Quality Characteristics of Some Algerian Olive Oils with Antioxidant Activity

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Abstract

Herein, the physicochemical properties of ten samples of olive oil from various Algerian regions (the acidity, peroxide, and saponification index, the specific extinction coefficient (K_{232}, K_{270}), the content of chlorophyll, carotenoids, and total polyphenols), in addition to their antioxidant activity were investigated and were compared with three other control samples. The physicochemical characteristics of the tested olive oils proved oil quality varying from virgin to extra virgin olive oil of excellent nutritious and healthy quality for the consumer according to the commercial standards recommended by the International Olive Council (IOC). Moreover, the olive oil collected samples showed that the antioxidant activity of oil samples from south Algeria (Sahara) is higher than that of Northern Algeria, and the oils of Chemlal variety exhibited higher antioxidant activity than that of Segoise variety.

Introduction

The olive tree is the main indicator of the Mediterranean climate and a widespread with a long history among the Mediterranean people. Thus, olive oil or green gold becomes an ancestral product having powerful beneficial effects on human health, in addition to its high nutritional value (Brahmi et al., 2020). The beneficial effect of olive on human health can be attributed, to its composition in polyphenols (Djemaa-Landri et al., 2021). Up to now, the economic and modernization development has put olive cultivation in a system providing greater olive oil quality. Algeria is one of the main Mediterranean olive oil-producing countries and the third largest olive oil producer in North Africa (80,000 tonnes during the season 2017–2018) (Haoua and Mohamed, 2021). Interestingly, olive oil is characterized from other plant oils by its specific olfactory qualities, like fruitiness, astringency, and bitterness. It is composed of a high amount of phenolic compounds derived from the secondary metabolism process in the plant, including phenolic alcohols (e.g. tyrosol), flavonoids (e.g. apigenin), and phenolic acids (e.g. vanillic acid), making oils a promising curative agent against bacterial infections, inflammations and some chronic diseases such as heart disease, Alzheimer disease and certain cancers (Lucas et al., 2011). Also, olive oil is a valuable nutritional product and known for ages as a unique oil among other food oils due to its typical physicochemical properties, including high water solubility and volatility, as well as the health benefits owed to its exceptional organoleptic characteristics (Gorzynik-Debicka et al., 2018). The human can consume olive oil solely or mixed with food (such as soups, and vegetables) to provide a good food taste and texture in the mouth. Several studies investigating the physicochemical features and the health benefits of olive oils have been extensively conducted in the northern regions of Algeria (Cherfaoui et al., 2018; Chennit et al., 2021). Noteworthy, the content of the secondary metabolites in the plant may vary throughout its development stages and can be related to extreme climatic conditions (high temperature, sun exposure, drought, salinity...etc.) promoting consequently the biosynthesis of secondary metabolites such as polyphenols (Falleh et al., 2008). Since no previous study investigated the oil quality in the southern parts of Algeria (Sahara), the present work was conducted to investigate the physicochemical, organoleptic, and antioxidant properties of some samples of olive oils varieties from some cities of southern Algeria, and to compare their properties with those of local varieties from northern Algeria and three samples from abroad area as controls.

Materials And Methods

Collection of olive oil samples

The sampling process was conducted from various Algerian regions (North-east, North-west, and south-east) during a period 2017–2018. Whilst, three other commercial olive oil samples obtained from abroad (Tunisia, Syria, and Italy) were analyzed and used as controls. The olive oil physicochemical indices include acidity, peroxide, saponification index, and the standard UV absorption value (K_{232}, K_{270}). The content of chlorophyll, carotenoids, and total polyphenols, were determined as reported elsewhere (Ghaoues and Namoune, 2021).

Determination Of The Olive Oil Physicochemical Parameters

Free acidity

The free acidity, the percentage of free fatty acids of fatty body, was determined under the standard method and expressed as a percentage of oleic acid (Geneva: International Organization and (ISO). 1996).

Saponification index

The saponification index (the number of milligrams of potassium hydroxide required to saponify 1 g of fat or oil) was determined according to the method previously described by Paquot (1979).

The peroxide index

The peroxide index is a measure used to estimate the amount of peroxide present in a fat or oil. The peroxides are the characteristic components derived from the oxidation of unsaturated fatty acids and are determined based on their ability to release iodine from potassium iodide in acidic media. The released iodine is measured from the reaction with the thiosulfate, of note that 1ml of 0.01N thiosulfate corresponds to a quantity of 80 mg of oxygen fixed on fatty acids (Kavuncuoglu et al., 2017).

The specific extinction coefficients

The quality of a fat or oil, as well as its state of preservation and changes due to technological processes, was investigated through the determination of the specific extinction coefficient. This parameter was spectrophotometrically determined (232nm and 270nm) according to the method previously described (Jolayemi et al., 2021).

