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Assessment of chemical quality properties and phenolic content of different samples of Algerian olive oil.

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Abstract

The consumer necessity for a good quality of olive oil in terms of its lipid and phenolic profiles is demanded to preserve a good health and to combat illnesses. The conformity of olive oil with the International Olive Council standards requires the determination of certain chemical parameters including free acidity, saponification and peroxide indices. Our study was based on a comparative evaluation of chemical quality indices and extraction of phenolic compounds from different samples of olive oil of different durations of storage, from different regions of Algeria and with different preparations. The most recent olive oil sample presented the least acidity (1.88%) and saponification index (185.32 mg of KOH/g of oil). However, the sample conserved for five years revealed the highest quantities of total phenolics (0.56 ± 0.02 mg GAE/g oil) and flavonoids (0.174 ± 0.019 mg CE/g oil). Different results were collected comparing samples of olive oil from different regions from Algeria. Acidity percentages were ranged from 0.7 to 3.1%, peroxide index from 8 to 53meqO_2/Kg of oil and saponification number from 166.61 to 201.11 mg KOH/g of oil. Yields of phenolic extraction results revealed percentages from 0.11 to 0.24%. The traditionally prepared olive oil presented the best quality with an acidity of 1.01% and a saponification number of 187.10 ± 13.68 mg KOH/g oil. Whereas, the industrially prepared one exhibited the lower number of peroxide with 8.30 ± 2.88 meqO_2/ kg oil. The quality of olive oil was influenced by time, geographical region and mode of extraction. Conserved olive oils may be destined for the manufacture of soaps or the extraction of phenolic compounds.

Key words: olive oil; quality; lipid indices; phenolics.

الملخص

إن حاجة المستهلك للحصول على نوعية جيدة من زيت الزيتون من حيث الخصائص الدهنية والفينولية مطلوبة للحفاظ على الصحة الجيدة ولمكافحة الأمراض. يتطلب توافق زيت الزيتون مع معايير مجلس الزيتون الدولي تحديد معايير كيميائية معينة بما في ذلك الحموضة الحرة ، والتصبن وأرقام البيروكسيد. استندت دراستنا إلى التقييم المقارن لمؤشرات الجودة الكيميائية واستخلاص المركبات الفينولية من عينات مختلفة من زيوت الزيتون لفترات تخزين مختلفة ، من مناطق مختلفة من الجزائر و طرق تحضير مختلفة. أظهرت أحدث عينة من زيت الزيتون أقل نسبة حموضة (1.88٪) و أقل مؤشر تصبن (185.32 ملي غرام من KOH /غرام من الزيت). ومع ذلك بينت العينة المحفوظة لمدة خمس سنوات أعلى كميات من الفينولات الكلية (0.56 ± 0.02 ملي غرام مكافئ حمض الغاليك/ غرام زيت) والفلافونويدات (0.174 ± 0.019 ملي غرام مكافئ كاتشين / غرام زيت). تم جمع نتائج مختلفة لعينات زيت زيتون المأخوذة من مناطق مختلفة من الجزائربحيث تراوحت نسب الحموضة من 0.7 إلى 3.1٪ ، رقم البيروكسيد من 8 إلى 53 ملي ما يعادل O_2 / كغ من الزيت ورقم التصبن من 166.61 إلى 201.11 ملي غرام من KOH/ غرام من الزيت. أظهرت نتائج الاستخلاص الفينولي نسب تتراوح من 0.11 إلى 0.24٪. قدم زيت الزيتون المحضر تقليديا أفضل جودة مع نسبة حموضة تقدر ب 1.01٪ ورقم تصبن 187.10 ± 13.68 ملي غرام من KOH/ غرام من الزيت. في حين أن العينة المُحضرة صناعيًا أظهرت أقل عدد من البيروكسيد يقدر ب 8.30 ± 2.88 ملي ما يعادل O_2 / كغ من الزيت. تأثرت جودة زيت الزيتون بالوقت والمنطقة الجغرافية وطريقة الاستخراج. كما يمكن استخدام زيوت الزيتون المحفوظة في صناعة الصابون أو استخراج المركبات الفينولية.

الكلمات المفتاحية: زيت الزيتون ، جودة، مؤشرات الدهون ، الفينول

Introduction

From the very ancient times, the olive tree has been cultivated in the Mediterranean basin and considered as the first tree on earth. It is a sacred tree which translates peace and hope in many different civilizations (Çolak and Çulha, 2020). Algeria has diverse olive trees genotypes with important nutritional and beneficial properties (Boucheffa et al., 2018).

