00	1.70

Anthocyanin content:

The black color of mature olives is due to the phenolic anthocyanins, and could be supposed that they were present in fermentation and packed fruits; as happens in wine and other commodities, a polymerization process of these compounds occurs during fermentation, and simple anthocyanins were not detected in the final product (Romero *et al.,* 2004). Thus, the content of total anthocyanin in the black olive higher than green olive (Table 4). A higher concentration in total anthocyanins was observed for naturally black olives than turning color olives (Californian method).

Chlorophyll (a & b) content:

Table (4) shows the effect of processing methods as well as the fermentation time (12 months) on chlorophyll (a & b) content of pickled olives. Results revealed that fresh green olives contained the highest chlorophyll (a and b) content followed by black olives. Results also revealed that green and black Manzanilla olives were markedly and differently affected by the processing methods as well as the fermentation time. Results demonstrated that chlorophyll a significant decreased in the pickled olives (green and black) in all processing methods after fermentation periods.

During the first fermentation phase, chlorophyll a rapidly gives rise to pheophytin and other derivatives. The transformation to pheophytin is due to the effect of the slight acidity of the medium. The conversion to other derivatives in the first days of brine pickling seems to indicate that this has taken place by means of an enzymatic and not chemical, hydrolysis, caused by the action of chlorophyllase, present in almost all green tissues (Minguez- Mosquera *et al.*, 1989). Therefore, the color changes in the fruits during pickling are due to exclusively to pigment transformations catalyzed by the acid pH of the medium and the action of chlorophyllase, Which demonstrates the absence of other types of oxidative reactions that degrade them to uncolored products.

Chemical composition of polyphenols:

High performance liquid chromatography (HPLC) was used for the qualitative and quantitative determination of the total polyphenols. In the present study, only 9 phenolic acids were identified, i. e., Hydroxytyrosol, tyrosol, caffeic, gallic, Elagic, vanillic, ferulic, p-hydroxybenzoic and protocatechuic acids. Table (5) shows the

chemical composition of polyphenols of table olives (green and blck) Manzanilla (fresh and pickling). Tyrosol, hydroxytyrosol and p-hydroxybezoic acids were the major phenolic compounds in green and black olives while caffeic, ferulic and Elagic acids present as minor compounds and gallic and protocatechuic acids present as traces compounds, respectively. Polyphenol patterns of both green and black Manzanilla olives were quite different.

Table (5): Analysis of polyphenol of Manzanilla table olive (fresh and after pickled).

Processing methods	Polyphenol (%)								
	Hydroxy tyrosol	Tyrosol	Caffeic acid	Gallic acid	Elagic acid	Vanillic acid	Ferulic acid	p-hydroxy-brnzoic	Proto-catechuic
Green olive (fresh)	35.30	22.50	6.50	3.50	6.30	3.00	5.40	20.18	2.01
Green olive (in brine)	30.01	19.30	4.20	3.00	4.00	2.50	4.01	15.30	1.50
Green olive (Spanish-style)	13.02	9.40	3.11	2.20	2.10	1.00	2.55	7.90	0.81
Oxidation olive (Californian-style)	25.13	13.11	3.90	2.80	3.34	1.83	3.53	12.41	1.00
Black olive (fresh)	32.15	19.90	5.40	3.21	5.81	2.30	4.15	18.60	1.73
Black olive (in brine)	24.00	17.11	4.40	2.72	4.21	1.25	3.00	13.20	0.89
LSD value at p > 0.05	5.00	2.10	1.50	0.50	0.77	0.15	0.13	0.33	0.39

In case, Spanish -style green olives showed the lowest concentration of tyrosol, hydroxytyrosol and p-hydroxybezoic acids (Table 5), while California method showed the highest concentration of these phenolic compounds. The Greek –style method of processing olives is similar to that of Californian method.

Chemical analysis of pickled olives:

PH: Table (6) shows the effect of processing methods and time of storage during fermentation process for 12 months on the pH values of the brine. Results revealed that the pH values at zero time were approximately close and varied from green Manzanilla to black Manzanilla. Results also revealed that the normal fermentation process the pH values of the untreated samples was progressively decreased during the storage for 12 months. In case of Californian method, results revealed that the pH values very significant decreased during the storage.

Table (6): Effect of processing methods on the chemical analysis of Manzanilla table olives during storage.