The olive oil pH

The pH provides an important indication about the medium alkalinity or the acidity and is determined from the number of free hydrogen ions contained in the oil (Crespo et al., 2012).

The water content in olive oil

The olive oil water content is the loss in sample mass after heating and expressed as a percentage of mass (Hatzakis and Dais, 2008).

The refractive index

The refractive index is the ratio between the light speed in a vacuum (abbreviated C, C = 299,792.458 km/second) and that in a material (abbreviated V). This index varies as a function of the wavelength of the incident light and the temperature and is measured by Abbe refractometer at a temperature of 20°C (Mat Yunus et al., 2009).

The relative density

The relative density of oil is the relation between the mass and volume of the evaluated substance with the mass and volume of the distilled water at the same temperature (Hughes, 2006).

Chemical Composition

Chlorophylls and carotenoids

They are the essential color pigments in olive oils and are sensitive components to heat, acid degradations, and oxygen. These pigments were determined as previously described (Hughes, 2006).

Phenolic compounds

Phenolic compounds, including cinnamic acids, derivatives of benzoic, and phenyl ethyl alcohols such as tyrosol and hydroxytyrosol, and secoiridoids are polar molecules relatively found in higher quantities in olives. In this study, these olive oil molecules were extracted by the liquid-liquid extraction method (Pirisi et al., 2000).

Antioxidant activity

The antioxidant activity of the extracts was determined using the free radical 2,2'-diphenyl-1-picrylhydrazyl (DPPH) assay. Indeed, compounds with anti-radical activity trap DPPH° by providing it a hydrogen atom, leading subsequently to a discoloration that can be followed by spectrophotometry at 517 nm (Fanali et al., 2018).

Statistical analysis

The results were displayed as mean ± (SD), and all statistical tests were performed using *Prism GraphPad* (*GraphPad Software Inc*. 2019) with a significance level $p < 0.05$. Pairwise comparisons (parameters-samples) were tested for statistical correlation using the Principal Component Analysis (PCA) test. Of note, each parameter is analyzed in triplicate for each studied parameter.

Results And Discussion

Physicochemical properties of olive oil samples

Free acidity

As shown in Fig. 1a, the percentages of free acidity of oils from different studied regions are between 0.304 and 1.863 for Algerian samples extracted industrially, since they are ranging from 0.248 to 0.688 in the olive oils from foreign countries (Italy, Tunisia, Syria). The free acidity of oil samples of El-Oued traditional, Guelma segoise, and Tlemcen segoise is significantly higher ($p < 0.01$) as compared to that of the control samples. Besides, the other oil samples showed no significant difference from the control samples. The low values of oil-free acidity indicate weak hydrolysis during oil extraction and storage. Overall, all results comply with the standard values recommended by the International Olive Oil Council (IOOC – International Olive Oil Council, 2008), except those of the traditional oil of El-Oued region (4.79 ± 0.02). Hence, the oil samples can be classified under the category of extra virgin olive oil (69%). Additionally, the amount of acid numbers of the Segoise oil variety is higher than that of the Chemlal variety in both El-Oued and Mila regions, excluding that of Guelma oil (Virgin current 0.7%), Segoise variety from Tlemcen and El-Oued (Virgin 15%). As reported by Dag et al. (2011), high acidity is referred to bad olive oil handling, harvesting, and manufacturing practices. Thus, the very advanced state of the fruit maturity due to the inadequacy of the precautions is occurred during the harvesting or storing of olives. Moreover, the noticed high significant temperature in the region of El Oued (Saharan Climate) promotes the chemical and enzymatic deterioration of the fruits and, consequently the increase in the content of free fatty acids in presence of lipases.

The saponification index

In Fig. 1b, most olive oil samples display saponification indices that meet the National standard values as recommended by the Algerian official journal (The Algerian Official Journal, 2011), reporting a value of 170–200 mg/g, except that found in the Chemlal oils from Mila (211,778 ± 1,403) showing a significant increase ($p < 0.05$) as compared to control oil samples. The olive oil of Chemlal variety of Mila is less rich in long fatty acid chains than other oils, and hence this parameter becomes inversely proportional to the chain length. On top of that, the olive oil of Guelma has a minimum value of saponification index (163.391 ± 0.701). A study characterizing three varieties of the olive oils of Béjaia city (Northeast Algeria) has reported saponification index values as 185,44, 190.66, and 191,94 mg of KOH/g of oil, which is very far from those of Tbessa and El-Oued (Belarbi-Benmahdi et al., 2009).

