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Assessment of the Quantitative Genetic Diversity among some Imported Olive Cultivars at Benghazi Governorate - Libya

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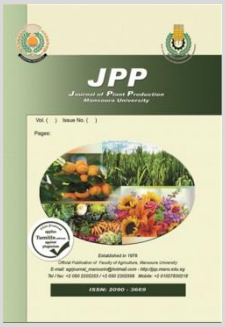

ABSTRACT

Quantitative morphological characters were used to characterize and assess the genetic diversity among seven imported olive cultivars in Sidi Farag region at Southeast of Benghazi Governorate, Libya during 2020 and 2021. Results analyses of 12 morphological characters revealed the existence of a recorded genetic variability among the studied cultivars. Morphological data were collected for quantitative traits such as mean number of fruits per kg, mean of fruit weight, and its volume, shape as well as mean of stone weight, and shape, fruit flesh/stone ratio, flesh thickness and weight, mean of oil percentage, humidity percentage. The morphological traits and analysis of variance showed a highly significant variation among various olive cultivars under study. Although the Kal Kadeke variety recorded the highest values of fruit size and weight, fruit flesh/stone ratio as well as Flesh weight and humidity percentage, they gave the lowest oil content in wet and dry weight by 15%, and 11.4% respectively. On the other hand, the Ascolano variety has the highest oil content in wet and dry weight which reached 47.05%, and 38.28%, respectively.

Keywords: Olive, varieties, morphological characters, Libya

INTRODUCTION

The olive tree (*Olea europaea* L.) is one of the most important, oldest, and most known trees in the Mediterranean basin including Libya, due to its social, economic, and environmental impacts (Carrión, *et al.*, 2010). It is a woody tree species that characterizes the Mediterranean landscape, its spread in the Mediterranean basin and the northern Levant dates back more than 6,000 years (Besnard, *et al.*, 2013). The distribution of wild and cultivated olives overlaps in the Mediterranean Basin region, although both wild and cultivated olives can be distinguished through morphological and genetic differences (Gianguzzi, and Bazan, 2019). Oleaster in the most ancient indigenous civilizations has long been exploited to renew trees and convert them into productive olive trees (*Olea europaea*) to produce both fruits and oil (Gianguzzi, and Bazan, 2019). The domestication and selection processes are the best source of a lot of varieties productive and highly adaptable trees, which led to a constantly increasing number of varieties (Besnard, *et al.*, 2013). Although estimates indicate that varieties are grown all over the world more than 2,000 (Arenas-Castro, *et al.*, 2020; and Fanelli, *et al.*, 2022), but the International Olive Council (IOC, 2021) estimates that about 85% of the world's olive production is represented by only 139 varieties, which are cultivated in 23 different countries. These trees are considered good genetic sources for cultivated olives (Lev-Yadun *et al.*, 2000; and Barazani, *et al.*, 2023). Olive landraces, presumably encompass a higher level of genetic diversity than their modern decedents (Zhang *et al.*, 2017).Where it is generally thought that the cultivation of olive trees started through selection from natural populations of wild landraces (Kaniewski *et al.*, 2012; and Barazani, *et al.*, 2023). but it's unclear whether the domestication of crops was initiated by the conscious selection of desirable traits (Spengler, 2020), such as the propagation of 'better' phenotypes, which is clear in trees with larger fruits, high oil content, increased yield, etc. (Zohary *et al.*, 2012; and Barazani, *et al.*, 2023).

According to the Food and Agriculture Organization of the United Nations (FAO, 2012), Libya ranks the twelfth largest globally among olive oil producers, with average production reaching 0.25% of global production. According to data from the Ministry of Agriculture (FAO,2012), Libya has 8 million olive trees and the average production of 160,000 tons of olives and 32,000 tons of olive oil, after Morocco, Tunisia, and Algeria. Recently, Libya has moved towards diversifying its economy, which depends on oil, to compete with its neighbors in the region by improving the quality of olive production as well as olive oil to become more competitive in European markets, as olive production and consumption is of vital economic importance in Mediterranean countries basin, including Libya (El-Khatib, *et al.*, 2012; and Abdul, *et al.*, 2013). According to Sadeg, 2014, the number of genotypes of cultivated olives has reached about 91 genetic varieties in Libya (39 local strains, 36 introduced varieties, and 16 wild species). About 205,000 hectares were cultivated with more than 9 millions olive trees with an average of 135,000 tons of olive fruit in Libya according to 2008 official statistical data and FAOSTAT data, (Daham and Ashur, 2008; and FAO,2012), representing more than 100 cultivars.

