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## LIST OF ABBREVIATIONS

%	Percent
AOAC	Association of Official Analytical Chemists
AV	Acid value
CIE	International Commission on Illumination
DPPH	Diphenyl-1-picrylhydrazyl radical
EC	European Council
EVOO	Extra virgin olive oil
FFA	Free fatty acids
GLC	Gas-Liquid Chromatography
HPC	High phenolic compounds
HPLC	High performance gas liquid chromatography
IOC	International olive council
IOOC	International olive oil council
IUPAC	International Union of Pure and Applied Chemistry
LDL	Low density lipoprotein
LOX	Lipoxygenase
LPC	Low phenolic compounds
LVOO	Lampante virgin olive oil
MPC	Medium phenolic compounds
NM	Nanometer
PDO	Protected designation of origin
PEGA	Polyethylene glycol adipate
PET	Polyethylene terephthalate

PPM	Part per million
PUFA	Poly unsaturated fatty acids
PV	Peroxide value
RBD	Refined bleached deodorized
RI	Refractive index
R.R.T	Relative retention time
TUSFA	Total unsaturated fatty acid
UV	Ultraviolet
VVOO	Veiled (cloudy) virgin olive oil

## **5. SUMMARY**

Virgin olive oil is the only edible oil of great production obtained by physical methods from the fruit (*Olea europaea L.*); it shows sensory characteristics and nutritional properties which are the main reasons for the increment of its consumption all over the world in the recent years.

The olive industry today requires new cultivars adapted to modern intensive mechanized orchards. Narrow erect trees for mechanical harvest, adaptability to irrigation, uniform maturation, minimal alternate bearing, and resistance to leaf and root diseases are the goals of most present olive breeding programs. The development of new olive products and freezing resistance are also considered. The objective of the present study was carried out to evaluate the olive oil extracted from new varieties growing in Egypt with respect to the following:-

- 1- To study and compare the sensory, physical and chemical characteristics as well as oxidative stability of six different olive oil types extracted namely from four new cultivated olive fruit varieties No (19, 40, 43, and 95) compared with *Koronakii* and *Coratina* varieties currently cultivated in Egypt.
- 2- To identify and evaluate fatty acids composition, polyphenol compounds, unsaponifiable matter, tocopherols and pigments (chlorophyll and carotene) of different investigated olive oil samples.
- 3- To study some physical and chemical properties of pomace oil samples extracted from the pastes remained after extracting oil from the investigated olive fruit varieties.
- 4- To study the effect of storage period of 24 months at ( $25\pm 5^{\circ}\text{C}$ ) on the quality properties of the extracted oil from the investigated olive fruit varieties

## **1. Chemical composition of the investigated olive fruit varieties**

The moisture content of tested olive varieties (*Koronakii*, *Coratina*, No 19, 40, 43 and 95) was 56.55, 56.75, 57.42, 55.41, 60.32 and 56.52%; respectively. The variety No 43 was the highest value in moisture content compared with the other varieties, the variety No 95 was the highest of oil content (43.33%) followed by variety No 43 (42.55%), in contrast the variety No 40 was the lowest of oil content (25.26%) on dry matter. Variety No 40 had the higher content of protein (14.52%) followed by *Koronakii* (13.43%), ash content in tested olive varieties ranged between 16.98 to 23.96% and the results showed that the total hydrolysable carbohydrates ranged between (16.01 to 22.76%) on dry matter.

## **2. Physical and chemical properties of oil extracted from the investigated olive fruit varieties.**

### **a- Physical properties:**

The Refractive index values at 25°C of olive oil extracted from (*Koronakii*, *Coratina*, No 19, 40, 43 and 95) was 1.4692, 1.4700, 1.4704, 1.4697, 1.4696 and 1.4700; respectively. The color of olive oil after immediate extraction of varieties (*Koronakii*, *Coratina*, No 19, 40, 43, and 95) was as follows: yellow cells fixed at 35 and red cell was 3.72, 3.75, 3.60, 3.30, 3.10 and 3.30; respectively, and blue cell was 2.90, 1.00, 2.20, 2.00, 3.00 and 0.20; respectively.