The peroxide index

As depicted in Fig. 1c, the peroxide number expressed in milliequivalent of active oxygen per kilogram of oil show values between 2 and 8.25, and comparable to those reported by the IOC standards (IOC, 2021). Also, this parameter is significantly higher in oil samples of El-Oued and Mila (Chemlal) as compared to control samples ($p < 0.01$). Despite this, all the analyzed oil samples concord with the standard value, by which the oil samples can be classified in the “extra virgin” category ($IP \leq 20$). Further, the obtained values of the oil peroxide index are lower compared to those reported by Zegane et al. (2015). (9.22–2.142 meq g of oxygen/ kg of oil). The low values of the peroxide value indicate the quick oil extraction process after harvesting the olives, in addition to the short-term oil storage (samples of the year 2017/2018) in good conditions. Therefore, it is noteworthy to suggest that the oil does not oxidize prematurely and can be kept over time.

The relative density

Figure 1d showing the changes in the relative density of oils in the function of sampling regions reveals values between 0.910 and 0.913. Interestingly, this parameter whether for industrial or traditional oils is comparable to the standard established by the IUPAC (International Union of Pure and Applied Chemistry (IUPAC), In: Paquot C, Hautfenne A, 1987) which varies from 0.910 to 0.916. However, the Guelma oil sample shows a very slightly lower value (ns) than that of the IUPAC.

Refractive index

As shown in Fig. 1e, most of the analyzed samples exhibited comparable values of refractive index; in the CA range (1,4677–1,4705), and consequently, all the oils conform to the standard. Unlike these samples, the refractive index values of the olive oil samples from Tebessa, Souk Ahras, and Guelma are significantly superior ($p < 0.05$) to that of the standards (as seen in the standards: 14 and 15), and to that of control samples.

Water and volatile materials content

The obtained values of this parameter in the oil samples from El Oued segoise, Tebessa, and Mila (chemlal) showed significantly higher values ($p < 0.01$) than those seen in the control samples. But generally, all obtained data are consistent with the standards established by CA (*Codex Alimentarius*) and IOC ((IOC) International Olive Council, 2021) (Fig. 1f).

Determination of olive oil pH

In Fig. 1g, only the Guelma variety shows a significantly higher pH value as compared with the control samples ($p < 0.05$). Further, the majority of pH values of olive oil samples change slightly compared with standards. However, olive oils of Mascara (3.73) and Mila (Chemlal) (3.72) revealed lower pH values than those of Standards, and so they are characterized by slightly acidic pH compared to the standards.

Spectral analysis

Specific absorbance in UV (232 and 270nm)

The results of the specific extinction coefficient K_{232} of the majority of the olive oil samples (nearly 69.23%) whose absorbance values are accordingly comparable to those recommended by IOC ((IOC) International Olive Council, 2021) make it possible to classify the main studied samples in the category of extra virgin oils, except 23.27% of oil samples, including the sample of variety Milla Chemlal which is considered as lampante virgin. On the other hand, the oil samples of El Oued (EO), Souk Ahras (S), and Mascara (Msc) showed a significant increased (EO & S $p < 0.001$; Msc 0.05) values of the specific extinction coefficient K at 232nm as compared to those of the control samples. The increase in absorbance at 232 nm and 270 nm could be explained by the late harvest and excessive exposure of olives, and the extraction process of oil to oxygen in contact with air and light, or even to a warming of the olives, as well as the dough during crushing (Boulfane et al., 2015). Further, the high values of the Segoise variety (1.035) of Mascara which does not meet IOC standards could be influenced by the used extraction method and other manufacturing practices. Moreover, the specific extinction coefficient K_{270} showed higher significant values of the oil samples of El Oued and Souk Ahras ($p < 0.01$) and Mascara ($p < 0.05$) compared with the controls. It's noteworthy that the higher value of the extinction at 270nm leads to the richness of oil in secondary oxidation products, and so it has a lower shelf-life. Overall, the El Oued traditional variety of El-oued ranges between a minimum of 0.17 and a maximum of 0.541. Also, 30.76% of the olive oil samples are classified as extra virgin oils, since 23.03% of these samples are considered as lampante virgin, and surprisingly 46.15% of the study samples don't meet the limit authorized by IOC ((IOC) International Olive Council, 2021) (Figs. 1h and 1i).

The extinction coefficient Δk of olive oil

As indicated in Fig. 1j, the majority of the studied olive oil samples (84.61%) have absorbance values within the limit allowed by IOC (**$p < 0.01$), however, 23.03% of the oil samples (Guelma 0.0460; El-Oued traditionally extracted oil 0.0725), don't meet the standards fixed by IOC.

