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ANALYSIS OF OIL QUALITY FROM VARIOUS OLIVE GROWING REGIONS OF LIBYA

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Olive oil is one of the oldest and best known edible oils, which is in category of unrefined vegetable oils produced in hugest quantities. Olive oil is distinguished from other oils by the various specific characteristics, so demand for olive oil is permanently in progress. Olives are grown in all regions of the world, where climate conditions are favorable for their growth. In some countries of North Africa production of olive oil is significant. In Libya olive is a primary oil culture and olive oil is produced by many individual producers in a traditional way of cold pressing or by centrifugation. The aim of this paper was to examine basic chemical and nutritive quality of virgin olive oil from five different regions in the north of Libya: Aboras, Be, Zwit, El Farok and Alati. Olives are processed by Rapanelli system (Italy, Foligno). Processing included cleaning and washing of olive fruits, crushing and malaxation after which the oil separated by centrifugation.

It has been established that examined oil samples that originate from Libya have a good chemical and nutritive quality. Content of primary oxidation products varied from 0.96 mmol/kg (oil from the Zwit region) to 2.40 mmol/kg (oil from the Alati region). Content of free fatty acid varied in the range from 1.39 to 3.17 % of oleic acid. According to a high content of total phenolic compounds (121.2 mgGAE/kg of oil) and the highest antiradical activity (proportion of neutralized free DPPH radicals 70.72%) among examined oil samples, the oil sample from the Alati region distinguished itself, while the minimum content (64.9 mgGAE/kg of oil) of such extremely valuable nutrient, as well as the minimal antiradical activity (60.12% of neutralized free DPPH radicals) has been registered in the sample from the Zwit region.

Key words*: virgin olive oil; peroxide and acid value, phenolic content, DPPH activity*

ANALIZA KVALITETA ULJA SA RAZLIČITIH REGIJA MASLINARSKOG PODRUČJA LIBIJE

Maslinovo ulje danas je jedno od najstarijih i najpoznatijih jestivih ulja koje se u kategoriji nerafinisanih biljnih ulja proizvodi u najvećim količinama. Maslinovo ulje se posebno izdvaja od drugih ulja po raznim specifičnim atributima, te je potražnja za njim u stalnom porastu. Masline se gaje u svim regionima sveta gde su povoljni klimatski uslovi za njihov rast. U pojedinim zemljama na severu afričkog kontinenta takođe postoji značajna proizvodnja maslinovog ulja. Maslina je i u Libiji osnovna uljana kultura i veliki je broj individualnih proizvođača koji proizvode ulje na tradicionalan način procesom hladnog presovanja ili pomoću centrifuge.

U okviru ovog rada ispitivan je osnovni hemijski i nutritivni kvalitet devičanskih maslinovih ulja poreklom iz pet različitih maslinarskih regiona na severnom području Libije: Aboras, Be, Zwit, El Farok i Alati. Plodovi maslina su prerađivani sistemom Rapanelli (Italy, Foligno). Prerada je obuhvatila čišćenje i pranje maslina, mlevenje i malaksaciju, nakon čega je ulje izdvojeno pomoću centrifuge. Ustanovljeno je da su ispitivani uzorci ulja poreklom iz Libije dobrog hemijskog i nutritivnog kvaliteta. Sadržaj primarnih produkata oksidacije kretao se od 0,96 mmol/kg (ulje sa područja Zwit) do 2,40 mmol/kg (ulje sa područja Alati). Sadržaj slobodnih masnih kiselina je varirao u opsegu od 1,39 do 3,17%. Po visokom sadržaju ukupnih fenolnih jedinjenja (121,2 mgGAE/kg ulja) i najvećoj antiradikalnoj aktivnosti (udeo neutralizovanih slobodnih DPPH radikala 70,72%) među ispitivanim uljima istakao se uzorak ulja sa područja Alati, dok je najmanji sadržaj ovih izuzetno vrednih nutrijenata (64,9 mgGAE/kg ulja), kao i najmanja antiradikalna aktivnost (60,12% neutralizovanih slobodnih DPPH radikala) zabeležena u uzorku sa područja Zwit.

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Ključne reči: *devičansko maslinovo ulje, peroksidni i kiselinski broj, sadržaj fenola, DPPH aktivnost*

INTRODUCTION

Olive oil is one of the most popular edible oils, which is in category of unrefined vegetable oils produced in hugest quantities. Olive oil is distinguished from other oils by the various specific characteristics, so demand for olive oil is permanently in progress.

