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SUMMARY

The present study was undertaken in an effort to give a detailed picture on the morphological and chemical characteristics of fruits together with the quality of oil in four olive cultivars named; Toffahi, Yonani, Kalamata and Chemlali grown in four well established agroecosystems (rain-fed; rain-fed improved; irrigated and irrigated improved) common in the northwestern coastal zone of Egypt. The work was also conducted to estimate the level of polymorphism among the last mentioned olive cultivars in addition to other three less common cultivars named Khodery, Manzanella and Frontero. Two PCR-based molecular markers (RAPD and AFLP) together with a biochemical marker (protein profile) were used to identify unique DNA markers and generate fingerprints for each cultivar. Such identification was to explore the genetic diversity among the selected cultivars.

The concentration of total soluble sugars (mg g^{-1}) increased gradually from the time of fruit set (May) till fruit ripening (August). Starch increased gradually till it attained its maximum in August. The concentration of total carbohydrates did not show the same trend for the selected cultivars. The variation in the concentration of total nitrogen in the fruits of Toffahi, Yonani and Kalamata from fruit set till fruit ripening was not significant. There was a decrease in the concentration of total nitrogen during the last period of fruit ripening (after September till November) in Toffahi cultivar. The concentration of soluble organic nitrogen decreased from the time of fruit set to that of fruit ripening. Toffahi, rainfed improved, had the lowest concentration (0.101 mg g^{-1}) at the end of September. Yonani cultivar attained its minimum concentration in August (0.108 mg g^{-1}). Total concentration of insoluble organic nitrogen decreased gradually from fruit set to the full ripening of the fruits in all the four cultivars. Toffahi showed its highest decrease in the concentration of total insoluble organic nitrogen in December where it lost 52% of its starting concentration, concentration of crude protein was nearly constant during the period after fruit set till fruit ripening in the Toffahi, Yonani and Kalamata fruits. There was a decrease in the percent of crude protein during the last period of fruit ripening (after September till November) in the Toffahi cultivar.

Total concentration of free amino acids followed the same trend for the selected cultivars, and even within the different agro ecosystems, within each cultivar. The highest concentrations recorded were that for the rainfed Toffahi (18.600 mg g^{-1})

during August. Kalamata, rainfed and Chemlali rainfed also followed the same trend of the Yonani, where they attained their maximum concentration of free amino acids during August (18.250 and 17.410 mg g⁻¹ respectively). The highest values of proline concentration were that of the rainfed agro ecosystem during May; 0.53, 0.55, 0.59 and 0.58 for Toffahi; Yonani; Kalamata and Chemlali respectively.

Fruit weight, length and width increased gradually from the time of fruit set till that of fruit ripening. The highest increase in fruit weight was that of Toffahi cultivar in June. The highest fruit width was that attained by Toffahi; rainfed improved at the beginning of June. Flesh weight of Yonani irrigated improved had the highest share where it reached a maximum of 5.66 g of flesh weight during November. The highest value recorded next was that of Kalamata; irrigated improved (5.32 g) during October. Chemlali comes at the end of the list with only 2.12 g for the same agro ecosystem during October.

The highest seed weight was that recorded for the Yonani, irrigated improved (1.54 g) while the lowest (0.29 g) was attained by Chemlali, rainfed. Both records were observed during December. The highest values recorded for the olive volume was that of the Toffahi, Yonani, Kalamata and Chemlali irrigated rainfed during October (7.32, 4.20, 3.27 and 1.81 cm³ respectively). The highest moisture content (76.44%) was recorded for Toffahi irrigated improved during August.

The highest oil content (28.34%) was obtained during December by the irrigated improved agro-ecosystem of Chemlali cultivar. Kalamata, irrigated improved comes second with a percentage of 9.07 % and it was recorded during December. The highest oil percentage recorded by Toffahi (4.36%) was that of the irrigated improved one during December.

The total saturated fatty acids percent did not show a specific trend. The percent of unsaturated fatty acids was much lower than that of the saturated ones.

The highest acid value recorded was that of rainfed Chemlali during October (6.68124) and the lowest was that recorded during November by the Kalamata, rainfed improved (3.20134). Iodine value ranged from 79.2617 to 81.2040 for the Chemlali cultivar (rainfed and irrigated improved agro-ecosystem respectively). Toffahi attained a range from 89.1196 to 90.3495 (rainfed and irrigated agro-ecosystem respectively). Yonani, irrigated improved showed a maximum iodine value of 88.7415 during October. The rainfed Yonani showed the minimum iodine value of 87.1346 during September. Kalamata had an iodine value range from 78.4651 to 80.0985 (rainfed and

irrigated improved agro-ecosystem respectively). The highest saponification value was recorded during October for all the cultivars by the irrigated improved agro-ecosystem. The values were 174.971, 120.701, 104.118 and 90.852 for Chemlali, Kalamata, Yonani and Toffahi respectively. The highest reflective index was recorded by the Kalamata, irrigated improved (1.48117) at the end of October.

Chlorophyll (a) showed a gradual increase from the time of fruit set till fruit ripening after which the trend of increasing declined till October. Chlorophyll (b) showed a non-specific trend for increasing. Carotenoids followed an increasing trend in all the cultivars, but mainly increased with the decline phase of the chlorophyll (a) in August.

The selected olive cultivars were assayed for RAPD and AFLP using forty primers and three selective primer combinations respectively. The AFLP generated a total of 283 bands. Out of the 283 amplified fragments, 244 were polymorphic, representing 86.2% polymorphism. The high percent of polymorphism reflects the genetic differences among the tested cultivars that belong to six different geographical locations.

The genetic similarity ranged from 65.5 % to 81.7%. The highest genetic similarity revealed by the RAPD analysis (81.7) between Yonani and Kalamata, both belonging to the same geographical location (Greece).

The similarity matrices resulting from DNA based markers (RAPDs, AFLPs) and biochemical marker (protein profile) were combined and computed to generate more accurate relationships based on the large and versatile genome coverage. The highest percentage of similarity was detected between Yonani and Kalamata (79.6) followed by 75.9% between Yonani and Frontero.

Dice RAPD-based coefficients of genetic similarity among the seven cultivars of olive resulted in a dendrogram, which grouped Toffahi and Chemlali together. RAPD assay permitted the identification of seven Olive cultivars by the usage of unique markers. Forty-one unique markers were able to characterize the selected olive cultivars. Khodery and Frontero were the highest cultivars characterized with unique markers (7). On the other hand, the lowest number of unique markers was detected in Kalamata that was identified by only two unique markers. Certain primers were more informative than the others e.g., OPA01 and OPG16 since they identified the highest number of cultivars (4).

A total of sixty-six unique AFLP markers identified the seven Olive cultivars. The total number of unique markers per cultivar ranged from 2 to 14. The highest number; 14, of unique markers was exhibited by Chemlali while the lowest number (2) of unique markers was revealed by Manzanello. The Combination *Mcag X Eact* revealed a total of 22 unique markers. Thus the latter combination revealed the highest number of unique markers.

The results of the present investigation assessed the usefulness of the molecular markers in identifying the Olive cultivars.

AFLP markers revealed the highest percentage of polymorphism per experiment (28.7%), followed by RAPD. The RAPD markers showed lower percentage of polymorphism per experiment (9.3). On the other hand, the AFLP exhibited higher multiplex ratio (94.3), however, the RAPD showed lower multiplex ratio (12.4).