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PHYSICAL PROPERTIES FOR SOME VARIETIES OF OLIVE FRUITS

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ABSTRACT

Physical properties of some olive varieties were determined. The selected varieties represented more than one cultivated areas and included the oil producing varieties (kronaki, Coration and Arabqueen) and the duel purpose varieties (Watiken, Picuel and Manzanillo). The studied Physical properties included principal dimension of fruits and their pits, flesh thickness, pit cross section area, fruit shape index, number of fruits per kilogram ,flesh /fruits mass percentage and flesh/ pit mass ratio. Statistical analysis was also proceeded to examine the significant variation among varieties and the deviation of the measured values around its average. The results show that , the mean values of physical properties for the investigated oil producing varieties were ranged from (15.57 to 23.7 mm) for fruit length , (11.30 to 16.22 mm) for fruit diameter, (2.06 to 4.06 mm) for flesh thickness, (11.86 to 16.94 mm) for pit length, (5.537 to 7.369 mm) for pit diameter, (16.85 to 29.467 mm^2) for pit cross section area, (1.661 to 1.940) for fruit shape index and (101.33 to 760.67) for number of fruits per kilogram. Meanwhile, the corresponding values for the duel purpose varieties were ranged from (23.02 to 25.74mm), (5.681 to 21.452mm), (3.486 to 5.669mm), (14.093 to 16.830 mm), (7.99 to 8.84 mm), (34.336 to 47.242mm^2) (0.992 to 1.643) and (193.0 to 361.67) respectively.

INTRODUCTION

Physical properties of the materials such as shape, size, volume and surface area are important in many problems associated with design or developing a specific machine, analysis of the material behavior during handling process and stress distribution in the material under load. (Mohsenin, 1984).

In Egypt, a great care has been given in the last few years to increase the area cultivated with olives, therefore a number of foreign cultivars of olive trees have been imported and grown, beside local cultivars. Data are lacking about fruit characteristics of most cultivars under the local conditions.(Fouad *et. al.,* 1992).

Matouk *et. al.,* (2005) investigated the physical properties of five different varieties of olive fruit that represent the two main classes of olive oil namely Shimalaly and Cronaki as oil producing varieties and Watiken, Picual and Manzanillo as duel purpose varieties. The results show that, the fruit length, diameter, flesh thickness ranged from (11.85 to 31.53 mm), (7.99 to 24.01 mm) and (1.18 to 7.20 mm) respectively.

Blahovec *et. al.,* (1994) classified the most important four cultivars of olive grown in Egypt at harvest as unripe, ripe or overripe. He found that, the ripening of olives is connected with decreasing firmness and/or detachment force and with increasing diameter and mass.

Owies, (2003) measured the spherisity of five different varieties of olive fruits (Shimalaly, Cronaki, Watiken, Picual and Manzanillo). He found that,

the fruit spherisity ranged from 1.232 for Manzanillo variety to 1.526 for Shimalay variety.

Davies and Albrigo, (1994) stated that, fruit size is a function of several factors including cultivator, root stock, fruit load and cultural practices such as nutrition and irrigation.

The present study aims to investigate physical properties for some prevailing olive fruits representing both oil producing and duel purpose varieties. These measurements will provide rational bases for designing and developing olive oil extraction machine.

MATERIALS AND TEST PROCEDURE

Materials:

The selected varieties of the present study represent two main categories of olive fruits. The first category included oil producing varieties (Kronaki, Coratina and Arabqueen) and the second included the duel purpose varieties (Watiken, Picual and Manzalillo). The studied varieties were also selected from more than one cultivated areas as shown in Table (1).

Table (1): The investigated varieties and their growing locations.

Olive Varieties	
1-Oil Producing Varieties:	**2-Duel Purpose Varieties:**
Kronaki Arish	**Watiken Siwa**
Kronaki Sahrawy	**Watiken Sahrawy**
Coratina Arish	**Picual Arish**
Coratina Sahrawy	**Picual Sahrawy**
Arab queen Sahrawy	**Manzanillo Arish**
	Manzanillo Sahrawy

The collected samples were kept in plastic bags and stored in a refrigerator adjusted at 4°C ± 1. The average moisture content of olive fruits was ranged from 58 to 65% w.b. as determined by the oven method at 105 °C for 24 hr.

The investigated physical properties for fruits of different studied varieties included fruit size, shape index, pit cross section area, flesh thickness, flesh/fruit mass percentage, number of fruits per kilogram and flesh/pit mass ratio. However, the measured parameters for pit included pit principal dimension, weight and cross section area.

Fruit size and shape index:

Principal dimensions of olive fruits and their pits were determined by measuring the main two axes of fruit and pit (fruit and pit length, the intermediate diameter and the flesh thickness) using a digital vernier caliper with an accuracy of 0.01 mm. Shape index of the measured samples was calculated according to (Buyanor and Voronyuk, 1985) as follows:

$$K = L/D_f \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where:

K = shape index

Lr = length of fruit, mm

D_f = diameter of fruit at the middle of its length, mm

The obtained data were compared and classified according to the classification of Buyanov and Voronuak, 1985 in which the K ≤ 0.9 represent the oblate shape, 0.9 < K ≤ 1.1 represent the round shape while K > 1.1 represent the oblong shape.

Pit cross section area:

Pit cross section area of different studied varieties was measured for 100 sheared pits using scan processing method with Auto Cad program as explained by (Matouk *et. al.,* 2004)

Flesh/fruit mass and flesh/pit mass ratio.