Chemical analysis of olive oil pigments

Determination of chlorophylls and carotenoids content

Figure 2a depicts that the level of chlorophyll is significantly higher in olive oils from Souk Ahras ($p < 0.001$) and El Oued ($p < 0.05$) when compared with control samples. Also, the minimum value of this parameter was observed in the oil sample of Segoise Mila with an average of 0.48 mg/Kg, since most other studied samples revealed chlorophyll content strictly less than 2 mg/kg. This result is believed to avoid the pro-oxidant action of chlorophyll pigments and, thus to ensure good conservation of the oils (Boulfane et al., 2015). The chlorophyll content contributes to the "fruity" of the olive oil taste, and it tends to decrease with the progression of fruit ripening. Actually, through the extraction process and the method of olives picking, other compounds can be formed in the occurrence of anthocyanins. However, the intensity of this decrease remains strongly dependent on the characteristic metabolism of each variety (Giuliani et al., 2011). As shown in Fig. 2b, the level of carotenoids increased significantly (**$p < 0.01$) in olive oils from the regions Guelma, El Oued segoise, and the other samples (*$p < 0.05$) when compared with control samples. The increased level of carotenoids is likely due to the high temperatures and prolonged extraction time, and as a result, the oil exhibits high antioxidant activity. Interestingly, the amount of carotenoids content can vary in function of the variety of fruit, the growing region, the level of ripeness fruit, the extraction method, and the conditions of the oil storage (Serani and Piacenti, 1992; Benamirouche-Harbi et al., 2020).

Total phenolic compounds

The indicated results in Fig. 2c reveal that the level of the phenolic compounds increased significantly in olive oils of El Oued, Souk Ahras, and Tlemcen segoise (** $p < 0.01$) when compared with two control samples (Italy and Syria), and conversely, the oils of Tunisia sample showed a significant higher (^{c} $p < 0.001$) value of phenolic contents compared with Italy and Syria. Conclusively, the obtained data prove that the studied olive oils contain an appreciable amount of phenolic compounds. As previously reported (Pirisi et al., 2000), the abundance of phenolic compounds in vegetable waters provides effective antioxidant activity.

The antioxidant activity of olive oils

The anti-radical activity

As indicated in Fig. 3, the olive oil from EL-Oued and Tunisia exhibits significant ($p < 0.05$) higher percentages of DPPH inhibition activity than that seen in the control samples of Italy and Syria. Hence, the sample of Tunisia shows very high antioxidant inhibition activity 84.96%, since that from the Chemlal variety of the Mila and Guelma cities show percentages of DPPH inhibition activity as 73.45% and 67.70% respectively. A study investigating the antioxidant activity of methanolic extracts using the colorimetric test has shown that olive oil qualitatively contains several secondary metabolites, such as total polyphenols (Falleh et al., 2008). Conclusively, the analysis of the oil antioxidant activity showed that the oil samples from the South (Saharan) Algerian region have a higher activity than the samples from the Northern regions, and similarly the Chemlal variety has a higher antioxidant activity than the Segoise variety.

Statistical analysis

All data were statistically analyzed by using Principal Component Analysis (PCA) test enabling us to visualize the scores and loadings.

Figure 4 illustrates the projections of the different oil samples on the first two principal components analysis (CPA1 and CPA2). This Figure displays 4 groups of variables; Group 1 (pH, Carotenoids content, free acidity, and Polyphenol content); Group 2 (The saponification index); Group 3 (Refractive index, k_{232}, k_{270}, and relative density), and Group 4 (ΔK, Chlorophyll content and Water content). The first principal component CP1 showing 25.38% of the variability is dominated by the variables: pH, carotenoid, k_{270}, k_{232}, density (positive value), saponification index, and Δk (negative value). Whilst, the second principal component CP2 indicating 22.06% of the total variability essentially reflects the opposition between the percentage of inhibition, refractive index (positive value), free acidity (negative value), and the contents of polyphenols, chlorophyll, and water (negative value). The factorial map of oils from different sampling regions (Fig. 4) reveals an obvious relationship between the different parameters:

1-Carotenoid content, Polyphenol content, and inhibition percentage of DPPH, which is considered a good indicator of the oil antioxidant activity.

2-pH and free acidity correspond to the acidity of studied samples.

3-K_{232} and K_{270} provide valuable information about the auto-oxidation of oil due to the shift in the position of the double bonds.

4-Chlorophyll content, water content, and ΔK where their increased values affect the oil quality.

Noteworthy, the relationship between the first and the last parameter is antagonistic; the first improves the quality of the oil and the latter negatively influences the quality.

In light of this study, promising results have been obtained for the interest of olive oil from the Saharan region as a functional food product with antioxidant potential, particularly regarding oxidative stress-related pathologies.

