Evaluation of Quality Testing California Olive Oil 2014/15 Season

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UC DAVIS OLIVE CENTER
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Evaluation of Quality Testing, California Olive Oil, 2014/15 Season

SUMMARY

The Olive Oil Commission of California (OOCC) contracted with the UC Davis Olive Center to analyze the results of quality testing of 104 California olive oils from the 2014/15 season. This report summarizes the results for the first year of mandatory sampling and testing under California olive oil standards.

Our review finds that 90 percent (94 samples) passed California standards for Extra Virgin Olive Oil (EVOO) grade, and 10 percent (10 samples) failed California standards for the grade. Of the 10 samples that failed EVOO grade, six passed all of the chemistry standards and failed solely the organoleptic standard, two passed the organoleptic standard but failed a chemistry standard, and two samples failed at least one chemistry standard as well as the organoleptic standard.

The commission may wish to establish quality goals for California olive oils to seek to achieve in future years, promote continuing education to Handlers on best practices, investigate new methods to assess quality, and establish reporting protocols for laboratories and panels.

BACKGROUND

The Olive Oil Commission of California contracted with the UC Davis Olive Center to analyze the quality-testing results for 104 oil samples produced during the 2014/15 season.

The oils were sampled and tested pursuant to California olive oil standards,[1] which require annual sampling and quality testing of olive oil produced in California. The standards require the OOCC to conduct sampling and testing under the direction of the California Department of Food and Agriculture (CDFA) or by an approved independent third party. The sampling party must take five samples at random from each Handler,[2] following the sampling procedures and plan of the International Organization for Standardization (ISO),[3] and send the samples to an accredited laboratory for analysis. In addition, the standards require each Handler to sample, test, and grade all lots, with testing conducted either by the Handler or by a laboratory chosen by the Handler. Analysis of the oils is based on the quality tests and standards summarized in Table 1.

[1] See California Department of Food and Agriculture, "Grade and Labeling Standards for Olive Oil, Refined-Olive Oil and Olive-Pomace Oil", Effective September 26, 2014, Incorporating Amendments Since February 15, 2015.

[2] "Handler" is defined by Section 5.13 of the California standard as "a person who engages, in this state, in the operation of marketing olive oil that he or she has produced, or purchased or acquired from an olive oil producer, or that he or she is marketing on behalf of an olive producer," and Section 1.0 further states that the standards apply to handlers producing 5,000 or more gallons of olive oil per year.

[3] ISO 5555:2001 Animal and vegetable fats and oils – Sampling.

Table 1. Quality tests and standards for California EVOO grade

Test	*Determination*	*Indicator*	*CA Standard*
Free Fatty Acidity (FFA) *%m/m expressed as oleic acid*	Free fatty acids are formed by hydrolysis from the triacylglycerols in olives that are damaged or improperly stored before processing. Free fatty acidity is determined by a titration of sodium hydroxide solution that neutralizes the acidity.	Elevated FFA indicates poor-quality/damaged fruit, fermentation of olives prior to processing, or prolonged contact between the oil and vegetable water. A high level of FFA at bottling means shorter shelf life for the oil.	≤0.5
Peroxide Value (PV) *meq. O_2/kg oil*	Peroxides are primary oxidation products that form when oils are exposed to oxygen, high temperature, or light. This chemical reaction leads to rancidity in oils. However, as oxidation advances and secondary oxidation products are formed, peroxides are degraded and the level of PV decreases. Peroxide value is determined by a titration that releases iodine from potassium iodide.	Elevated PV indicates oxidized oil from oxidized and/or poor-quality fruit, prolonged fruit storage before processing, or improper storage of the oil. A high level of PV at bottling means shorter shelf life for the oil.	≤15
Ultraviolet Absorbance (UV) *$K^{1\%}_{1cm}$*	The ultraviolet light absorbance is determined by applying UV light through the oil at specific wavelengths. Absorbance at 232 nm (K_{232}) indicates the primary oxidation level, while absorbance at 270 nm (K_{270}) indicates the secondary oxidation level. ΔK detects oil treatments with color-removing substances and the presence of refined/pomace oil.	Elevated UV indicates oxidized, poor-quality, and/or adulterated oil. Because this method measures the changes in the fatty acid structure, oxidation that occurs due to aging or refining would increase the values.	K_{232} ≤2.40 K_{270} ≤0.22 ΔK≤/0.01/
Moisture and Volatile Matter *%m/m*	Olive oil retains water and volatile compounds during processing. Moisture and volatile matter are determined by the loss in mass of olive oil in an air oven at 130±2°C or in a vacuum oven at the temperature range of 20°C to 25°C under specific test conditions.	An elevated level of moisture and volatile matter could be caused by improper extraction methods, leading to poor olive oil quality, organoleptic defects, and reduced shelf life.	≤0.2
Insoluble Impurities *%m/m*	Insoluble impurities (meal, dirt, and other foreign matter) are determined when the impurities are insoluble in petroleum ether under specific experimental conditions.	Elevated insoluble impurities can be caused by substandard manufacturing practices, leading to poor olive oil quality, organoleptic defects and reduced shelf life.	≤0.1
Pyropheophytin a (PPP) *% total pheophytins*	Pyropheophytins are the thermal degradation products of chlorophyll formed during olive oil storage, especially under elevated temperature and light exposure. Chlorophyll converts to pheophytins and ultimately to pyropheophytins. Pyropheophytin is determined by the ratio of pyropheophytin a to the sum of pheophytins and pyropheophytin a.	PPP increases with time and is influenced by the storage conditions. PPP is also a useful indicator of the presence of refined and/or aged olive oil.	≤17
1,2–Diacylglycerols (DAGs) *% total 1,2- and 1,3- diacylglycerols*	As oil ages, or undergoes heat treatment, fatty acids on the triacylglycerol can break off from hydrolysis to form 1,2-diacylglycerols. Over time, these molecules equilibrate to form 1,3-diacylglycerols. DAGs is determined by the ratio of 1,2-diacylglycerols to the sum of 1,2- and 1,3-diacylglycerols.	DAGs decrease with time. A low ratio of 1,2-diacylglycerols to 1,2- and 1,3-diacylglycerols indicates oil that is hydrolyzed, oxidized, of poor quality, and/or adulterated with refined oil.	≥35
Organoleptic *Median of Defects (MeD)* *Median of Fruity (MeF)*	A trained panel of at least eight tasters determines flavor and aroma intensity of positive attributes (fruity, bitter, and pungent) and defective attributes (such as rancid, fusty, and musty.)	The absence of fruitiness and presence of defective attributes indicates oil made from substandard fruit, processing, and/or storage.	MeD=0 MeF>0