These percentages or ratios were calculated for the individual fruit using the weight of fruit and its pit as follows:

$$\text{Flesh/fruit mass ratio} = (W_{fr} - W_{pit})/W_{fr} \quad \ldots\ldots\ldots\ldots\ldots\ldots(2)$$

$$\text{Flesh/pit mass ratio} = (W_{fr} - W_{pit})/W_{pit} \quad \ldots\ldots\ldots\ldots\ldots\ldots..(3)$$

Where:

W_{fr} = the mass of single fruit, g

W_{pit} = the mass of pit for the same fruit, g

RESULTS AND DISCUSSION

Size and weight of fruits and their pits:

Fruit length:

Fig. (1) shows the variation in fruit length for different studied varieties of olive fruits. As shown in the figure, the fruit length was ranged from 15.570 to 23.700 mm for the oil producing varieties, while it was ranged from 23.029 to 25.740 mm for the duel purpose varieties.

Meanwhile, for oil producing varieties the frequency distribution curves show that, variety Coratina Arish recorded the highest dispersions while variety Coratina Sahrawy showed the lowest value. On the same time the obtained (C.V.) values for fruit lengths were sorted gradually from the maximum to the minimum such as (10.079, 7.247, 6.091, 5.635 and 5.209%) for varieties Coratina Arish, Kronaki Arish, Kronaki Sahrawy, Arab queen and Kronaki Sahrawy respectively. For duel purpose varieties, variety Watiken Siwa showed the highest dispersions while variety Manzanillo Arish was the lowest.The obtained (C.V.) values for fruit lengths could be sorted gradually from the maximum to the minimum such as (8.981, 7.915, 7.639, 7.457, 5.687 and 5.362%) for varieties Watiken Siwa, Watiken Sahrawy, Bicual Sahrawy, Bicual Arish, Manzanillo Sahrawy and Manzanillo Arish respectively.

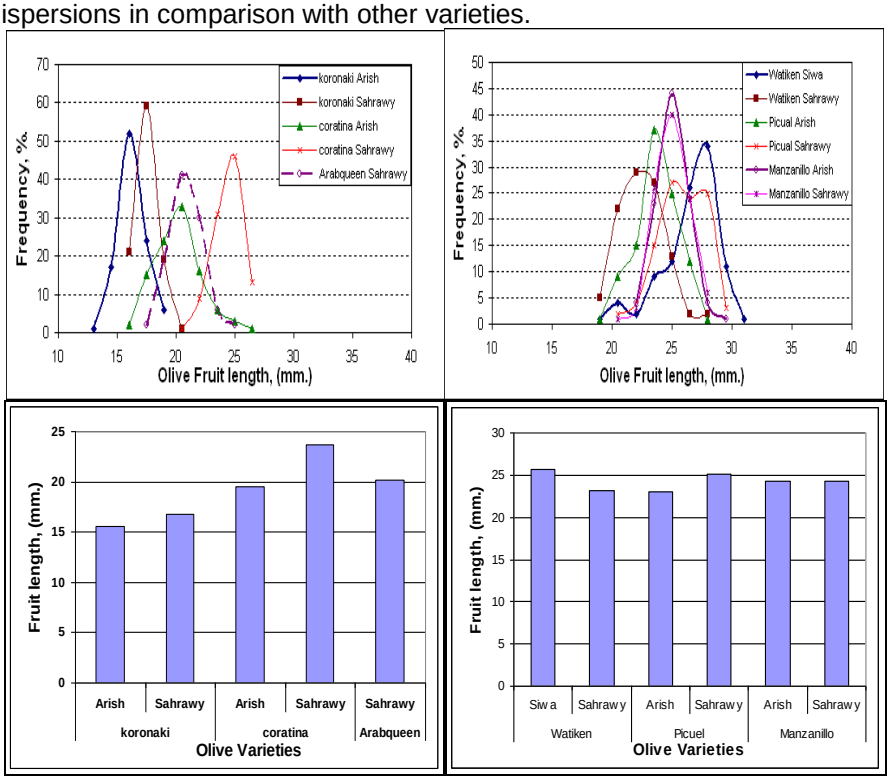
Fruits diameter:

Fig. (2) shows the variation in fruit diameter for different studied of oil producing and duel purpose olive varieties.

The results presented in Fig. (2) show that, for oil producing varieties, Arab queen Sahrawy recorded the highest fruit diameter of (16.221 mm) while, variety Kronaki Arish recorded the lowest value of (11.3 mm). Meanwhile, the dispersions of variety Coratina Arish and Arab queen Sahrawy are higher than other varieties.

The obtained values of (C.V.) for fruit diameter were (7.782, 7.59, 7.027, 5.540 and 4.924%) for varieties Koratina Arish, Kronaki Arish, Cronaki Sahrawy, Arabqueen and Coratina Sahrawy respectively.

While for duel propose varieties Fig. (2) also shows that, fruit diameters were ranged from (21.452 mm) for Manzanillo to (5.861 mm) for Watiken Sahrawy. Also, the frequency distribution curves indicated that, the two varieties Bicual Sahrawy and Bicual Arish have much bigger base and higher dispersions in comparison with other varieties.



Oil varieties **Duel varieties**

Fig. (1): Normal distribution curves and histograms for olive fruit lengths of both oil producing and duel purpose varieties.

