Influence of Several Physical Treatments on the Improvement of Some Quality Parameters of Olive Oil

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- **Virgin olive oil is the oil obtained from the olive fruit through physical procedures without refining or being mixed with other oils or any substances.**
- **Olive (*Olea europaea*) oil is a fundamental component of the Jordanian and Mediterranean diet.**

- **There has been a significant increase in the consumption of olive oil due to its nutritional and health-promoting effects.**

The quality of virgin olive oil

Geographical area (Soil, Altitude and Climate conditions), Irrigation, Diseases, Pesticides Storage, Cultivar and Extraction methods.

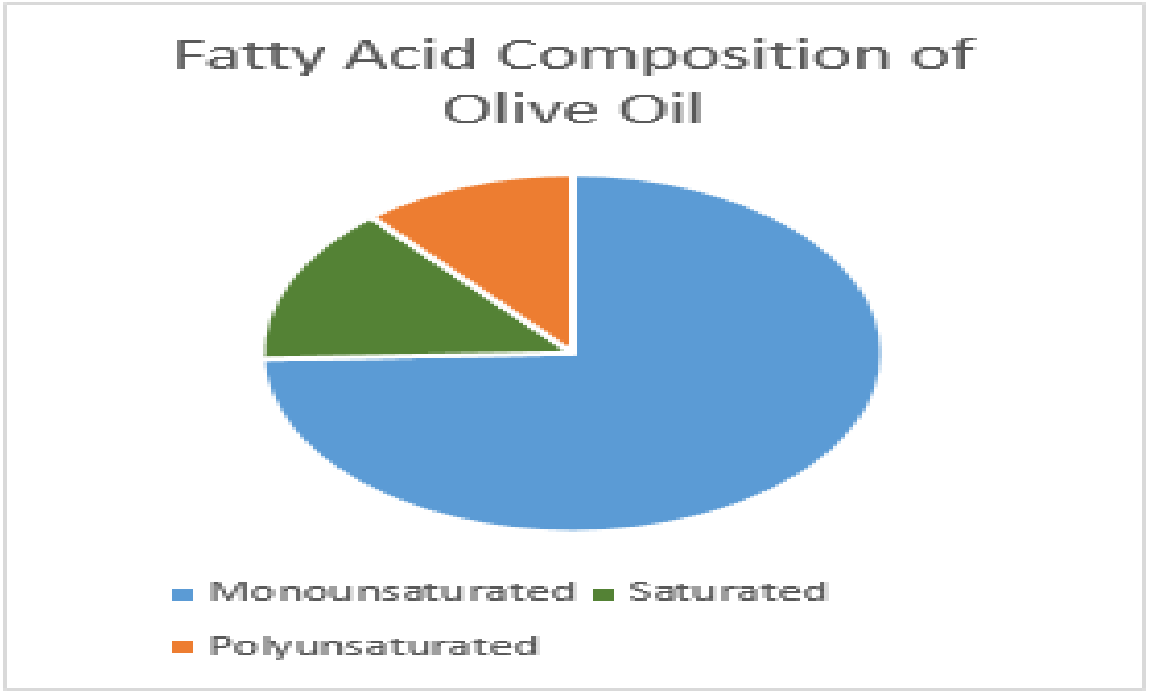
- **These factors affect both the quality and keeping quality of olive oils like its chemical components such as free fatty acids, peroxide value, antioxidant content, aroma compounds…etc.**

Olive oil composition

- **Triglycerides form 98-99%**
- **The main fatty acid in virgin olive oil is oleic acid (18:1) (56-83%). Other fatty acids including: linoleic acid (18:2), α-linolenic acid (18:3) and arachidonic acid (20:4) all are polyunsaturated.**

- **The major saturated FA in olive oil is palmitic acid (16:0) and stearic acid (18:0).**

- **Olive oil has small amounts of compounds (usually less than 1%) including: sterols; triterpene alcohols; tocopherols; phenols; phospholipids; chlorophylls and flavor compounds .**



Storage of Olive Oil

- Appropriate storage methods for olive oil are very vital to ensure that it does not deteriorate and become rancid.

- Olive oil should be kept in a cool and dark place because faster oxidation may occur due to the light effect.

