A STUDY OF FATTY ACIDS AND TRIGLYCERIDES OIL COMPOSITION AND QUALITY PARAMETERS OF FIVE AUTOCHTHON OLIVE VARIETIES IN MOROCCO

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ABSTRACT

Bouchouk Laghlid, Bouchouk Rguigue, Bakhboukh Beldi, Bouchouika and Berri Meslal are some of the olive autochthon varieties in the North of Morocco. These varieties have morphological characteristics distinguishing them from the dominating local cultivar "Picholine marocaine". However, the evaluation of some oil quality and purity parameters isn't yet made. This paper has the objective to compare the performances of these varieties considering olive maturity. The results show that these varieties have a low rate of total phenols. Nonetheless, the bitterness of the produced oils is very high. The olive oil from studied autochthons varieties is characterized by high saturated fatty acids. Similarly, the evolution during the maturity of total fatty acids' proportions permits to distinguish the cultivar "Picholine marocaine" from other autochthon varieties. In Picholine cultivar, triglycerides composition shows a dominance of triolein. Some other triglycerides are given as potential markers of varietal identification.

Keywords: olive oil, autochthons varieties, quality, fatty acids composition, triglycerides, Morocco

INTRODUCTION

The *Olea europaea*, a kind of an olive tree characterizing the Mediterranean landscape, contains a large number of varieties having an important phenotypic and genotypic diversity (Belaj *et al*., 2001). The origin of these varieties remains indefinite. Lumaret *et al*. (2000) suggest that interfertility occurring between cultivated forms and/or wild forms is the reason behind the diversification of the cultivated olive tree.

In Morocco, the Picholine cultivar is a population variety which dominates the olive zone (90% of the cultivated olive patrimony). Nonetheless, there are other olive varieties which are not widely spread and which are distinguished by their own biometric characteristics, especially, autochthon varieties.

In Ouazzane region (northern Morocco), several autochthons varieties are protected by the population especially Bouchouk Laghlid, Bouchouk Rguigue, Bakhboukh Beldi, Bouchouika and Berri Meslal. These limited diffusion cultivars are locally appreciated for their fruits size and weight. Ouazzani *et al*. (2002) have demonstrated that these varieties present genotypic and phenotypic variations. However, the chemical composition of their oils is not yet characterized.

Indeed, the varietal characteristics are also appreciated by the chemical composition analysis which is extremely influenced by the agronomic and technological conditions (Salvador *et al*., 2003).

Tous *et al*. (2005), who analyzed and characterized 28 cultivars from Cataluna during six years and 74 cultivars from Cordou during eight years, reported that the varietal effect on fatty acids composition, total phenols and bitterness, is most important than maturity and year effects. This research is the study of these parameters only for one year, in order to evaluate the potential of the mentioned varieties.

Besides the potential evaluation of some oil quality parameters, the current study concerns the characterization of fatty acid and triglycerides composition at the beginning and the middle of ripening. It concerns five Moroccan autochthon varieties compared with the "Moroccan Picholine". This characterization can promote them as a source of biodiversity in the chemical and technological fields and assess their potential compared to to the "Picholine".

MATERIALS AND METHODS

Vegetal material

The studied vegetal material includes the population variety, Moroccan Picholine and five Moroccan autochthons varieties: Bouchouk Laghlid (BL), Bouchouk Rguigue (BR), Bakhboukh Beldi (BB), Bouchouika (BK) and Berri Meslal (BM). Also, Berri Meslal (BM) is considered as domesticated variety from oleaster in the sampling area.

Sampling

Sites of sampling

The studied varieties are specific to the region of Ouazzane. They are only localized in rural areas: Masmouda (m), Bousber (b) and Mjaara (mj) which are chosen as the sites of sampling. As opposed to the Moroccan Picholine cultivar (PM) which is found in the three studied sites (m, b and mj), some of these autochthons varieties are limited in space, within a specific site.
The varieties, Bouchouk Laghlid (BL) and Bouchouk Rguigue (BR), are localized in Masmouda site (m) and which further take the following codes: BLm and BRm. Bouchouika (BK) and Berri Meslal (BM) are localized in Mjaara (mj) labelled BKmj and BMmj. The code BBb is attributed to the Bakhboukh Beldi (BB) variety, localized in Bousber site (b).

Dates of samplings

In order to follow the evolution of the quality and purity parameters at the beginning and the middle of the harvest season, stages of maturity which offers the greatest content of poly phenols in the oil (Beltran *et al*., 2005), two dates were chosen during 2006/2007: the first one in October when most of the fruits are green, purple-green skin and green flesh, and the second one in November, when most of the fruits are purple-green, purple and black with white flesh.

Modality of sampling
Six representative trees were chosen as the sampling plot from each variety which have the same canopy vigour and productivity. The harvest was carried out manually, at breast height (the correct sampling is from all the canopy). In each locality, the fruits from each tree were mixed to form only one single sample from each variety.

Experimental methods

Maturity index
The olives maturity index was determined twice on a batch of 100 olives randomly-chosen from each variety, according to the fruit classification, based on skin and flesh color described in the ripening index method (Uceda & Frias, 1975). This method was based on the evaluation of the olive skin and flesh colours, Ripeness index values ranged from class 0 (100 % intense green skin) to class 7 (100 % black flesh and skin).

Biometric indices
To identify the maturity index of the fruits chosen, the following biometric indices are defined: the fruit total weight and the pit weight.

Oil extraction
Extracted oil is obtained via "Oléodoseur" (a laboratory equipment of olive oil extraction similar to the Abencor system). This system reproduces the industrial process (at laboratory scale) through three basic elements: hammer mill, paste beater, and centrifuge. The temperature and the time of malaxation ware 25°C and 30 min, respectively. The virgin olive oils obtained were then decanted, transferred into dark glass bottles and stored at dark at 4°C until analysis.

Water and oil content
Water and oil contents are identified by AFNOR method (1984) respectively by T60-201 and NFV 03-907 methods.

Oil analyses
The determination of the acidity and the specific extinction at 270 nm and 232 nm are achieved by AFNOR method (1984) namely by the methods T60-204 and T60-223 respectively.

Oil's composition of total fatty acids is achieved by AFNOR method (T60-233-234): methyl esters were prepared according the AFNOR method (NF.T. 60-233). Gas liquid chromatography (GLC) analysis was carried out in a Varian CP 3380 Chromatograph, equipped with a capillary column (CP-Wax 52 CB: L=25m; Φ = 0.25mm; Ft = 0,20µm), an injector split-splitless equipped with CP-8400 auto-sampler and a FID detector. The temperature of the injector, the detector and the oven were held at 220, 230 and 190°C. The carrier gas was Hydrogen.

Oil bitterness (K225) is achieved by the method described by Gutierrez *et al*. (1992), which consists of the extraction of the phenols substances responsible of bitter taste from a sample of 1.0 ± 0.01 g of oil dissolved in 4ml of hexane passed through a C18 column (Varian, Mega BE-C18, 1GM 6ML) previously activated with methanol and washed with hexane. After elution, 10 ml of hexane was passed to eliminate the oil residues and then the retained compounds were eluted with methanol/water (1:1) to 25 ml. The absorbance of the extract was measured at 225 nm against methanol/water (1:1).