The present study aimed to develop a reliable reference database to discriminate between the major varieties of olive (*Olea europaea* L.) in Libya.

MATERIALS AND METHODS

The experimental site and sampling region:

The research was conducted on one of the private farms located southeast of Benghazi Governorate in the Sidi

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Farag region, where field expeditions were carried out during the years 2020 and 2021, and seven olive varieties were selected from the cultivated varieties, including table varieties, oil varieties, and dual-purpose varieties. These varieties were imported from different sources and have been cultivated for more than 20 years and have proven their adaptation under rain-fed agricultural conditions in Libya.

Plant material:

Morphological quantitative traits measurements:

Characteristics of the fruit:

These characteristics were determined in samples of 50 fruits from I kg of each variety in 4 replicates.

- Fruit weight of 4 fruit categories: Low (<2g), Medium (2-4g), High (4-6 g), Very high (>6 g).
- Fruit shape was determined from length (L) and width (W) ratio which was divided into 3 groups: Spherical (L/W < 1.25), Ovoid (L/W 1.25-1.45), and Elongated (L/W > 1.45).
- Fruit flesh/stone ratio: It is the percentage between the weight of the fruit flesh and the weight of the stone, using the following equation:

$$\left[\frac{\textbf{weight of flesh}}{\textbf{weight of stone}} * \mathbf{100}\right]$$

- No. of fruits/kg: which was estimated in 4 replicates for each variety.
- Fruit size: The size of the fruits was estimated by placing several fruits in a beaker of water of known size. The amount of increase in the volume of water was determined, and the average size of the fruits was calculated according to the following equation:

$$\textbf{Fruit size (cm}^3\textbf{)} = \left[\frac{\textit{The amount of increase in the volume of water}}{\textbf{Number of fruits}}\right]$$

Table 1. List of the seven olive cultivars studied and their corresponding country of origin.

No.	Cultivar	Origin
1	Kal Kadeke	Greece
2	Ascolano	Greece
3	Frantoio	Italy
4	Manzanillo	Spain
5	Thehabea	Morocco
6	Koroneiki	Greece
7	Cevellano	Spain

Characteristics of the endocarp (Stone):

These characteristics were evaluated in a sample of 50 stones from each variety in 4 replicates.

- Stone weight was also divided into 4 categories: Low (<0.3g), Medium (0.3-0.45g), High (0.45-0.7 g), Very high (>0.7 g).
- Stone shape was determined from length (L), and width (W) ratio which was also divided into 4 groups: Spherical (L/W < 1.4), Ovoid (L/W 1.4-1.8), Elliptic (L/W 1.8-2.2) and Elongated (L/W > 2.2).

Olive oil percentage (%):

The percentage of olive oil was estimated at the Agricultural Research Laboratory at Al-Fataeh Station in Derna city, using a SOXHLET, it is the percentage of the weight of the oil compared to the wet and dry weight of the fruits by using the following equations**:**

$$\textbf{Olive oil content in dry matter (\%)} = \left[\frac{\textbf{weight of oil}}{\textbf{weight of dry matter}} * \mathbf{100}\right]$$

$$\textbf{Olive oil content in wet matter (\%)} = \left[\frac{\textbf{weight of oil}}{\textbf{weight of wet matter}} * \mathbf{100}\right]$$

Statistical analysis:

The analysis of variance was carried out according to Gomez and Gomez (1984). The data was analyzed by the SPSS statistical tool (V. 20), and the differences between means, were examined by using the least significant difference ($LSD_{0.05}$).

RESULTS AND DISCUSSION

Morphological traits of the olive fruits:

Table 2 shows the study characteristics of olive fruits for seven imported olive varieties that have been grown in Libya for more than twenty years. Analysis of variance shows that there are significant differences among all varieties for all studied traits.