Declarations

Acknowledgments

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Conflict of interest statement

The authors declare no conflict of interest.

References

1. Belarbi-Benmahdi M, Khaldi D, Beghdad C, et al. Physicochemical and nutritional study of Argan oil (*Argania spinosa* L.) in south-western Algeria. Pigment and Resin Technology. 38: 96–99 (2009). doi: 10.1108/03699420910940581
2. Benamirouche-Harbi K, Keciri S, Sebai Z, et al Effect of cultivar and year of harvest on the mineral composition of Algerian extra-virgin olive oils. Spanish Journal of Agricultural Research. (2020). doi: 10.5424/sjar/2020181-14472
3. Boulfane S, Maata N, Anouar A, Hilali S, et al. Caractérisation physicochimique des huiles d'olive produites dans les huileries traditionnelles de la Région de la Chaouia-maroc. Journal of Applied Biosciences. 87: 8022 (2015). doi: 10.4314/jab.v87i1.5

4. Brahmi F, Haddad S, Bouamara K, et al. Comparison of chemical composition and biological activities of Algerian seed oils of *Pistacia lentiscus* L., *Opuntia Ficus indica* (L.) mill. and *Argania spinosa* L. Skeels. Industrial Crops and Products. 151: 112456 (2020). doi: 10.1016/j.indcrop.2020.112456
5. Chennit B, del Carmen Pérez-Camino M, Gómez-Coca RB, et al. Characterization of kabylian virgin olive oils according to fatty alcohols, waxes, and fatty acid alkyl esters. Journal of Food Measurement and Characterization. 15: 4960–4971 (2021). doi: 10.1007/s11694-021-01063-w
6. Cherfaoui M, Cecchi T, Keciri S, Boudriche L. Volatile compounds of Algerian extra-virgin olive oils: Effects of cultivar and ripening stage. International Journal of Food Properties. 21: 36–49 (2018). doi: 10.1080/10942912.2018.1437627
7. Crespo GA, Ghahraman Afshar M, Bakker E. Direct detection of acidity, alkalinity, and ph with membrane electrodes. Analytical Chemistry. 84: 10165–10169 (2012). doi: 10.1021/ac302868u
8. Dag A, Kerem Z, Yogev N, et al. Influence of time of harvest and maturity index on olive oil yield and quality. Scientia Horticulturae. 127: 358–366 (2011). doi: 10.1016/j.scienta.2010.11.008
9. Djemaa-Landri K, Hamri-Zeghichi S, Belkhiri-Beder W, et al. Phenolic content, antioxidant and anti-inflammatory activities of some Algerian olive stone extracts obtained by conventional solvent and microwave-assisted extractions under optimized conditions. Journal of Food Measurement and Characterization. 15: 4166–4180 (2021). doi: 10.1007/s11694-021-00992-w
10. Falleh H, Ksouri R, Chaieb K, et al. Phenolic composition of *Cynara Cardunculus* L. Organs, and their biological activities. Comptes Rendus Biologies. 331: 372–379 (2008). doi: 10.1016/j.crvi.2008.02.008
11. Ghaoues S, Namoune H. Impact of variety and extraction process on physico-chemical and sensory characteristics of virgin olive oil. Acta Scientifica Naturalis. 8: 80–90 (2021). doi: 10.2478/asn-2021-0007
12. Giuliani A, Cerretani L, Cichelli A. Chlorophylls in olive and in olive oil: Chemistry and occurrences. Critical Reviews in Food Science and Nutrition. 51: 678–690 (2011). doi: 10.1080/10408391003768199
13. Gorzynik-Debicka M, Przychodzen P, Cappello F, et al. Potential health benefits of olive oil and plant polyphenols. International Journal of Molecular Sciences. 19: 686 (2018). doi: 10.3390/ijms19030686
14. Haoua AS, Mohamed F. Les exploitations oléicoles en Algérie; quelle performance économique?. Recherche Agronomique. 19: 65–76 (2021).
15. Hatzakis E, Dais P. Determination of water content in olive oil by 31p NMR spectroscopy. Journal of Agricultural and Food Chemistry. 56: 1866–1872 (2008). doi: 10.1021/jf073227n
16. Hughes SW. Measuring liquid density using Archimedes' principle. Physics Education. 41: 445–447 (2006). doi: 10.1088/0031-9120/41/5/011
17. International Olive Council (IOC) Trade standard applying to olive oils and olive pomace oils. COI/T.15/NC N°3/Rev (2021). November 2021. Available from:

https://www.internationaloliveoil.org/wp-content/uploads/2021/11/COI-T15-NC3-REV-17_ENK.pdf. Accessed 2021 December 3