Extracted from the fruit of olive tree, olive oil is considered to be one of the best edible oils. It is a pure fruit juice and the only oil which is not obtained by solvents or chemical processes but only by mechanical processes in its virgin state (Gunstone, 2002) which guarantees the availability of all vitamins and phytochemical substances found in the fruit, they will be found intact in the oil.

The nutritional, biological, sensory and physicochemical properties of olive oil explain the consumer interest in it to be an essential component of the Mediterranean diet (Çolak and Çulha, 2020). Its consuming benefits have been known from the very earlier times and have traditionally been attributed to its high content of oleic acid (Marcelino et al., 2019). It is generally composed mainly of triglycerides and other minor various substances including phenolics which constitute its unsaponifiable fraction and give it its color, flavor and stability (Pérez et al., 2021).

Phenolic compounds of olive oil are natural powerful antioxidants. Their role in preventing the oxidative damages of tissues and cells is significant as well as in preventing inflammatory related ailments (Foscolou et al., 2018). As its high lipid content helps overcoming and preventing cardiovascular diseases, its minor content of secondary metabolites gives the olive oil its potential pharmaceutical and biological characteristics in dealing with various health problems and maintaining in a good health condition (AL-Asmari et al., 2020).

The important medicinal properties of olive oil are correlated with its phytochemical composition which is affected by multiple different factors. The main interest of this study was to research and evaluate the impact of time, harvest region and mode of extraction on the quality of olive oil for the consumer. This was due by the determination of some physicochemical indices including free acidity, peroxide and saponification indices for different samples of olive oil conserving from different years, harvesting from different regions of Algeria and extracting by two modes of preparation often used by Algerian people. Moreover, yields of extraction of phenolic compounds and the quantitative estimation of total phenolics and flavonoids were carried out for the studied olive oil samples.

Material and methods

Sampling

Dealing with the duration of storage, we had collected five samples of olive oil from different years of conservation (from one to five years) harvested from the region of Tlemcen. In addition, we studied four other samples produced in different olive-growing regions from Algeria: Jijel (region of eastern Algeria), Blida (centre Algeria), Tlemcen (western Algeria) and Tizi-Ouzou (the northern part of central Algeria/ Mountainous region). The four samples were collected during the period of December-February, 2020. Furthermore, we compared two olive oil samples prepared by different processes. For the industrial mode of preparation, the fresh olives underwent a chain extraction (cold extraction) with a maximum storage of 48 hours, starting by washing, crushing, kneading and decanting. The traditional preparation of oil was carried out at home by cooking olives freshly harvested. Olives were crushed by a mortar and transformed into a paste which was boiling into water for 30 to 40 minutes. After that, the floating oil was collected. Samples of olive oils were stored in glass vials and protected from light at room temperature. The olive studied variety was Sigoise of code SAA000191 (IOC, 2019) for all samples.

Chemical index analysis

The analysis of olive oil indices was carried out using standard techniques of manual titration for measuring the free acidity, the index of saponification and peroxide level.

Determination of free acidity

The determination of the free acidity of olive oil is considered to be the first parameter to study for the evaluation of its quality and its hydrolysis state (Grossi et al., 2019). The determination of the acidity of the oil was based on a titration of free fatty acids with a solution of potassium hydroxide in the presence of a colored indicator. The technique was performed according to the method described in the official regulation of the International Organization for Standardization (**ISO, 2020)**. 1 g of each olive oil sample was dissolved in 5 ml of ethanol. Then, we added phenolphthalein at 2%. Using a burette, we titrated the free fatty acids with ethyl KOH solution of 0.1 N. The volume paid was noted in equivalence as soon as the pink color appeared. Percentage of acidity was calculated according to the following formula:

$$\mathbf{A\%} = \frac{\mathbf{N \times M \times V}}{\mathbf{m \times 1000}} \times \mathbf{100}$$

N: ethyl KOH normality; m: mass of oil; V: volume of ethyl KOH solution titrated; M: molar mass of oleic acid.