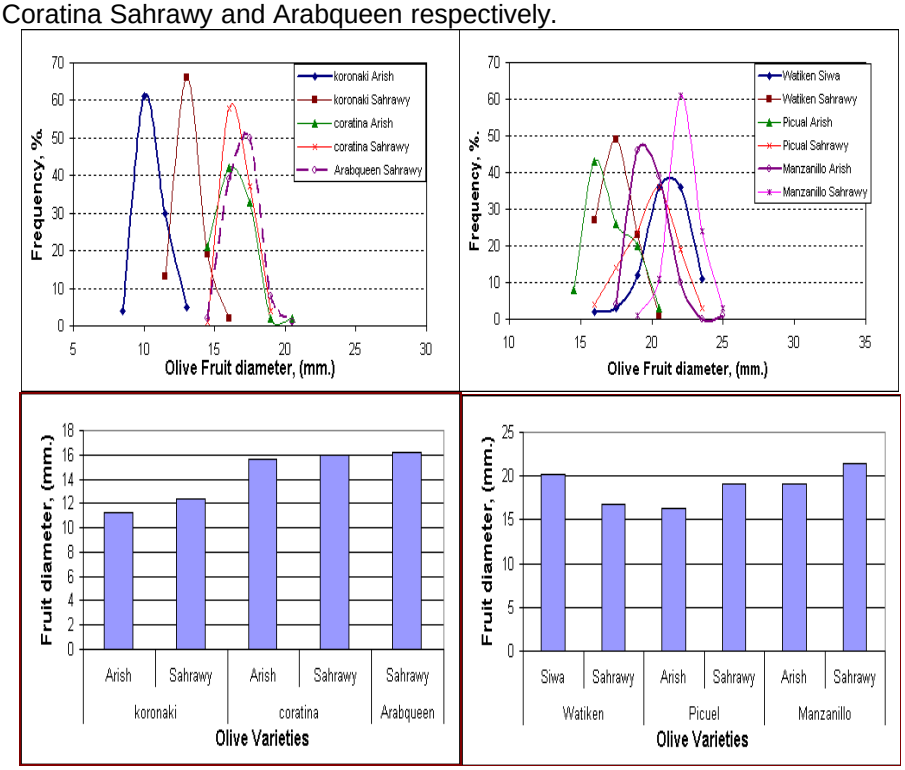
Consequently the obtained values of (C.V.) for fruit diameter were sorted gradually from the largest to the smallest as 8.878, 8.825, 7.609, 6.141, 5.861 and 4.593% for varieties Bicual Sahrawy, Bicual Arish, Watiken Siwa, Manzanillo Arish, Watiken Sahrawy and Manzanillo Sahrawy respectively.

Flesh thickness:

Fig. (3) shows the variation in flesh thickness for different studied varieties. For oil producing varieties the figure indicated that, the flesh thickness of olive fruits was varied from (2.06 mm) for variety Kronaki Arish to (4.066 mm) for variety Coratina Arish and the frequency distribution curves

showed that, variety Kronaki Arish has much bigger base and higher dispersions than other varieties.

Consequently the obtained values of (C.V.) for flesh thickness were sorted from the highest to the lowest such as 15.895, 13.668, 12.158, 11.451 and 11.390% for varieties Kronaki Arish, Kronaki Sahrawy, Coratina Arish, Coratina Sahrawy and Arabqueen respectively.



Oil varieties **Duel varieties**

Fig. (2): Normal distribution curves and histograms for olive fruit diameter of both oil producing and duel purpose varieties.

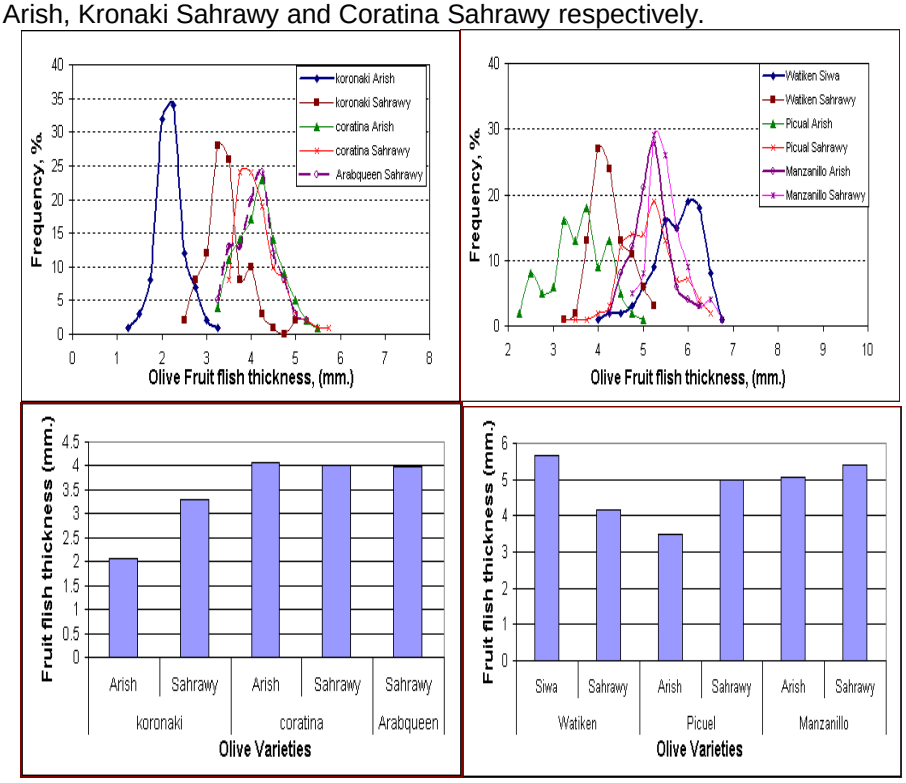
For duel purpose varieties Fig. (3) also shows that, the flesh thickness of olive fruits was ranged from (3.486 mm) for Bicual Arish to (5.669 mm) for Watiken Siwa. Also, the frequency distribution curves indicated that, variety Bicual Arish has the highest dispersion followed by varieties Bicual Sahrawy, Watiken Siwa, Watiken Sahrawy, Manzanillo Arish and Manzanillo Sahrawy.