The results in Table 2 showed that the Kal Kadeke variety had the largest average size and weight of fruits compared to other varieties, as the average size and weight of the fruit were 7 cm^3 and 6.32 g, respectively, weight of the fruits varied from low to very high, and thus the lowest average number of fruits/kg recorded, amounted to 158 fruits /kg for the same variety. On the other hand, the Koroneiki variety recorded the minimum average fruit size and weight with an average of 0.93 cm^3 and 0.95 g, respectively. It also had the highest average number of fruits, which amounted to 1049 fruits/kg. It is also clear from the results that there were significant differences among all varieties about the number of fruits per kilogram, and regarding the size of the fruits, there were no significant differences between the two olive varieties, Manzanillo and Koroneiki, and between the two varieties, Cevellano, and Frantoio. Likewise, the differences in the weight of the fruits were significant among all varieties. As for the shape of the fruits, it differed between spherical for the Cevellano variety, oval for the Koroneiki variety, and elongated for the other varieties under study. These results are in general agree with those obtained previously by Matouk, *et al.,* 2007; Al-Menaie, *et al.,* 2014; and Kartas, *et al.,* 2016.

Table 2. Morphological fruits traits of the various olive cultivars under study

Variety	No. of fruits/kg	Fruit size cm^3	Fruit Weight (g)	Fruit shape
Kal Kadeke	158	7.0	6.32	1.51
Ascolano	208	4.6	4.77	1.46
Frantoio	505	2.0	2.01	1.57
Manzanillo	842	1.11	1.22	1.51
Thehabea	304	3.23	2.05	1.82
Koroneiki	1049	0.93	0.95	1.30
Cevellano	536	1.9	1.87	1.21
$LSD_{(0.05)}$	2.39	0.18	0.056	0.076

The data presented in Table 3 shows the characteristics of the fleshy part of olive fruits, where it showed highly significant difference among some varieties for the measured characteristics of the fleshy part, where the highest average thickness of the fleshy part was 3.0 cm of the Ascolano variety, with significant differences from the rest of the varieties, while the lowest average thickness of the fleshy part was for the fruits of the Manzanillo variety which reached 0.25 cm, and there were no significant differences between it and the Koroneiki and Cevellano varieties, for which the thickness of the fleshy part reached 0.34 cm, and 0.29 cm, respectively.

Although the Ascolano variety was superior in terms of the average thickness of the fleshy part of the fruit, it came in second for the weight of the fleshy part and the ratio of the fleshy part to the stone after the Kal Kadeke variety, which recorded the maximum average weight of the fleshy part, which amounted to 5.71 g, and the ratio of the fleshy part to

stone. The fruit flesh to stone reached 90.35%, while the average weight of the fleshy part of the Ascolano variety reached 3.9 g, and the ratio of the fleshy part to the weight of the stone was 77.36%. On the other hand, the Manzanillo variety recorded the lowest average weight of the flesh thickness, as well as the ratio of the fleshy part to the stone weight, which reached 0.25 g and 20.49%, respectively. Similar results were obtained previously by Matouk, *et al.*, 2007 in Egypt.

Table 3. Flesh fruit traits of the various olive cultivars under study

Variety	Flesh thickness (cm)	Flesh weight (g)	Fruit flesh/stone ratio
Kal Kadeke	0.54	5.71	90.35
Ascolano	3.90	3.69	77.36
Frantoio	2.20	1.41	70.15
Manzanillo	0.25	0.25	20.49
Thehabea	3.09	1.51	73.66
Koroneiki	0.34	0.65	68.42
Cevellano	0.29	1.39	74.33
LSD (0.05)	0.099	0.107	0.466

The results presented in Table 4 show the morphological traits of the inner stone of the different olive varieties, where the weight of the stone varied from a low of 0.27 g for the Manzanillo variety to a very high 1.08 g for the Ascolano and Cevellano varieties. As for the stone shape of the olive fruits, it differed between ovoid for the Koroneiki variety, elliptical for the Kal Kadeke variety, and elongated for the rest of the varieties (Ascolano, Frantoio, Manzanillo, Thehabea, and Cevellano).

Table 4. The endocarp (stone) morphological traits of the various olive cultivars under study

Variety	Stone weight (g)	Stone shape
Kal Kadeke	0.62	2.07
Ascolano	1.08	2.21
Frantoio	0.57	2.26
Manzanillo	0.27	2.29
Thehabea	0.54	2.8
Koroneiki	0.3	1.67
Cevellano	1.08	2.25
LSD (0.05)	0.049	0.16

The data in Table 5 shows the oil content of olive fruits, as well as the moisture content of the fruits of the olive varieties under study. There were highly significant differences in the oil content between the fruits of the different olive varieties, as the oil percentage varied in relation to the wet and dry weight of the fruits. The results showed that the Ascolano variety was superior in the oil content of the fruits, as it recorded the maximum mean oil percentage, which amounted to 38.28% and 47.05% for wet and dry weight, respectively. On the other hand, the minimum average oil percentage in the fruits was 11.4% and 15% for the wet and dry weight, respectively, of the Kal Kadeke variety.