Saponification index

The process of saponification consists of the decomposition of fatty acid esters present in triglycerides by the action of a strong base followed by the regeneration of glycerol and the appearance of soap according to the International Organization for Standardization (**ISO, 2020)**. 1 g of olive oil sample was mixed with 25 ml of ethyl KOH and made for ebullition for 60 min. After cooling, we added phenolphthalein and titrated the contents with hydrochloric acid. We shacked constantly until the discoloration of phenolphthalein. Then, we determined the volume V_1 of neutralization. A control was carried out by mixing 1 ml of distilled water and 25 ml of ethyl KOH in the same experimental conditions of the sample by determining the volume V_0 of the titration. The calculation of the saponification index was carried out according to this equation:

$$SI = \frac{M_{KOH} \times (V_0 - V_1) \times C_{HCl}}{m}$$

V_0: Volume of neutralization of control; V_1: Sample neutralization volume; C_{HCl}: concentration of hydrochloric acid solution; M_{KOH} : molar mass of KOH; m: mass of oil). Results were expressed by mg KOH / g oil.

Peroxide index

For the measurement of peroxide level of each studied sample of olive oil, we adopted the method described in the International Organization for Standardization (**ISO, 2017)**. We dissolved 1 g of each olive oil sample with 15 ml of acetic acid, 10 ml of chloroform and 1 ml of saturated potassium iodide solution. Then, the mixture was incubated for 5 minutes in darkness at 15 to 25 ° C of temperature. After that, the reaction was stopped by the addition of about 75 ml of distilled water. We added a few drops of starch as a color indicator. We titrated the iodine released with sodium thiosulfate solution (0.01 N) stirring vigorously until the purple color disappeared. A blank test was carried out under the same conditions replacing olive oil by distilled water. The calculation of peroxide index (meq O_2/kg of oil) was given by the following formula:

$$IP = \frac{V - V_0}{m} \times 1000 \times N$$

V: volume of $Na_2S_2O_3$ required to titrate the sample; V_0: volume of $Na_2S_2O_3$ required to titrate the blank; N: normality of $Na_2S_2O_3$; m: olive oil mass.

Phenolic content estimation

The estimation of total phenolic and flavonoids contents was carried out for the different conserved olive oil samples during different years of storage.

Total phenolic quantification

The quantitative estimation of total phenolics in different conserved olive oil samples was performed as described by Li et al. (2007) 1g of each sample was diluted in 5 ml of methanol. Then, 125 µl of each sample dilution was added to 500 µl of distilled water and 125 µl of Folin-Ciocalteu reagent. After six minutes in darkness, we added 1250 µl of Na_2CO_3 solution and 3 ml of distilled water. The tubes were incubated in the dark for 90 minutes. The absorbance was measured at 760 nm against a blank. We performed the same operations for a calibration curve using gallic acid as standard using concentrations from 0 to 0.1 mg/ml. results were expressed in milligrams equivalent of gallic acid per *gram of olive oil (mg GAE/g oil).*

Total flavonoids quantification

The method of Zhishen et al. (1999) was adopted for the quantitative estimation of flavonoids in different olive oil conserved samples. 125 µl of each sample dilution was added to75 µl of sodium nitrite, 150 µl of aluminum trichloride, 500 µl of sodium hydroxide and 1525 µl of distilled water. The absorbance of the solution was read after 15 min at 510 nm. Catechin was used from concentrations of 0 to 0.25 mg/ml. Total flavonoid content of olive oil samples was expressed in milligrams of catechin equivalent per gram of olive oil (mg CE/g oil).

Phenolic compounds extraction

A hydromethanolic extraction was opted to extract the phenolic compounds from olive oil samples of the different chosen regions from Algeria and those prepared differently in a traditional and industrial ways. We mixed 25 ml of each sample of olive oil with the same volumes of hydro-methanol (30/70) and chloroform. After decantation, we collected the hydromethanolic phase and evaporated it. Then, we collected the dry crude enriched phenolic extract and we calculated the yield of extraction as following: yield % = $M / M_0 \times 100$ (M: dry extract mass; M_0: olive oil mass).

Statistical analysis

Experiments were carried out in three tests and results were expressed as mean ± standard deviation. Graphs were plotted by Graph Pad Prism 5 software (version 5.03, 2009).

Results and discussion

Olive oil parameters quality

The quality of virgin olive oil is determined through a number of criteria including chemical parameters and organoleptic properties characterized by the abundance of phenolic compounds (Plasquy et al., 2021). The main interest of the current research was to analyze the indices of virgin olive oil quality of different samples in a comparative study. We were interested in the variation of the duration of storage taking account different years of conservation, the geographical region and the mode of preparation of olive oil. Furthermore, a quantitative estimation of total phenolics and flavonoids was carried out for the different conserved olive oil samples as well as the determination of yields of phenolic extraction for the rest of the samples.