### **b- Chemical properties:**

The specific extinction values UV absorbance at 232 and 270 nm for olive oil extracted from olive varieties under investigation (*Koronakii*, *Coratina*, No 19, 40, 43 and 95) was 1.82, 1.77, 2.06, 1.95, 1.90 and 1.88; respectively at 232 nm, and 0.075, 0.073, 0.120, 0.09 and 0.077; respectively at 270 nm. Besides  $\Delta k$  of tested oil extracted from olive varieties (*Koronakii*, *Coratina*, No 19,

40, 43 and No 95) was 0.007, 0.005, 0.009, 0.008, 0.008 and 0.007; respectively.

The free fatty acid (as oleic acid%) was ranged between 0.014 to 0.27%, while the peroxide value (meq O<sub>2</sub> /kg oil) was ranged between 2.14 to 4.88 (meq o<sub>2</sub> /kg oil), while the iodine value (Hanus) of the tested oil extracted from olive oil varieties (*Koronakii*, *Coratina*, No 19, 40, 43 and No 95) was 82.60, 85.51, 91.52, 85.33, 82.52 and 88.72; respectively.

The higher content of unsaponifiable mater was found in *Coratina* (1.46%), while the lowest content was found in variety No19 (1.33%). Besides the total polyphenols compounds ranged between 93.00 to 232.00 ppm, while the total tocopherols content in the tested olive oil varieties was found between 109.00 to 154.00 ppm, at the last the induction period (oxidative stability) of oil extracted from the investigated olive fruit varieties (*Kornakii*, *Coratina*, No 19, 40, 43 and 95) using Rancimat method at 100°C was 31.15, 36.20, 17.30, 25.20, 29.50 and 27.40 hour; respectively.

### **3. Fatty acids composition of the olive oil extracted from the olive fruit varieties under investigation:**

The major saturated fatty acids was palmitic (C<sub>16:0</sub>) which was ranged between 14.16 to 18.61%. Oleic acid (C<sub>18:1</sub>) was the major mono unsaturated fatty acid which was found in higher percentage in all tested samples, whereas represented about 72.16, 70.12, 48.79, 67.37, 75.46 and 60.13% for (*Koronakii*, *Coratina*, No 19, 40, 43 and No 95); respectively. The highest percentage of linolenic acid (C<sub>18:2</sub>) was found in the variety No 19, which was 26.68%. The variety No 43 was rich in total unsaturated fatty acids (USFA) (83.66%).

### **4. Phenolic compounds of oil extracted from the investigated olive fruit varieties:**

The major phenolic compounds in olive oil was protocatechuic acid, which was ranged between 15.27 to



17.64% followed by vanillic acid which was ranged between 14.81 to 17.56%. The feruic acid, tyrosol, hydroxytyrosol and *P*-hydroxybenzoic acid were the minor compounds in all tested oil samples.

**5. The composition of unsaponifiable matter of the oil extracted from the investigated olive fruit varieties:**

The unsaponifiable matter of all tested olive oil composed of hydrocarbon compounds, which were ranged between 79.30 to 81.03% and Sterol compounds, which were ranged from 18.97 to 20.70%. Variety No 43 was the highest amount of squalene (66.18%), while the lowest amount was found in oil extracted from variety No 95 (65.20%). The highest percentage of  $\beta$ -sitosterol was found in oil extracted from variety No 43, while the oil extracted from variety No 95 had the lowest amount of  $\beta$ .sitosterol. The minor sterols in all tested oil samples were campesterol, ergosrerol and cholesterol.

**6. Pigments (chlorophyll and carotene) and  $\alpha$ -tocopherol contents of oil extracted from the investigated olive fruit varieties:**

The highest chlorophyll content was observed for *Coratina* and variety No 95, which were 0.19 mg/kg oil, while the lowest content was found in variety No 19 which was 0.17mg/kg oil. The oil extracted from *Coratina* variety was higher amount of total carotene (7.03 mg/ kg oil) than those found in the other varieties. total carotene in oils extracted from the new varieties was ranged between 6.0 to 6.55 mg/kg oil.  $\alpha$ -tocopherol was the highest amount in *Coratina*.

