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Comparision of Polyphenol Content in Olive Oil *cv* Kalinjot Obtained in Two Different Extraction System

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Abstract

In Albania, continuous lines are used to extract olive oil using centrifugal force for phase separation. So far, two centrifugal systems are known, the 2-phase and the 3-phase system. In recent years Pieralisi has launched a new "Leopard" system known as the two and a half phase system. From this system are obtained 3 products, vegetable water plus olive oil, pate and solid.In regardwith the processing techniques of olive oil, the aim of this study was to compare the two systems: respectively 3phase and 2 and a half phase system. We have studied how different processing systems are related with the quality of olive oil and the content of total polyphenols in extra virgin olive oil.

To achieve the main objective, the study has been focused on the following analytical parameters:totalpolyphenol content, free acidity, peroxide index, K_{232} and K_{270}, total polyphenols, pigment content and bitterness index.

the results obtained showed that the olive oil extracted from the two and a half phase system presented a higher content in the total polyphenols (534.57 ± 15.87mg/kg), while for the three-phase system the content in polyphenols wasabout 443, 18 ± 22.29 mg/kg of caffeic acid.

Results obtained in this study showed that the content of total polyphenols for 'Kalinjot' variety was higher in olive oil extracted with the two and a half phase system, a result affirmed by literature as well

Keywords: System Extraxtion; Olive variety; Total polyphenols.

1. Introduction

As an important ingredient of the Mediterranean diet interest on olive oil has been growing in recent years. Due to the high nutritional value of olive oil, this product is gaining importance in places where olive cultivation is not possible (Trichopoulou, 2010). The Mediterranean diet, as it is already widely known, is generally based on the use of olive and olive oil, therefore it has been considered by many researchers as the best diet (Kipnis et al., 1993).

Since Albania is a Mediterranean country, olives and olive oil have been and are a very important part of the Albanian diet and economy. Albania has a large number of olive cultivars withhigh productivity (Ismaili et al.,2013) and and high capacity for producing qualitative olive oils.

The olive oil in Albania is based mostly on continuous lines which use the centrifugal force for phase separation. So far, two centrifuge systems are known, the 2-phase system and the 3-phase system, the latter of which is widely used in Albania. In recent years one of the most important brands of olive oil extraction production lines, Pieralisi has launched an intermediate system known as "Leopard" which consists of a two and a half phase system. From this system 3 products are obtained; vegetable water plus olive oil, paté and pomace.

Regarding the techniques of recent years, the aim of this study is to compare the two systems 3F and 2F and a half in the quality of olive oil and the content of total

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polyphenols in extra virgin olive oil. Our study focuses on: analytical determinations of total polyphenols content, pigments and bitterness index, as well as analytical determinations of olive oil quality such as free acidity, peroxides index, K_{232} and K_{270}.

2. Material and Methods

To carry out this study, olive fruits of the Kalinjot variety from Vlora area were used. The oil extraction was carried out in two processing plants; a three-phase processing line and another that processes the olive with a two-and-a-half phase line. Olive oil samples were taken directly from the vertical centrifuge and sent directly to the laboratory of the Food Research Center for further analysis. Oil samples were marked, filtered, and stored at -15 °C.

2.1.Analitic Determination:

To determine the values of free acidity and specific absorbance at 232 and 270 nm (K_{232} and K_{270}) and the peroxide index were used according to the official methods described in European Regulation EC 2568/91 and amendments (CCE, 1991).

2.2. Chlorophylls and carotenoids contents

These parameters were determined according to procedures described by (Minguez-Mosquera, 1990). The chlorophyll fraction was measured in a UV spectrophotometer (Libra S22 Biocrom) at (630, 670, and 710 nm) and the carotenoids fraction at 470 nm.

2.3. Total phenol content

Polyphenols content was analyzed as described by (Vázquez-Roncero, 1973) using the Folin–Ciocalteau reagent and absorbance measurement at 726 nm, the results were expressed as mg/kg of caffeic acid.

2.4. Bitterness Index

The determination of the bitterness index defined as K_{225} is carried out according to the method described by Gutiérrez and Perdiguero (1992). For the chemical analysis of the bitterness index of olive oil, a solid phase extraction column CPE C18 with a volume of 6 mL is used. Determination of bitterness index is completed by measure in a UV spectrophotometer (Libra S22 Biocrom) at 225 nm.

2.5. Statistical analysis

For each sample three replications were used. Medium and SD was performed using Statistix 9.0

3. Results and Discussion

3.1. Effect on VOO quality parameters

Olive oil is a product which is obtained from olive fruit and contains about 98% fat and 2% other saponifiable and non-saponifiable components (Boskou, 2006). The amount of free acids in olive oil are very important as they affect the classification of olive oil. Extra virgin and virgin olive oil should not be more than 1 – 0.8% oleic acid (CEE, 2015), Table 1 presents the total free acidity values of the oil obtained in the study.