The free acidity is the first quality index to research in order to provide information about the deterioration state of olive oil by hydrolysis and the degradation of its fats profile. Degraded oil contains more free acids which increases its acidity. Consequently, higher acidity indicates the bad quality of oil (Baldo et al., 2019). The large constitutional proportion of olive oil is determined by its

profile of oleic acid which has a key role in reducing the risk of cardiovascular diseases as well as its crucial nutritional properties (Borges et al., 2017). Thus, the consumer need for beneficial lipids requires lower acidity values of olive oils.

Results obtained from the analysis of the five conserved samples demonstrated a variability of acidity percentages. The most ancient samples for five and four years of storage were the most acidic with percentages of 8.178% ± 0.03 and 4.512% ± 0.06, respectively. Indeed, they were not conforming to the international oleic council standards of virgin olive oil classification (IOC, 2019). The least acidity level was presented by the most recent olive oil sample of one year (1.084% ± 0.02). Comparing olive oil samples from the different olive-growing regions of Algeria, results showed a high percentage of acidity for oil Jijel (3.1 % ± 0.03). Tlemcen oil was the least acidic with a value of 0.7 % ± 0.02. In addition, the both traditional and industrial prepared olive oil samples revealed lower acidity rates of 1.01% ± 0.03 and 1.57% ± 0.02, respectively. These samples were classified as virgin olive oils according to the standards of the international oleic council (IOC, 2019) (Table1; Figure1).

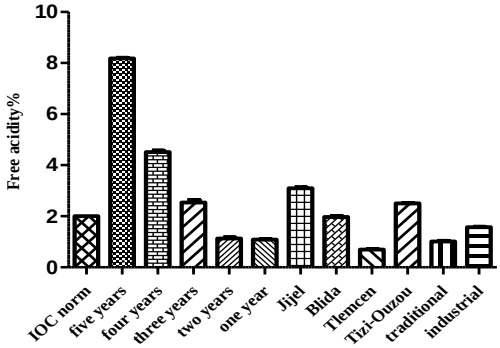

Figure 1. Free acidity percentages of different samples of olive oil in comparison with IOC norm. IOC: International Olive Council; Values were represented as mean ± SEM (n = 3).

The quality of olive oil is defined from commercial, nutritional and organoleptic perspectives which are essentially linked to the variety of olives, the region of harvest, extraction method, and other factors. Acidity rates differences in the analyzed samples might be explained by the differences in fruit maturity. A high level of free acidity can be due to the advanced state of fruit ripeness or an improper storage of the olives before extraction by the action of lipases on the triglycerides of the olive oil which causes the increase of its free fatty acids content (Pérez et al., 2021). Furthermore, it is important to know that the storage of the olive oil intended for consumption constitutes an important factor for its quality. After extraction, it is necessary to preserve it away from light, humidity and air within glass or steel containers, plastic is not preferable (Lolis et al., 2020). In addition, Jimenez-Lopez et al. (2020) limited the duration of storage of virgin olive oils from 9 to 18 months under ideal conditions of conservation. Tsimidou et al. (2005) reported that the quality of the oil is determined during the first step for its production. Therefore, to produce olive oil with low acidity, it is necessary to choose none injure olives quickly extracted and cold pressed in the shortest time (Plasquy et al., 2021). The quality of olive oil is closely related to the genetic factor of olive variety (Reboredo-Rodríguez et al., 2018). In our study, the different samples of olive oil used in analysis were extracted from the variety Sigoise olive (*Olea europea L.)*.

The saponification index is an indirect measure of the molecular weight of fatty acids which classifies oils according to their length chains. A weak saponification index indicates higher molecular weight of fatty acids and less hydrolysable oils (Almeida et al., 2020). The most conserved olive oil (of five years) presented the highest saponification index (454.41 ± 0.1 mg KOH/g), followed by samples from four and three years of storage (274.89 ± 0.02 and 272.08 ± 0.03 mg KOH/g, respectively). Thus, these oils are highly recommended for the production of soaps (Arbel, 2021). The lowest saponification index was noted for oil olive from Tizi-Ouzou (166.61 ± 0.02) (Table1; figure2).