SAMPLE INFORMATION

Of the 104 samples collected by the OOCC and Handlers for the 2014/15 season, 38 samples were collected by the OOCC and 66 samples were collected by the Handlers. The OOCC samples were collected by CDFA officials in February 2015 from Handler lots, and the samples were sent to the Australian Oils Research Laboratory in Wagga Wagga, New South Wales.

The data for OOCC samples did not report information on variety. As shown in Table 2, a total of 46 of 66 Handler samples (70 percent) were from super-high-density varieties: Arbequina (22 samples), Arbosana (16 samples), and Koroneiki (8 samples).

Table 2. Handler samples by variety or blend (66 samples)

Variety	*Number of samples*
Arbequina	22
Arbosana	16
Koroneiki	8
Mission	4
Frantoio	2
Leccino	2
Manzanillo	2
Picual	1
Coratina	1
Pendolino	1
Sevillano	1
Blend – 3 varieties	2
50% Mission/50% Manzanillo	2
85% Arbosana/15% mix	1
Blend - 7 varieties	1
TOTAL	**66**

RESULTS

Of the 104 samples, 90 percent (94 samples) met California quality standards for EVOO grade, while 10 percent (10 samples) failed one or more of the quality tests for the grade.

Tables 3 and 4 summarize the results for the OOCC and Handlers, respectively. The tables show that the average values for the samples were well inside the limits for the California EVOO grade, which would be expected given that the oils were relatively fresh. The very high rate in which the samples achieved EVOO grade shows that Handlers had little difficulty meeting California quality standards. The low standard deviations indicate that results from the various Handlers did not deviate much from the average. Median values for bitterness and pungency were reported for the OOCC samples but not the Handler samples, and Median of Defects (MeD) was reported for the Handler samples but not the OOCC samples.

Table 3. Summary of the OOCC results (38 samples)

Test (CA EVOO Standard)	Average Value	Standard Deviation	# Meeting CA EVOO Standard	% Meeting CA EVOO Standard
Free Fatty Acidity (≤0.5)	0.3	0.1	36	95
Peroxide Value (≤15.0)	8.3	2.4	37	97
UV K_{232} (≤2.40)	1.85	0.31	37	97
UV K_{270} (≤0.22)	0.12	0.03	37	97
UV ΔK (≤/0.01/)	<0.003	0	38	100
Moisture and Volatile Matter (≤0.2)	0.1	0	38	100
Insoluble Impurities (≤0.1)	0.1	0	38	100
Pyropheophytins (≤17)	2	2	38	100
1,2-Diacylglycerols (≥35)	76	9	38	100
Organoleptic (MeD=0)	n/a	n/a	35	92
Organoleptic (MeF>0)	4.18	0.92	38	100
Median of Bitterness	2.84	1.29	n/a	n/a
Median of Pungency	3.66	1.26	n/a	n/a

Table 4. Summary of the Handler results (66 samples)

