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Evaluation of Changes in Phenolic Compounds of Two Varieties of Olives during the Course of Maturation

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ABSTRACT: Fats and oils are made of triglycerides. The fatty acids are the main constituents of triglycerides. There are minor components present in the oils and fats that are of great importance in human health, namely tocopherols and phenolic compounds that exhibit antioxidant activities. The concentrations of these compounds vary during ripening and maturation of olives. The object of the present study is to find out the time when the maximum concentrations of these compounds are present in the fruit, therefore the harvesting time can be determined. In the present work, two varieties of olives, Koroneiky and Arbeqina were selected and obtained during the months of Mordad, Shahrivar, Mehr and Aban in Fars province. The phenolic comopounds were determined according to the official method of analysis. The results indicated that phenolic compounds were increased during ripening periods and then started to decline during maturation. It was concluded that for Arbeqina variety the end of Aban and for Koroneiky variety beginning of Azar were selected as the best harvesting point in respect of phenolic compounds concentrations.

Keywords: *Maturation Period, Olive, Phenolic Compounds.*

Introduction

Olive, a fruit and a source of a popular oil has been grown and produced in the Mediterranean region. Almost 3000 varieties of olives exist in the world and the history of this ancient fruit goes back to hundreds of years. The fruit due to its composition that consists of water, high quantity of oil and carbohydrate, moderate amount of fiber, ash, protein and particular aroma, taste and color has been consumed not only in the Mediterranean area but all over the world (Hui, 2007). The oil extracted from the fruit depending on the history of the fruit and the processing procedures has been distributed and consumed in different grades. The popularity of the oil is due to its monounsaturation, presence of natural antioxidants and phenolic compounds, stability, flavor characteristics (Hui, 2007). The polyphenolic compounds are present in olive oil as minor compounds but the effect on the oil particularly the stability is substantial. The concentration of polyphenolic compounds in olive oils is about 50-800 ppm and 44 compounds up to present have been identified (Boskou, 2009). These compounds might be divided into three groups consisting of simple phenols, lignons and secoridoids (Cerretani et al., 2004). It is not only the fatty acid composition of the olive oil that might affect the oxidation rate and low density lipoproteins (LDL) but the presence of some

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antioxidants such as α-tocopherol and polyphenols that might be effective. Phenolic compounds might make a complex with low density lipoprotein and consequently reduce LDL (Fuller & Jialal, 1994). The antitumor and cancer effectiveness and the role of polyphenolic compounds have been proved. The biological and nutritional roles and need of polyphenols have been studied and investigated (Owen et al., 2000). The concentrations and quality of polyphenolic compounds in different varieties of olives have been investigated and studies and different compounds have been reported (Aparicio & Luna, 2002; Rotondi, 2004; Bouaziz, 2004).

The beneficial effect of olive oil due to its phenolic compounds and fatty acid composition on various medical factors have been investigated and regarded as positive (IOC standard, 2009). The object of the present work is to find out the time when the maximum concentrations of phenolic compounds are present in the fruit.

Materials and Methods

Two varieities of olives Arbequina and Koroneiky were collected from olive gardens located in Fars province. The samplings were carried out in four successive months. Samples (2 kg) were collected from north, south, west and east of trees and were sent to laboratory for further analysis. Ripening index was determined according to Bolandnazar *et al*. (2012). Oil extraction was carried out by application of soxhlet apparatus using cold press (Bolandnazar *et al*., 2012). Phenolic compounds were determined according to IOC number RES-4/94-v/06 using HPLC apparatus. SPSS software and Duncan test were used for the statistical analysis of the results. All the chemical used in this research was obtained from Merck Chemical Company.

Results and Discussion

The concentration of oils in fruits during maturation is presented in table 1.

Table 1. Oil content (dry weight bases) of two varieties of olives during maturation (%)

Name of variety	Harvesting dates	Oil (%)
Arbequina	06.05.1388	6.0
	05.06.1388	10.0
	06.07.1388	15.3
	22.08.1388	30.0
Koroneiky	06.05.1388	6.0
	05.06.1388	6.5
	06.07.1388	11.5
	22.08.1388	19.0

As presented when the fruits reached its maturation point, the oil concentration was at the highest level.

Table 2 shows the phenolic compounds present in Arbeqina variety of olive. The concentration of polyphenols in Arbeqina variety has increased by almost 100% after one month and the difference was significant while in the following months the concentrations were almost steady and changes were insignificant. Tyrosol and hydroxytyrosol, ferolic acid, coumaric acid, decarboxymethyl oleuropein aglycone (D. OL. AG; dialdehyde form), ligstroside aglycone (LIG. AG; dialdehyde form), increased considerably in the final stage after four months of maturation while some compounds namely oleuropein that is responsible for bitterness in the unripe olive and tyrosol acetate (TYR. Acetate) decreased considerably.

Table 2. The composition and concentrations of phenolic compounds in Arbeqina variety of olive during maturation

Arbeqina	phenolic compounds (%)	Harvesting time			
		06.05.1388	05.06.1388	06.07.1388	22.08.1388
1	Hydroxyl tyrosol	1.13	0.92	8.26	16.60
2	Tyrosol	1.78	1.43	12.60	26.40
3	Vanadic+caffeic acid	2.68	11.10	9.40	6.80
4	Syringic acid (inter standard)	7.20	1.65	0.76	0.71
5	Vanilic acid	4.00	1.21	2.00	5.80
6	p.Coumaric acid	8.21	2.85	2.70	8.00
7	Ferullic acid	0.69	3.83	11.50	6.85
8	O. Coumaric acid	1.50	3.32	1.33	4.60
9	D.OL.AG	1.40	0.80	7.60	14.80
10	Oleuropein	14.40	0.80	8.83	2.55
11	TYR. acetate	0.0	36.60	1.36	0.54
12	D. LIG. AGL.	10.60	2.08	2.50	2.60
13	Cynamic	0.82	4.00	1.18	0.82
14	Luteoline	2.27	0.27	3.64	5.94
15	OL. AG.	0.80	0.54	5.14	10.40
16	Apigenin	1.26	6.00	3.30	3.30
17	LIG. AG	1.13	0.91	8.26	6.80
18	Others	41.35	1.43	17.90	0.00
	Total Pholypenols (ppm)	83.37	161.70	159.10	166.40

The reason for the decrease might be the conversion of these compounds to tyrosol and hydroxy tyrosol. The changeds during ripening is to do with the formation of phenolic compounds (Boskou, 2009).