As shown in Table 1 the olive oils extracted from the Kalinjot cultivar with both extraction systems had a free acidity values within the set limits (≤ 0,8 %). According to the standards of the Republic of Albania, the Regulation of the European Community as well as the standards of the IOOC, olive oils belong to the category of Virgin Oil.

UV spectrophotometric values K_{232} and K_{270}, are very important indicators to show the quality of olive oil, storage state and technological changes that have occurred during its extraction. Absorption with these wavelengths is dedicated to the formation of conjugated dienes and triins. K_{232} values for the analyzed olive oils vary from 1.04–1.09 as shownin Table 1. K_{232} values for the extracted oils are within the set limits (≤ 2,50), as well as for total free acidity these oils are classified as virgin oils.

Whereas for K_{270} the values of this parameter for the oils obtained in the study range from 0.13 - 0.21 (Table 1. For the category of extra virgin olive oil, the limits set according to IOOC, 2015 and CEE, 2003 are >0.22, and consequently the results obtained for the oils taken in the study classify these oils in the category of virgin oil.

The peroxide index is a parameter which determines the initial oxidation state of olive oil, expressed in milliequivalent of active oxygen per kilogram of fat. Peroxides or initial oxidation, comes as a result of incorrect oil extraction practices, or the oil is not protected and stored from light and heat and, consequently, the higher the value of the peroxide, the lower the antioxidant capacity of an oil.

For this reason, the European Community, in order to maintain the high organoleptic value of this product, has set the standard 2568/91, which for the category of virgin oil this parameter should not be higher than 20 meq O_2/Kg. From the obtained results, the analyzed oils show peroxide index values ranging from 4.55 - 14 meqO_2/Kg. These values are within the set limits and classify these oils into extra virgin olive oil.

3.2. Total phenols contents

Most of the antioxidants in olive oil are phenolic compounds. These compounds have two functions, one to protect the oil from autoxidation, and the other is the nutritional effect in humans (Beltrán et al., 2005).

Phenolic compounds are not only responsible for the stability of the oil but also interfere with its sensory organ properties (Beltrán et al., 2000). During the fruit ripening process there is a decrease of polyphenols in the oil, this tendency changes depending on the variety and the area of cultivation (Gutiérrez, et al., 1989; Beltrán, 2000).

Figure 1 shows the amount of total polyphenols of olive oil extracted by two different systems.

Olive oil extracted from the system with 2 F and a half presented a higher content in the total polyphenols about 534.57 ± 15.87mg/Kg of caffeic acid, while for the three-phase system the content in polyphenols is about 443.18 ± 22.29 mg/Kg of caffeic acid. Referring to Cimato et al. (1990), Uceda et al. (1998) and Beltrán et al. (2000) the differences that exist above the levels of phenolic compounds of the same variety are due to agronomic and oleotechnical facts. Supported by these studies we claim that the differences in the content of total polyphenols for the olive oil of the variety 'Kalinjot' is caused by the extraction system.

Chlorophyll and carotenoid pigments are present in the fruit until the end of maturity. These ingredients are fat soluble; therefore, they pass into the oil, thus affecting the color of the oil (Garrido et al., 1990; Beltrán et al., 2000).

These compounds have antioxidant activity, as long as the oil is kept in the dark (Beltrán et al., 2000). It has been reported that in the early ripening of the fruit, the chlorophyll and carotene content is high (Mínguez-Mosquera et al., 1990).

3.3. Change of chlorophyll and carotenoids contents.

a) chlorophyll contents

Chlorophyll components include a group of components that are responsible for the green color of the oil. The main constituent of these components is chlorophyll (Mínguez-Mosquera et al., 1989).

Figure 2 shows the amount of chlorophyll pigment of olive oil extracted by two different systems.

As shown in Figure 2, in a two and a half phase system the amount of chlorophyll pigment waslower (3.29 ± 0.5 mg/Kg) than olive oil obtainedwith a three phase (18.06 ± 2.59 mg/Kg). in the 3-phase system sample, the amount of chlorophyll washigher than the normal amount of this compound for the 'Kalinjot' variety. At optimal maturity the amount of chlorophyll pigment in the oil for the 'Kalinjot' variety is about 2.80 ± 0.4 mg/kg (Kycyk et al., 2011). However, this high amount of chlorophyll is because the fruit ripening index was very low.