Processing methods / Time storage (month)	Green olive									Natural black olive		
	In brine			Spanish-style			Californian-style					
	pH	Nacl	Acidity*	pH	Nacl	Acidity*	pH	Nacl	Acidity*	pH	Nacl	Acidity*
Zero	7.7	8.00	0.00	8.2	8.00	0.00	8.5	8.00	0.00	7.6	8.0	0.00
1	6.2	7.10	0.05	5.3	7.00	0.10	4.4	7.80	0.11	6.5	7.00	0.10
2	5.4	10.1	0.08	4.7	10.0	0.18	4.4	10.0	0.11	5.7	10.1	0.80
3	5.3	9.75	0.21	4.6	9.60	0.26	4.4	9.80	0.11	5.5	9.75	0.20
4	5.2	9.50	0.33	4.6	9.30	0.39	4.4	9.40	0.11	5.3	9.45	0.31
5	5.1	9.00	0.41	4.5	8.90	0.46	4.4	8.80	0.11	5.2	9.20	0.40
6	5.0	8.90	0.59	4.4	8.40	0.61	4.4	8.50	0.11	5.1	8.80	0.58
7	4.8	8.70	0.70	4.3	10.0	0.73	4.4	10.0	0.12	5.0	8.50	0.70
8	4.6	10.0	0.80	4.2	10.0	0.82	4.4	10.0	0.12	4.8	10.2	0.78
9	4.6	10.0	0.89	4.2	9.90	0.96	4.5	9.80	0.12	4.7	10.1	0.85
10	4.5	10.0	0.98	4.0	9.80	1.04	4.5	9.80	0.13	4.6	10.0	0.95
11	4.4	9.90	1.10	3.9	9.80	1.11	4.5	9.70	0.13	4.5	10.0	1.00
12	4.3	9.80	1.20	3.9	9.80	1.30	4.5	9.70	0.14	4.4	9.90	1.12
LSD value At p> 0.05	0.20	0.31	0.13	0.20	0.31	0.13	0.20	0.31	0.03	0.2	0.31	0.13

* Titratable acidity.

Nacl content:

Table (6) shows the effect of processing methods as well as the fermentation time (12 months) on the salt contents of the brine. Data revealed that the fresh and treated olives contained no Nacl at the start of fermentation process. However, after a month of fermentation process, the samples (salt) showed the highest Nacl content due to the high brine concentration used in this process. The Nacl content in samples (Spanish-style) were less than that detected in samples pickled by the traditional process.

Titratable acidity:

Table (6) effect of processing methods and fermentation time (12 months) on the titratable acidity of the brine. Results showed that the titratable acidity significant increased with the Spanish and Californian methods and as the fermentation time.

Overall, it could be said that table olives are a good source of phenolic compounds as natural antioxidants, in some olive oil (Garcia *et al.*, 2003). Therefore, the results observed in this work will rekindle interest in table olives from a nutritional point view and could contribute to a higher consumption of this commodity if their higher polyphenolic antioxidant content is compared with the low contents of other fermented vegetables such as cucumber and cabbage (Tolonon *et al.*, 2002).

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التغيرفى المركبات الحيوية اثناء تصنيع زيتون المائدة

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يهدف هذا البحث الى دراسة تاثير طرق تصنيع زيتون المائدة (الطريقة التقليدية – الطريقة الاسبانية – الطريقة الكاليفورنية) على المركبات الحيوية فى ثمار صنف المنزانيللو الاخضر والاسود. تم دراسة التركيب الكيماوى (رطوبة – زيت – بروتين – السكريات المختزلة – الالياف – الرماد) ومحتوى الفينولات الكلية ومحتوى الكلورفيل (ا، ب) ومحتوى الانثوسيانين ومحتوى العناصر بواسطة جهاز الامتصاص الذرى.

ايضا تم التعرف على تركيب الفينولات بواسطة جهاز الكروماتوجراف السائل وذلك فى ثمار الزيتون التى تم تصنيعها بطرق مختلفة (الطريق التقليدية – الطريقة الاسبانية – الطريقة الكاليفورنية). كما تم تقدير قيم الـ PH الحموضة الكلية ومحتوى كلوريد الصوديوم فى ثمار الزيتون الى تم تصنيعها.

اشارت النتائج المتحصل عليها ان محتوى الفينولات الكلية والانثوسيانين ومحتوى الكلورفيل (أ، ب) ينخفض انخفاضا معنويا فى حالة طريقة التصنيع الاسبانية والكاليفورنية لثمار زيتون المائدة الاخضر صنف المنزانيللو. ايضا وجد ان قيم الـ pH يحدث لها انخفاض معنوى اثناء فترة التخمر بينما قيم الحموضة الكلية ومحتوى كلوريد الصوديوم تتزايد وذلك فى جميع طرق التصنيع. ايضا وجد ان مركبى التيرزول والهيدروكسى تيرزول هما المركبات الاكثر وجودا فى ثمار زيتون المائدة (صنف المنزانللو) الاخضر والاسود. كما اشارت النتائج ايضا الى ان طريقة التصنيع التقليدية افضل طرق التصنيع بالمقارنة بالطرق الاخرى حيث احتوت الثمار على اعلى نسبة فينولات (المحتوى الكلى للفينولات) سواء فى زيتون المائدة الاخضر او الاسود.

ومن نتائج هذه الدراسة يتضح ان زيتون المائدة يعتبر مصدر جيد للمركبات الفينولية والتى تعمل كمواد مضادة للاكسدة طبيعية ويعتمد تركيز هذه المركبات فى المنتج النهائى على كلا من صنف الزيتون وطريقة التصنيع.