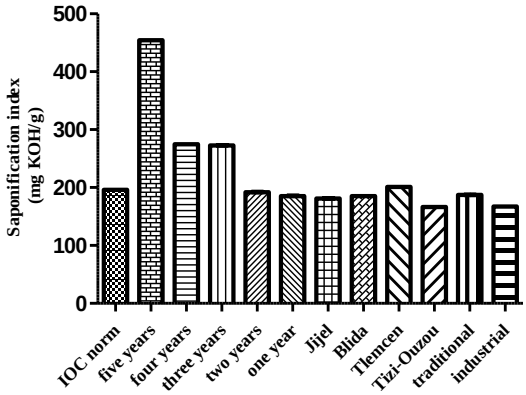

Figure 2. Saponification index values of different samples of olive oil in comparison with IOC norm. IOC: International Olive Council; Values were expressed as mean ± SEM (n = 3)

The differences in saponification values depend on many factors including the geographical variations, altitude, cultivar, climate and the pressing conditions (Ibanez and Usubillaga, 2006; Haider et al., 2009).

Another quality parameter of oils identity is the peroxide index which was performed to assess the deterioration of olive oil samples by oxidative rancidity. In fact, determining the peroxide value of olive oil is an indicator of its oxidation by atmospheric oxygen. Therefore, its degradation leads to the formation of unpleasant compounds (ketones, alcohols, aldehydes, acids, hydroperoxides and free radicals) affecting the quality of oil, causing the deterioration of its taste and odor and some of them are known to be harmful for health (Wang et al., 2016). A high peroxide index is the result of an extensive oxidation, the breakdown of unsaturated fatty acids (oleic and linoleic acid) and the rancidity of oil (Araújo, 2019).

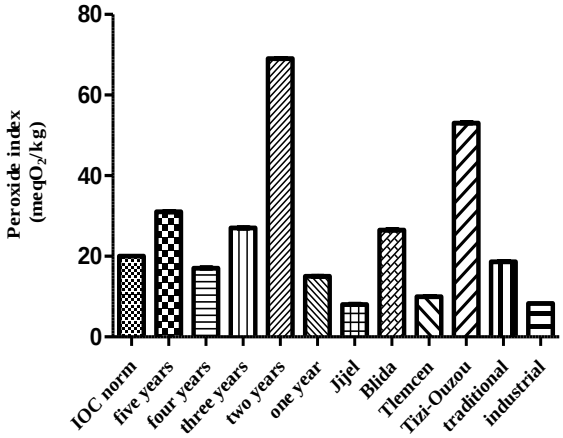

Figure 3. Peroxide index values of different samples of olive oil in comparison with IOC norm. IOC: International Olive Council; Values were expressed as mean ± SEM (n = 3)

Analyzing the peroxide index of the different olive oil samples allowed recorded that its values surpassed the standards of the international oleic council (IOC, 2019) for the conserved samples of five, three, two years of storage and for Blida, Tizi-Ouzou oils with a highest value of 69 ± 0.03 meqO_2/kg (of two years of storage). The other samples remained in the category of virgin oils which explained their resistance to oxidation. The lower values were illustrated for Jijel oil (8 ± 0.08 meqO_2/kg) and the industrial prepared one (8.30 ± 0.01 meqO_2/kg) (Table1; figure3).

Table 1. Quality parameters of different samples of olive oil

Olive oil samples	Free acidity %	Saponification index (mg KOH/g)	Peroxide index (meqO_2/kg)
Five years	8.178 ± 0.03	454.41 ± 0.1	31 ± 0.02
Four years	4.512 ± 0.06	274.89 ± 0.02	17 ± 0.1
Three years	2.538 ± 0.1	272.08 ± 0.03	27 ± 0.06
Two years	1.128 ± 0.04	191.94 ± 0.2	69 ± 0.03
One year	1.084 ± 0.02	185.32 ± 0.1	15 ± 0.02
Jiel	3.1 ± 0.03	180.92 ± 0.1	8 ± 0.08
Blida	1.97 ± 0.03	185.13 ± 0.1	26.5 ± 0.06
Tlemcen	0.7 ± 0.02	201.11 ± 0.03	10 ± 0.01
Tizi-Ouzou	2.5 ± 0.01	166.61 ± 0.02	53 ± 0.1
Traditional	1.01 ± 0.03	187.10 ± 0.06	18.66 ± 0.02
Industrial	1.57± 0.02	167.46 ± 0.01	8.30 ± 0.01
IOC norms	**1-3.3**	**185 -196**	**≤20**

Values were expressed as mean ± SEM (n = 3). IOC: International Olive Council

Peroxide index indicates the primary degradation of fatty acids by oxygen which fixes on lipids resulting their oxidation and damage leading to the increase of the acidity and rancidity of oil. During transport, storage and postharvest time of olive oil, a low temperature is recommended to preserve its physicochemical properties (Brki´c et al., 2020).