Virgin olive oil is a basic component of mediteranean food, where it is mainly used for dressings, for salads and for meal preparation. Olive oil contributes in total vegetable oil production with less than 2%, however its consumption is permanently in progress, even in countries that are not olive producers (Augusto Ballus et al., 2014), due to its sensory and nutritive quality and demands of consumers for minimum processed food (Salvador et al., 2003).

The health benefits of unrefined olive oil have been documented in numerous publications (Farhoosh et al., 2013; Santosa et al., 2013; Becerra-Herrera et al., 2014). The various components producing those benefits have been identified from monounsaturated fatty acids to specific types of phenolic compounds (Owen et al., 2000; Santosa et al., 2013).

Health properties, sensory quality as well as oxidative stability of virgin olive oil are associated with prominent and well-balanced chemical composition (Bendini et al., 2007). The chemical characterization of unrefined olive oil is also an important way for the selection of new cultivars with olive oil of good quality characteristics and because of their potential use in the future. Moreover, today, the introduction into the market of different olive oil types with different characteristics and chemical quality is of big interest (Krichene et al., 2007), especially for the so called fraud (adulteration) which is unfortunately very common, even in developed countries. Namely, it is well known that according to International Olive Oil Council (2006) olive oils are classified into several categories by its quality and characteristics. Basic categories of such oil are so called virgin oil or refined olive oil, i.e. a mixture of them. Depending on the free fatty acids content virgin olive oil is further classified as: a) virgin olive oil – extra, b) virgin olive oil and c) virgin olive oil – ordinary.

The high cost of virgin olive oil makes it prone to adulteration with olive oils of lower categories in order to increase economic benefits. However, this practice deteriorates its quality and nutritional value leading to major economic losses for the consumers and the loss of consumer confidence can also arise. One of the most common adulteration practices consists of blending virgin olive oil with refined olive oil, without adequate oil declaration (Fragaki et al., 2005; Gurdeniz and Ozen, 2009; Frankel, 2010). In order to avoid such a situation it is necessary to conducts permanent examinations of the composition and quality of olive oils produced in various countries and regions, where olive growing and oil production becomes very often and profitable business. To favor this statement basic chemical and some nutritive quality of virgin olive oils produced in Libya, as one of the important producer of this type of oil in north Africa, has been analyzed in this paper.

MATERIALS AND METHODS

Material

Virgin olive oil samples originated from five different geographic regions of Libya: Aboras, Be, Zwit, El Farok and Alati were produced in small local oil mills. Olive fruits of cultivar trees, grown in the Mediterranean region of north Libya, were handpicked. Olive fruits were processed using a Rapanelli system (Italy, Foligno). Processing included cleaning and washing of olive fruits, crushing and malaxation after which a solid phase is separated by the centrifuge and from the rest of water-oil phase oil is separated by means of the separator. Afterwards the oil is filtered, and samples were stored under refrigeration conditions at temperature of 8 °C in glass bottles. Before analysis samples were tempered at room temperature for 24h.

By examination of chemical and nutritive quality as well as antiradical potential, except from samples originated from Libya, three more samples of extra virgin olive oil are examined, which are produced in Italy and Greece, i.e. countries that are among the most important producers of olive oil.

Methods

For examination of parameters of the *basic chemical quality* of analyzed oil samples methods for determination of peroxide value, PV, standard iodine metric method SRPS EN ISO 3960: 2011 and acidity as free fatty acid content, FFA, titrimetric method SRPS EN ISO 660: 2011 were applied.

Nutritive quality of olive oils has been established by determination of total phenolic compounds (Haiyan et al., 2007) and antiradical activity with reduction of stable free DPPH radicals using the spectrometric method according to Martinez and Maestri (2008).

RESULTS AND DISCUSSION

1. Peroxide values and acidity

Basic chemical quality of analyzed oil samples was examinated by determination of peroxide value and FFA content (Table 1). These two parameters are very important because they demonstrate current oxidative state and the quality of oil, but the quality and possible damages of olive fruit before pressing as well (e.g., olive fly attacks or improper systems of harvesting, transport and storage of olives) (Kiritsakis et al., 1998; Dabbou et al., 2010).

