A comparison of some Physical and Chemical Characteristics of Two Local and Seven Introduced Cultivars of Olives *Olea europaea*

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A comparison of some Physical and Chemical Characteristics of Two Local and Seven Introduced Cultivars of Olives *Olea europaea*

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Abstract. Olive oil is one of the most edible oils in the world due to its many health. Therefore, knowledge of its physical and chemical properties is indispensable for evaluating its quality. Different cultivars have been introduced in Iraq to improve yield and oil quality. However, there are few studies to compare these cultivars, so this study aimed to compare two local cultivars with seven introduced cultivars of the most cultivated olive cultivars in central and northern Iraq, using some physical and chemical parameters. The statistical analyses revealed that there were significant differences between the cultivars, and the values of the studied traits were as follows: density (0.9101 - 1.0377g / ml), pH (5.98 - 7), viscosity (40 -49 mpa.s), smoke point (200 - 245 °C), boiling point (190 – 213 °C), melting point (-2 – 10 °C). When comparing the varieties, local varieties had the highest density, viscosity, smoking point, and melting point values, while they had the lowest pH value. The results also showed that the introduced variety, Marnzanilla, was one of the best varieties, whose characteristics were among the Gulf standard specifications.

Key words. *Olea europaea*, Physical characteristics, Chemical characteristics, Local cultivars of olives, Introduced cultivars of olives.

1. Introduction

Olive *Olea europaea* L. belongs to the olive family Oliaceae and is the eastern Mediterranean home of olives such as Syria, Lebanon, Palestine, and Iraq [1]. The Mediterranean and adjacent areas, including Iraq, make up 92% of the world's cultivated area, which is estimated at 1010 million hectares occupied by 1017 million trees [2]. The cultivated area of olive trees in Iraq is approximately 555 thousand dunums during the 15 years. It constitutes 0.7% of the total cultivated area. Olive cultivation prevails in all types of land, especially those that are not suitable for planting fruit trees [3].Olive oil is a major ingredient in the diet, being an important factor in the prevention of diseases. It is made up of unsaturated single fatty acids, oleic acid is the main acid, in addition to having secondary ingredients that act as effective antioxidants, such as hydroxytyrosol, studies have also shown that olive oil consumption can be a primary and secondary protective factor against cardiovascular disease because it reduces concentrations of low-density lipoproteins(LDL) and increases the concentration of high-density lipoproteins(HDL), moreover, it is anti-inflammatory, and

the ingredients in olive oil are also associated with promoting gut health because it stimulates the high biodiversity of beneficial gut bacteria, enhancing their balance [4]. During the period of olive growth, physical and chemical changes occur, important for the production of olive oil where different varieties can show different properties due to their chemical composition, and environmental conditions can also show an impact on the characteristics of the oil [5,6]. Physical and thermal qualities are of great importance to consumers and industries and are closely related to chemical composition[7].

[8] mentioned, when studying three varieties of olive trees (Achersi, Bashiqi and Dakal), that the density of olive oil ranged from 1.027 to 1.060 g/cm^3. [9] reported that the pH of five cultivars of Turkish olive trees ranged from 5,037 to 5,667. Viscosity is one of the indicators used to evaluate changes in the physical properties of edible oil. Which depend on density, melting point, molecular weight, temperature, and degree of unsaturation [10]. The cooking process is a complex process that is affected by several factors, including temperature, pH, oxygen, and others [11]. Fried food usually absorbs a large amount of frying oil. Therefore, it is important that we ensure the high quality of the oil by using various parameters. This helps to identify the point at which the oil should be discarded, to maintain optimal oil quality. An increase in the frying temperature will increase thermal oxidation reactions and oligomerization reactions, not only in fatty acids or triglycerol molecules, but also in secondary components such as antioxidants present in the oil, whose levels will be severely disrupted or reduced due to high heat during frying [12,14]. The smoke point of cooking oil should be at least 170 °C and should not differ from the fresh fat temperature by more than 50 °C so that we can classify the fat as still usable [15]. The aim of this study is to evaluate and compare some physical and chemical properties of virgin olive oils extracted from two local varieties and seven introduced varieties grown in central and northern Iraq, including density, viscosity, pH, smoke point, boiling point, melting point and finding out the best varieties.