On the same time, the calculated (C.V.) values of fruit flesh thickness were sorted from the highest to the lowest such as 19.443, 12.398, 9.975, 9.662, 8.474 and 7.571% for varieties Bicual Arish, Bicual Sahrawy, Watiken Siwa, Watiken Sahrawy, Manzanillo Arish and Manzanillo Sahrawy respectively.

Pit length:

Fig. (4) present pit lengths of both oil producing and duel purpose olive varieties. For the oil producing varieties the average pit lengths were ranged from 11.868 mm for variety Kronaki Sahrawy to 16.964 mm for variety

Coratina Sahrawy. The frequency distribution curves show that, the dispersions are higher for varieties Coratina Arish and Arab queen Sahrawy than other varieties. On the other hands, the obtained values of (C.V.) for pit lengths were sorted from highest to the lowest such as 13.48, 8.97, 7.883, 6.921 and 5.607% for varieties Coratina Arish, Arabqueen Sahrawy, Kronaki Arish, Kronaki Sahrawy and Coratina Sahrawy respectively.



Oil varieties **Duel varieties**

Fig. (3): Normal distribution curves and histograms of Flesh thickness of both oil producing and duel purpose varieties.

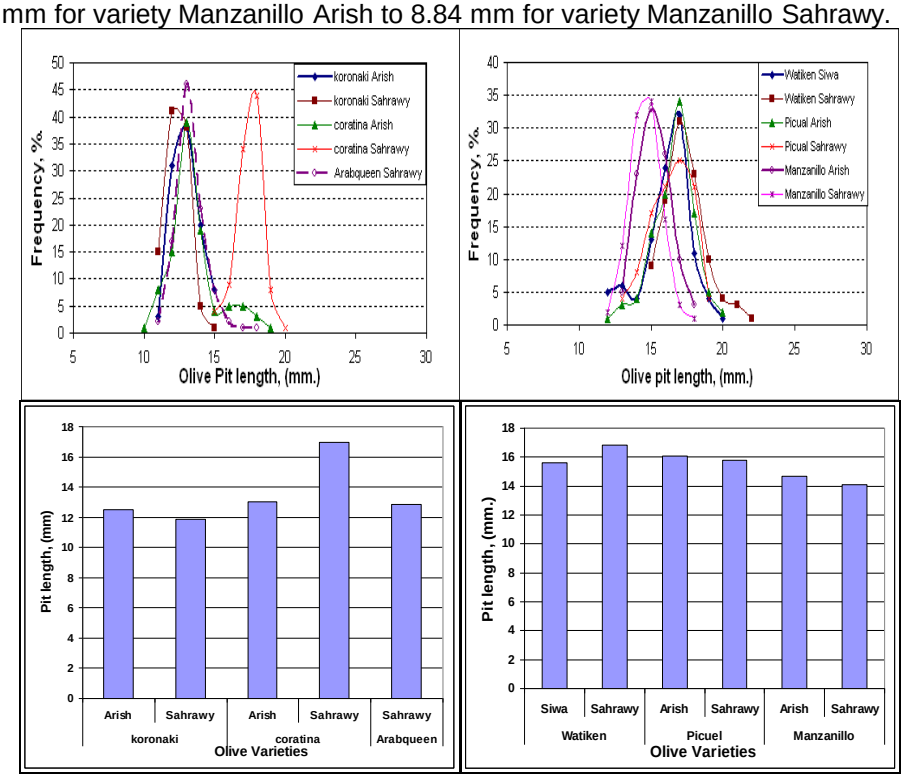
Meanwhile, for duel propose varieties the figure also shows that, the average pit lengths for the investigated varieties was ranged from 14.093mm for variety Manzanillo Sahrawy to 16.83 mm for variety Watiken Sahrawy. Also, variety Watiken Siwa showed the highest dispersions while variety Manzanillo Arish was the lowest. The obtained values of C.V. were stored from the highest to the lowest such as 11.08, 9.524, 9.450, 8.439, 7.975 and 7.268% for varieties Watiken Siwa, Picual Sahrawy, Picual Arish, Watiken Sahrawy, Manzanillo Sahrawy and Manzanillo Arish respectively.

Pit diameter:

Fig. (5) illustrates the variation in pit diameter of both oil producing and duel purpose varieties. For oil producing varieties Fig. (5) shows that, pit diameter was ranged from 5.537 mm for variety Kronaki Sahrawy to 7.369 mm for variety Coratina Sahrawy. Also, the frequency distribution curves

showed that, variety Coratina Arish recorded the highest dispersions in comparison with other varieties. The obtained (C.V.) values for pit diameter were sorted from the highest to the lowest such as 8.921, 6.45, 6.424, 6.189 and 5.252% for varieties Coratina Arish, Kronaki Arish, Kronaki Sahrawy, Coratina Sahrawy and Arab queen respectively.

However, for duel purpose varieties, the figure indicated that, pit diameters of the investigated varieties were very close and ranged from 7.99 mm for variety Manzanillo Arish to 8.84 mm for variety Manzanillo Sahrawy.



Oil varieties **Duel varieties**

Fig. (4): Normal distribution curves and histograms for olive pit lengths of both oil producing and duel purpose varieties.