Phenolic compounds were isolated from a solution of oil in hexane by triple-extraction with water-methanol (60:40 v/v). Total phenols, expressed as caffeic acid equivalents (ppm), were determined with a UV-visible spectrophotometer (Secomam 1000pc) at 725 nm using Folin-Ciocalteu reagent as established by Vazquez Roncero *et al*. (1973).

The determination of triglycerides was carried out in a LC Jasco PU-2080 plus intelligent HPLC pump equipped with a Jasco CO-2065 plus column oven and a Jasco RI-930 refractive index detector and equipped with Jasco AS-2055 auto-sampler. The column used was a Chromsep HPLC Omnispher 5 C18, length 250 mm, ID 4.6 mm. The conditions for the analysis were: solvent acetone/acetonitrile 50:50 v/v, flow rate 1.5 ml/min, oven temperature 35°C. Identification of triglycerides was similar to that reported by the official method of the European Union Commission (1991).

The theoretical value of ECN42 triglycerides was calculated by the computer program of the IOOC method. All the tests were carried out at least twice.

Statistical analysis

The variance analysis (ANOVA) of the general linear model of the software SPSS (the 10th version) was used. The LSD test ($p < 0,05$) was adopted to compare the averages of different parameters. In addition, the Euclidean distances were applied to assess the homogenous groupings.

RESULTS AND DISCUSSIONS

Biometric indices

The biometric indices of fruit emerge as varietal characteristics (Table 1). These indices show a highly significant variation ($P < 0,05$) according to the maturity of the fruit and the variety.

The trend of the fruit weight, according to the olives maturity is outstanding in these cultivars. Bouchouk Laghlid variety is characterized by the highest values that varies between the first and the second sampling from 4,37g to 7,19g, compared to the Moroccan Picholine in which the values varies from 2,21g to 3,8g and to those of Bouchouika which varies from 2,46g to 2,67g.

The fruit weight / pit weight ratio provides values which have enabled one to categorize the studied varieties into four groups:

1) The Berri Meslal variety with the lowest ratio, less than 5, showed a stability of ratio during the maturity.
2) The average values of Moroccan Picholine, Bouchouk Laghlid, Bouchouk Rguigue, and Bouchouika varieties ranged between 5 and 7,5.
3) Bakhboukh beldi variety with higher values fluctuated around 10.

4) Bouchouk Laghlid variety marked an extremely high ratio (13.98) in the 2nd sampling.

However, in the first sampling, Bouchouk Laghlid variety constitutes one group with the Moroccan Picholine cultivar, especially in Masmouda and Mjaara sites. As for the second sampling, only the Berri Meslal variety is similar to the Moroccan Picholine in Bousber site.

The difference noted on the level in the studied parameters is related to the genetic inheritance of each variety, which has a significant incidence according to Cimato (1990). Cultural conditions may have a role in modifying these parameters without modifying the varietal characteristics of origin (Michelakis, 1995).

TABLE 1

Biometric Index of Fruits and Pit

Cultivar codes	Sampling	FW(g)	PW(g)	FW/SW
PMm		3,62 ^{d}±0.02	0,49 ^{c} 0.005	7,31 ^{b}±0.115
PMb		2,21 ^{g}±0.01	0,55 ^{b} ±0.005	3,98 ^{f}±0.02
PMmj		3,79 ^{c} ±0.005	0,50 ^{c}±0.005	7,51 ^{b}±0.085
BLm		4,37 ^{b}±0.005	0,60 ^{a}±0.0	7,29 ^{b}±0.01
BRm		3,55 ^{e}±0.005	0,51 ^{c}±0.01	6,97 ^{c}±0.13
BBb		4,99 ^{a}±0.005	0,50 ^{c}±0	9,99 ^{a}±0.01
BKmj		2,46 ^{f}±0.01	0,43 ^{d}±0.01	5,72 ^{d}±0.11
BMmj	1	1,71 ^{h}±0.015	0,37 ^{e}±0	4,63 ^{e}±0.04
SD		0.45	1.67	1.70
LSD		0.03	0.02	0.26
PMm		3,30 ^{f}±0.0	0,47 ^{d} ±0.005	6,94 ^{d} ±0.075
PMb		3,39 ^{e} ±0.005	0,67 ^{b} ±0.0	5,06 ^{f} ±0.005
PMmj		3,80 ^{d} ±0.0	0,51 ^{c} ±0.01	7,45 ^{d} ±0.15
BLm		7,19 ^{a} ±0.005	0,51 ^{c} ±0.015	13,98 ^{a} ±0.42
BRm		5,81 ^{b} ±0.015	0,70 ^{a} ±0.005	8,24 ^{c} ±0.08
BBb		4,65 ^{c} ±0.01	0,46 ^{d} ±0.0	10,10 ^{b} ±0.025
BKmj	2	2,67 ^{g} ±0.01	0,45 ^{d} ±0.005	5,86 ^{e} ±0.045
BMmj		2,00 ^{h} ±0.005	0,41 ^{e} ±0.015	4,83 ^{f} ±0.165
SD		0.27	2.37	3.14
LSD		0.03	0.03	0.56

FW : Fruit Weight
PW: Pit Weight
SD : Standard Deviation
LSD : Little Standard Deviation (Significant differences in a same row are showed by different letters ($P<0.05$))

Maturity index and color classes

Maturity index is specific for each variety and may form an indicator of fruit maturity so as it shows a significant increase with harvest time. The values show that Bouchouk Laghlid and Bouchouk Rguigue varieties have relatively high maturity indices: 3,3 and 3,33 respectively in the second sampling (Table 2). The represented color classes during November for these varieties are dominated by the Class 3 and 4 (90% and 94% of total olives). Nevertheless, the Moroccan Picholine and Bouchouika varieties are marked by a very weak maturity (between 2.18 and 2.8) compared to the previous varieties. In the same way, the varieties Bakhboukh Beldi and Berri Meslal, show a low maturity (1 to 1.98 and 1 to 1.65 respectively in the 1st and the 2nd sampling).

In conclusion, the variation of these values is justified by the variation of the sampling time and also by the variation of the trees' loads. In fact, with a high load, a competition between the fruits becomes higher leading to low maturity values index at the harvest time (Cimato, 1990).