2. Material and Methods

2.1. Sample Preparation

Olive cultivars [Two local Iraqi varieties (Baashiki, Dahkan), and seven introduced cultivars (Marnzanilla, Picual) Spanish, (Ascolana, Frantoio) Italian, (Sorani) Egypt, (Kaissy) Syrian, (Nabali Muhasan) Jordanian] were collected from some regions of central Iraq (Tikrit, Al-Alam, Yathrib, Al-Dhuluiya, Al-Mu'tasim) and the northern (Sharo, Chamchamal, Alton Kupri, Taslujah) during the period from the end of September 2021 until the end of April 2022, the fruits were chosen to be as homogeneous as possible. The experiment was conducted for each trait in three copies. The average samples for each variety were calculated and analyzed as follows. and analyzed as follows:

2.2. Density of Olive Oil

To measure the density of olive oil a pycnometer was used as suggested by(AOAC 920.212) and the results are expressed in g/ml [16].

2.3. Olive Cultivar's pH

pH: It was estimated by pH meter type Phillips after adjusting the device using a standard solution buffer, the experiment was carried out in triplicate and the samples were averaged for each cultivar according to [16].

2.4. Viscosity

The viscosity of olive oil samples was determined using the Ostwald Viscometer and measured at a temperature of 25.7 °C by inserting a probe directly into the sample experiments were conducted in triplicate and the average samples were taken [17].

2.5. Smoking and Boiling Point

The smoke and boiling point for each item was recorded using (YD-1) the automatic oil smoke point instrument based on the AOCS official method Cc 9a-48, The samples were tested with a glass of

olive oil for each item and then heated the oil samples until continuous blue smoke appeared and then measured by duplicate, the experiment was carried out in triplicate and the samples were averaged for each cultivar [16,18].

2.6. Melting Point

The melting point was measured by taking the average of triplicate for each cultivar according to the methods used in [19].

2.7. Statistical Analysis

The rate of three repeaters (prepared separately) was calculated and then the statistical results were analyzed by a one-way analysis of the ANOVA variation using the SPSS software (version 18.0) and at the probability level $p < 0.05$ and to determine the differences between the varieties the LSD test was used at the probability level $p < 0.05$.

3. Results and Discussion

3.1. Density

Tables (1) and (2) show that there are significant differences between cultivars in density and that the two local cultivars differ significantly from each other, the local cultivar Baashiki differed significantly from the introduced cultivars Marnzanilla, Frantoio Sorani, Kaissy, and Ascolana, while the local item cultivar Dahkan it did not vary significantly with the input items, which may be due to the species' tolerance of environmental conditions. We note from Figure (1) that the highest density was (1.0377 g/ml) for the local cultivar Dahkan, while the lowest density was (0.9101 g/ml) for the introduced Marnzanilla cultivar. The highest increase was observed in Iraqi olive oil, followed by Syrian and then Spanish olive oil [20]. These results did not agree with [6,21], where the olive oil density of all cultivars was within the international standard value.

Table 1. Physical and chemical characteristics of olive oils samples.

Olive cultivars	Density g\ ml	pH	Viscosity 25 °C (mpa's)	Smoking point (°C)	boiling point (°C)	melting point (°C)
Baashiki	0.9806	6.84	49	222	195	2
Dahkan	1.0377	5.98	44	245	203	10
Marnzanilla	0.9101	6.53	45	201	190	-1
Picual	0.9717	6.32	48	224	200	6
Ascolana	0.9151	7	43	200	192	-2
Frantoio	0.9715	6.68	42	230	213	6
Sorani	1.0053	6.02	41	238	210	8
Kaissy	0.9687	6.73	41	219	201	6
Nabali Muhasan	0.978	6.90	40	220	198	6

Table 2. Signification levels of the studied effects(Olive cultivars) on the physicochemical properties of the olive oil.