In the case when the olive oil was extracted with the two-phase system, the amount of this pigment is lower, this decrease in the amount comes as a result of the influence of the extraction system.

b)Carotenoid pigments

Olive oil also contains carotenoid pigments, which are responsible for the yellow color of the oil. Generally when the olive fruit is ripe and the fruit has turned black the amount of this pigment is higher than chlorophyll (Mínguez-Mosquera et al., 1990). Graph 3 shows the average values of carotenoids of olive oil extracted with the two systems obtained in the study. As shown in Figure 3, in the triphasic system the amount of carotenoid pigment varied at 12.60 ± 1.5 mg/Kg while for the biphasic system the amount of this pigment was6.10 ± 0.9 mg/Kg. As can be seen, in the 3-phase system the amount of carotenoids wasgreater than that extracted with the 2-and-a-half phase system. It is already known that the optimum maturity of the olive is 3.5 to 4.5 (Aparicio et al., 2002) at this degree of maturity all the chemical components found in the olive have their highest quantity. The more mature the olive, the greater the amount of carotenoid pigments (Mínguez-Mosquera et al., 1990). In our study it wasobserved that in the olive oil extracted with the 3-phase system, the amount of carotenoids is high although the maturity of the fruit is not optimal. This increase in the amount of this component may be due to the extraction system.

3.4. Bitterness Index

Parameter K_{225} is the chemical determination of the bitterness of virgin olive oil. This definition is related to the sensory evaluation of olive oil (Gutiérrez et al., 1992), it is also related to the amount of phenolic components found in olive oil, the latter reduce their amount during the maturation process of the olive oil (Beltra et al., 2000).

Figure 4 shows the values of the oil bitterness index of the 'Kalinjot' variety extracted with two different systems.

As shown in the Figure 4, the olive oil extracted from the 2 and a half phase system presents high average values of the bitterness index compared to that with a 3 phase. The high amount of this parameter is at the same levels as the total polyphenols, which demonstrates the connection that exists between them. The higher the level of polyphenols in the oil the more bitter the oil (Uceda et al., 2004). As polyphenols are responsible for the bitterness of olive oil. As with total polyphenols the impact of the extraction system affected the differences presented in this study, other factors such as maturity index and genetic one was the same.

Table 1. Olive oil quality parameters, extracted with two different systems (with 3 phases and 2 half phases)

	2 half phases	**3 phases**
Free acid (g/L ac oleic)	0,84 ±0,08[a]	0,14 ±0,01
K_{230}	1,09 ±0,59	1,04 ±0,59
K_{270}	0,30 ± 0,52	0,24 ± 0,43
Peroxideindex(meq/Kg O_2)	17,77 ± 0,04	10,50 ± 7,11

Media, SD

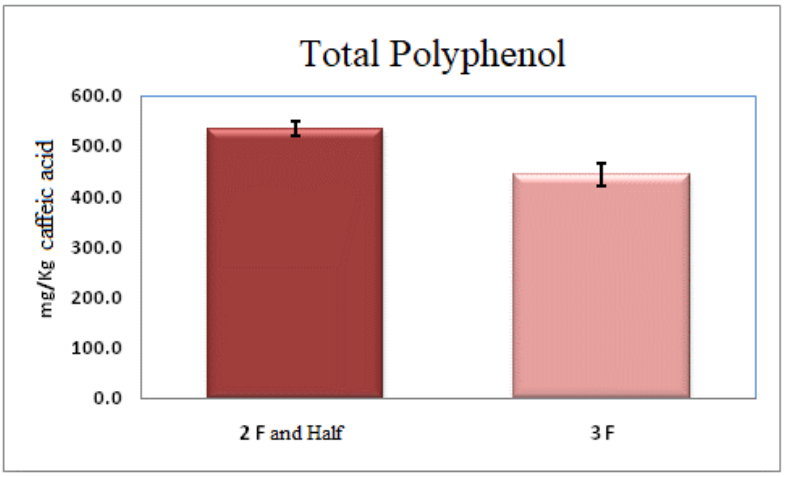

Figure 1. The amount of total polyphenols of olive oil of the 'Kalinjot' variety extracted with two different systems (2 half phases and 3 phases)