18. International Olive Oil Council (IOOC). Spectrophotometric investigation in the ultraviolet. COI/T20/Doc, N°19, (2008)
19. International Organization, Geneva: (ISO) S. Animal and vegetable fats and oils–Determination of acid value and acidity, 2nd Ed (1996). doi: 10.3403/02187685u
20. International Union of Pure and Applied Chemistry (IUPAC), In: Paquot C, Hautfenne A editors. (1987) Standard methods for the analysis of oils, fats and derivatives, 7th rev. e
21. Jolayemi OS, Tokatli F, Ozen B. UV–VIS spectroscopy for the estimation of variety and chemical parameters of Olive Oils. Journal of Food Measurement and Characterization. 15: 4138–4149 (2021). doi: 10.1007/s11694-021-00986-8
22. Kavuncuoglu H, Dursun Capar T, Karaman S, Yalcin H. Oxidative stability of extra virgin olive oil blended with sesame seed oil during storage: An optimization study based on combined design methodology. Journal of Food Measurement and Characterization. 11: 173–183 (2016). doi: 10.1007/s11694-016-9384-2
23. Lucas L, Russell A, Keast R. Molecular mechanisms of inflammation. anti-inflammatory benefits of virgin olive oil and the phenolic compound oleocanthal. Current Pharmaceutical Design. 17: 754–768 (2011). doi: 10.2174/138161211795428911
24. Mat Yunus WM, Fen YW, Yee LM. Refractive index and Fourier transform infrared spectra of Virgin Coconut Oil and virgin olive oil. American Journal of Applied Sciences. 6: 328–331 (2009). doi: 10.3844/ajas.2009.328.331
25. Paquot C. Determination of the saponification value (S.V.). Standard Methods for the Analysis of Oils, Fats and Derivatives. 56–59 (1979). doi: 10.1016/b978-0-08-022379-7.50022-x
26. Paquot C, Hautfenne A. Standard methods for the analysis of oils, fats and derivatives, 7th edn. Analytica Chimica Acta. 201: 373 (1987). doi: 10.1016/s0003-2670(00)85376-3
27. Pirisi FM, Cabras P, Cao CF, et al. Phenolic compounds in virgin olive oil. 2. reappraisal of the extraction, HPLC separation, and quantification procedures. Journal of Agricultural and Food Chemistry. 48: 1191–1196 (2000). doi: 10.1021/jf991137f
28. Serani A, Piacenti D. Kinetics of pheophytin-a photodecomposition in extra virgin olive oil. Journal of the American Oil Chemists' Society. 69: 469–470 (1992). doi: 10.1007/bf02540951
29. The Algerian Official Journal (JORADP). Standard of Saponification index of Olive oils. JO2000/2011/V64/FP26 (2011). Available from: https://www.joradp.dz/JO2000/2011/064/FP26.pdf. Accessed 2021 December 3.
30. Zegane O, Keciri S, Louaileche H (2015) Physicochemical characteristics and pigment content of Algerian olive oils: effect of olive cultivar and geographical origin. International Journal of Chemical and Biomolecular Science 1:153–157