**7. Sensory characteristics of virgin olive oil extracted from the investigated olive fruits varieties:**

The olive oil extracted from *Coratina* olive fruit had the highest fruity, bitter and pungent sensory attributes of all tested olive oil samples, which was 8.251, 1.823 and 7.727; respectively. Whereas the olive oil extracted from variety No 95 was the highest fruity, bitter and pungent sensory

attributes of all tested oil samples extracted from the new investigated olive fruit varieties which was 6.251, 1.580 and 5.127; respectively. Otherwise, the olive oil extracted from the investigated olive fruits variety No 19 was the lowest fruity, bitter and pungent sensory attributes which was 2.301, 0.491 and 1.130; respectively, there was no negative attributes in all tested olive oil samples.

## **8. Physical and chemical properties of pomace oil extracted from the investigated olive fruit varieties.**

### **a- Physical properties:**

The refractive index value at 25°C of pomace olive oil extracted from (*Koronakii*, *Coratina*, No 19, 40, No 43 and No 95) was 1.4700, 1.4706, 1.4701, 1.4687, 1.4696 and 1.4700; respectively. The color of pomace olive oil after immediate extraction for varieties (*Koronakii*, *Coratina*, No 19, 40, 43, and No 95), was yellow cell fixed at 35 and red cell was 5.51, 5.75, 5.57, 6.20, 6.78 and 4.00; respectively, and blue cell was 2.90, 4.00, 3.20, 3.10, 3.88 and 0.16; respectively.

### **b- Chemical properties:**

The  $\Delta k$  of pomace oil extracted from the investigated olive fruit varieties (*Koronakii*, *Coratina*, No 19, 40, 43 and No 95) was 0.13, 0.11, 0.12, 0.14, 0.12 and 0.15; respectively. The UV absorbance at 232 and 270 nm for pomace olive oil extracted from investigated olive fruit varieties (*Koronakii*, *Coratina*, No 19, 40, 43 and No 95) was 1.40, 1.73, 2.70, 2.10, 1.10 and 1.80 at 232 nm and 0.83, 0.73, 1.00, 0.81 and 0.91 at 270 nm; respectively.

Likewise the free fatty acid (as oleic acid %) was ranged between 0.8 to 0.95%, in all tested pomace olive oil varieties.

Besides the peroxide value (meq O<sub>2</sub> /kg oil) was ranged between 8.14 to 11.33, (meq O<sub>2</sub> /kg oil).

The iodine value (Hanus) of the pomace oil extracted from the olive fruit varieties (*Koronakii*, *Coratina*, No 19,

40, 43 and No 95) was 80.90, 83.51, 76.32, 87.11, 84.22 and 78.64; respectively.

The highest content of unsaponifiable matter was found in pomace oil obtained from variety No 95 (2.06%) followed by variety No 43 (1.99%), and the lowest content was found in pomace oil obtained from variety No 19 (1.73%).

Pomace oil obtained from *Koronakii* variety was te highest content (147.00 ppm) of total phenolic compounds, followed by pomace oil obtained from *Coratina* variety (112.00 ppm) compared to the pomace oil obtained from the new varieties, which were accounted ranged from 84.00 to 101.00 ppm.

Besides the total tocopherols content in the all tested pomace oil from olive fruit varieties, it was ranged between 150.00 and 200.00 ppm. The total tochopherols of all tested pomace olive oil samples.

The induction period of pomace oil obtained from *Coratina* variety was obvious higher (29.8hr) than those found compared to the other tested pomace oil. In contrary, the lowest induction period was found in pomace obtained from No 19 variety (12.3 hr). On the otherhand, the highest induction period (oxidative stability) in pomace oil obtained from the new varieties was in variety No 43 (24.2 hr).

### **9. The effect of storage period for 24 months at the ambient temperature on the physico-chemical proprieties of oil extracted from the investigated olive fruit varieties:**

#### **a- Refractive index:**

The Refractive index for the investigated olive fruits varieties (*Koronakii*, *Coratina*, No 19, 40, 43, and No 95) was found to be 1.4702, 1.4706, 1.4705, 1.4703, 1.4704 and 1.4703; respectively at zero time at the initial of storage period, while at the end of storage period (24

months) the refractive index was found to be 1.4690, 1.4693, 1.4671, 1.4693 and 1.4688; respectively.

