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 Corresponding author email :
 tay_idoui@yahoo.fr

Physical and chemical characteristics of a local Jijel's olive oils

Tayeb IDOUI

Laboratory of Biotechnology, Environment and Health, University of Jijel, BP 98 Ouled Aissa, Jijel (18000) Algeria

Abstract

The purpose of this study was to evaluate the physical and chemical characteristics of a local Jijel's olive oils. The olive oils samples were examined for physical and chemical properties (acidity (%), peroxide values, saponification number, pH, density, moisture and impurities), fatty acids composition and total phenol content. Results indicate that the physical and chemical characteristics of olive oils samples were favourable for Algerian Official Journal limits. Oleic acid was found in highest percentage, followed by palmitic, linoleic, stearic and linolenic. Palmitoleic acid was detected in two out of five olive oils samples. Total phenol contents expressed as gallic acid of olive oils values ranged from 116.98 to 162 mg /kg.

Keywords: Olive Oils- Composition- Fatty acids- Total Phenol.

1. Introduction

The Mediterranean coastal areas have a mild, warm climate that fully meets the climatic requirements of *Olea europaea* trees, and they are thus considered an ideal habitat for their growth and development [1]. The olive tree is one of the major agricultural trees in Jijel (Algeria), with an area of 14000 hectares distributed essentially in mountainous areas [2]. The major part of production is generated in the production of olive oil.

Olive oil has a unique position among edible oils due to its delicate flavour, stability and health benefits [3]. The Mediterranean people considered olive oil not only an excellent food but also a healing agent. During the past four decades a renewed interest in the nutritional and health aspects of olive oil has been generated. Olive oil is a key component of the traditional Mediterranean diet, which is believed to be associated with a relatively long life in good health [4][5].

An abundance of oleic acid, a monounsaturated fatty acid, is the feature that sets olive oil apart from other vegetable oils. The Mediterranean diet includes the consumption of large amounts of olive oil, which contains high amounts of phenolic substances [6].

The annual olive oil production in Jijel (Eastern Algeria) was estimated to 34. 10³ hectolitres [2], but the quality of a share of this product is affected because before processing extraction, olives are stored at environmental temperature for every week for what the spontaneous fermentation take place. Much work has

been done on the effect of storage conditions and packaging materials on olive oil quality [3] but a few works has been done on the effect of olive storage conditions on olive oil quality.

The objective of this study was to evaluate physical and chemical characteristics of a local Jijel's olive oils.

2. Materials and Methods

2.1. Olive oils samples

Five (05) olive oils samples were collected from five locations (five samples from each region) such as Milia (M), Ziam Mansouria (ZM), El Jemea (EJ), El Emir (EE) and Beni-Ahmed (BA) in Jijel, East of Algeria in the year 2007. Samples were collected during the period when olives are usually harvested for oil production (November 2007). The olive oils samples were placed into sterilized bottles.

2.2. Physical and chemical analysis

The pH measurements of olive oils were obtained with a pH meter (HANNA), calibrated with two standard solutions buffered at pH= 4.00 and pH= 7.00. The impurities and moisture were determined according to the method described by Lecoq [7].

Chemical analysis (Free oil acidity, peroxide value) was performed according to AOAC [8]. Saponification

number was determined using the method described by Lecoq [7].

For the free oil acidity, a known weight of olive oil was dissolved in a mixture of diethyl ether / ethanol (1:1 v/v). The mixture was titrated with potassium hydroxide in methanol (0.05M) in the presence of phenolphthalein as indicator. For peroxide value, about 5g of olive oil was dissolved in a mixture of acetic acid/ chloroform (3:2 v/v), and saturated solution of KI (1ml) was then added.

The liberation iodine was titrated with sodium thiosulphate solution (0.05M) in the presence of starch as indicator. For saponification number, a known weight of olive oil (1g) was dissolved in alcoholic potassium hydroxide (25 ml) then evaporated for 30mn. The sample was titrated with chlorydic acid (0.5N) in the presence of phenolphthalein as indicator.