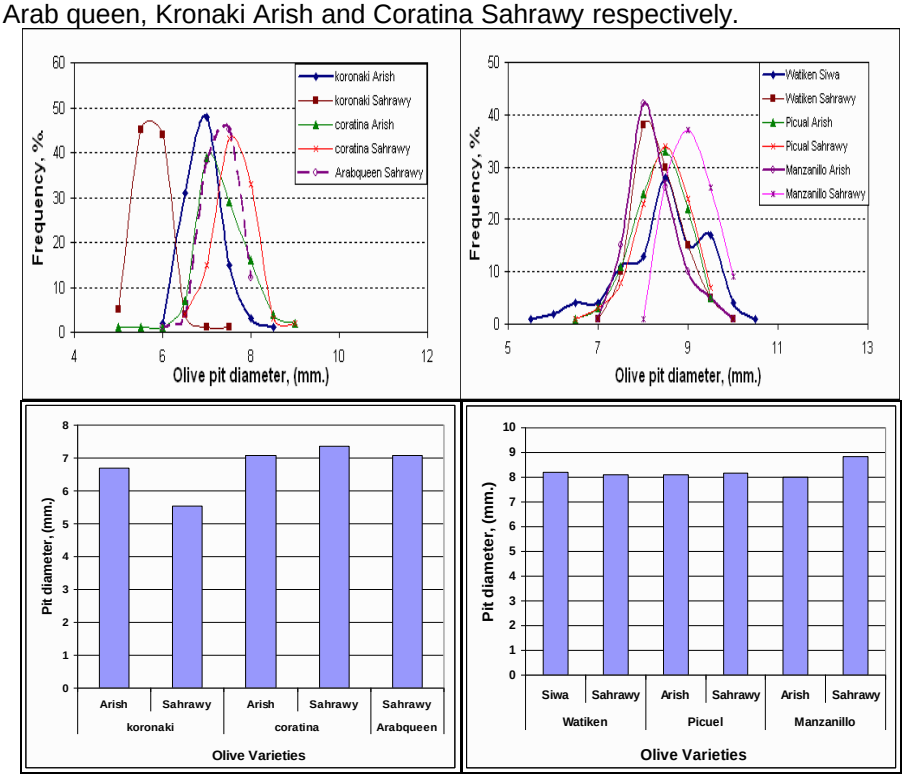
The frequency distribution curves for pit diameter also showed that, variety Watiken Siwa recorded the highest dispersions while variety Manzanillo Sahrawy was the lowest. On the same time, the calculated (C.V.) values were sorted from the highest to the lowest such as 5.128, 6.80, 6.850, 7.425, 7.563 and 11.936% for varieties Manzanillo Sahrawy, Manzanillo Arish, Watiken Sahrawy, Picual Arish, Picual Sahrawy and Watiken Siwa respectively.

Pit cross section area:

Fig. (6) illustrates the pit cross section area and the frequency distribution curves for different investigated of oil producing and duel purpose olive fruits.

The obtained results for oil producing varieties show that, the pit cross section area was varied for different studied varieties and it was the highest for variety Coratina Sahrawy (29.467 mm^2) and the lowest for variety Kronaki Sahrawy (16.875 mm^2).

Also, the frequency distribution curves showed that, variety Coratina Arish recorded the highest dispersions and very close depressions were noticed for other varieties. On the same time the calculated C.V. values for the studied varieties were sorted from the highest to the lowest such as 20.167, 10.855, 15.102, 14.60 and 12.88% for the varieties Coratina Arish, Arab queen, Kronaki Arish and Coratina Sahrawy respectively.



Oil varieties **Duel varieties**

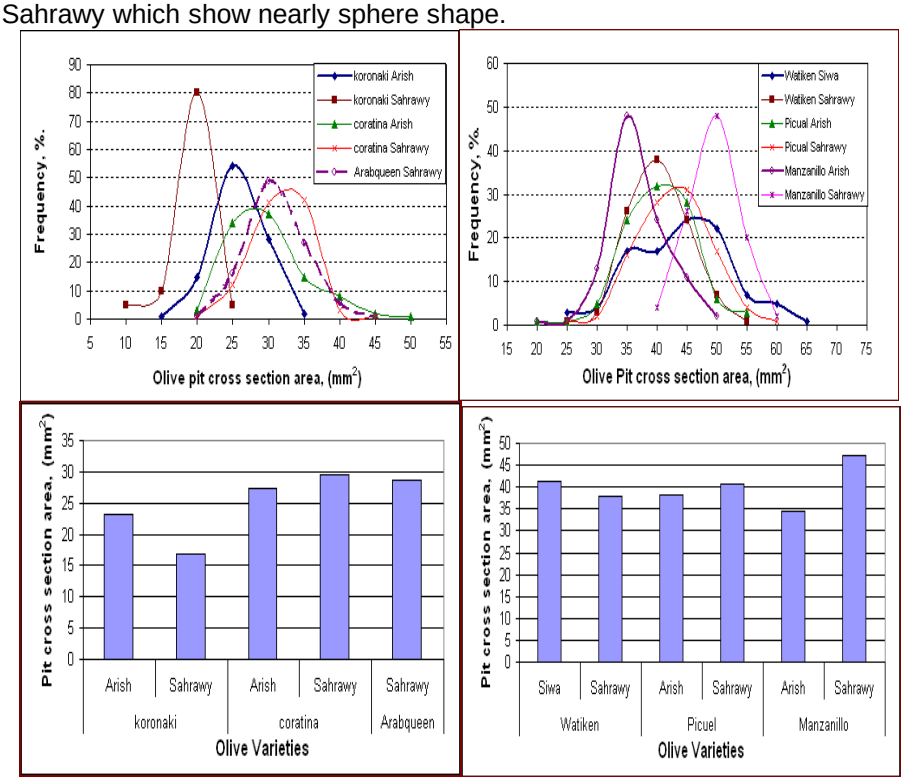
Fig. (5): Normal distribution curves and histograms for pit diameter of both oil producing and duel purpose olive varieties.

