Evaluation of Fatty Acid and Sterol Profiles
California Olive Oil
2018/19 Season

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Evaluation of Fatty Acid and Sterol Profiles, California Olive Oil, 2018/19 Season

SUMMARY

The Olive Oil Commission of California (OOCC) requested that the UC Davis Olive Center analyze fatty acid and sterol profiles of California olive oil produced in the 2018/19 season.

The study team collected 30 single-variety samples of olive oil (19 varieties from 14 counties) from California commercial producers. Samples that were found to be outside one or more parameters at the UC Davis laboratory were sent to Modern Olives Laboratory (Woodland, CA) for retesting. The study team also analyzed fatty acid and sterol profiles data of 17 single-variety lots provided by two California commercial producers and analyzed in in-house or third-party laboratories.

Our analysis and review of the data found that 89 percent (42 of 47 samples) were within the fatty acid and sterol parameters required in California while 11 percent (five samples) were outside at least one fatty acid or sterol parameter. All five samples that were outside fatty acid or sterol parameters were from varieties used in the super-high-density (SHD) system in the Central Valley region. Three of these samples were outside the heptadecenoic acid parameter, one was outside two sterol parameters and one was outside three sterol parameters.

Our review of data from the past five seasons, totaling 308 single-variety samples, found that 11 percent of samples (33 samples) were outside at least one fatty acid and/or sterol profile parameter. The Desert region had the highest rate of outliers at 29 percent (13 of 45 total samples from the Desert region), SHD varieties accounted for 85 percent of outlying samples (28 of 33 samples) and Koroneiki was the most common outlying variety at 45 percent (15 of 33 samples).

Our finding that some legitimate olive oil is outside fatty acid or sterol profile standards is consistent with California data from previous seasons, as well as similar research in Australia, Chile, Argentina, Palestine, New Zealand, Italy, Spain and Tunisia. The commission may want to recommend to the California Department of Food and Agriculture that the standard for heptadecenoic acid be increased to ≤ 0.60%, consistent with a revision adopted by the International Olive Council and European Union in 2016. The commission also may want to recommend modifications to California olive oil standards so that fatty acid and sterol profile standards accommodate all olive oil produced in California.

BACKGROUND

The OOCC requested the UC Davis Olive Center to collect data on the fatty acid and sterol profile of California olive oils. The Commission requested that the Olive Center collect 30 samples as well as analyze fatty acid and sterol profile data submitted by California producers from a wide range of varieties and counties.

California olive oil must meet standards for fatty acid and sterol profiles set by the California Department of Food and Agriculture (CDFA), California law, and the USDA. Two of the key authenticity tests referenced in these standards are fatty acid profile and sterol profile[1]. Every type of cooking oil, whether corn, canola, soy, or olive, has a distinctive fatty acid and sterol profile, which is why these tests can be useful for determining whether an olive oil has been adulterated [1]. Table 1 lists indicative fatty acid/sterol parameters of common adulterants (seed or vegetable oils) detected in olive oil [2].

At the same time there is a significant body of international literature showing that fatty acids and sterols can be affected by factors unrelated to the authenticity of an oil, including geographical origin [3], climate and altitude [4], cultivar and harvest period [5], irrigation strategies [6], and processing techniques [7]. California data collected between 2010 and 2017 shows that authentic olive oils from the Desert region can have excessive levels of palmitic acid, palmitoleic acid, and campesterol and insufficient levels of oleic acid and apparent β-sitosterol under existing standards [8].

[1] Oils mainly consist of triacylglycerols comprised of various fatty acids, including oleic, palmitic, and linolenic acids, which together make up the fatty acid profile of the oil. Each plant species also contains a unique combination of organic molecules known as sterols, including campesterol, brassicasterol, and cholesterol, which make up the sterol profile of the oil.

Table 1. Indicative fatty acid/sterol parameters of common adulterants detected in olive oil

		USDA Standard (%)	Change of Concentration	Potential Adulterant (oil)
Key fatty acid	Palmitic acid	7.5-20.0	Increase	Palm, cottonseed
	Oleic acid	55.0-83.0	Decrease	Corn, cotton, safflower, soybean, sunflower
	Linoleic acid	3.5-21.0	Increase	Canola, corn, cotton, safflower, soybean
	Linolenic acid	≤1.5	Increase	Canola, soybean
Key sterol	Brassicasterol	≤0.1	Increase	Canola
	Campesterol	≤4.5	Increase	Canola, corn, cotton, grapeseed, palm, safflower, soybean, sunflower
	Stigmasterol	≤Campesterol	Increase	Corn, cotton, palm, safflower, soybean, sunflower
	Delta-7-stigmastenol	≤0.5	Increase	Corn, cotton, palm, safflower, soybean, sunflower
	Apparent B-Sitosterol	≥93.0	Decrease	Canola, corn, safflower, soybean, sunflower

In this report, we summarized the results fatty acid and sterol profile analysis of 30 single-variety California olive oil samples as well as data from 17 lots from the 2018/19 Season and compared findings with the Center's research from previous years [9], as well as research from the other olive-growing regions around the world.