2.3. Analysis of fatty acids

The analyses of fatty acids were performed according to the official method of the European Community Regulation [9]. The olive oil samples were esterified in a methanol solution of 2N KOH for 30minutes at 50°C. The gaschromatographic analyses of fatty acid methyl esters were performed on a Perkin Elmer gas chromatograph, equipped with a flame ionisation detector (Shimadzu QP2010): The column was a fused silica capillary SE30 length 25meters, diameter 0.25 μ m. Helium was the carrier gas (6ml/min). The column temperature program was: initially isotherm at 140°C for 10min, an initial programmed rate of 1°C/min up to 160°C, then a second rate of 2°C/min up to 220°C and a final isotherm for 15min. Samples were injected into the split mode. The apparatus itself carried out recording and integration.

The gas-chromatographic peaks were identified as corresponding fatty acid methyl esters by check of the elution order on the column and compared the retention times with those of pure standards.

2.4. Determination of total phenol content

The total phenol content was determined according to the methods described by Tsimidou [10]. 100g of oil was extracted three times with 500ml of methanol (methanol / Water: 40v/60v). The total phenols in the oil extracts were measured by the Folin-Ciocalteu assay. The measurement was carried out at 765nm via UV-spectrophotometer. Results were expressed as mg of gallic acid equivalent in one kg oil.

3. Results and Discussion

3.1. Chemical and physical properties of olive oils samples

The Chemical and Physical characteristics of olive oils sample are shown in Table 1. As is shown, differences were found in chemical values (free fatty acid, peroxide value) among olive oils samples. These properties especially depend on the initial quality of the olives samples.

Acidity (% oleic acid) was in the range of 0.70% and 1.54 %. According to Algerian Official Journal N°1166 and C.O.I (2003), olive oils should have acidity (%) \leq 3.3% and the acidity contents of all samples were not higher than this limit. These results are in agreement with those reported on Turkish olive oils samples (Acidity: 0.5%- 1.7%) by Tamilgan et al. [5]. Moussa et al. [11] established free fatty acid in Koroneiki and Mastoides olive oil as 0.55%- 0.62%.

The results obtained also indicated that peroxide values were not higher and ranged between 2.24 meq O₂/kg and 12.80 meq O₂/kg. It is clear that peroxide values of all olive oils samples were under the value of 20 meq O₂/kg of olive oil, which is the maximum established by the Council for International Olive Oil and Algerian Official Journal. Our results are in agreement with those found in a study conducted by Vekiari et al. [3] on the effects of processing methods and commercial storage conditions on the extra virgin olive oil quality indexes, peroxide values in all cases did not exceed 20 meq O₂/kg of olive oil. In the other study conducted by Kiritsakis and Dugan [12], the peroxide values of olive oils obtained from olive fruits collected with different methods in Greece were found between 6.0- 47.7 meq O₂/kg.

Saponification number of all olive oils samples ranged from 159.8 mg KOH/ g to 185.0 mg KOH/ g. Four out of five samples were under the limits established by C.O.I [13] and Algerian Official Journal (184- 196 mg KOH/ g) [14].

In table 1, pH, moisture and impurities values of all olive oils samples are ranged from pH4.91- pH5.52, 0.47% -2.81% and 1.25% -7.95% respectively. According to C.O.I [13] and Algerian Official Journal [14], the moisture and impurities of all olives oils samples were higher than the limits. These results are not in agreement with those obtained by Vekiari et al. [3], between impurities gains 0.21% and 0.43%.

Table 1

Chemical and physical properties of olive oils samples

Sample	Free fatty acid (% oleic acid)	Peroxide value (meq O ₂ / kg)	Saponification number (mg KOH/ g)	pH	Moisture (%)	Impurities (%)	Density (g/ml)
M	1.54 ± 0.62	5.12 ± 0.03	170.3 ± 0.10	5.11 ± 0.30	1.48 ± 0.92	1.25 ± 0.05	1.93 ± 0.19
ZM	1.50 ± 0.94	8.32 ± 0.07	185.0 ± 0.09	4.91 ± 0.20	0.92 ± 1.00	5.76 ± 0.10	0.89 ± 0.20
EJ	0.90 ± 0.80	3.50 ± 0.12	181.0 ± 0.04	5.02 ± 0.30	2.81 ± 0.85	4.03 ± 0.11	0.87 ± 0.20
EE	0.70 ± 0.14	2.24 ± 0.08	167.2 ± 0.07	5.52 ± 0.20	2.01 ± 0.69	3.13 ± 0.35	0.88 ± 0.32
BA	1.40 ± 1.20	12.80 ± 0.05	159.8 ± 0.12	4.95 ± 0.20	0.47 ± 0.89	7.95 ± 0.25	0.87 ± 0.25