Meanwhile, for duel purpose varieties the pit cross section area was ranged from 34.336 mm^2 for variety Manzanillo Arish to 47.242 mm^2 for variety Manzanillo Sahrawy. Also, the frequency distribution curves declared that, variety Watiken Siwa recorded the highest dispersions, while variety Manzanillo Sahrawy recorded the lowest dispersions. The calculated C.V. values for the duel purpose varieties were sorted from the highest to lowest such as 20.185, 15.214, 14.458, 14.108, 13.262 and 8.714% for varieties

Watiken Siwa, Picual Arish, Picual Sahrawy, Manzanillo Arish, Watiken Sahrawy and Manzanillo Sahrawy, respectively.

Fruits shape index:

The results presented in Fig. (7) show that, the average values of shape index for the oil producing varieties was ranged from (1.661 to 1.94) and it was ranged from (0.992 to 1.643) for the duel purpose varieties. This means that, most of the investigated varieties may be considered as Oblong shape in which the fruit length axis bigger than the width axis except variety Watiken Sahrawy which show nearly sphere shape.



Oil varieties **Duel varieties**

Fig. (6): Normal distribution curves and histograms for pit cross section area of both oil producing and duel purpose olive varieties.

The frequency distribution curves for oil producing varieties also show a relative similarity in the dispersions values of all varieties and the calculated (C.V.) values were also very close and ranged from 4.031 to 5.838%.

However, for duel purpose varieties the frequency distribution curves show that, variety Picual Arish recorded the highest dispersions while, variety Manzanillo Arish was the lowest.

The calculated (C.V.) values for duel purpose varieties were sorted from the highest to the lowest such as 6.62, 6.316, 5.278, 5.182, 4.762 and

4.467for varieties Picual Arich, Picual Sahrawy, Watiken Sahrawy, Manzanillo Sahrawy and Manzanillo Arish, respectively.

Number of fruits per Kilogram:

Fig. (8) illustrates the number of fruits per kilogram for the investigated oil producing and duel purpose olive varieties.

As shown in the figure, for oil producing varieties the obtained number of fruits/kg were 760.67, 391.67, 331.33, 318.67 and 101.33 g for varieties Kronaki Sahrawy, Arab queen, Coratina Sahrawy, Coratina Arish and Kronaki Arish.

Meanwhile, for duel purpose varieties the number of fruits/kg were 361.67, 245.00, 298.33, 213.67, 169.33 and 193.00 g for varieties Picual Arish, Manzanillo Arish, Watiken Sahrawy, Manzanillo Sahrawy, Watekin Siwa and Picual Sahrawy.

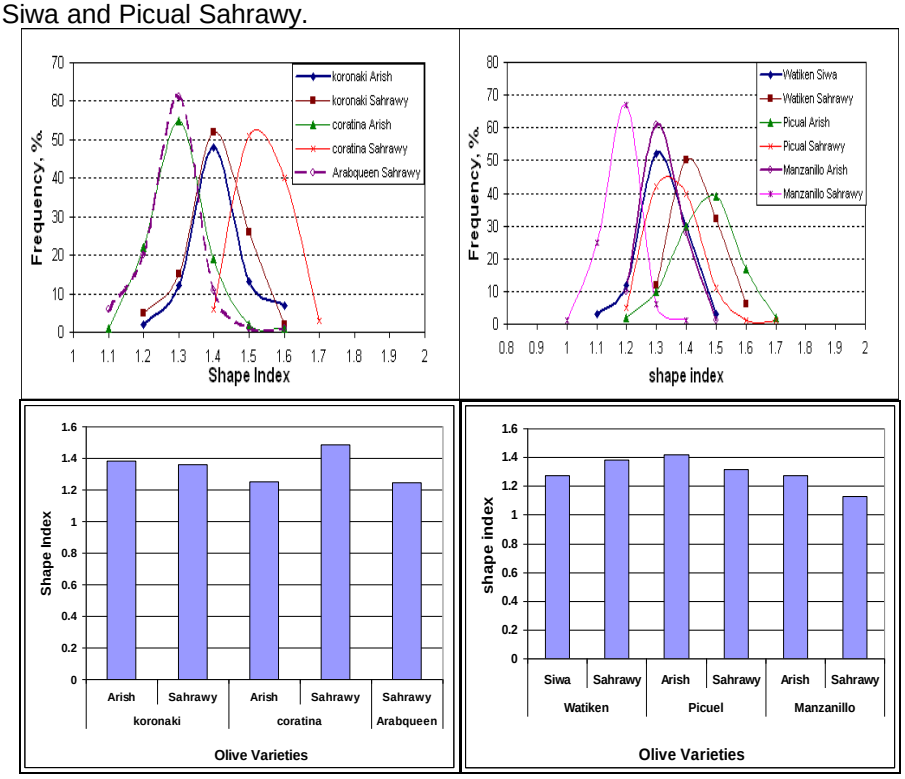
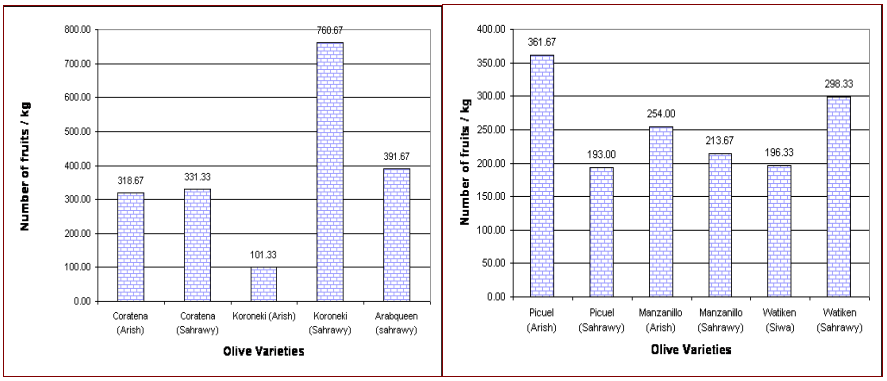