Boussahel and her collaborators (Boussahel et al., 2020) analyzed qualitative parameters of different samples of olive oil extracted from five olive varieties from northeast Algeria. They found results of free acidity in the range of 0.48 ± 0.03 - 1.25 ± 0.11% and peroxide levels between 12.75 and 15.50 meq O_2/kg. In another study, results of acidity rates of seven western Algerian olive oil samples found by Bendi Djelloul et al. (2020) were ranged from 0.6% to 2% extracted from the olive variety Chemlal. Sigoise oil recorded, in their study, the highest acidity of 2.8%. They noted peroxide values of 6.7 meq of O_2/kg for (Chemlal oil) and 14.6 meq of O_2/kg (Sigoise oil). In a comparative research on physicochemical parameters between two modes of olive oil preparations from Tlemcen region, Selka et al. (2019) revealed better peroxide level and saponification index results for the industrial mode of oil preparation than the traditional one which concords our findings.

Estimating phenolic profile of olive oil samples

Olive oil is known from the very earliest time as a nutritional and healthy regime in favor to its beneficial fats constituents. Nowadays, it makes a subject of research for many studies because of its distinctive phenolic composition (Marcelino et al., 2019). Olive oil phenolic compounds are considered as potent antioxidants to manage a wide range of health disorders such as breast cancer, diabetes mellitus and cardiovascular diseases (AL-Asmari et al., 2020). Furthermore, extracted virgin olive oil is a rich natural source of effective phenolics which are responsible for its stability and its specific remarkable sensory properties (Kalogeropoulos and Tsimidou, 2014). Thus, phenolic compounds concentration in olive oils is considered as a measure for their quality, among others.

Table2 collected results of dosage of total phenolic and flavonoids for five olive oil samples studied according to different years of conservation. The findings revealed that quantities of total phenolic and flavonoids decreased slightly according the studied years of storage. The most conserved oil (for five years) contained the highest values of these compounds (0.56 ± 0.02 mg GAE/g oil total phenolic and 0.174 ± 0.019 mg CE/g oil flavonoids). However, the least quantities were presented by the sample of two years of torage (0.32 ± 0.016 mg GAE/g oil total phenolic and 0.051 ± 0.012 mg CE/g oil flavonoids). The obtained data might explain the use of ancient conserved olive oils in the alternative Algerian medicine in terms of their richness of phenolic compounds.

Table 2. Total phenolic and flavonoids contents in different olive oil samples from different years of storage

Olive oil samples	**Total Phenolic** (mg GAE/g oil ± SD ; n=3)	**Flavonoids** (mg CE/g oil ± SD; n=3)
Five years	0.56 ± 0.02	0.174 ± 0.019
Four years	0.55 ± 0.01	0.102 ± 0.019
Three years	0.45 ± 0.06	0.076 ± 0.016
Two years	0.32 ± 0.016	0.051 ± 0.012
One year	0.41 ± 0.009	0.101 ± 0.002

Values were expressed as mean ± SEM (n = 3). GAE: gallic acid equivalents, CE: catechin equivalents

Yields of phenolic extraction were estimated from 25g of oil sample. The best percentage was noted for the sample from Tizi-Ouzou (0.24%), followed by that from Jijel and Blida of 0.19% and 0.11%, respectively. A low yield was recorded for Tlemcen olive oil (0.04%). Comparing between the two modes of olive oil preparation, the traditional one revealed the best yield of phenolic extraction with 0.19% while the industrial mode recorded 0.11%.