3.2. Fatty acid composition of olive oils samples

The fatty acid compositions of the ten olive oils samples were determined by gas chromatography and the results are shown in table 2. When examining the fatty acid composition, differences among the samples were observed. It is clear that oleic acid was present in the highest concentration; the values were ranged between 58.46% and 70.71%. It was followed by palmitic acid (17.32% - 26.30%), linoleic acid (3.46% - 5.76%), stearic acid (3.39% - 4.42%), linolenic acid (2.26% - 4.73%) and palmitoleic acid (1.93%-2.63%). Sample coded **EJ** contained the highest concentration of oleic acid (70.71%) but sample coded **EE** has a lowest percentage of the same fatty acid (58.46%). These results showed that palmitoleic acid was detected in two out of five olive oil samples. It is appeared that the total unsaturated fatty acid contents such as palmitoleic, oleic, linoleic and linolenic acids were in high levels. Unsaturated fatty acid values were between 69.28% and 78.69%. Differences in these values can be due to species, genetics, variety, growing conditions, locality,

climatic conditions and postharvest treatment [12] [15]. To our knowledge there is still no information about the fatty acid composition of our local olive oils (Olive oils produced in Jijel's area) and there is not any studies carried out to determine this chemical parameter. The results found in this study were in agreement with those reported by several authors. Tamilgan et al. [5] determined that the contents of the main fatty acid of olive oils from five Turkish olive varieties ranged between 65.7-81.1% oleic, 3.5-15.5% linoleic, 0.1-3.0% linolenic, 8.1-15.2% palmitic and 2.0-5.6% stearic acids. Ollivier et al. [16] reviewed 8.49-13.72% palmitic, 2.11-2.6% stearic, 66.36-79.39% oleic, 5.82-11.85% linoleic and 0.61-0.65% linolenic acids. In a study conducted by Aparicio and Luna [17], the main fatty acids of monovarietal virgin olive oils was ranged between 9.17-11.6% palmitic, 2.2-2.4% stearic, 78.1-80.3% oleic, 4.8-5.7% linoleic and 0.4-0.8% linolenic acid respectively.

Table 2

Fatty acid content of olive oils samples (%)

Sample	Palmitic	Palmitoleic	Stearic	Oleic	Linoleic	Linolenic
M	21.38	ND	3.74	67.98	4.64	2.26
ZM	17.32	1.93	4.15	67.70	5.17	3.73
EJ	17.92	ND	3.39	70.71	5.06	2.92
EE	26.30	2.63	4.42	58.46	3.46	4.73
BA	23.87	ND	4.08	62.72	5.76	3.57

ND: Not detected

3.2. Total phenol contents of olive oils

The results of total phenol contents of olive oils samples are shown in table 3. Total phenol contents expressed as gallic acid of olive oils values ranged from 116.98 and 162 mg /kg. Total phenol content as gallic acid equivalent in sample coded **M** was the highest (162 mg/kg) but sample coded **EE** has a lowest percentage of these components (116.98mg/kg). These results showed a difference in total phenol contents of olive oils samples.

These differences may be due to maturation state and nature of cultivar. The phenol contents of olive oils were found higher than reported by Tamilgan et al. [5]. These authors determined that the contents of the total phenol of olive oils from five Turkish olive varieties ranged between 22.5-97.1mg/kg as gallic acid equivalent. The results of study conducted by Garcia et al. [6] showed that the total phenol content of commercial olive oil is about 400mg/kg as caffeic acid equivalent.

Table 3

Total phenol contents of olive oils samples (mg/kg)

Sample	M	ZM	EJ	EE	BA
Gallic acid equivalent	162 ± 1.21	134 ± 1.23	125 ± 1.24	116.98 ± 2.12	140 ± 1.56

4. Conclusion

To our knowledge, no information existed on physical and chemical characteristics of olive oil produced in East Algeria and especially in regions of Jijel. The physical and chemical characteristics of five olive oils samples collected from five regions in Jijel showed considerable differences. The fatty acid compositions are useful for distinguishing the monovarietal olive oils belonging to particular cultivars. Our results showed that samples of olive oils are extracted from different cultivars.

Finally, in order to confirm the differences among the olive oils other studies must be done.

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