Table 1. Basic chemical quality parameters and total phenolic content in olive oil samples
Tabela 1. Parametri osnovni hemijskog kvaliteta i sadržaj ukupnih fenola u uzorcima maslinovog ulja

Sample **Uzorak**	**PV** (mmol/kg) **Pbr** (mmol/kg)	**FFA** (% ol. acid) **SMK** (%. ol.kis.)	**Phenolics** (mg GAE/kg oil) **Fenoli** (mgGAE/kg ulja)
Oils produced in Libya			
Aboras	1.46 ± 0.08	3.19 ± 0.02	92.4 ± 2.05
Be	1.45 ± 0.06	1.39 ± 0.05	77.0 ± 1.88
Zwit	0.96 ± 0.05	2.95 ± 0.02	64.9 ± 0.98
El Farok	1.95 ± 0.10	3.03 ± 0.01	81.6 ± 3.86
Alati	2.40 ± 0.12	3.17 ± 0.01	121.2 ± 2.65
Oils produced in Europe			
Greece (Terra Creta)	2.10 ± 0.11	0.50 ± 0.02	254.1 ± 3.12
Greece (Lezbos)	1.75 ± 0.10	0.80 ± 0.06	129.1 ± 3.97
Italy (Baso)	0.78 ± 0.09	0.60 ± 0.03	187.6 ± 2.55

The data obtained for PV, which ranged from 0.96 mmol/kg (oil origine the region Zwit) to 2.40 mmol/kg (oil origin the region Alati) (Table 1), are much lower from maximum value which is limited for all virgin oils to 10 mmol/kg (Codex, 1981). It may be concluded that the investigated samples of olive oil from Libya are of good oxidative quality, and this is an indication that neither the olive fruit itself nor the pressing process caused substantial oxidative changes. Regarding acidity examined oils are of different quality, considering that FFA content ranged from 1.39 to 3.19% of oleic acid. Criteria of acidity quality (<0.8% FFA) for extra virgin olive oil are not met for any sample. Minimum value for the acidity is obtained in oil produced in the region of Be, 1.39%, so this oil can be characterized simply as virgin olive oil (<2.0% FFA). In the other samples free fatty acid level ranged from 2.95%, in the oil from the region Zwit, to 3.19%, in the sample from the region Aboras, which classify them in category of virgin olive oil - ordinary. Acidity of oils produced in Europe is much lower, range from 0.50 to 0.80 % of oleic acid, so these oils belong to category of extra virgin olive oils. On the other hand, the data of PV of oils are similar, regardless of their origin.

Data from the literature also demonstrate significant ranges regarding the content of free fatty acids and primary oxidation products in the virgin olive oils produced in various countries and regions, which are considered to be limited by differences in geographic regions of olive grow and oil production, but by many other factors, first of all fruit cultivar, agronomical and weather conditions (Salvador et al., 2003; Arslan et al., 2013). A clear declining of PV during ripening process (Salvador et al., 2001) is determined as well. Ripening process of olive fruit has a significant influence on the content of free fatty acids in produced oil since, at later maturation stage, even olives carefully chosen (in order to avoid high infestation) develop a hydrolytic lipase activity, and release free fatty acids from the triacylglycerol (Uccella, 2001). Inadequate conduction of technological production process of olive oil, also may favor the hydrolysis of triglycerides, resulting in an increase of the free fatty acid (Benabid et al., 2008; Dabbou et al., 2010; Karabagias et al., 2013), but also may cause increase of the content of primary oxidation products.

Differences established in the basic chemical quality of analyzed virgin oils that origine from Libya may be attributed to differences of olive varieties and geographic region, growing condition i.e. oil production, which is demonstrated in the literature. For example group of authors Bejaoui Kefi et al. (2010) examined the chemical quality of oil produced from olives grown from two different