TABLE 2

Fruit Color Classes (%) and Maturity Index

Cultivar Codes	Sampling	Classe0	Classe1	Classe2	Classe3	Classe4	Maturity index
PMm		55 ^{d}±0.5	25 ^{d}±0.5	15 ^{d}±1.0	5 ^{c}±0	0 ^{a}±0	0,70 ^{d}±0.015
PMb		38 ^{f}±1.0	11 ^{f}±1.0	29 ^{a}±1.0	22 ^{a}±1.0	0 ^{a}±0	1,35 ^{a}±0.0
PMmj		47 ^{e}±0.5	34 ^{c}±0.5	8 ^{e}±0.5	11 ^{b}±0.5	0 ^{a}±0	0,83 ^{c}±0.01
BLm		64 ^{c}±0	11 ^{f}±0.5	25 ^{b}±0.5	0 ^{e}±0	0 ^{a}±0	0,61 ^{e}±0.005
BRm		77 ^{b}±0.5	23 ^{d}±0.5	0 ^{f}±0	0 ^{e}±0	0 ^{a}±0	0,23 ^{f}±0.005
BBb		25 ^{g}± 0	48 ^{b}±0.5	23 ^{c}±0.5	2 ^{d}±0	0 ^{a}±0	1,00 ^{b}±0.005
BKmj		82 ^{a}±1.0	18 ^{e}±1.0	0 ^{f}±0	0 ^{e}±0	0 ^{a}±0	0,18 ^{g}±0.01
BMmj	1	0 ^{h}±0	100 ^{a}±0	0 ^{f}±0	0 ^{e}±0	0 ^{a}±0	1,00 ^{b}±0
SD		1.71	2.68	6.60	11.04	0	1.51
LSD		1.91	2.07	1.91	1.28	0	0.03
PMm		0 ^{a}±0	3 ^{e}±0.5	53 ^{c}±0.5	30 ^{d}±0	14 ^{d}±0	2,55 ^{d}±0.005
PMb		0 ^{a}±0	21 ^{c}±1.0	29 ^{d}±1.0	23 ^{e}±0.5	27 ^{b}±0.5	2,56 ^{d}±0.015
PMmj		0 ^{a}±0	5 ^{e}±0.5	26 ^{e}±0.5	54 ^{a}±0	15 ^{c}±0	2,79 ^{c}±0.005
BLm		0 ^{a}±0	0 ^{f}±0	10 ^{g}±0	50 ^{b}±0	40 ^{a}±0	3,30 ^{b}±0
BRm		0 ^{a}±0	0 ^{f}±0	6 ^{h}±0.5	55 ^{a}±1.0	39 ^{a}±0.5	3,33 ^{a}±0
BBb		0 ^{a}±0	23 ^{b}±0	58 ^{a}±0.5	17 ^{f}±0	2 ^{e}±0.5	1,98 ^{f}±0.01
BKmj		0 ^{a}±0	14 ^{d}±0	54 ^{b}±0.5	32 ^{c}±0.5	0 ^{f}±0	2,18 ^{e}±0.005
BMmj	2	0 ^{a}±0	58 ^{a}±0.5	19 ^{f}±0.5	23 ^{e}±0	0 ^{f}±0	1,65 ^{g}±0.005
SD		0	4.28	2.48	1.73	2.50	0.40
LSD		0	1.52	1.82	1.41	0.99	0.02

SD : Standard Deviation
LSD : Little Standard Deviation (Significant differences in a same row are showed by different letters ($P<0.05$))

Water content and oil content

Water and oil contents demonstrate a significant increase ($P<0,05$) between the first and the second sampling. Compared to the Moroccan Picholine, the varieties Bouchouk Laghlid, Bouchouk Rguigue and Bakhboukh Beldi show the highest oil contents, especially in the 2nd sampling (43.51 ; 45,04 and 45.31% respectively), (Table 3). As for the Moroccan Picholine, it shows a higher content (48.25%) in Bousber site in the 2nd sampling.

The biometry and the evolution of oil content demonstrate that all studied varieties offer the possibility in double aptitude; olives and olive oil.

Parameters of oil Quality

The oil quality parameters taken into account in this study are acidity, specific extinction, total phenols and oil bitterness (Table 3).

Acidity

The free acidity does not exceed 0,8%, except for Bakhboukh Beldi and Bouchouika varieties whose oil acidity reaches 0,9% of oleic acid. These values show that all the produced oils are classified extra virgin according to the IOOC (2006) regulation. This parameter increase significantly during the olive maturity.

Spectrophotometric indices

The values of specific extinction at 270 nm and 232 nm found in all studied varieties do not exceed the respective limits ⩽0,22 and ⩽2,50 set up by the IOOC (2006) regulation for extra virgin olive oils.

The specific extinction values at 270 nm are practically similar noticing a slight decrease as to all the varieties in the 2nd sampling. However, concerning 232 nm values, an increase is noticed with the ripening time in favor of Bouchouika, Bakhboukh Beldi and Bouchouk Laghlid which register respectively the highest values: 3.82, 3.39 and 3.22 in the 2nd sampling.

Total phenols

The effect of the variety regarding total phenols is highly marked. The only autochthons variety showing a high rate in phenolic compounds is Berri Meslal (309.54 ppm). These contents decrease with ripening time. Thus, only marking 209,50 ppm in the 2nd sampling. These values are very low in comparison with those marked by the Moroccan Picholine in the same site Mjaara (319,95 et 303,50 ppm respectively in the 1st and 2nd sampling). In the opposit, Bouchouk Laghlid, Bouchouk Rguigue, Bakhboukh Beldi and Bouchouika have marked a considerable decrease between first and second studied harvest time. These varieties attain small contents of phenolic compounds in the 2nd sampling (53,63 ; 57,41 ; 62,81 et 48,93 ppm respectively). Baccouri *et al*. (2008) noted a great correlation between the oxidative stability and the concentration of total phenols, the small level of these compounds can probably determine a very low stability of their oils in advanced stages of olives maturity. It is reported that the proportions and the speed of phenolic compounds decrease depend on variety (Caponio *et al*., 2001) and the harvest time (Cimato, 1990).

Oil bitterness

Bitterness is a positive sensory attribute necessary for identifying olive oil's acceptability and stability. The method described by Gutierrez *et al*. (1992) allows the extraction and the evaluation of phenolic compounds rates of responsible oil bitterness. In the 1st sampling, Moroccan Picholine cultivar shows very high values of bitterness (2,49 ; 2,06 and 2,25 respectively in Masmouda, Bousber and Mjaara sites). In the 2nd sampling, these values decrease: 0,49 ; 1,20 and 1,33 respectively in the same site. However, a highly significant variation (P<0,001), is noted between varieties. Hence, the varietal effect on this parameter is noted.

However, Bouchouk Laghlid has the lowest bitterness (0,47 and 0,23 respectively in the 1st and the 2nd sampling). The other varieties Bouchouk Rguigue, Bakhboukh Beldi, Bouchouika and Berri Meslal register medium values, in the first sampling between PM and BL varieties (0,8 ; 0,87 ; 1,39 and 1,90). In the other side, Bouchouk Rguigue and Bakhboukh Beldi show a slight increase of oil bitterness in the second sampling.

Regarding this parameter, the varietal influence is also involved (Beltran *et al*., 2000). In the same way, the oil bitterness in the studied varieties show a positive correlation with the rate of total phenols; r^2=0,94.

Oil purity parameters

The contents of total fatty acids

According to the variety and the olives maturity, total fatty acids' proportions (Table 4) show a significant variations (P< 0,05).

Major fatty acids

The oleic fatty acid is the most dominant fatty acid. Its percentage varies from 64 to 77%. This fatty acid enables to distinguish the Moroccan Picholine and Bouchouk Laghlid showing the highest proportions ranging between 75% and 77%. The percentage of oleic acid for the other autochthon varieties is lower, fluctuating between 64% and 71%.

The palmitic fatty acid helps to carry out a similar variety grouping as that observed with oleic acid. However, in Bousber site, the proportions marked in the first sampling for the Moroccan Picholine were 11.63%, and 12.13% for Bouchouk Laghlid variety in Masmouda site. These values are lower than the proportions achieved by other varieties which vary between 15.07% and 17.36% during the followed samplings.

Except for Bouchouk Laghlid variety where palmitic fatty acid is stable, the other varieties show a decrease proportions during the olives maturity. This evolution also helps to distinguish Bouchouk Laghlid from Moroccan Picholine.
The proportions of linoleic fatty acid characterize Bouchouk Laghlid variety as having the lowest values and Bakhboukh Beldi variety with the highest values. Nonetheless, the Moroccan Picholine marks medium values.