Lipid Autoxidation

- The oxidation process is a radical chain reaction involving three stages:

Initiation

$$RH \rightarrow H^{\bullet} + R^{\bullet}$$

Propagation

$$R^{\bullet} + O_2 \rightarrow ROO^{\bullet}$$

$$ROO^{\bullet} + RH \rightarrow ROOH + R^{\bullet}$$

Termination

$$ROO^{\bullet} + R^{\bullet} \rightarrow ROOR$$

$$ROO^{\bullet} + ROO^{\bullet} \rightarrow ROOR + O_2$$

$$R^{\bullet} + R^{\bullet} \rightarrow RR$$

Formation of stable products

Processing of Olive Oil

- Olive processing involves the following phases: cleaning, milling, mixing, pressure or centrifugation and separation of the oil.

- The most chief aspects affecting the quantity of olive oil, are the kind of processing system and circumstances during the different stages of olive oil extraction process

Objectives of the study

To improve the overall quality characteristics of locally produced olives oil using several physical treatments to reduce the levels of Peroxide Value (PV) and Free Fatty Acids (FFA) contents and the effect of these methods on olive oil overall chemical quality.

Materials and Methods

Oxidation Induction

Fresh olive oil (Initial PV= 7.76 meq O2/kg , initial FFA= 1.24%)

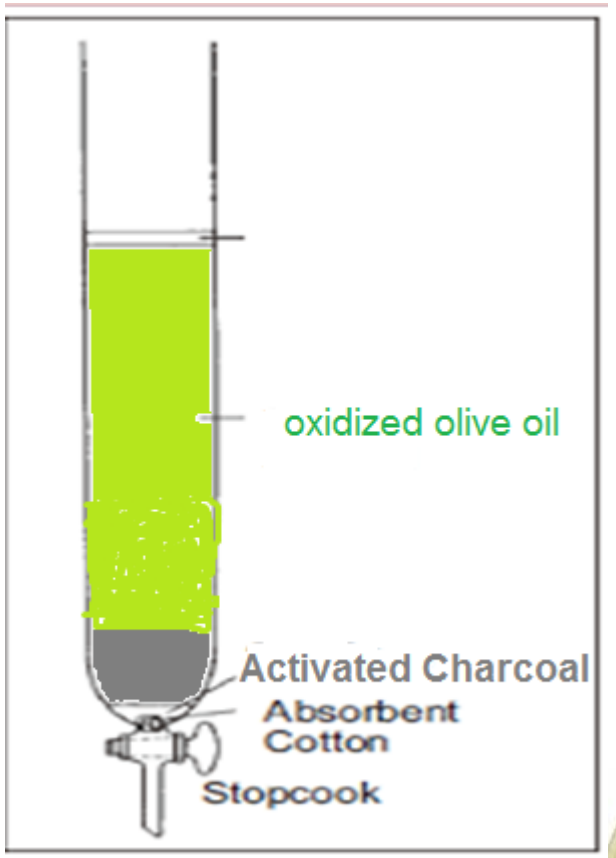
10 Kg of the fresh olive oil was intentionally exposed for oxidation process (PV= 32.39 meq/O2 FFA= 1.67%)

500g of the oxidized olive oil was eluted, separately through a glass column (10 X 75 cm) loaded with several adsorbent

PV , FFA, Vit. E and Phenolic content were determined after elution from the adsorbent

Adsorbent

-Activated charcoal
- Clay
- Pectin
- Acacia gum
- Acacia powder
- Arabic gum
-Bentonite
-Swelieh sand
- Silica gel
- Aluminum oxide
-Calcium chloride



Chemical analysis

Determination of peroxide value

- The peroxide value of olive oil was determined by AOAC method (AOAC, 2012). The PV was expressed in mills equivalents of oxygen per kg of oil (meq of O_2/kg)

Determination of Free Fatty Acids

- The acidity of olive oil was determined by AOAC method (AOAC, 2012). The FFAs was expressed as % oleic acid.

Determination of total phenolic content

- The total phenol contents (TPC) of the fresh, oxidized and eluted olive oil was determined, separately by the Folin–Ciocalteau spectrophotometrically at 725 nm. Expressed as mg gallic acid /kg

Determination of vitamin E

- Vitamin E content in fresh, oxidized and eluted olive oil was determined according to Gimeno et al. (2000) method (HPLC) and expressed as mg/kg

Sensory Evaluation

- The sensory analysis of fresh olive oil sample was conducted before olive oil treated and oxidation by Twenty panelists according to the international olive oil council (IOOC, 1996) protocol.

Statistical Analysis

- Data were analyzed using SAS program, 2000. All treatments were conducted in triplicate.