locations in the north of Tunisia (Bizerte and Kef: semi-arid zones) and from the centre and southern arid regions (Monastir and Medine) reported the content of free fatty acids from 0.29±0.02 to 0.75±0.05%, and the content of primary oxidation products from 10.95±0.03 to 19.68±0.02 meqO_2/kg. In the commercial olive oil produced in Tunisia location of Sfax, average content of fatty acids ranged from 1.12±0.06 mgKOH/g, and primary oxidation products 0.99±0.04 meqO_2/kg (Borchani et al., 2010). In the refined and virgin oil from the Iran market the FFA content has the value, 0.08-1.88 and 0.64-2.02 mgKOH/g, and PV 7.9-15, i.e. from 8.6 to 15.1 meqO_2/kg, respectively (Farhoosh et al., 2013). In the mechanically produced oil from Pakistan acidity was 0.3% of oleic acid, while the PV of this oil was 26±0.00 meqO_2/kg (Anwar et al., 2013). The acidity of the virgin olive oils produced in Turkey (from varieties Sanulak, grown on three different location in the South of Turkey: Antalya, Karaman, Mersin) varied between 0.50 and 0.83%, while the PV values 3.99-4.33 meqO_2/kg oil (Arslan et al., 2013). Within characterization and classification 47 samples of virgin olive oils produced in four different islands of Western Greece (Zakynthos, Kefalonia, Lefkada and Kerkyra) belonging to six local cultivars (Koroneiki, Ntopia of Zakynthos, Thiaki, Mouzolia, Asprolia and Lianolia) Karabagias et al. (2013) discovered extremely huge differences in chemical quality of analyzed oils: oil acidity ranged from 0.12 to 4.71%, while PV ranged widely from 6.20 to even 74.65 meqO_2/kg oil. In18 samples of monovarietal Nabali virgin olive oil obtained from different geographical areas of the northern West Bank of Palestine (Nablus, Salfit, Qalqilya and Jenin) the acidity ranged from 0.30 to 0.52%, and the content of primary oxidation products ranged from 8.45-12.08 meqO_2/kg (Abu-Reidah et al., 2013). Analyzing 16 samples of unrefined olive oils origin from various geographic regions of Algeria huge differences in oil acidity have been discovered (FFA from 0.77±0.19%, up to 9.26±0.19%). Signifficant differences have been determined in oxidative stability of these oils (PV from 0.01 meqO_2/kg oil even to 32.83 meqO_2/kg oil) (Benabid et al., 2008). In the samples of virgine olive oil (variety Manzanilla) produced in the Province of Cordoba in Argentina, Torres et al. (2011) have found that acidity is low, 0.18%, and PV value from 5.92 meqO_2/kg oil, pointed out the average resistance to oxidation of these oils. Studying the effect of different cultivar areas located in Egypt (Wady El-Netron, El-Esmalia and El-Arish) and varieties (Koronaki, Picual and Arbequin) on the quality characteristics of virgin olive oils obtained at the same extraction conditions, it has been found that acidity of examined oils varied in interval from 0.10% to 0.81%, while the content of primary oxidative products in these oils was 2.22-4.73 meqO_2/kg oil (Atta et al., 2010). In the refine olive oil and extra virgin olive oil from Italy it is found that FFA is of the value, respectively, 0.21±0.02%, i.e. from 0.19±0.01 to 0.71±0.02%, while the PV values in these samples respectively were 1.9±0.1 meqO_2/kg oil, i.e. from 4.4±0.2 up to 31.2±0.7 meqO_2/kg oil (Frega et al., 1999). Salvador et al. (2003) studied the oxidative stability of olive oils from different geographical origins located in central Spain and published the results of PV which varied between 7.8 and 12.9 meqO_2/kg oil.

2. Total phenolic compounds content

Content of phenolic compounds in analyzed oil samples is demonstrated in the table 1 and it is in the range of 64.9 mgGAE/kg in the oil sample from Zwit region, up to 121.2 mgGAE/kg in the oil from Alati. Amongst five examined samples from Libya the phenolic content of four oil samples was under 100 mgGAE/kg. Investigated oils are produced in various regions of Libya and by different producers. Many data from the literature point out that determined differences in the content of phenolic compounds may be results from many factors first of all from differences in: variety of olive, region where the olives are grown, agricultural techniques for growing the olive, time of harvest and the maturity of the olives at harvest, olive oil processing and way and condition of storage of olive fruits and olive oils (Morello et al., 2004; Vinha et al., 2005; Cicerale et al., 2009; Bejaoui Kefi et al., 2010; Virga and Aguzzi, 2013; Abu-Reidah et al., 2013; Augusto Ballus et al., 2014).

Comparing the content of phenolic compounds it can be concluded that oils produced in Europe have much higher phenolic content, even 254.1 mgGAE/kg in the oil from Greece. However at these samples the influence of various regions on the content of phenolic compounds has been found, too. In oil produced in Greece, the region of Lesbos phenols are found in the quantity of 129.1, and from the region of Terra Creta 254.1 mgGAE/kg.