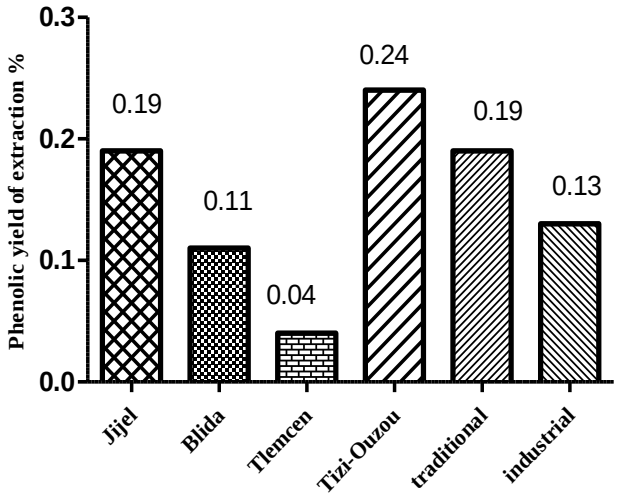

Figure 4. Phenolic yields of extraction of 25 ml of olive oil samples from different regions of Algeria and samples prepared differently. Values were expressed as mean ± SEM (n = 3)

Phenolic compounds are largely distributed in olive oils with more than thirty ones identified such as hydroxytyrosol, oleuropein and tyrosol (Kalogeropoulos and Kaliora, 2015; Houshia et al., 2019). According to AL-Asmari et al. (2020), the way olive oil is extracted affects their quantification and qualification. Thus, the process of filtration or refining removes some of them and decreases their quantity. In addition, the harvest geographical region determines the composition of olive oils in phenolic compounds (Mansour et al., 2016). Similar to our results in comparing olive oil samples from different regions, the study conducted by Bouchenak and her team (Bouchenak et al., 2018), on five olive oil samples from different parts from Algeria, revealed that Jijel olive oil presented the highest yield of extraction (of 11%) and contained the highest amounts of total phenolics (107 ± 1.317 mg GAE/ kg). Likewise, in a comparative study of olive oil phenolic contents between north and south Tunisia, Issaoui et al. (2010) indicated that the quantity of these compounds was much higher for northern oil. Besides, they noted that regions of higher altitude were characterized by higher contents of phenolics. This might explain the highest yield of phenolic extraction found in our study of the oil from the mountainous region of Tizi-Ouzou. Other researches mentioned the cultivar as a determining factor of olive oil phenolic composition. Bengana et al. (2013) showed that the variety of Chemlal was genetically poor in phenolic compounds in comparison with Sigoise from the north-central Algeria. In contrast, Ghaoues and Namoune (2021) revealed that Chemlel cultivar showed an oxidative stability

better than Sigoise type. Boussahel et al. (2020) found that olive oil issued from cultivar of Tefahi contained the highest amounts of total phenolics (237.19 ± 23.70 µg GAE/mg) in comparison with other varieties of Chemlal, Gelb Elfarroud, Manzanilla and Zebboudj, from the northeast of Algeria. Cavaca et al. (2020) added that size and maturation stage of olives influence their composition in phenolic compounds. They found that fruits variety of small size contain more phenolics than big ones. Moreover, the temperature used during extraction affects the phenolic content. Our results showed that the traditional mode of olive oil preparation gave better yield of phenolic extraction than the industrial cold process. Thus, elevated temperature favored the solubility extraction of phenolic compounds. However, too high temperature can induce the degradation of some of these compounds (Herrera et al., 2018). Indeed, previous studies involving the possibility of oxidation of phenolic compounds during a prolonged extraction time (Yap et al., 2009; Herrera et al., 2018). Previous studies found that mature olives gave lower quantities of phenolic compounds than earlier harvested ones (Bengana et al., 2013; Bakhouche et al., 2015). They suggested collecting olives in their color between the green and dark. Previous studies indicated that the genetic variability of olive trees has a key role in the stability of extracted oils, their organoleptic characteristics as well as their phenolic yields (Sion et al., 2019).

Conclusion

Olive oil is one of the healthiest and the most preferable consumed foods in Algeria. It is famous for its diverse significant biological properties. In the Algerian culture, people prefer the most ancient conserved olive oil for therapy. Results of this study confirmed that conserved olive oils were not useful for nutrition, they were degraded and deteriorated. Nevertheless, they were suggested for the extraction of phenolic compounds and the production of soaps. It was concluded that time, region of harvest and extraction method influenced the quality of olive oil. Generally speaking, recent extracted olive oil from the northern western region of Algeria (Tlemcen) prepared industrially was of a superior quality in comparison with the other analyzed olive oil samples, for the studied parameters of quality. It had a decreased acidity index, low saponification value as well as an inferior peroxide index. Moreover, olive oil from the mountain region of Tizi-Ouzou was recommended for the extraction of phenolic compounds for further researches or for pharmaceutical aims.

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Disclosure statement

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