Property	Olive cultivars (MS)
Density g\ ml	0.040 *
PH	0.419 *
(mpa,s) Viscosity	29.370 *
Smoking point (°C)	654.750 *
boiling point (°C)	174.315 *
melting point (°C)	19.663 *

One-way ANOVA , * $p < 0.05$.

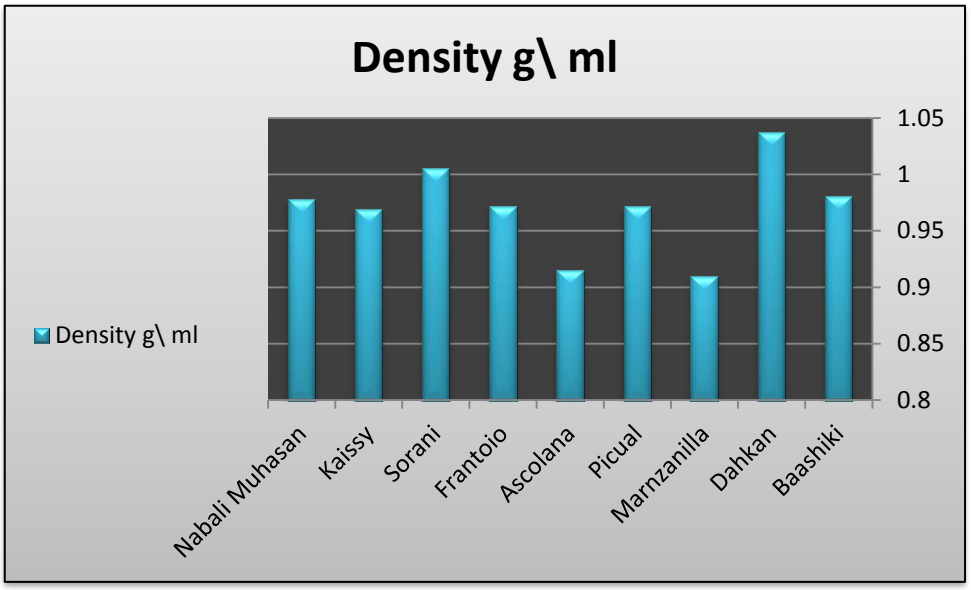

Figure 1. Density of olive oil samples.

3.2. pH

Tables (1) and (2) show a significant difference in pH between the two local cultivars, and that the local cultivar Baashiki is significantly different from the introduced cultivars, with the exception of Ascolana, Frantoio, Kaissy, and Nabali Muhasan , where the differences between them did not reach the level of significance. The local cultivar Dahkan differed significantly with all the cultivars introduced except for the cultivar Sorani. From Figure (2) we notice that the lowest pH value was (5.98) for the local cultivar Dahkan, while the highest pH value was (7) for the introduced variety Ascolana. As for the rest of the cultivars, the pH value ranged between (6.02-6.90). These results did not agree with [7], where the highest pH of its cultivars was (5.05), and they did not agree with [22], where the pH of the studied olive cultivars ranged between (4.91 - 5.51).