Phenols are especially estimated group of compounds, which in virgin olive oil take at least 36 compunds various by the structure. Thanks to signifficant antioxidative characteristics, phenolic com-

punds contribute to favourable nutritive and chemical characteristics of oil. The importance of phenolic compounds from nutritive perspective is confirmed by the facts that the beneficial effects of a diet rich in unprocessed olive oil may be defined exactly by the unique antioxidant properties of its phenolic compounds (Okogeri and Tasioula Margari, 2002; Vujasinović, 2011). Antioxidative activity of polyphenols is attributed to *o*-dihydroxi phenolic structure, which has a great ability of chelate formation with metallic ions and in such a way inhibits the formation of oxygen radicals. Polyphenols have the antioxidant activity for alcoxyl and peroxyl radicals, they regenerate α-tocopherol by reduction of tocopheryl radical. Thanks to such characteristics polyphenols increase oil stability, and in organism the stability of low density lypoproteins-LDL. Their contribution in prevention of cardiovascular diseases and possible therapeutic role can be attributed beside the antioxidant abilities to other metabolic processes (Virgili et al., 2001; Kroon i Williamson, 2005; Choe, 2008; Vujasinović, 2011). Beside the antioxidance ability phenolic compounds show the other very significant characteristics such as hormone therapeutic abilities (estrogenic or antiestrogenic effects) (Fruhwirt et al., 2003). They are also compounds with indications of anticancer and cardioprotective abilities (protective effects on cardiovascular system) (Coni et al., 2000; Fruhwirt et al., 2003), some of them have antimicrobe, antivirus and anti-inflammatory abilities. Therefore, the phenolic compounds of virgine olive oil are of particular interest for human health (Abu-Reidah et al., 2013; Augusto Ballus et al., 2014).

Phenolic compounds also contribute to the formation of sensoric characteristics of olive oils since they have influence on color (Cheikh-Rouhou et al., 2006), but on other parameters of sensoric quality, especially on pungency and bitterness in flavour and taste of oil sensation as well (Abu-Reidah et al., 2013).

In regard to the total phenol content in olive oils, lots of reports by different authors have been described in the bibliography; Boskou (1996) has reported that the amount of total phenols shows a great variability from 50 to 1000 mg/kg, depending on various factors including among others, the cultivar, climate and environmental factors. The Tunisian Chetoui virgine olive oil showed total phenol concentrations between 250 and 600 mg/kg as caffeic acid esters (Temime et al., 2006). In the olive oil that originate from Tunisia produced from olives collected from two different locations in the north of Tunisia (Bizerte and Kef: semi-arid zones) and from the centre and southern arid regions (Monastir and Medine) the amounts of total phenols showed significant differences ($p<0.01$) between the different varieties. The highest contents of these components were detected in oil from the north, 400.32-1123.52 mg/kg, whereas, the lowest amounts were recorded in oil from the centre, 146.23-415.35 mg/kg (Bejaoui Kefi et al., 2010).

In the commercial olive oil, also from Tunisia (region of Sfax) the content of phenolic compounds was 53.33±0.55 mg/kg as a caffeine acid (Borchani et al., 2010). On the other hand, some sicilian virgin olive oils, showed total phenol concentration of 180 mg GAE/kg (Baccouri et al., 2007). While other results for total phenol content concentrations in commercial Spanish virgin olive oils, ranged from 330 to 500 mg/kg (García et al., 2003). In the mechanical extracted oil from Pakistan the content of phenol compounds was 157±10 mg GAE/kg (Anwar et al., 2013), and in a refined oil from Iran market 11-173 mg GAE/kg of oil (Farhoosh et al., 2013). In the virgin oil from the Iran market the content of phenolic compounds varried in interval from 88 to 221 mg GAE/kg ulja (Farhoosh et al., 2013). In18 samples of monovarietal Nabali virgin olive oil obtained from different geographical areas of the northern West Bank of Palestine (Nablus, Salfit, Qalqilya, and Jenin) phenol compounds take part from 294.66 to 480.86 mg/kg (Abu-Reidah et al., 2013), while the samples from virgin olive oil (from Manzanilla variety) produced in the Province of Cordoba in Argentina Torres et al. (2011) published the data of 255.61 μg of gallic acid/g of oil.