Table 3 shows the phenolic compounds present in Koroneiky variety of live. Similar chemical compounds as identified for Arbeqina variety was detected but at different concentrations. Here again the concentration of polyphenols have increased considerably after one month but with a steady increase for the successive months. The compounds responsible for bitterness, fruitiness and nutty taste and several flavour have been increased or decreased during the course of maturation. In this variety the concentration of vanadic acid and caffeic acid increased considerably and the increase was higher than the Arbeqina variety.

The increase in hydroxy tyrosol and tyrosol was not similar to Arbeqina variety as indicated previously. It therefore might be concluded that the presence of different chemical components at different concentrations at certain age of the fruit might give particular characteristics to the fruit or the oil extracted from it and one might decide the suitability of the fruit at certain periods for particular processing namely preservation or oil extraction.

In order to follow the changes in the phenolic compounds of the final product, sampling was also carried out about a month later at 15.09.1388 from the olives that were collected for oil extraction. Table 4 presents the final concentration of phenolic compounds in the oil after full maturation.

As indicated in table 4, oleuropein and its derivatives constituted approximately 50% of the total phenolic compounds for Koroneiky variety while this figure was about 37% for Arbeqina variety. Therefore it is well clear that these compounds present at different ratios in olive fruit or its extracted oil might provide and give different characteristics to different varieties of the fruits.

Table 3. The composition and concentrations of phenolic compounds in Koroneiky variety of olive during maturation

Koroneiky	phenolic compounds (%)	Harvesting time			
		06.05.1388	05.06.1388	06.07.1388	22.08.1388
1	Hydroxyl tyrosol	2.47	0.43	4.12	7.70
2	Tyrosol	6.60	10.00	2.40	11.70
3	Vanadic+caffeic acid	2.68	2.90	8.76	15.80
4	Syringic acid (inter standard)	0.66	0.35	1.69	2.70
5	Vanilic acid	1.48	5.08	5.38	13.50
6	p.Coumaric acid	4.90	8.00	5.50	5.40
7	Ferullic acid	2.56	2.30	4.30	2.77
8	O. Coumaric acid	0.40	1.30	0.85	3.60
9	D.OL.AG	0.47	2.11	3.25	7.70
10	Oleuropein	8.70	37.90	6.81	2.50
11	TYR. acetate	1.23	2.80	2.41	0.60
12	D. LIG. AGL.	1.94	5.90	11.30	12.60
13	Cynamic	0.66	0.12	2.23	3.08
14	Luteoline	0.35	0.20	6.37	4.86
15	OL. AG.	33.30	8.10	30.10	5.11
16	Apigenin	6.76	0.57	0.00	2.10
17	LIG. AG	2.47	0.43	4.12	7.70
18	Others	24.84	11.94	4.53	0.00
	Total Pholypenols (ppm)	83.30	163.60	169.40	186.90

Table 4. The compositions and concentrations of the phenolic compounds in the oil extracted after full maturation of the fruits

	Pholyphenol Composition (%)	Arbeqina variety	Koroneiky variety
1	Syringic acid – internal standard		
2	Hydroxytyrosol	7.00	2.40
3	Tyrosol	12.50	4.48
4	Vanillic acid	0.20	0.50
5	Caffeic acid	0.20	0.40
6	Vanillin	1.38	1.20
7	Para-coumaric acid	0.40	0.60
8	Hydroxytyrosol acetate	0.98	2.20
9	Ferulic acid	0.44	0.30
10	Ortho-Coumaric acid	0.28	0.70
11	Decarboxymethyl Oleuropein aglycone, dialdehyde form	0.40	0.10
12	Oleuropein	4.46	4.08
13	Oleuropein aglycone, dialdehyde form	0.93	0.10
14	Tyrosyl acetate	2.50	5.04
15	Decarboxymethyl Ligstroside aglycone, Oxidized dialdehyde form	4.58	8.05
16	Decarboxymethyl Ligstroside aglycone, Dialdehyde form	1.09	2.20
17	Pinoresinol, 1 acetoxy-pinoresinol	1.50	2.72
18	Cinnamic acid	1.73	1.47
19	Ligstroside aglycone, dialdehyde form	3.90	1.00
20	Luteolin	4.04	1.36
21	Oleuropein aglycone, aldehyde and hydroxylic form	37.21	50.30
22	Apigenin	11.06	7.60
23	Ligstroside aglycone, aldehyde and hydroxylic form	4.60	3.20
	Total phenols (ppm)	87.69	119.4

Conclusion

Maturation of olives increases the oil concentration in the fruit and affects the quality of the extracted oil. The concentrations of phenolic compounds in the fruit and extracted oil vary according to the time of maturation. These compounds are responsible for stabilizing the oil as antioxidants and contribute to the aroma and taste of the product. Therefore this study might suggest the proper harvesting time for oil extraction.

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