The evolution of linoleic fatty acid during the maturity shows an increase in favor of the Moroccan Picholine. The same trend is noticed for the autochthons varieties Bouchouk Rguigue, Bouchouika and Berri Meslal. However, the highest increase between the two studied samplings is obtained by Bouchouk Rguigue variety noticing a difference of 3.23%. Nevertheless, a slight decrease with the maturity is noticed for Bouchouk Laghlid and Bakhboukh Beldi autochthons varieties.

TABLE 3

Water and Oil Levels (%) and Oil Quality Parameters

Cultivar codes	Sampling	Water content / FM	Oil content / DM	Free fatty acids (% oléic acid)	E 270	E 232	Total Phenols (mg/kg)	Bitterness K 225
PMm		57,62 ^{b}±0.02	38,16 ^{a}±0.16	0,34 ^{a}±0.04	0,20 ^{a}±0.005	1,22 ^{f}±0.02	320,75 ^{a}±0.75	2,49 ^{a}±0.005
PMb		50.00 ^{g}±0	30,50 ^{d}±0.5	0,37 ^{a}±0.02	0,16 ^{c}±0.005	1,31 ^{e}±0.015	239,57 ^{c}±0.43	2,06 ^{c}±0.04
PMmj		53,54 ^{e}±0.04	33,12 ^{c}±0.12	0,33 ^{a}±0.03	0,19^{ba}±0.005	2,10 ^{a}±0.015	319,95 ^{a}±0.05	2,25 ^{b}±0.05
BLm		53,71 ^{d}±0.015	33,75 ^{c}±0.76	0,32 ^{a}±0.025	0,10 ^{e}±0	1,07 ^{g}±0.023	71,96 ^{g}±0.035	0,47 ^{h}±0.005
BRm		54,83 ^{c}±0.03	33,57 ^{c}±0.07	0,34 ^{a}±0.04	0,17^{bc}±0.005	1,50 ^{d}±0	179,99 ^{e}±0.11	0,80 ^{g}±0
BBb		61,32 ^{a}±0.02	28,67 ^{e}±0.075	0,23 ^{bc}±0.03	0,16 ^{dc}±0.01	1,62 ^{c}±0.02	142,85 ^{f}±2.15	0,87 ^{f}±0.005
BKmj		54,95 ^{c}±0.05	26,88 ^{f}±0.015	0,20 ^{c}±0.005	0,14 ^{d}±0.01	1,70 ^{b}±0	186,60 ^{d}±0.40	1,39 ^{e}±0.01
BMmj	1	51,88 ^{f}±0.115	35,94 ^{b}±0.06	0,31 ^{ba}±0.01	0,18 ^{bc}±0.01	1,61 ^{c}±0.01	309,54 ^{b}±0.46	1,90 ^{d}±0.005
SD		0.13	1.43	12.80	6.06	1.56	0.54	2.04
LSD		0.16	1.08	0.09	0.02	0.05	2.76	0.07
PMm		57,62 ^{f}±0.025	42,18 ^{d} ±0.18	0,85 ^{a} ±0.05	0,11^{c} ±0.005	1,61 ^{f}±0.015	101,89 ^{d}±0.11	0,49 ^{e}±0.005
PMb		56,19 ^{g} ±0.19	48,25 ^{a} ±0.25	0,55 ^{b} ±0.05	0,20^{a} ±0.005	1,19 ^{g}±0.005	152,70 ^{c}±0.30	1,20 ^{b} ±0.005
PMmj		58,05 ^{e} ±0.05	42,00 ^{d} ±0.065	0,34 ^{c} ±0.04	0,16 ^{b} ±0.01	2,11 ^{e} ±0.01	303,50 ^{a} ±1.5	1,33 ^{a} ±0.01
BLm		63,05 ^{b} ±0.05	43,51 ^{c} ±0.01	0,30 ^{c} ±0.005	0,09 ^{c} ±0.005	3,22 ^{c} ±0.02	53,63 ^{g}±0.37	0,23 ^{g} ±0.015
BRm		61,10 ^{c}±0.10	45,04 ^{b} ±0.04	0,55 ^{b}±0.055	0,20^{a} ±0.005	0,96 ^{h}±0.01	57,41 ^{f} ±2.59	0,94 ^{c}±0.01
BBb		65,10 ^{a}±0.1	45,31 ^{b} ±0.31	0,90 ^{a}±0.1	0,17 ^{b}±0.01	3,39 ^{b}±0.005	62,81 ^{e} ±0.19	0,92 ^{c}±0.02
BKmj		60,12 ^{d}±0.12	40,44 ^{e} ±0.44	0,90 ^{a}±0.10	0,21 ^{a}±0.01	3,82 ^{a}±0.02	48,93 ^{h} ±1.065	0,80 ^{d} ±0
BMmj	2	57,50 ^{f}±0.10	39,81 ^{e} ±0.185	0,34 ^{c}±0.04	0,11 ^{c} ±0.01	2,20 ^{d} ±0.005	209,50 ^{b} ±0.5	0,36 ^{f} ±0
SD		0.24	0.75	14.91	7.04	0.77	1.32	1.88
LSD		0.34	0.75	0.20	0.03	0.04	3.76	0.03

FM : fresh matter; DM :dry matter; SD: Standard Deviation; LSD: Little Standard Deviation (Significant differences in a same row are showed by different letters ($P<0.05$))

Minor fatty acids

The linolenic fatty acid has great importance, since its upper limit is seriously taken into consideration by IOOC norm (2006). El Antari *et al*. (2000) have demonstrated that the level of this fatty acid is related to genetic and crop zone. Indeed, concerning the Moroccan Picholine cultivar the proportions of this fatty acid decrease from the south to the north of Morocco.

The current study confirms the same finding concerning the Moroccan Picholine, which normally register proportions generally lower than 1% in the North region.

Actually, the proportions of linolenic fatty acid marked by the Moroccan Picholine between the 1st and the 2nd sampling are 0.82% to 1.02%, which distinguish it from other autochthons varieties where the values fluctuate between 0.53% and 0.76% in the two studied samplings. The lowest values are marked by Bakhboukh Beldi variety (0,61 et 0,53% respectively in the 1st and the 2nd sampling). However, the proportions of this fatty acid decreases with maturity.

The stearic fatty acid shows the lowest proportions (1,75% to 2,09%) for the Moroccan Picholine in the 1st sampling, in the three sampling sites. In the 2nd sampling, the Moroccan Picholine, Bakhboukh Beldi and Bouchouika varieties mark an increase of this fatty acid, while it decreases in Bouchouk Laghlid and Bouchouk Rguigue varieties. The values remain stable (2,11%) in Berri Meslal variety.

The lowest values of palmitoleic fatty acid are obtained in the 1st sampling by Bouchouk Laghlid (0,58%) and Moroccan Picholine (0,81 – 0,71 and 0,86%) respectively in Masmouda, Bousber and Mjaara unlike the other varieties proportions which fluctuate between 1,28 and 1,73%. Whereas, Moroccan Picholine, Bakhboukh Beldi and Berri Meslal marked a decrease with maturity. As for the other autochthons varieties, Bouchouika, Bouchouk Rguigue and Bouchouk Laghlid registered an increase.