Fig. (7): Normal distribution curves and histograms for fruit shape index of both oil producing and duel purpose varieties.

These results are expected since the number of fruits per kilogram inversely proportional with the weight of one fruit as mentioned by (Matouk et. al., 2005).



Oil varieties **Duel varieties**

Fig. (8): The mean values for number of fruits per kilogram of both oil producing and duel purpose olive varieties.

Flesh/Fruit mass percentage and flesh/pit mass ratio:

Flesh/Fruit mass percentage:

Fig. (9) illustrates the variations in flesh/fruit mass percentage for the oil producing and duel purpose varieties.

For oil producing varieties, the flesh/fruit percentage was the highest for variety Arab queen (84%) and the lowest for variety Kronoki Arish (71.388%). On the same time the frequency distribution curves showed that, variety Kronaki Arish recorded the highest dispersions while the other investigated varieties showed a very similar dispersions.

Meanwhile, variety Kronaki Arish recorded the highest C.V. value of 5.558% while variety Arab queen recorded the lowest value of 1.945%.

For the duel purpose varieties, variety Manzanillo Sahrawy recorded the highest flesh/fruit percentage of 87.72% while variety Picual Arish recorded the lowest value of 78.592%. The frequency distribution curves showed that, variety Picual Arish recorded the highest dispersions while, variety Manzanillo Sahrawy showed the lowest dispersions. the obtained C.V. values were ranged from the highest of 4.65% for variety Picual Arish to the lowest 1.896% for variety Manzanillo Sahrawy.

Fruit flesh/pit ratio:

Fig. (10) presents the variation in fruit flesh/pit ratio for the oil producing and duel purpose olive varieties. As shown in the figure, variety Arab queen recorded the highest flesh/pit ratio of 5.31 while variety Kronaki Arish recorded the lowest value of 2.561. Meanwhile, the frequency distribution curves declared that, variety Cronaki Arish showed the largest dispersions while the dispersions of other varieties were relatively similar. Also, the statistical analysis showed that, variety Cronaki Arish recorded the highest C.V. of 19.055% while variety Coratina Sahrawy recorded the lowest value of 10.875%.

On the other hands, for duel purpose varieties, variety Manzanillo Sahrawy recorded the highest fruit flesh/pit ratio of 7.29 while variety Picual Arish recorded the lowest value of 3.814.

The frequency distribution curves also declared that, variety Picual Sahrawy showed the highest dispersions while variety Watiken Sahrawy was the lowest.