Table 5. Olive oil content and humidity of the fruits for the various olive cultivars under study

Variety	Humidity (%)	Olive oil content in dry matter (%)	Olive oil content in wet matter (%)
Kal Kadeke	32.0	11.40	15.00
Ascolano	22.9	38.28	47.05
Frantoio	10.1	24.84	30.05
Manzanillo	31.2	14.10	18.60
Thehabea	16.3	22.40	25.00
Koroneiki	25.6	28.62	32.60
Cevellano	24.0	11.70	16.00
LSD (0.05)	1.18	0.24	0.59

On the other hand, the humidity percentage in olive fruits varied from 10.1% in the Frantoio variety to 32% in the fruits of the Kal Kadeke variety, followed by Manzanillo, where the humidity percentage in the fruit reached 31.2%. These results agree with Matouk, *et al.*, 2007; and Mezghani, *et al.*, 2012.

CONCLUSION

The results obtained, it is possible to clarify and divide these different varieties of olives according to the purpose of use, as found that the varieties Ascolano, Koroneiki, and Frantoio, are preferred to be used as an oil varieties, due to their high oil content, on the other hand, it is preferable to use the varieties Kal Kadeke, Cevellano, as a table varieties, due to the large size of the fruits and their low oil content, while the varieties Thehabea and Manzanillo can be used for dual purposes.

REFERENCES

Abdul, S., Volk, G. M., Richards, C. M., Hughes, H. (2013). Characterization of Libyan olive, *olea europaea* L., cultivars using morphological data. In Meeting Abstract (No. 15849).

Al-Menaie, H., Al-Ragam, O., Mahgoub, H., Al-Hadidi, M., Al-Shatti, A., & Al-Zalzalah (2014), M. Evaluation of some olive cultivars under kuwait environmental conditions. Olivebioteq, 45.

Arenas-Castro, S.; Gonçalves, J.F.; Moreno, M.; Villar, R. (2020). Projected climate changes are expected to decrease the suitability and production of olive varieties in southern Spain. Sci. Total Environ. 709, 136161.

Barazani, O., Dag, A., Dunseth, Z. (2023). The history of olive cultivation in the southern Levant. Frontiers in Plant Science, 14, 1131557.

Besnard, G., Khadari, B., Navascués, M., Fernández-Mazuecos, M., El Bakkali, A., Arrigo, N. Savolainen, V. (2013). The complex history of the olive tree: from Late Quaternary diversification of Mediterranean lineages to primary domestication in the northern Levant. Proceedings of the Royal Society B: Biological Sciences, 280(1756), 20122833.

Carrión, Y., Ntinou, M., Badal, E. (2010). *Olea europaea* L. in the north Mediterranean Basin during the Pleniglacial and the Early–Middle Holocene. Quaternary Science Reviews, 29(7-8), 952-968.

Daham, M., Ashur, A. H. (2008). Book of agriculture statistics.League of Arab States.Arab Organization for Agricultural Development. Khartoum. Sudan.

El-Khatib, A. A., Radwan, D. E. M., Alramah-Said, A. A. (2012). Morpho-anatomical characteristics of olive (*Olea europaea* L.) trees leaf as bio-indicator of cement dust air pollution in Libya. Journal of Environmental Studies, 9(1), 65-72.

Fanelli, V., Mascio, I., Falek, W., Miazzi, M. M., Montemurro, C. (2022). Current status of biodiversity assessment and conservation of wild olive (*Olea europaea* L. subsp. *europaea* var. *sylvestris*). Plants, 11(4), 480.

Food and Agriculture Organization of the United Nations. (2012). FAOSTAT.FAO.org

Gianguzzi, L., Bazan, G. (2019). The *Olea europaea* L. var. *sylvestris* (Mill.) Lehr. forests in the Mediterranean area. Plant Sociology, 56(2), 3-34.