**b- Color value:**

The color index of the olive oil obtained from the investigated olive fruit varieties (*Koronakii*, *Coratina*, No 19, 40, 43 and No 95), was found to be 3.72, 3.75, 3.60, 3.30, 3.10, and 3.30 in the red cell and 2.9, 1.00, 2.20, 2.00, 3.00 and 0.20 in the blue cell fixed at 35 yellow; respectively.

The color index was gradually decreased during the storage period up to 24 months in all tested oil samples (*Koronakii*, *Coratina*, No 19, 40, 43 and No 95) that reached 0.99, 2.00, 1.75, 1.50, 1.59, and 2.00 in red cell and 1.88, 0.11, 0.70, 0.30, 1.18 and 0.00 in blue cell, with fixed at 35 yellow cell; respectively.

**c- conjugated diene and triene fatty acids:**

The absorbance in UV region at 232 nm and 270 nm increased progressively with the increase in the storage period. The conjugated diene (at 232 nm) was increased from 1.82 to 2.63, 1.77 to 2.61, 1.90 to 2.77, 1.88 to 2.71, 1.90 to 2.77 and 1.88 to 2.71 and conjugated triene (at 270 nm) was increased from 0.075 to 0.151, 0.073 to 0.150, 0.08 to 0.157, 0.077 to 0.153, 0.08 to 0.157 and 0.077 to 0.153, for *Koronakii*, *Coratina*, No 19, 40, 43 and No 95; respectively, as the storage period increased from the initial zero time up to 24 months.

**d- Free fatty acids (FFA% as oleic acid):**

The free fatty acids of virgin olive oils at zero time was 0.19, 0.15, 0.25, 0.15, 0.27 and 0.14 for *Koronakii*, *Coratina*, No 19, 40, 43 and No 95; respectively. After 24 months of storage period, the free fatty acids reached to 0.65, 0.55, 0.79, 0.60, 0.79 and 0.62 for *Koronakii*, *Coratina*, No 19, 40, 43 and 95; respectively.

**e- Peroxide value:**

peroxide value at zero time for oil extracted from olive varieties (*Koronakii*, *Coratina*, No 19, 40, 43 and No 95)

was 3.21, 2,14, 4.88, 3.76, 3.95 and 3.95 meq O<sub>2</sub> /kg oil; respectively. Peroxide value was gradually increased in all tested oil samples during storage up to 24 months, which was reached to 15.43, 14.22, 24.44, 15.41, 14.99 and 14.99 for *Koronakii*, *Coratina*, No 19, 40, 43 and 95; respectively.

**f- Thiobarbituricacid (TBA) value:**

The TBA value was 0.008, 0.007, 0.009, 0.009, 0.009 and 0.008 for *Koronakii*, *Coratna*, No 19, 40, 43 and No 95; respectively at the initial of zero time, then increased gradually as the storage period increased up to 24 months at the end of of storage period, the TBA value was reached to 0.158, 0.152, 0.186, 0.172, 0.160 and 0.159 for *Koronakii*, *Coratina*, No 19, 40, 43 and No 95; respectively. The TBA value of oil obtained from olive variety No 19 was higher than those found in the other olive tested oil samples.

**g- Iodine value:**

The iodine value at the initial of zero time for the olive oil extracted from the investigated olive varieties *Koronakii*, *Coratina*, No 19, 40, 43 and 95 was 82.60, 85.51, 91.52, 85.33, 82.52 and 88.72; respectively. After 24 months of storage period the iodine number was reached to 75.55, 79.33, 70.00, 75.66, 75.10 and 77.77 for olive oil extracted from olive varieties *Koronakii*, *Coratina*, No 19, 40, 43 and 95; respectively.

## **CONCLUSION**

From all the previous results in this study, it can be concluded that the oil extracted from variety No 19 had the lowest quality than those extracted from the other olive oil extracted from varieties No 40, 43, and 95 which gave the high quality in physical and chemical characteristic from high content of  $\alpha$ -tocopherol, polyphenolic content and more oxidative stability (high induction period) as well as high content of oil yield.

Therefore, it can be recommended that Varieties No 40, 43 and 95 can be grown in Egypt that gave high quality of olive oils.