The level of phenolic compounds in unrefined oils is an important factor when assessing the quality of oil also and because these compounds have a positive influence on oxidative stability and shelf-life of oil (Cheikh-Rouhou et al., 2006; Abu-Reidah et al., 2013).

It is known that the content of phenolic compounds in unrefined oil is primarly determined by the type of row material. In order to compare results, Siger and al. (2008) analyzed cold-pressed oils and determined the phenolic content at soybean, sunflower, rape, corn, grapeseed, hempseed, linseed, rice bran and pumpkin. The highest total phenolic content was obtained in the pumpkin and hemp oils (2.5 and 2.4 mg/100g, respectively). Grapeseed oil was characterized by the lowest total phenolic compound content (0.51 mg/100g). The content of those compounds in the remaining oils (soy, sunflower, rapeseed, corn, flax, rice bran) was at the level above 1 mg/100g and did not exceed 2 mg/100g. Parry et

al. (2006) found that the total phenolic contents ranged from 0.98 to 3.35 mg gallic acid equivalents per gram of cold-pressed oils (onion, parsley, cardamom, mullein, roasted pumpkin and milk thistle).

3. Antiradical potential of oils

Antioxidants may protect significant cell components, like DNA and membrane lypides, from oxidative damage and thus decrease the cancer pathology, cardiovascular diseses, and other diseases related to organism growing old. Edible oils rich in natural antioxidants may have certain role in risk control of chronical diseases. In this regard antiradical capacities, i.e. antioxidative activity of oil in relation to free radicals is especially significant because it decreases the LDL-oxidation (Parry et al., 2006).

However there is no the uniform standard method of determination of antiradical oil activity, which would be fast, simple and with minimum of chemicals (Rabrenović, 2011). For that reason various researches are directed towards determination of antiradical activity of phenolic and similar compounds, which can be determined by examination of antiradical potential of methanolic extracts of oil (determination of their ability to neutralize the stable 2,2-diphenil-1-picrylhydrasil radical (DPPH•) in certain period of time (about 30 minutes), using the method of so called polarography with direct current (based on expected process of hydrogenperoxyde oxidation and reduction of diffusion current in the presence of antioxidants), as well as by determination of antiradical potential of oil applying direct methods. It is often determined kinetics of DPPH radicals reduction depending on antiradical potential of examined oil samples.

Figure 1 represents antioxidant activity of examined samples of olive oil in relation to a stable DPPH radicals and time function. As it can be noticed the antiradical activity of oils origin from Libya is rather uniform. After 30 minutes reaction time all samples neutralized 60.12-70.72% of free DPPH radicals. The highest antiradical activity had the oil sample from Alati region and the lowest antiradical activity had the oil from Zwit. This sample characterizes the minimum (64.9 mgGAE/kg), and sample from the region Alati the maximum (121.2 mgGAE/kg) content of phenolic compounds from analyzed oils, which points out that presence of these and other minor components with expressive antioxidant and antiradical characteristics have a significant influence to antiradical activity of oil.

The greatest antiradical activity showed oil from the region Terra Creta-Greece, which after 30 min neutralized more than 80% of free DPPH radicals.

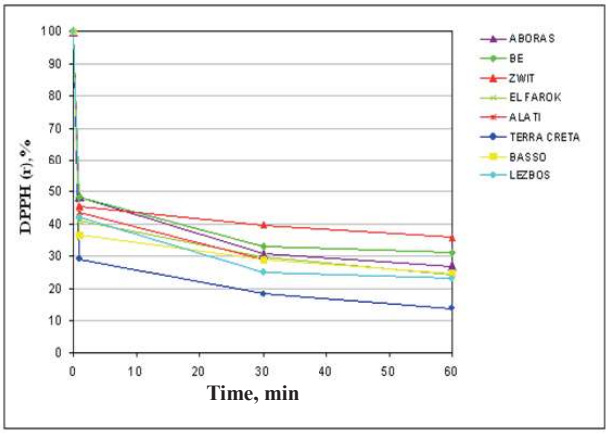

Figure 1. Antiradical potential of olive oils in relation to free DPPH radicals in function of time
Slika 1. Antiradikalski potencijal maslinovih ulja u odnosu na slobodne DPPH radikale u funkciji vremena