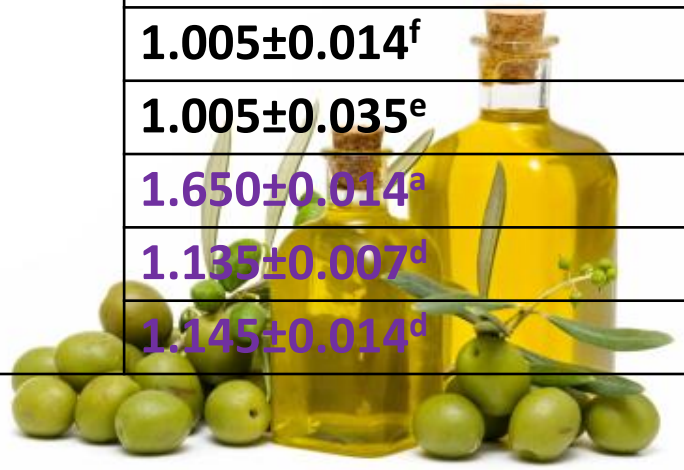
Results and Discussion

Table 1.Quality criteria for different grades of olive oil and for fresh olive oil sample before and after oxidation induction.

Quality parameter	Extra Virgin Olive Oil	Virgin Olive Oil	Fresh olive oil (Before oxidation)	Olive oil (After oxidation)
Free Fatty Acid (Oleic acid %)	< 0.8	≤ 2.0	1.24±0.011	1.67±0.05
Peroxide (meq O2/kg)	< 20	≤ 20	7.76±0.12	32.39±0.86
Total Phenolic Content(mg gallic acid /kg)	150 - 800	50 - 800	189.43±0.46	101.4±0.28
Vitamin E(mg/ kg) mg ATE	No specific range (100-150)	No specific range(100-150	45.31 ±0.67	34.45±0.49

Table 2. Free fatty acid contents (%) for fresh olive oil (control) and after elution of oxidized olive oil through several adsorbents

Treatment (adsorbents)	FFA (%) of control Mean ±SD	FFA (%)after elution Mean ±SD
Charcoal	1.675±0.007[a]	1.664±0.014[a]
Acacia gum		1.160±0.014[d]
Pectin		1.465±0.021[b]
Swelieh sand		1.230±0.014[c]
Bentonite		1.025±0.035[ef]
Silica gel		0.915±0.007[g]
Acacia powder		1.005±0.014[f]
Arabic gum		1.005±0.035[e]
Clay		1.650±0.014[a]
Aluminum oxide		1.135±0.007[d]
Calcium chloride		1.145±0.014[d]