Test (CA EVOO Standard)	Average Value	Standard Deviation	# Meeting CA EVOO Standard	% Meeting CA EVOO Standard
Free Fatty Acidity (≤0.5)	0.3	0.1	66	100
Peroxide Value (≤15.0)	7.1	3.2	65	98
UV K_{232} (≤2.40)	1.64	0.29	65	98
UV K_{270} (≤0.22)	0.13	0.03	66	100
UV ΔK (≤/0.01/)	0	0	66	100
Moisture and Volatile Matter (≤0.2)	0.1	0.1	66	100
Insoluble Impurities (≤0.1)	0	0	66	100
Pyropheophytins (≤17)	2	1	66	100
1,2-Diacylglycerols (≥35)	83	10	66	100
Organoleptic (MeD=0)	0.1	0.6	61	92
Organoleptic (MeF>0)	3.96	0.8	66	100

Table 5 provides details on the 10 samples that failed one or more California EVOO grade standards. Eight of the 10 failed the organoleptic standard, and as noted earlier, only the Handler samples include the MeD. Sample 141014CS C 2/18/15 failed several chemistry standards: the high free fatty acidity (FFA) indicates that the fruit had undergone hydrolysis/fermentation prior to processing, while the high peroxide value (PV), and ultraviolet (UV) K_{232}, and K_{270} indicate that oxidation has already begun in the oil that was only a few months old. Combining the chemistry and organoleptic results, it is very likely that this oil was produced with damaged fruit and there were prolonged delays between harvesting and processing.

Six of the 10 samples failed solely the organoleptic standard while passing all of the chemistry standards, while two samples failed solely chemistry standards while passing the organoleptic standard, confirming a weak relationship between the organoleptic and chemistry standards that we found in a previous report.[4] One of these samples, Handler ID 7180 (A), had a MeD of 4.5, meeting the California grade of Crude Olive Oil, yet this sample still passed all of the chemistry standards.

Sample ID 2/12/15 J Oct2014, failed due to an elevated level of FFA, which is mostly likely due in this case to damaged olives or delayed processing. While the oil passed the organoleptic and other chemistry standards, this oil would have limited shelf life due to its high FFA. Sample ID YUM-2894-2014 (D), failed due to an elevated level of UV K_{232}, which suggested that primary oxidation has begun. While this sample passed the organoleptic and other chemistry standards, the oil would have limited shelf life due to oxidation.

Table 5. Summary of samples outside one or more California EVOO standards (10 samples)

	Sample ID	*Test (CA EVOO Standard)*				
		FFA (≤0.5)	PV (≤15.0)	UV K_{232} (≤2.40)	UV K_{270} (≤0.22)	Organoleptic (MeD=0)
OOCC	141014CS C 2/18/15	0.8	17	3.33	0.23	Defective
OOCC	2/12/15 J Oct2014	0.7	--	--	--	--
OOCC	1/29/15 A Lot 7165	--	--	--	--	Defective
OOCC	2/12/15 J Fall2014	--	--	--	--	Defective
Handler	YUM-2864-2014 (D)	--	16	--	--	1.0
Handler	YUM-2894-2014 (D)	--	--	2.59	--	--
Handler	100300 WDT 2014 (Q)	--	--	--	--	2.0
Handler	7180 (A)	--	--	--	--	4.5
Handler	B001 (B)	--	--	--	--	0.3
Handler	B014 (B)	--	--	--	--	2.4

CONCLUSIONS AND RECOMMENDATIONS

- This report summarizes the results for the first year of mandatory sampling and testing under California olive oil standards. The data and analysis reported here provide a quality benchmark for the OOCC and Handlers to reference in future years.

- Ninety percent (94 of 104) of the samples met California standards for the EVOO grade. The average values for the quality tests were well within the limits of the standard, which would be expected given that the oils were relatively fresh. The OOCC may wish to consider establishing quality goals for California olive oils to seek to achieve in future years.

- Ten percent (10 of 104) of the samples failed California standards for the EVOO grade. While in some cases a Handler may have segregated lower-grade samples into specific lots with the knowledge that the oils were below EVOO grade (e.g. in response to a frost), it may also be possible that some Handlers would benefit from more familiarity with best

[4] UC Davis Olive Center, “Correlating Olive Oil Sensory and Chemistry Results,” 2014.

practices for grove management, harvesting, post-harvest handling, processing, and storage. The OOCC may wish to investigate the reasons for some samples not meeting EVOO grade and promote continuing education to Handlers on best practices.

- Six of the 10 samples did not meet California standards for the EVOO grade solely based on the organoleptic standard, while passing all of the chemistry standards, while two of the 10 samples passed the organoleptic standard but were outside a chemistry standard. The OOCC may wish to investigate new methods that show a better agreement for chemistry and organoleptic standards.

- The OOCC may wish to develop reporting protocols for laboratories and organoleptic panels so that data is provided to the commission in a uniform format.