Gomez KA, Gomez AA (1984). Statistical Procedures for Agricultural Research. John Wiley & Sons

International Olive Council (IOC). Available online: https://www.internationaloliveoil.org (accessed on 10 December 2021).

Kaniewski, D., Van Campo, E., Boiy, T., Terral, J. F., Khadari, B., Besnard, G. (2012). Primary domestication and early uses of the emblematic olive tree: palaeobotanical, historical and molecular evidence from the Middle East. Biological Reviews, 87(4), 885-899.

Kartas, A., Chliyeh, M., Touati, J., Ouazzani Touhami, A., Gaboun, F., Benkirane, R., & Douira, A. (2016). Evaluation of bio-agronomical characteristics of olive fruits (Olea europaea L.) of the introduced varieties and local types grown in the Ouazzane areas (Northern Morocco). International Journal of Advances in Pharmacy, Biology and Chemistry, 5(1), 39-43.

Lev-Yadun, S., Gopher, A., Abbo, S. (2000). The cradle of agriculture. Science, 288(5471), 1602-1603.

Matouk, A. M., Abou elmagd, A. E., Hamam, A. S., Owies, T. R. (2005). Physical Properties for Some Egyptian Varieties of Olive Fruits and Their Relation to Olive Conveying Auger Design. Egyptian Journal of Agricultural Research, 83(2), 1005-1029.

Matouk, A. M., Owis, T. R., El-Khawaga, S., Tharwat, A. (2007). Physical properties for some varieties of olive fruits. Journal of Soil Sciences and Agricultural Engineering, 32(8), 6361-6374.

Mezghani, M. A., Charfi, C. M., Gouiaa, M., & Labidi, F. (2012). Vegetative and reproductive behaviour of some olive tree varieties (Olea europaea L.) under deficit irrigation regimes in semi-arid conditions of Central Tunisia. Scientia horticulturae, 146, 143-152.

Sadeg, S. A. (2014). Morphological and molecular characterization of Libyan olive, *Olea europaea* L., cultivars (42 local and 16 wild type) in comparison to 41 introduced (world) cultivars (Doctoral dissertation, Colorado State University).

Spengler, R. N. (2020). Anthropogenic seed dispersal: rethinking the origins of plant domestication. Trends in plant science, 25(4), 340-348.

Zhang, H., Mittal, N., Leamy, L. J., Barazani, O., Song, B. H. (2017). Back into the wild—Apply untapped genetic diversity of wild relatives for crop improvement. Evolutionary Applications, 10(1), 5-24.

Zohary, D., Hopf, M., Weiss, E. (2012). Domestication of plants in the old world (Oxford: Oxford University Press).

تقييم التنوع الوراثي الكمي لبعض أصناف الزيتون المستوردة بمحافظة بنغازي – ليبيا

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الملخص

تم استخدام الصفات المورفولوجية الكمية لتوصيف وتقييم التنوع الوراثي بين سبعة أصناف زيتون مستوردة في منطقة سيدي فرج جنوب شرق محافظة بنغازي – ليبيا خلال عامي 2020، و2021. وقد كشف تحليل التباين لـ 12 صفة مورفولوجية عن وجود تباين وراثي بين أصناف الزيتون تحت الدراسة. تم جمع البيانات المورفولوجية للصفات الكمية مثل متوسط عدد الثمار لكل كجم، ومتوسط وزن الثمار، وحجمها، وشكلها وكذلك متوسط وزن الحجر، والشكل، ونسبة لحم الثمار إلى الحجر، وسمك اللحم ووزنه، ومتوسط عدد الثمار، نسبة الزيت، نسبة الرطوبة. أظهرت الصفات المظهرية وتحليل التباين وجود تباين معنوي بين أصناف الزيتون المختلفة قيد الدراسة. على الرغم من أن الصنف Kal Kadeke سجل أعلى القيم في حجم الثمار ووزنها ونسبة لحم الثمار إلى الحجر وكذلك وزن اللحم ونسبة الرطوبة، إلا أنه أعطى أقل محتوى زيت في الوزن الرطب والجاف 15% و11.4% على التوالي. من ناحية أخرى، يتمتع صنف Ascolano بأعلى نسبة زيت سواء في الوزن الرطب أو الجاف حيث بلغت 47.05%، و38.28% على التوالي.

الكلمات المفتاحية: الزيتون، أصناف، الصفات المورفولوجية، ليبيا