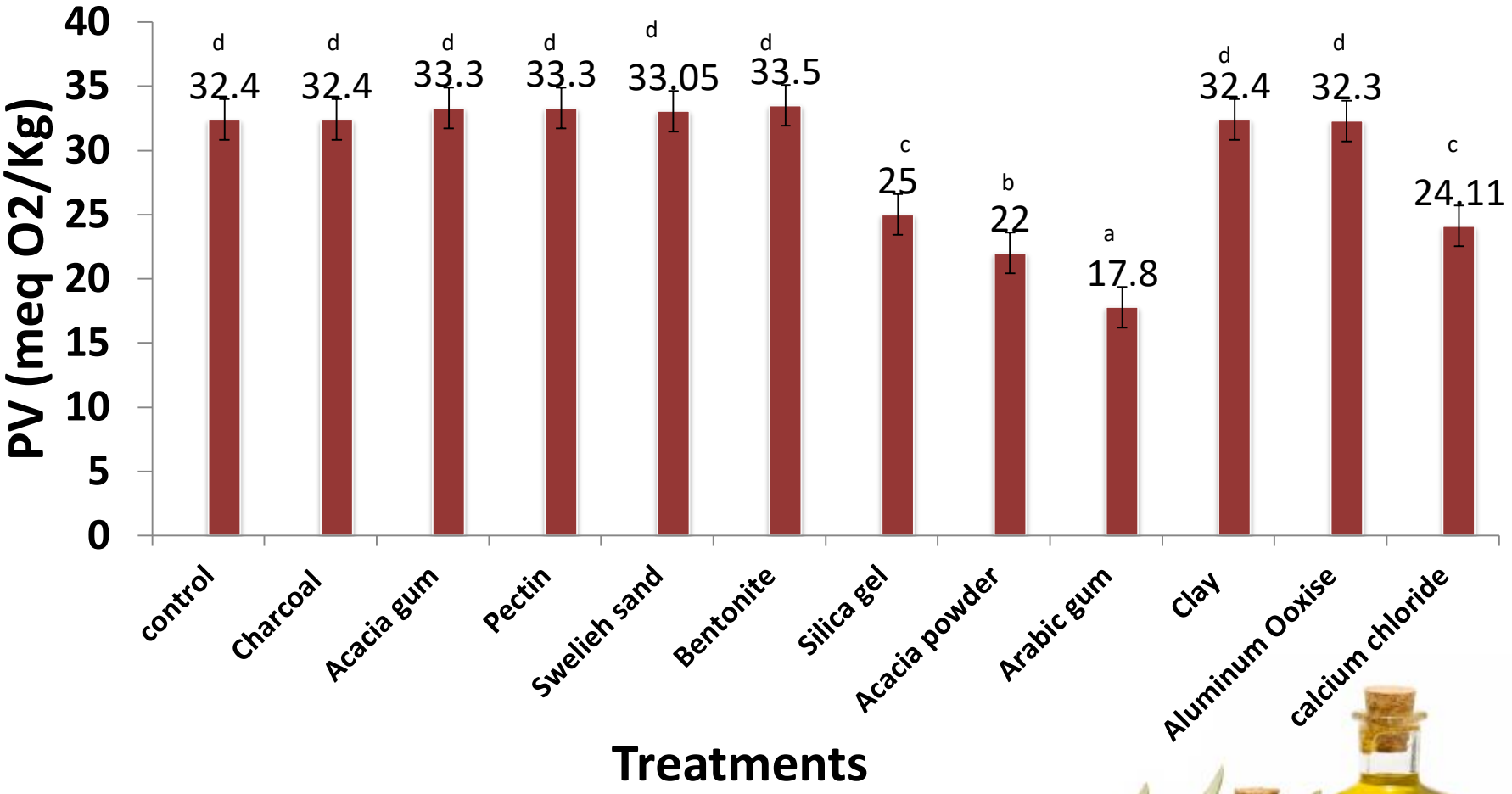


Fig. 1.Peroxide value (meq O_2/kg) for fresh olive oil (control) and after elution of oxidized olive oil through several adsorbents

Table 3.Total phenolic content (TPC) in mg GAE/Kg oil for oxidized olive oil (control) and after elution of oxidized olive oil through several adsorbents

Treatment (adsorbents)	TPC of (Control oxidized) Mean ± SD	TPC after elution Mean ± SD
Charcoal	101.4±0.282[a]	89.60±0.56[bc]
Acacia gum		75.85 ±0.77[e]
Pectin		90.25 ±0.21[bc]
Swelieh sand		90.30 ±0.56[bc]
Bentonite		91.10 ±1.69[b]
Silica gel		44.75 ±0.77[h]
Acacia powder		46.70 ±0.70[g]
Arabic gum		89.40 ±0.56[c]
Clay		89.25±0.77[c]
Aluminum oxide		50.05 ±0.77[f]
Calcium chloride		86.90 ±0.56[d]

Table 4.Vitamin E content (mg /Kg) for oxidized olive oil (control) and after elution of oxidized olive oil through several adsorbents

Treatment (adsorbents)	Vit E of oxidized olive oil (Control) Mean ± SD	Vit E after elution Mean ± SD
Charcoal	34.45±0.49[a]	21.82±0.38[c]
Acacia powder		17.72±0.33[e]
Pectin		23.43±0.55[b]
Swelieh sand		15.70±0.39[f]
Bentonite		10.36±0.41[h]
Silica gel		17.36±0.79[e]
Acacia powder		11.38±0.61[g]
Arabic gum		12.26±0.64[g]
Clay		19.19±0.75[d]
Aluminum oxide		10.36±0.13[h]
Calcium chloride		11.38±0.60[g]

Table 5. The results of the sensory evaluation of fresh olive oil (Positive 0-10) and negative (0-10)

Positive and negative attribute	Result of fresh Control
Fruity	1.400±0.502
Bitter	1.200±0.410
Pungent	1.300±0.470
Fusty	0.100±0.308
Musty	0.100±0.307
Muddy sediment	0.000±0.000
Rancid	0.000±0.000

Conclusion

-This research shows that the use of certain natural adsorbent in olive oil processing could improve some of the olive oil quality characteristics and prolong its shelf life.

-Silica gel, acacia powder, Arabic gum and calcium chloride adsorbent exhibited an excellent oil quality by improving the PV and FFA.

- **Some of the active compounds are lost (ex. Vitamin E and Total phenolic content).**

- **Activated charcoal, and clay were not effective in improvement quality of the olive oil.**

Thank You