Figures

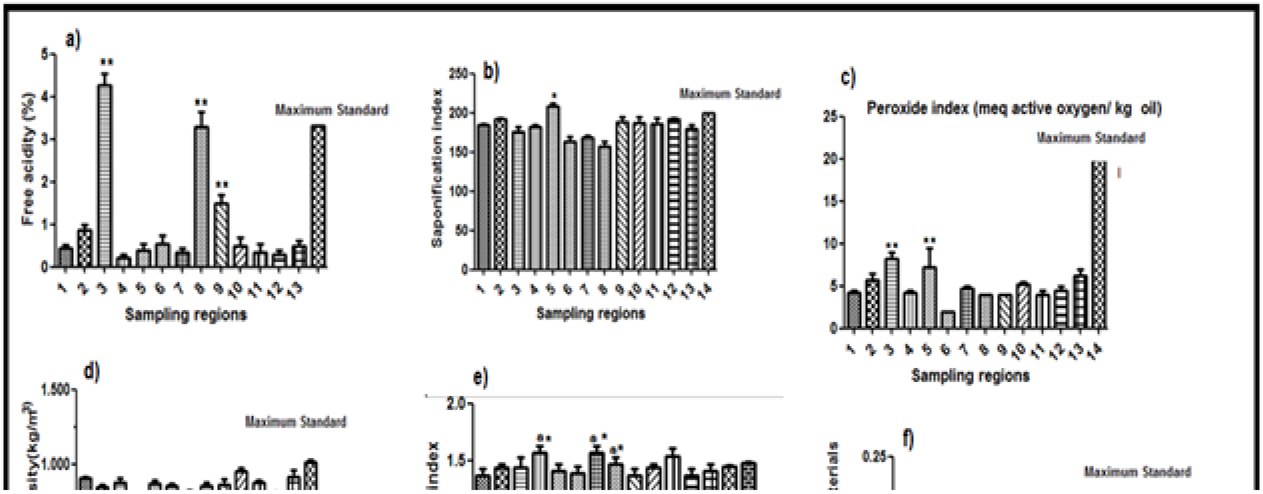

Figure 1

Physicochemical proprieties of olive oils from various sampling regions of Algeria**; a)** Percentage of olive oil free acidity, **b)**. Saponification index, **c)** Peroxide index**, d)** The relative density**, e)** The refractive index, f**)** The Water and volatile materials content, **g)** The pH values, **h)** The specific extinction coefficient at 232nm (K_{232}, **i)** The specific extinction coefficient at 270nm (K_{270}), **j)** The specific extinction coefficient of ***Δk.***

* p<0.05 significantly different from control samples (Italy, Syria, and Tunisia oil samples); ** p<0.01 significantly different from control samples (Italy, Syria, and Tunisia oil samples).

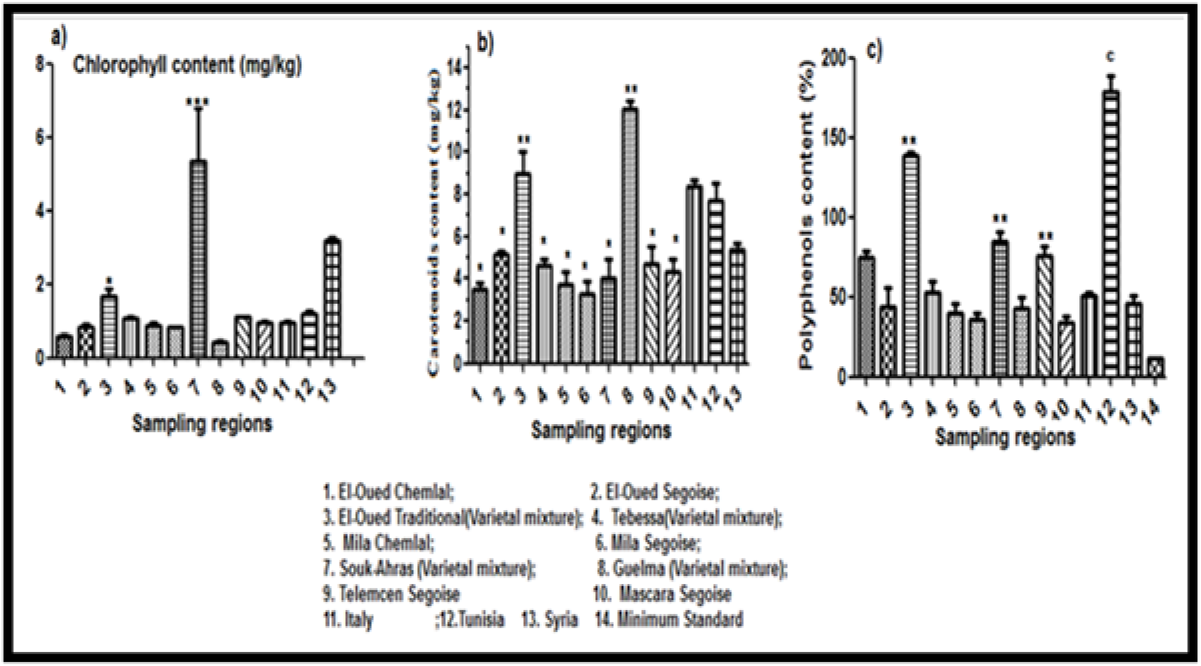

Figure 2

Phytochemical compositions of olive oils; **a)** The chlorophyll content**, b)** The carotenoids content, **c)** The polyphenols content

* p<0.05 significantly different from control samples (Italy, Syria, and Tunisia oil samples).