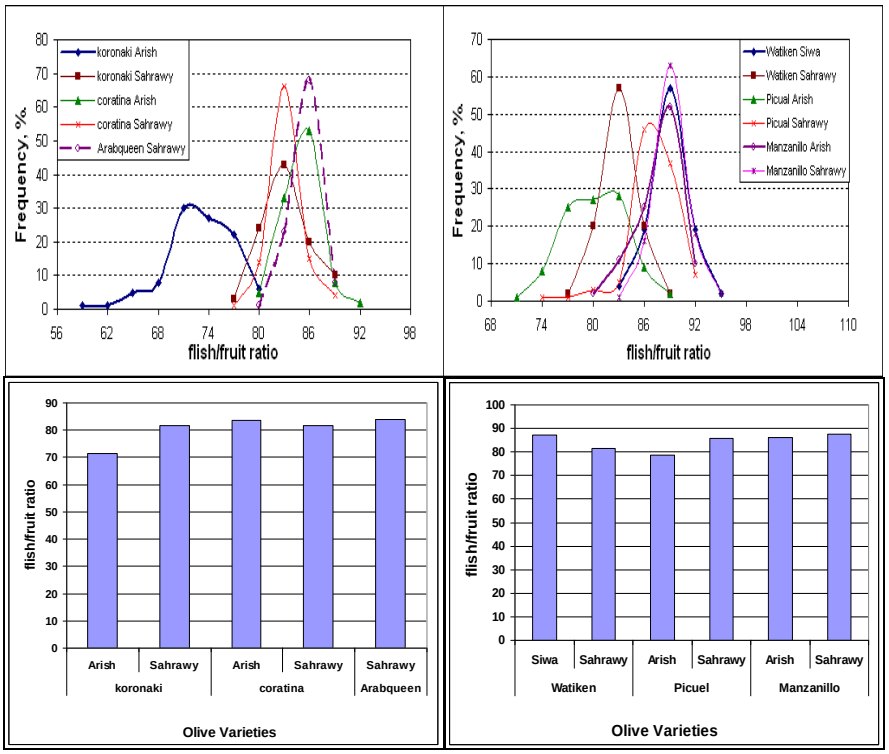
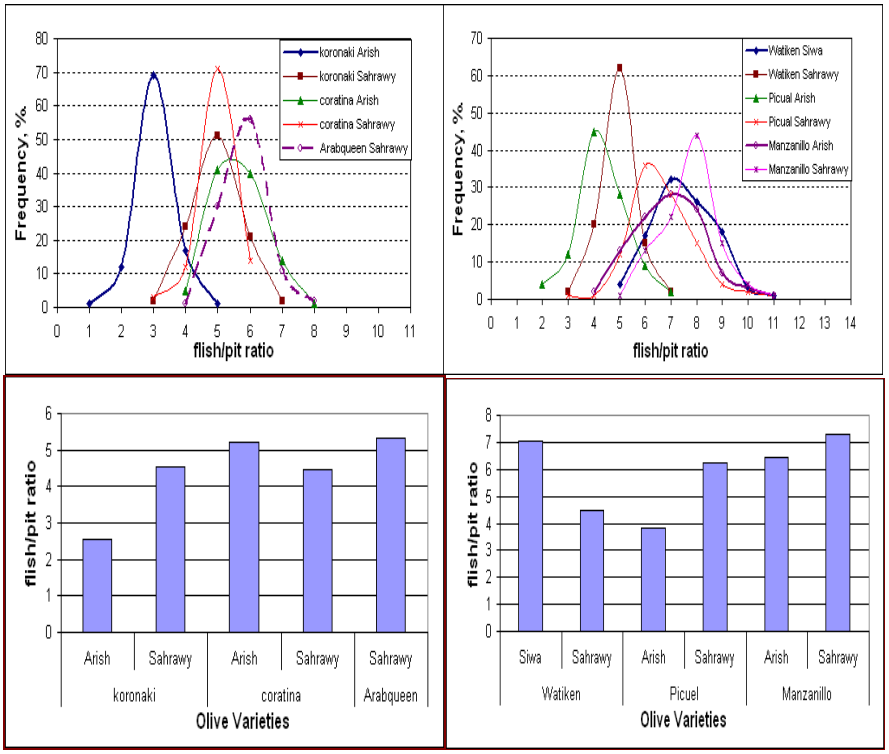


Fig. (9): Normal distribution curves and histograms for the flesh/ fruit ratio of both oil producing and duel purpose varieties.

Also, the obtained (C.V.) values could be sorted from the highest to the lowest such as 22.878, 20.325, 20.112, 18.209 and 15.004% for varieties Picual Arish, Mazanillo Arish, Picual Sahrawy, Watiken Siwa and Manzanillo Sahrawy respectively.



Oil varieties **Duel varieties**

Fig. (10): Normal distribution curves and histograms for the flesh/pit ratio of both oil producing and duel purpose varieties.

CONCLUSION

The mean values of physical properties for the studied oil producing varieties were ranged from (15.57 to 23.7 mm) for fruit length, (11.30 to 16.22 mm) for fruit diameter, (2.06 to 4.06 mm) for flesh thickness, (11.36 to 16.94 mm) for pit length, (5.537 to 7.369 mm) for pit diameter, (16.85 to 29.467) for pit cross section area, (1.661 to 1.940) for fruit shape index and (101.33 to 760.67) for number of fruits per kilogram. Meanwhile, the corresponding values for the duel purpose varieties were ranged from (23.02 to 25.74mm), (5.681 to 21.452mm), (3.486 to 5.669mm), (14.093 to 16.830 mm), (7.99 to 8.84 mm), (34.336 to 47.242mm2) (0.992 to 1.643) and (193.0 to 361.67) respectively.

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الخصائص الطبيعية لبعض أصناف الزيتون

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أجريت تلك الدراسة لتعيين بعض الخصائص الطبيعية لأصناف الزيتون المختلفة والتي تمثل كلا من الأصناف المنتجة للزيت (كروناكي، بيكوال، أرب كوين) والأصناف ثنائية الغرض (وطيقن، بيكوال، مانزانيللو) وإشتملت الخصائص التي تم تعيينها على الأبعاد الرئيسية للثمار والبذور، يمك طبقة اللحم، مساحة المقطع العرضي للبذره، معامل الشكل للثمرة، عدد الثمار/كجم، نسبة وزن اللحم/ثمرة، نسبة وزن اللحم/بذرة.

أظهرت النتائج المتحصل عليها أنه في حالة الأصناف المنتجة للزيت، تراوحت أطوال الثمار بين (15.07 – 23.7 مم)، أقطار الثمار بين (11.30 – 16.94 مم)، سمك اللحم بين (2.06 – 4.06 مم)، أطوال البذور بين (11.86 – 16.41 مم)، أقطار البذور بين (5.537 – 7.369 مم)، المقطع العرضي للبذرة بين (16.85 – 29.467 مم^2)، معامل الشكل للثمار بين (1.661 – 1.940)، عدد الثمار/كجم بين (101.33 – 670.67). من ناحية أخرى تراوحت تلك القيم للأصناف ثنائية الغرض بين (23.02 – 25.74 مم) لأطوال الثمار، (5.681 – 21.452 مم) لأقطار الثمار، (3.486 – 5.669 مم) لسمك اللحم، بين (14.093 – 16.830 مم) لأطوال البذور، بين (7.99 – 8.84 مم) لأقطار البذور، بين (34.336 – 47.242 مم^2) للمقطع العرضي للبذرة، بين (0.692 – 1.643) لمعامل الشكل للثمار، بين (193.5 – 361.67) عدد الثمار/كجم.