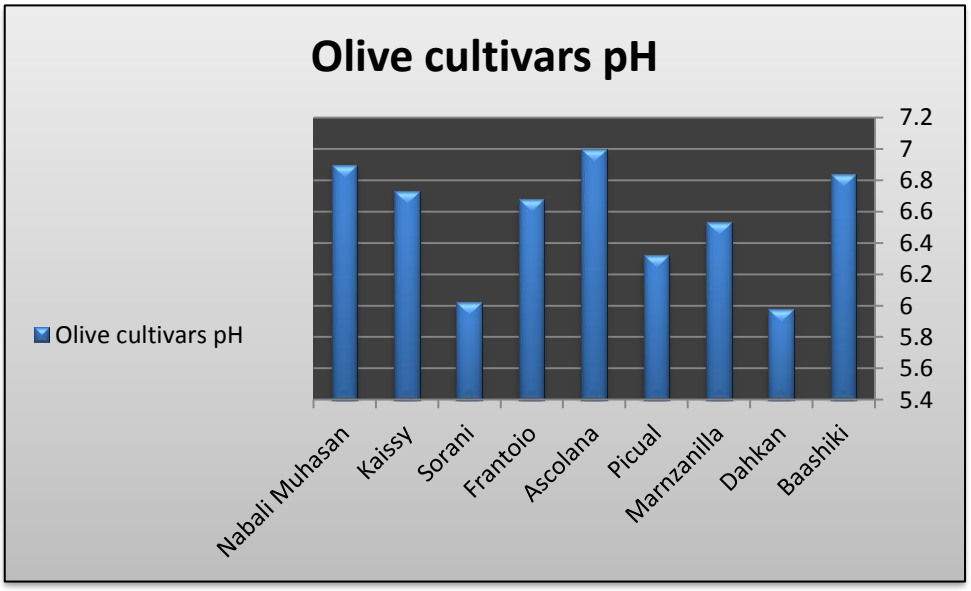

Figure 2. Olive cultivars pH.

3.3. Viscosity

From Tables (1) and (2) we notice that there are significant differences in the viscosity of olive oil between the two local cultivars, and all the introduced cultivars, as we notice from Fig (3), that the highest viscosity rate of olive oil at a temperature of 25 °C was (49mPa. s) for the local cultivar Baashiki, while the lowest rate (40 mPa.s) was for the introduced cultivar, Nabali Muhasan. The viscosity of the rest of the varieties ranged between (41-48 mPa.s). These results are inconsistent with [23] where the viscosity rate was found to be (60.7 cP) at 25 °C. These results are also inconsistent with [24]where the dynamic viscosity of olive oil was found to be (44.5cP) at 40°C. The different values of the dynamic viscosity of olive oil may be caused by the effects of fatty acid formation or the use of agricultural machinery [25].

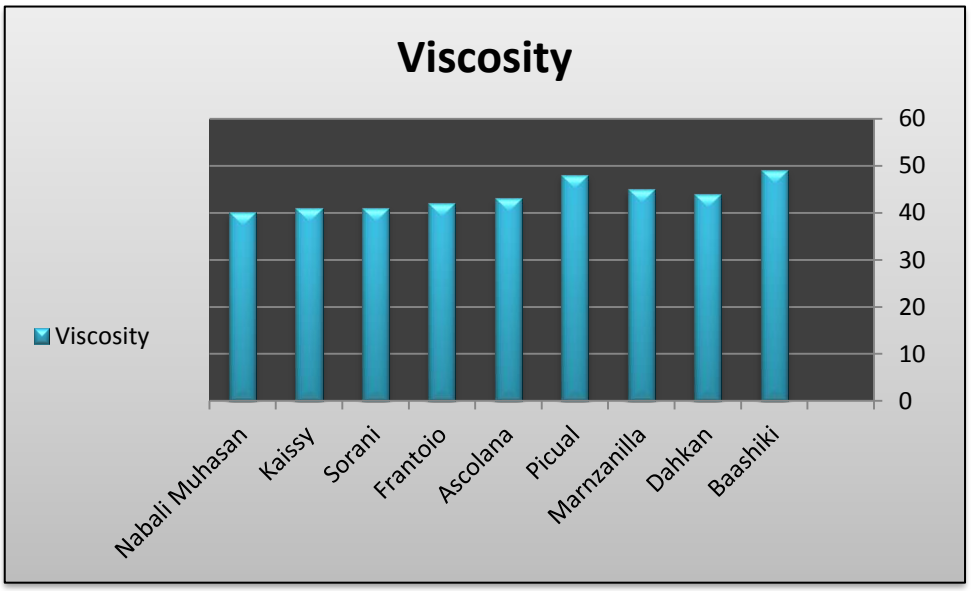

Figure 3. Viscosity of olive oil samples.

3.4. Smoking Point

We note from Tables (1) and (2) that there are significant differences between the smoking point of the studied varieties. As we can see from Figure (4) The highest rate was (245°C) for the local variety Dahkan, while the lowest rate was (200°C) for the introduced variety Ascolana. The reason for the difference in the smoking point between the varieties may be a result of the difference in the content of these varieties of free fatty acids. There is an inverse relationship between the smoke point and the production of free fatty acids, when the oil heats up, the production of free fatty acids increases by increasing the heating time, and thus the smoke point decreases (26). These results are consistent with [27], where the smoke point was 210°C. While these results did not agree with [15], where the smoke point was 190°C.