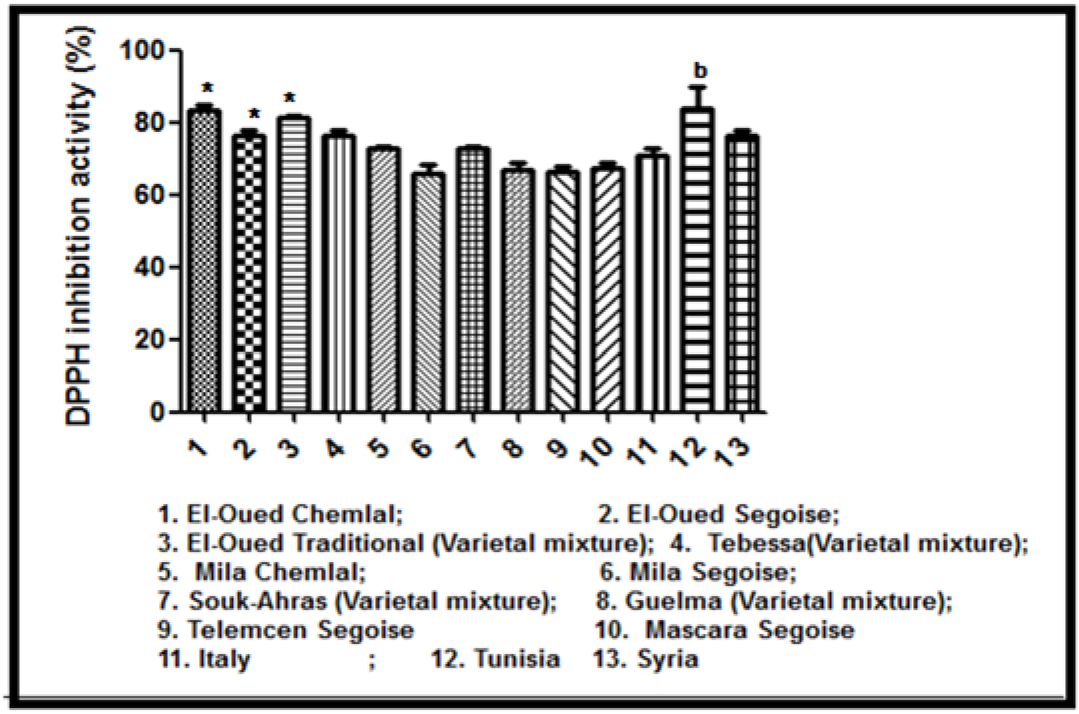

Figure 3

DPPH inhibition activity of olive oils from different sampling regions.

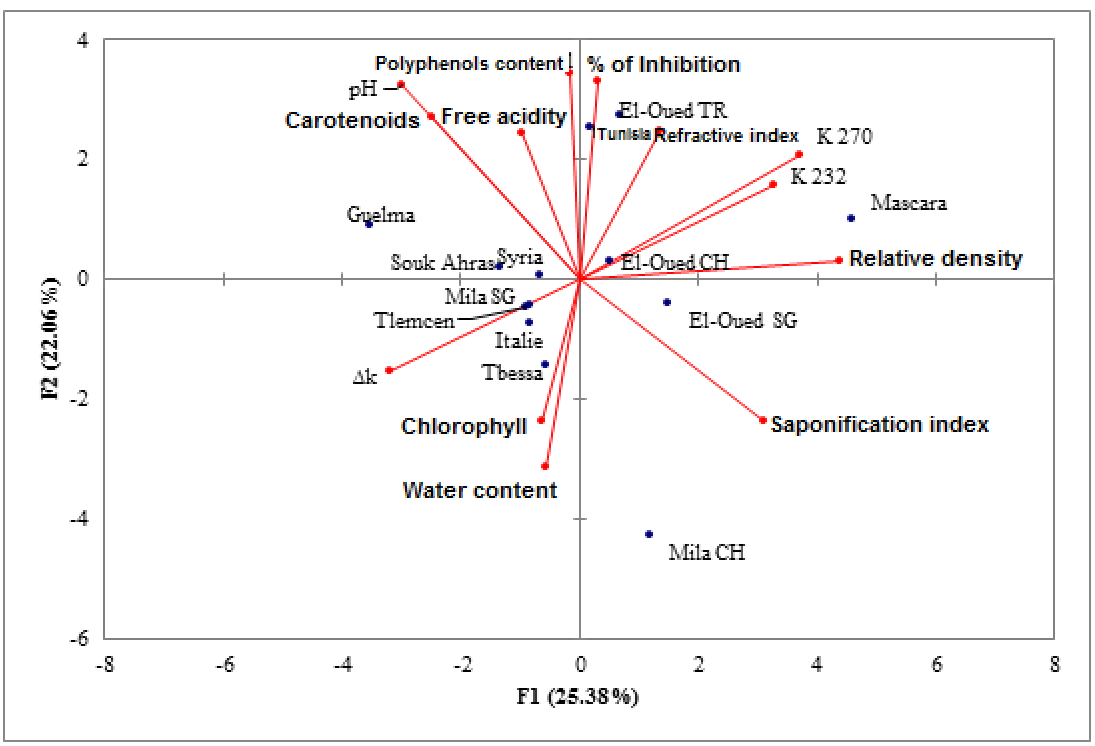

Figure 4

Principal components 1 and 2 (CP1 vs CP2) factor map of different oil samples.

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