Among the factors that influence the oil's composition of fatty acids and especially oleic acids, altitude, climate, variety and olives maturity are mentioned (Ranelli *et al*., 1997). According to Fiorino and NizziGrifi (1991), the Stearic acid may be used for the varietal distinction. Also, Tous *et al.* (2005) demonstrated that the varietal effect on the most fatty acids composition is more important than the effect of years and harvest time.

Indeed, in addition to the proportions of major fatty acids (oleic, palmitic and linoleic), the evolution during maturity of the fruit of stearic and palmitoleic fatty acids may be discriminating marker that can be used to separate the Moroccan Picholine cultivar from the other studied autochthons varieties.

These results concord with other authors, so Cavusoglu and Oktar (1994) reported the influence of the variety on the oil's composition, especially on oleic acid, linoleic acid proportions and the ratio saturated fatty acids/ unsaturated fatty acids.

Consequently, the observed variation concerning the fatty acids composition of these cultivars oil is essentially due to genetic factors since we have studied in several sites in the same region. This conclusion has already been confirmed in previous researches on some Mediterranean varieties (El Antari *et al*., 2000).

TABLE 4.1

Total Fatty Acids Proportions (%)

Cultivar codes	Sampling	C16:0	C16:1	C17:0	C17:1	C18:0	C18:1	C18:2	C18:3	C20:0	C20:1
PMm		11,96 ^{f} ±0.015	0,81 ^{e} ±0.005	0,03 ^{b} ±0	0,28 ^{a} ±0.055	1,75 ^{f} ±0.015	76,60 ^{a} ±0.01	7,09 ^{f} ±0.005	0,88 ^{c} ±0.005	0,26 ^{a} ±0.005	0,29 ^{ba} ±0.015
PMb	1	11,63 ^{h} ±0.05	0,71 ^{f} ±0.04	0,03 ^{b} ±0	0,24 ^{a} ±0.03	2,09 ^{d} ±0.01	76,46 ^{a} ±0.08	7,23 ^{e} ±0.035	0,95 ^{b} ±0	0,30 ^{a} ±0	0,33 ^{ba} ±0.005
PMmj		11,84 ^{g} ±0.005	0,86 ^{e} ±0.01	0,03 ^{b} ±0	0,19 ^{a} ±0.015	1,98 ^{e} ±0.005	75,19 ^{b} ±0.045	7,78 ^{d} ±0.015	1,02 ^{a} ±0.005	0,54 ^{a} ±0.25	0,31 ^{ba} ±0.015
BLm		12,13 ^{e} ±0.01	0,58 ^{g} ±0.03	0,04 ^{a} ±0	0,22 ^{a} ±0.015	3,01 ^{a} ±0.015	75,41 ^{b} ±0.27	6,73 ^{h} ±0.02	0,76 ^{d} ±0.01	0,44 ^{a} ±0.005	0,64 ^{a} ±0.3
BRm		17,08 ^{c} ±0.03	1,54 ^{b} ±0.005	0,03 ^{b} ±0	0,26 ^{a} ±0.04	2,25 ^{c} ±0	68,04 ^{d} ±0.06	9,49 ^{b} ±0.005	0,62 ^{f} ±0.005	0,40 ^{a} ±0.005	0,23 ^{b} ±0.005
BBb		16,26 ^{d} ±0.045	1,28 ^{d} ±0	0,04 ^{a} ±0	0,24 ^{a} ±0.05	2,24 ^{c} ±0.01	64,83 ^{e} ±0.1	13,75 ^{a} ±0.01	0,61 ^{f} ±0.015	0,43 ^{a} ±0.01	0,28 ^{b} ±0
BKmj		17,36 ^{a} ±0.01	1,47 ^{c} ±0.005	0,03 ^{b} ±0	0,22 ^{a} ±0.12	2,44 ^{b} ±0.04	68,15 ^{d} ±0.145	8,90 ^{c} ±0.02	0,67 ^{e} ±0	0,45 ^{a} ±0.005	0,26 ^{b} ±0.005
BMmj		17,18 ^{b} ±0	1,73 ^{a} ±0.01	0,03 ^{b} ±0	0,23 ^{a} ±0	2,10 ^{d} ±0	70,48 ^{c} ±0.02	6,83 ^{g} ±0	0,62 ^{f} ±0.025	0,42 ^{a} ±0	0,34 ^{ba} ±0.01
SD		0.26	2.34	0	31.92	1.07	0.24	0.28	2.08	30.72	44.51
LSD		0.08	0.06	0	0.17	0.05	0.39	0.05	0.04	0.28	0.35
PMm		8,70 ^{d} ±0.095	0,57 ^{e} ±0.005	0,03 ^{b} ±0	0,44 ^{a} ±0.03	2,64 ^{b} ±0	76,99 ^{a} ±0.05	9,00 ^{c} ±0	0,88 ^{a} ±0.005	0,32 ^{d} ±0.005	0,37 ^{a} ±0.005
PMb	2	12,21 ^{c} ±0.93	0,61 ^{e} ±0.04	0,03 ^{ba} ±0.005	0,38 ^{ba} ±0.1	2,12 ^{d} ±0.06	74,27 ^{b} ±0.49	8,82 ^{dc} ±0.17	0,90 ^{a} ±0.02	0,30 ^{d} ±0.02	0,31 ^{c} ±0.015
PMmj		11,23 ^{c} ±0.86	0,61 ^{e} ±0	0,03 ^{b} ±0	0,26 ^{bdc} ±0.065	2,53 ^{c} ±0.01	75,17 ^{b} ±0.61	8,64 ^{d} ±0.14	0,82 ^{b} ±0.005	0,31 ^{d} ±0.015	0,35 ^{ba} ±0.005

BLm	12,13 ^{c} ±0.075	0,62 ^{e} ±0	0,03 ^{b} ±0	0,35 ^{bac} ±0.01	2,12 ^{d} ±0.005	76,69 ^{a} ±0.045	6,50 ^{f} ±0.02	0,69 ^{c} ±0.005	0,36 ^{c} ±0	0,35 ^{ba} ±0.015
BRm	16,61 ^{a} ±0	1,73 ^{a} ±0.005	0,03 ^{b} ±0	0,15 ^{d} ±0	2,11 ^{d} ±0	65,31 ^{e} ±0.015	12,72 ^{a} ±0.005	0,67 ^{dc} ±0	0,39 ^{cb} ±0.01	0,24 ^{d} ±0.01
BBb	15,07 ^{b} ±0.04	1,14 ^{d} ±0	0,04 ^{a} ±0	0,19 ^{dc} ±0.015	2,47 ^{C} ±0.005	67,32 ^{d} ±0.07	12,47 ^{a} ±0.02	0,53 ^{f} ±0	0,44 ^{a} ±0.005	0,27 ^{d} ±0
BKmj	16,70 ^{a} ±0.055	1,61 ^{b} ±0	0,03 ^{b} ±0	0,22 ^{dc} ±0.04	2,75 ^{a} ±0.025	67,14 ^{d} ±0.005	10,16 ^{b} ± 0	0,62 ^{e} ±0.005	0,47 ^{a} ±0	0,25 ^{d} ±0.01
BMmj	15,29 ^{ba} ±0.03	1,46 ^{c} ±0.015	0,03 ^{b} ±0	0,27 ^{bdc} ±0.04	2,11 ^{d} ±0	71,18 ^{c} ±0.08	8,22 ^{e} ±0.005	0,66 ^{d} ±0.005	0,40 ^{b} ±0.005	0,33 ^{bc} ±0.01
SD	4.72	2.29	7.84	24.06	1.40	0.55	1.16	1.58	3.76	4.54
LSD	1.47	0.05	0.006	0.16	0.07	0.92	0.26	0.03	0.03	0.03