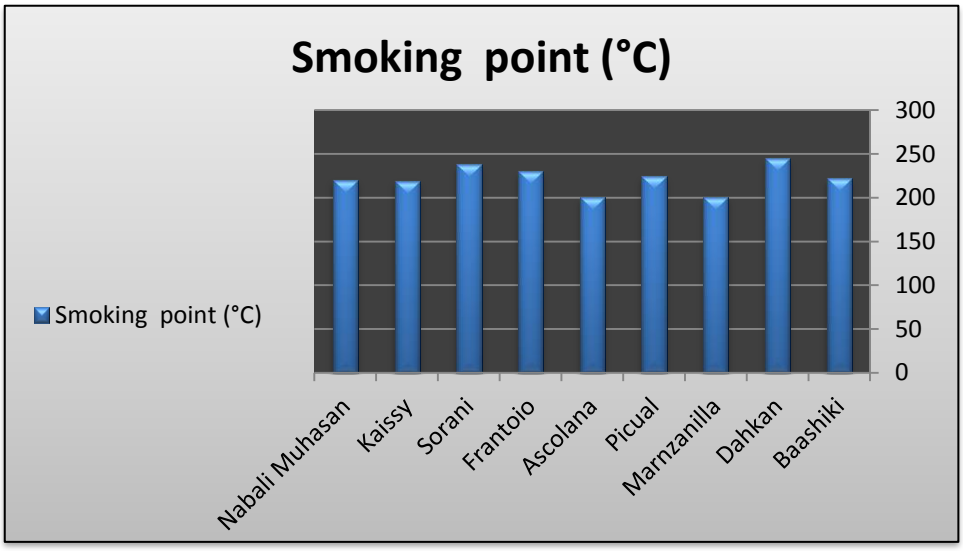

Figure 4. Smoking point of olive oil samples.

3.5. Boiling Point

From Tables (1) and(2) it is clear that there are significant differences in the boiling point of olive oil for the two local cultivars and all introduced cultivars, we notice from Figure (5) and that the highest boiling point average (213°C) was for the introduced variety Frantoio, while the lowest boiling point average was (190°C).) of the introduced cultivar (Marnzanilla). This is not consistent with [27], where it was stated that the Fire point of olive oil was (372 °C).

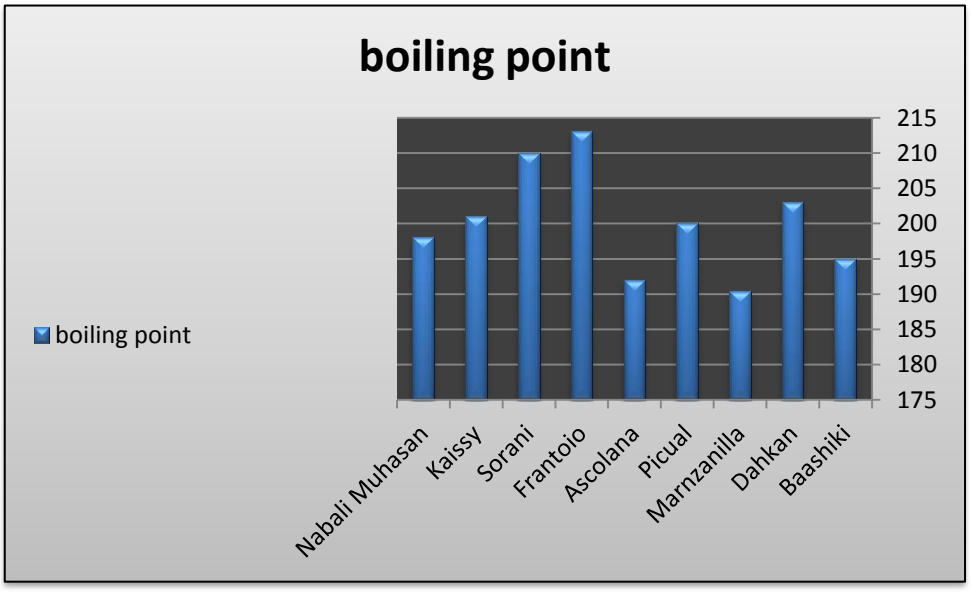

Figure 5. Boiling point of olive oil samples.