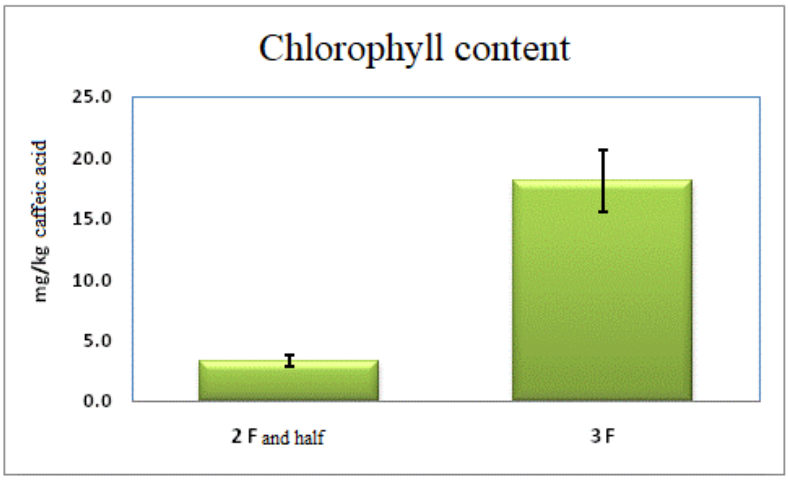

Figure 2. Amount of chlorophyll pigment of olive oil of 'Kalinjot' variety extracted with two different systems (2 half phases and 3 phases)

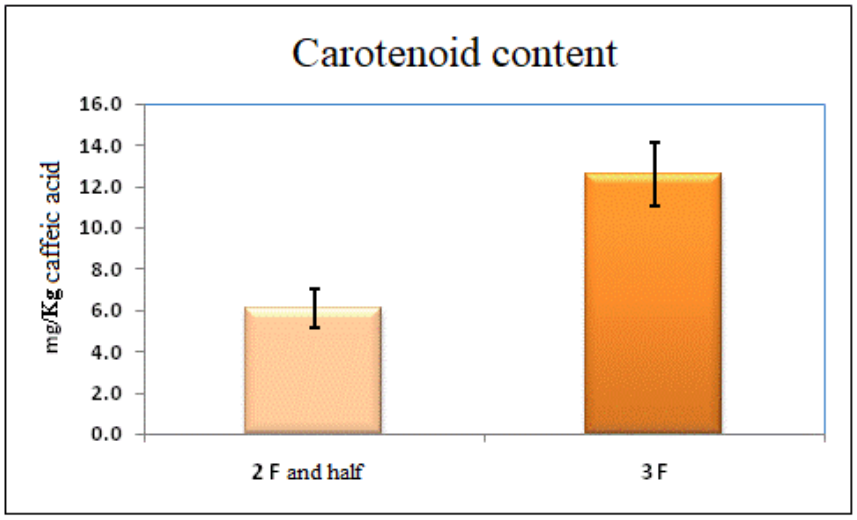

Figure 3. The amount of carotenoid pigment of olive oil of the variety 'Kalinjot' extracted with two different systems (2 half phases and 3 phases)

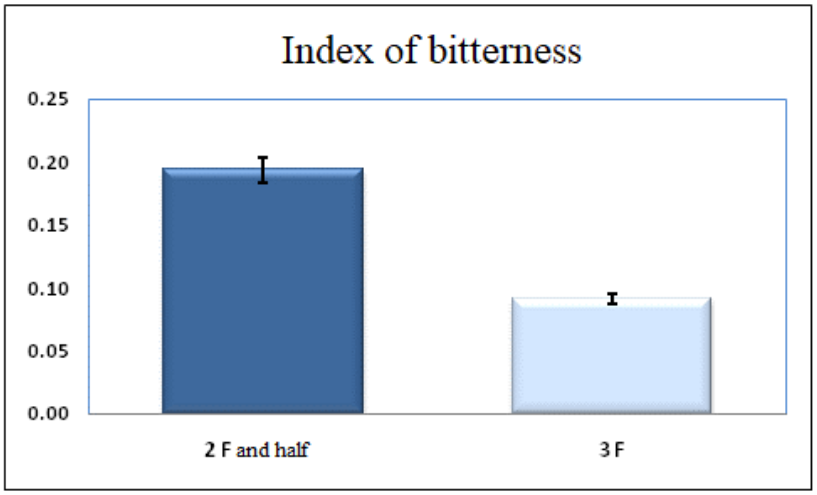

Figure 4. The amount of bitterness index of cultivar olive oil 'Kalinjot extracted with two different systems

4. Conclusions

From the data obtained in this study we conclude that:Olive oil obtained from two different extraction systems presents optimal values of quality parameters. Forboth systems used the samplespresented values which were within the set limits. These values are important to always keep below the limits as they affect the deterioration of the quality of the olive oil by affecting the classification of the oil.In oils extracted with two systems different average values in the pigment content were observed. The three-phase system extracted a higher amount of chlorophyll and carotenoid pigments. For the bitterness parameter, the oils which are extracted by the two and a half phase system produce more bitter oils. This is due to the higher amount of polyphenols extracted from this system.The two-system extracted oils showed moderately high polyphenol content. The two-and-a-half phase system extracts a higher amount of polyphenols. Judging by the results of quality parameters, the oil belongs to the category: virgin oil. However further studies will be needed to investigate for optimal oil storage conditions and how phenolic components affect the organoleptic evaluation of olive oil.

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