SD : Standard Deviation ; LSD : Little Standard Deviation (significant differences in a same row are showed by different letters ($P<0.05$))

TABLE 4.2

Total Fatty Acids Classes

Cultivar codes	Sampling	MUFA / PUFA	C18:1/C18:2	S/U
PMm		9,76 ^{b} ±0.005	10,79 ^{b} ±0.005	0,16 ^{e} ±0
PMb		9,49 ^{c} ±0.04	10,56 ^{c} ±0.04	0,16 ^{e} ±0
PMmj		8,68 ^{d} ±0.005	9,65 ^{e} ±0.015	0,16 ^{e} ±0.005
BLm	1	10,25 ^{a} ±0.015	11,20 ^{a} ±0.01	0,18 ^{d} ±0
BRm		6,92 ^{f} ±0.01	7,16 ^{g} ±0	0,24 ^{b} ±0
BBb		4,63 ^{g} ±0.015	4,71 ^{h} ±0.01	0,23 ^{c} ±0
BKmj		7,32 ^{e} ±0.01	7,65 ^{f} ±0	0,25 ^{a} ±0
BMmj		9,75 ^{b} ±0.035	10,31 ^{d} ±0.005	0,24 ^{b} ±0
SD		0.35	0.25	1,23
LSD		0,07	0.05	0,01
PMm		7,92 ^{d} ±0.005	8,55 ^{cb} ±0.005	0,13 ^{e} ±0
PMb		7,77 ^{e} ±0.085	8,41 ^{c} ±0.10	0,17 ^{d} ±0.01
PMmj		8,07 ^{c} ±0.05	8,70 ^{b} ±0.07	0,16 ^{d} ±0.01
BLm	2	10,84 ^{a} ±0.04	11,79 ^{a} ±0.045	0,17 ^{d} ±0
BRm		5,03 ^{h} ±0	5,13 ^{f} ±0	0,23 ^{ba} ±0
BBb		5,29 ^{g} ±0.015	5,39 ^{e} ±0.015	0,21 ^{b} ±0.005
BKmj		6,41 ^{f} ±0.005	6,60 ^{d} ±0	0,24 ^{a} ±0
BMmj		8,23 ^{b} ±0.005	8,64 ^{b} ±0.015	0,21 ^{c} ±0
SD		0.72	0.86	3.93
LSD		0.12	0.16	0.02

With : MUFA : Mono unsaturated fatty acids ; PUFA : Poly unsaturated fatty acids ; S : Saturated fatty acids; U: Unsaturated fatty acids C18:1/C18:2
SD : Standard Deviation ; LSD : Little Standard Deviation (significant differences in a same row are showed by different letters (P<0.05))

Fatty acid classes
The ratio saturated fatty acids / unsaturated fatty acid statistically shows the closeness between Bouchouk Laghlid variety and Moroccan Picholine, unlike the other varieties which constitute another group significantly distinct from the Moroccan Picholine.

In the same way, the ratio oleic fatty acid / linoleic fatty acid enables one to distinguish Bouchouk Laghlid variety with the highest values in the 1st and the 2nd sampling respectively (11. 20 and 11. 79) and Bakhboukh Beldi and Bouchouk Rguigue varieties with the lowest values (4,71 – 5,39 and 7,16 – 5,13 respectively).

The fatty acids composition may also be involved in oil oxidation. Actually, resistance against oxidation is influenced by the ratio mono unsaturated fatty acids / poly unsaturated fatty acids (Aparicio *et al*., 1999 ; Salvador *et al*., 1999). However, whenever this ratio is high, stability to oil oxidation is positively affected (Aparicio *et al.*, 1999 ; Beltran *et al*., 2000 ; Gutiérrez *et al*., 1999). Also, the oil stability is essentially related to oleic fatty acid proportions (Allam, 2001).

Triglycerides composition

The analysis of triglycerides of the studied oil varieties have emphasized that some triglycerides can be very useful as discriminating factors between varieties.

The analysis of euclidean distances in the 1st and the 2nd sampling (Figs. 1 and 2) of the total triglycerides composition shows clusters which are significantly distinct. Thus, Bouchouk Laghlid variety is very close to the Moroccan Picholine cultivar. As for the other varieties, they form another different group.

However, if we check only the essential triglycerides (OOO, SLO+POO, LOL, PLO and SOO), we notice that the Moroccan Picholine cultivar shows the highest proportions of triolein (OOO), whatever the site and the date of the sampling are. In the same way, Bouchouk Laghlid variety marks proportions close to those of the Moroccan Picholine (Table 5). In the 2nd sampling, the other studied autochthons varieties mark high proportions (SLO + POO) compared to the Moroccan Picholine and Bouchouk Laghlid varieties. In the opposit, the Bakhboukh Beldi variety marks triglyceride contents LOL, close to those of the Moroccan Picholine.

Bouchouk Rguigue and Bakhboukh Beldi varieties mark the highest contents of PLO noting a decrease for the other autochthons varieties, while the Moroccan Picholine cultivar marks the smallest contents.

According to Diaz *et al*. (2005), PPP, SOO and OOO are the most important variables for the differentiation of the olive oils classes.

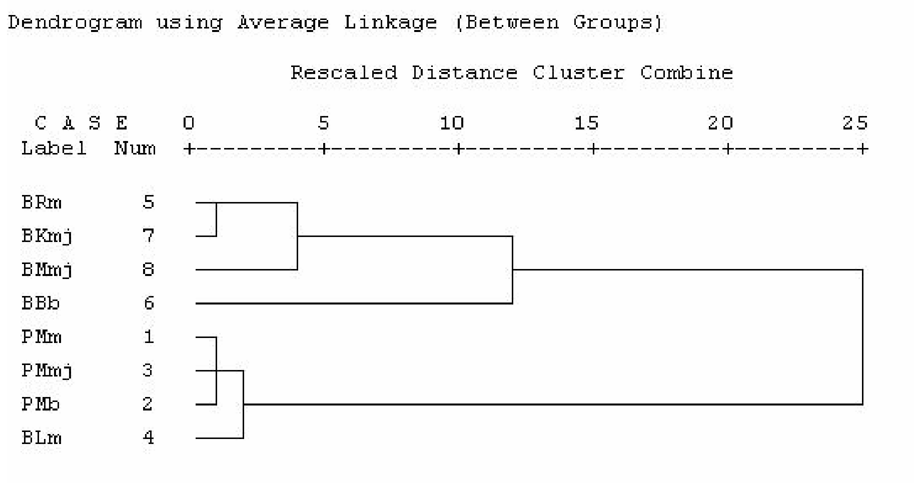

Figure 1. Euclidean distances of the total triglycerides composition comparing the Moroccan Picholine and the autochthons varieties in the 1st sampling.

PM: Moroccan Picholine BR: Bouchouk Rguigue ; BL : Bouchouk laghlid ; BB : Bechbouk Beldi ; BK : Bouchouika ; BM : Berri Meslal ; m : masmouda ; b : bousber ; mj : mjaara.