3.6. Melting Point

From Tables (1) and(2) it appears that there are significant differences in the melting point between the two local cultivars and between the introduced cultivars. The highest rate of the melting point was (10°C) for the local variety (Dahkan), while the lowest rate was (-2°C) for the introduced variety (Ascolana) Figure (6). The difference in melting point is a result of the pair bonds of the fatty acids, so the melting point decreases with the increase in the number of pair bonds, likewise, sunflower oil has a low melting point and reaches up to (-17°C) as a result of its high content of unsaturated fatty acids,

particularly linoleic polyunic acid. of it containing a high percentage of unsaturated fatty acids, especially poly linoleic acid with double bonds [28].

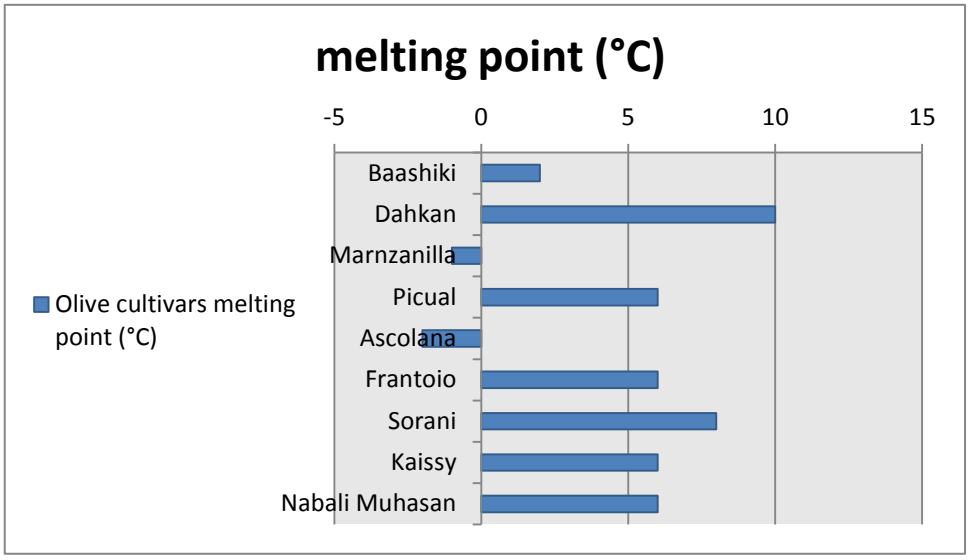

Figure 6. Melting point of olive oil samples.

Conclusions

There is not much information about the physical and chemical characteristics of the olive oil varieties found in Iraq, especially the characteristics of the smoking point, boiling point, and melting point, so the purpose of this research, was to evaluate the quality of the varieties of these oils, and to compare the local varieties with the introduced ones.

The results of the study showed that there were significant differences in the properties of olive oil samples between local and entered varieties in the characteristics of density, pH, viscosity, smoke point, boiling point, and melting point. The differences were most likely due to the composition of fatty acids, as we see that the difference in melting point between olive oil samples It is due to the difference in the composition of the fatty acids, as its melting point decreases with the increase in the double bonds and the percentage of unsaturated fatty acids.

The results also showed that the introduced variety, Marnzanilla, was one of the best varieties, whose characteristics were among the Gulf standard specifications, and the local variety, Dahkan, had the highest smoking and melting point, and the lowest pH value and this is considered one of the good characteristics.It is necessary to take advantage of the introduced and local varieties with good specifications in the processes of breeding and improvement to produce varieties that can be successfully used as a source of olive oil that has high productivity and specifications.

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