It is known that antiradical activity of oil depends on the composition and quality of raw material. In the samples of virgin olive oil, produced from olive fruits in Manzanilla variety in Argentina (Province of Cordoba) Torres et al. (2011) has been found that EC_{50} has the value of 393.70 mg oil/mgDPPH, in the mixture of virgin olive oil and walnut oil 437.51-657.54 mg of oil/mgDPPH, while in pressed walnut oil the antiradical capacity amounts 808.73 mg of oil/mgDPPH. Siger et al. (2008) by examination of DPPH radical activity (within 15 min) of methanol extract of unrefined cold pressed oils (soy, sunflower, rapeseed, grapeseed, hemp, linseed, rice bran and pumpkin oil) determined that according to antiradical capacity the methanol extract obtained from hemp and pumpkin oils (70%) is extremly high and than rapeseed oil (over 50% of DPPH• scavenged). According to results from Parry et al. (2006) DPPH activity of virgin oil of pumpkin seed, cardamom, parsley and onion in quantity of 25 mg after 10 min was respectively, 64.3, 58.2, 9.2-13.4 i 22.7-24.2%.

Among the minor components of non-refined oils phenolic compounds are especially distinguished by the antiradical activity, about which there are many studies in the literature, like results obtained from the team of authors Espin et coworkers (2000) who investigated the olive oil and oils from, linseed, rapeseed, sesam, walnut and saflor. The similar results obtained also De Leonardis et al. (2003) by examination of antioxidant i antiradical properties of cold pressed sunflower oil. Vuorela et al. (2004)

published that phenolic compounds extracted from rapeseed have strong antioxidant properties, scavenged over 60% of DPPH radicals and inhibited the formation of hexanal (over 90%) and hydroperoxides (over 80%). For that reason, in the context of these researche, examination the corellation between antiradical activity and phenolic compounds content in the examined oils samples has been determined. As it was expected, a good correlation between antiradical activity of phenolic compounds in relation to free DPPH radicals has been found, whereby the coefficient of corellation had the value R=0.86, fig. 2.

Siger et al. (2008) also pointed out to antiradical properties of phenolic compounds of non-refined oils originating of various raw material and existance of strong linear dependance between the content of total phenolic compounds and DPPH value of oils (R=0.87).

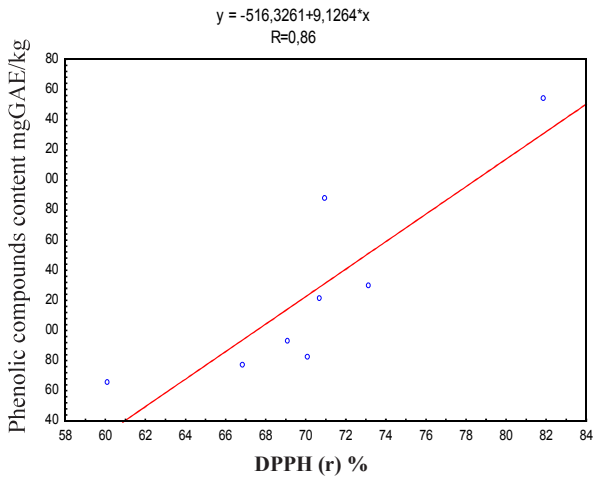

Figure 2. Linear correlation between the content of total phenols and DPPH (r) values of olive oil samples

Slika 2. Linearna zavisnost sadržaja ukupnih fenola i DPPH (r) vrednosti uzoraka maslinovih ulja

CONCLUSION

It is established that analyzed samples of virgin oil from Libya of the relative good chemical and nutritive quality, and noticed variation in the value of examined parameters may be attributed probably to differencies in olive types and regions of their growth, i.e. production process of oil.

In the examined samples the content of primary products of oxidation ranges from 0.96 mmol/kg (oil from Zwit) to 2.40 mmol/kg (oil from Alati), and the content of free fatty acids varies from 1.39% ol. acid, in the oil produced in Be, to 3.19%, in the oil produced in Aboras. By the high content of total phenolic compounds (121.2 mgGAE/kg oil) and the highest antiradical activity (neutralized 70.72% of free DPPH radicals) among the examined oils from Libya the oil sample from Alati is especially distinguished, while the least content of such extremely valuable nutrients (64.9 mgGAE/kg oil), and the least antiradical activity (neutralized 60.12% of free DPPH radicals) has been recorded in the sample from the region of Zwit. Namely, established the existence of significant linear correlation (R^2=0.86) between the results of the content of total phenolic compounds and antiradical activity of oil.

LITERATURE

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