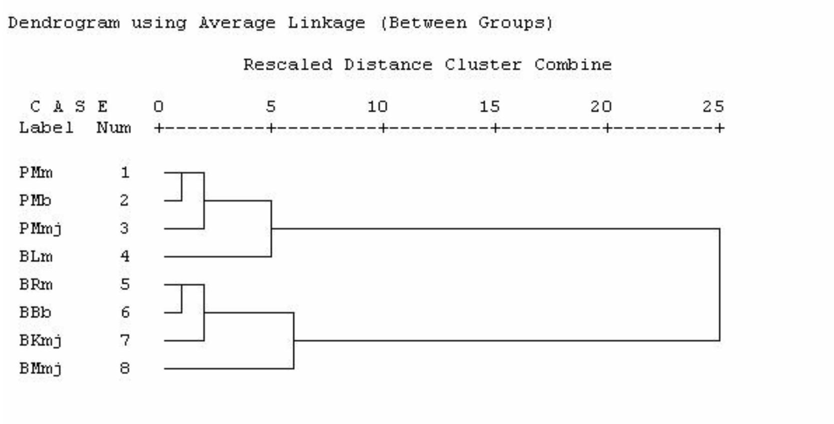

Figure 2. Euclidean distances of the total triglycerides composition comparing the Moroccan Picholine and the autochthons varieties in the 2nd sampling.

PM: Moroccan Picholine BR: Bouchouk Rguigue ; BL : Bouchouk laghlid ; BB : Bechbouk Beldi ; BK : Bouchouika ; BM : Berri Meslal ; m : masmouda ; b : bousber ; mj : mjaara.

The levels of ECN42 in the examined varieties (Table 5.2) greatly exceed the value of the maximum limit (0.2) set by the IOOC regulation (Figure 3), except for the Bakhboukh Beldi variety which marks 0,19 in the first sampling and Bouchouk Rguigue which marks 0,22 in the second sampling. However, the values exceeding this limit specified in the IOOC standard are noted also in the case of other varieties for example in Greek varieties (0,27; 0,33 and 0,42) (Stefanoudaki *et al*., 1997) and in Crete varieties (0,48) (Synouri *et al*., 1995).

The profile of triglycerides composition may yield results of great utility as far as the authenticity and the origin of olive oil are concerned (Cortesi,1993 ; Ollivier *et al*., 2006).

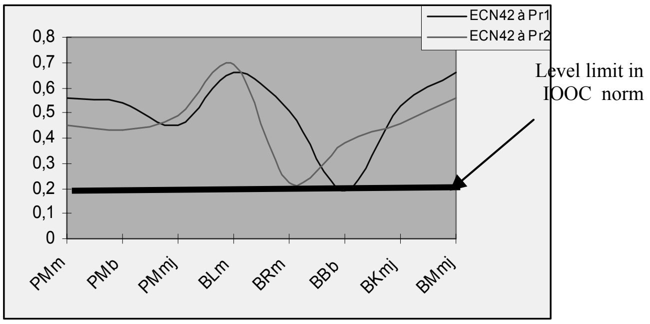

Figure 3. Evolution of ECN42 during maturity of the fruits.

Pr1 : first sampling
Pr2 : second sampling
PM: Moroccan Picholine BR: Bouchouk Rguigue ; BL : Bouchouk laghlid ; BB : Bechbouk Beldi ; BK : Bouchouika ; BM : Berri Meslal ; m : masmouda ; b : bousber ; mj : mjaara.

TABLE 5.1

Mayor Triglycerides Composition %

Cultivar codes	Sampling	Essential Triglycerides					
		LOL	**PLO**	**OOO**	**SLO+POO**	**POL**	**SOO**
PMm	1	12,06 ^{f} ±0.010	5,05 ^{f} ±0.015	44,05^{c} ±0.015	26,20 ^{d} ±0.1	4,15^{e} ±0.015	3,40 ^{f} ±0.010
PMb		12,91^{c} ±0.010	4,73 ^{h} ±0.015	45,92^{a} ±0.010	23,43 ^{f} ±0.015	3,25^{h} ±0.015	4,18 ^{b} ±0.010
PMmj		13,53^{b} ±0.010	5,49 ^{e} ±0.005	45,21^{b} ±0.005	25,71^{e} ±0.010	3,79 ^{f} ±0.005	3,93 ^{d} ±0.015
BLm		11,57 ^{g} ±0.015	4,97 ^{g} ±0.010	43,01^{d} ±0.005	25,8 ^{e} ±0.010	3,68^{g} ±0.010	6,06^{a} ±0.030
BRm		12,65 ^{d} ±0.005	9,16 ^{b} ±0.010	31,23 ^{f} ±0.015	29,45 ^{c} ±0.025	7,16 ^{a} ±0.020	3,91 ^{d} ±0.005
BBb		17,38 ^{a} ±0.010	11,43 ^{a} ±0.015	26,62 ^{g} ± 0.010	25,81 ^{e} ±0.005	5,94 ^{d} ±0.020	3,47 ^{ef} ±0.015
BKmj		12,15 ^{e} ±0.010	8,88 ^{c} ±0.010	31,18 ^{f} ±0.010	30,37 ^{b} ±0.015	6,9 ^{b} ±0.050	4,21 ^{b} ±0.005
BMmj		9,93 ^{h} ±0.015	6,82 ^{d} ±0.010	35,35 ^{e} ±0.015	32,35 ^{a} ±0.015	6,66 ^{c} ±0.020	4,08 ^{c} ±0.015
SD		0.12	0.24	0.04	0.19	0.63	0.51
LSD		0.04	0.04	0.04	0.12	0.07	0.05
PMm	2	16,73 ^{b} ±0.015	4,61 ^{e} ±0.005	47,57 ^{b} ±0.015	18,11 ^{h} ±0.010	1,84 ^{h} ±0.010	5,08 ^{b} ±0.020
PMb		16,64 ^{c} ±0.010	5,11 ^{e} ±0.510	45,47 ^{d} ±0.015	19,90 ^{g} ±0.05	2,26 ^{g} ±0.015	4,34 ^{d} ±0.010
PMmj		17,10 ^{a} ±0.005	0,22 ^{f} ±0.010	48,35 ^{a} ±0.015	21,14 ^{f} ±0.015	2,33 ^{f} ±0.015	5,22 ^{a} ±0.010
BLm		11,92 ^{g} ±0.010	4,77 ^{e} ±0.010	46,10 ^{c} ±0.05	25,24 ^{e} ±0.015	3,54 ^{e} ±0.015	4,25 ^{e} ±0.015
BRm		15,01 ^{e} ±0.005	11,27 ^{a} ±0.015	28,97 ^{h} ±0.015	28,14 ^{c} ±0.015	6,17 ^{b} ±0.015	3,18 ^{g} ±0.010
BBb		16,43 ^{d} ±0.015	10,45 ^{b} ±0.015	30,54 ^{f} ±0.020	26,52 ^{d} ±0.010	5,15 ^{d} ±0.015	4,09 ^{f} ±0.005
BKmj		12,51 ^{f} ±0.005	9,45 ^{c} ±0.015	30,01 ^{g} ±0.005	29,40 ^{a} ±0.15	6,58 ^{a} ±0.010	4,68 ^{c} ±0.010
BMmj		11,72 ^{h} ±0.010	6,92 ^{d} ±0.010	37,07 ^{e} ±0.025	28,90 ^{b} ±0.050	5,85 ^{c} ±0.015	4,33 ^{d} ±0.010
SD		0.09	3.91	0.08	0.34	0.47	0.38
LSD		0.03	0.59	0.07	0.19	0.04	0.04

SD : Standard Deviation, P, palmitic; S, stearic; O, oleic; and L, linoleic acids
LSD : Little Standard Deviation (Significant differences in a same row are showed by different letters ($P<0.05$))

TABLE 5.2

Minor Triglycerides Composition % and ECN42

Cultivar codes	Sampling	Minor triglycerides							
		LLL	**OLnL**	**PLnL**	**LOL+OLnO**	**PLL**	**PLnO**	**SLS+POS**	**ECN42**
PMm	1	0,08 [d] ±0.003	0,32 [dc] ±0.005	0,08 [c] ±0.001	1,49 [f] ±0.005	1,75 [c] ±0.005	0,36 [fe] ±0.015	0,98 [d] ±0.010	0,56
PMb		0,10 [c] ±0.005	0,37 [b] ±0.005	0,08 [c] ±0	1,80 [d] ±0.005	2,02 [b] ±0.010	0,37[e] ±0.005	0,98 [d] ±0.005	0,54
PMmj		0,14[b] ±0.005	0,41[a] ±0.005	0,10 [ba] ±0.005	1,90 [c] ±0.010	2,15[a] ±0.015	0,47[d] ±0.010	0,92 [e] ±0.015	0,45
BLm		0,06 [e] ±0.005	0,26 [e] ±0.010	0,06 [d] ±0	1,22 [g] ±0.010	1,55 [d] ±0.010	0,33 [f] ±0.015	1,37[b] ±0.010	0,66
BRm		0,12 [c] ±0.005	0,31 [d] ±0.005	0,10 [b] ±0.005	1,98 [b] ±0.005	0,81 [fe] ±0.005	0,87 [b] ±0.010	1,41 [b] ±0.005	0,51
BBb		0,39 [a] ±0.005	0,43 [a] ±0.005	0,12 [a] ±0.005	3,95 [a] ±0.010	0,77 [fg] ±0.005	1,59 [a] ±0.005	1,29 [c] ±0.005	0,19
BKmj		0,11 [c] ±0.005	0,35 [c] ±0.010	0,10 [b] ±0	1,78 [e] ±0.005	0,83 [e] ±0.015	0,78 [c] ±0.010	1,50 [a] ±0.010	0,53
BMmj		0,06 [e] ±0.003	0,20 [f] ±0.005	0,10 [b] ±0	1,11 [h] ±0.010	0,77 [g] ±0.010	0,45 [d] ±0.010	1,29 [c] ±0.005	0,66
SD		4.83	2.85	4.72	0.59	1.08	2.31	1.02	
LSD		0.02	0.02	0.01	0.03	0.03	0.04	0.03	
PMm	2	0,11 [b] ±0.005	0,37 [c] ±0.010	0,08 [c] ±0.001	2,32 [d] ±0.010	1,91 [b] ±0.005	0,41 [e] ±0.010	0,82 [f] ±0.010	0,45

PMb	0,13 [b] ±0.010	0,42 [b] ±0.010	0,08 [c] ±0	2,32 [dc] ±0.005	1,95 [a] ±0.015	0,51 [d] ±0.005	0,81 [f] ±0.010	0,43
PMmj	0,01 [d] ±0	0,02 [f] ±0	0,03 [e] ±0.003	2,34 [c] ±0.010	1,79 [c] ±0.005	0,41 [e] ±0.005	1 [d] ±0.005	0,49
BLm	0,05 [c] ±0.010	0,22 [e] ±0.010	0,06 [d] ±0.002	1,13 [g] ±0.010	1,42 [f] ±0.015	0,28 [f] ±0.010	0,97 [e] ±0.010	0,69
BRm	0,25 [a] ±0.010	0,49 [a] ±0.005	0,19 [a] ±0.005	3,18 [b] ±0.010	1,07 [g] ±0.010	0,75 [b] ±0.015	1,31 [c] ±0.005	0,22
BBb	0,22 [a] ±0	0,32 [d] ±0.010	0,10 [b] ±0.010	3,30 [a] ±0.010	0,73 [h] ±0.010	0,73 [b] ±0.010	1,37 [b] ±0.010	0,38
BKmj	0,11 [b] ±0.005	0,33 [d] ±0.015	0,11 [b] ±0.010	2,19 [e] ±0.005	1,60 [d] ±0.010	1,08 [a] ±0.010	1,88 [a] ±0.010	0,46
BMmj	0,02 [d] ±0	0,01 [f] ±0	0,01 [f] ±0	1,64 [f] ±0.015	1,47 [e] ±0.015	0,62 [c] ±0.010	1,39 [b] ±0.005	0,56
SD	8.50	4.79	8.89	0.60	1.06	2.30	1.00	
LSD	0.02	0.03	0.02	0.03	0.04	0.03	0.03	

SD : Standard Deviation; P, palmitic; S, stearic; O, oleic; L, linoleic; and Ln, linolenic acids.
LSD : Little Standard Deviation (significant differences in a same row are showed by different letters ($P<0.05$))

CONCLUSION

The results demonstrate the significant varietal influence on the biometric characteristics and the fatty acids and triglycerides composition of olive oil. Also, the important parameter characterizing each variety is the level of total phenols. So, the Berri Meslal is the only variety which shows a high rate in phenolic compounds but still is lower than in the Moroccan Picholine, whereas the other four autochthons varieties mark smallest contents and a crucial decrease during the maturity causing probably a very low stability of their oils. Also, the dominating cultivar remains the variety marking the highest oil content.

Fatty acids composition has shown that all the examined autochthons varieties mark high rates of palmitic fatty acid and Stearic fatty acid which are widely higher than in the Moroccan Picholine cultivar. Likewise, the influence of the variety on the fatty acids composition is marked by the ratio oleic fatty acid / linoleic fatty acid. The highest ratio is noticeable by Bouchouk Laghlid variety, followed by the Moroccan Picholine, whereas the lowest values are marked by Bakhboukh Beldi and Bouchouk Rguigue varieties.

The evolution of total fatty acids proportions permits to distinguish, especially, between the Moroccan Picholine and Bouchouk Laghlid.

The examined autochthons varieties have shown a low rate of saturated fatty acids, a high rate of poly unsaturated fatty acids and a small content of natural antioxidants. These facts are probably responsible for their low potential of stability compared to the Moroccan Picholine.

The triglycerides composition highlights the closeness of Bouchouk Laghlid variety and the Moroccan Picholine cultivar, in addition to the dominance of the triolein in comparison with the other examined varieties which constitute by their own a distinct group from the first one marked by the dominance of triglycerides, PLO and SLO+POO.

This study has emphasized exceptions to limits of the IOOC regulations in force especially for the ECN42 concerning all examined varieties which have not yet been well examined.

In the light of these results, the examined Moroccan autochthons varieties have distinguished performances which should be exploited especially during the early stages of maturity. However, the Moroccan Picholine, the dominating local variety, gave an oil with good chemical properties and presents more interesting technological potential during the two examined stages of maturity.

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