SAMPLE INFORMATION

The study team collected 30 single-variety olive oil samples produced between September and November 2018 directly from producers. The 30 samples collected by the study team had been processed within 24 hours of harvest based on harvest and processing dates supplied by the producers. The UC Davis Olive Center stored the 30 oil samples in a dark room at 22°C (71°F) prior to the samples being analyzed in March 2019. Oil samples that did not meet one or more fatty acid or sterol parameters in UC Davis testing were sent to Modern Olives laboratory (Woodland, CA) for retesting. Both laboratories used the same analytical methods specified by the International Olive Council [10]. This report considers a sample to be outside a fatty acid or sterol parameter only when the data from both laboratories agreed.

The 30 samples collected by the study team is less than in previous seasons, which was due to a smaller study budget related to the small 2018 harvest. The study team supplemented the data described above by also collecting from two producers the fatty acid and sterol data for 17 single-variety olive oil lots. These lots were analyzed either by an in-house laboratory or outside laboratory. The lots were processed during October and November 2018. This report will refer to the data collected from the 30 samples and from the lots of the two processors as "samples."

Table 2 summarizes the region, county and variety of the samples. Codes 1-30 were samples analyzed at UC Davis, Codes 31-47 were data provided by producers. Forty samples were collected from a sole county in three regions: Central Valley, Wine Country and Desert. Seven samples were from fruit harvested from multiple counties in the Central Valley region, which include at least two counties of the following: Glenn, Tehama, Butte, Colusa, Yolo, Fresno, San Joaquin, and Merced. The Central Valley was the source for 66 percent of the samples, followed by 23 percent from the Desert region and 11 percent from the Wine Country region.

The study team examined 23 varieties in all, with 51 percent (24 of 47 samples) of the varieties typically planted in the SHD system and 49 percent (23 of 47 samples) typically grown in lower-density planting configurations (Table 2). The SHD varieties included 20 samples of the dominant California oil varieties of Arbequina, Arbosana and Koroneiki, as well as crosses of these varieties. Crosses that have yet to be released commercially have been labeled in this report as SHD Cross 1, 2, or 3.

Table 2. Samples by region, county and variety

Code	Variety	County (# Samples)
CENTRAL VALLEY REGION - 31 SAMPLES (66%)		
37	SHD Cross 2 (Arbosana x Koroneiki)	Butte (4)
38	SHD Cross 3 (Arbosana x Koroneiki)	
39	Oliana	
40	SHD Cross 1 (Arbosana x Arbequina)	
7	Arbequina	Colusa (1)
35	Manzanillo	Glenn (1)
41	Arbequina	Multiple counties, at least two of the following: Glenn, Tehama, Butte, Colusa, Yolo, Fresno, San Joaquin, and Merced (7)
42	Arbequina	
43	Arbequina	
44	Arbosana	
45	Arbequina	
46	Koroneiki	
47	Arbosana	
1	Picual	Kern (2)
2	Coratina	
3	Arbequina	Madera (3)
4	Arbosana	
5	Koroneiki	
8	Arbosana	San Joaquin (1)
22	Mission	Shasta (1)
26	Maurino	Solano (2)
28	Arbequina	
30	Koroneiki	Tehama (1)
6	Ascolano	Yolo (8)
27	Arbequina	
29	Arbequina	
31	Picual	
32	Coratina	
33	Arbequina	
34	Arbosana	
36	Arbosana	
DESERT REGION - 11 SAMPLES (23%)		
18	Coratina	Imperial (1)
9	Itrana	Riverside (5)
10	Alglandau	
11	Calletier	
16	Arbequina	
19	Chemlali	
12	Nocella de Belice	San Diego (5)
13	Picudo-N40	
14	Taggiasca	
15	Empeltre	
17	Bouteillau	
WINE COUNTRY REGION - 5 SAMPLES (11%)		
20	Moraiolo	Marin (2)
21	Coratina	
23	Manzanillo	Napa (2)
24	Mission	
25	Taggiasca	Santa Clara (1)

RESULTS AND DISCUSSION

Test results indicate that 42 of 47 samples (89 percent) were within the parameters for fatty acid and sterol profiles required of California olive oil, which is the same rate as the five-year average for these studies. Table 3 shows the values and standard deviations (calculated when multiple samples are from the same region) for key fatty acids. This data shows that:

- ten Arbequina samples and six Arbosana samples from the Central Valley had very similar fatty acid profiles compared to those from the same region in the previous seasons [9];
- three Koroneiki samples from the Central Valley region tended to have low palmitic acid (C16:0) and high oleic acid (C18:1), which was consistent with previous years' data from the same region [9];
- SHD Cross 2 had heptadecenoic acid (C17:1) of 0.5%, which greatly exceeded the current USDA standard (≤ 0.3%). SHD Cross 3, which is a cross of the same two varieties, had lower levels of heptadecenoic acid and palmitic acid and higher levels of oleic acid than SHD Cross 2;
- a Nocella de Belice sample from the Desert region had low palmitic acid (< 10.0%) and high oleic acid compared to these of the rest of the varieties from all the regions. Data from the 2016/17 Season also showed the same tendency [9d]; and
- in general, regardless of the difference in varieties and regions, palmitic acid levels tended to correlate negatively with oleic acid levels.

Table 3. Average fatty acid profile by variety in each region

Variety (#)	Region	Palmitic Acid (C16:0)	Palmit-oleic Acid (C16:1)	Hepta-decenoic Acid (C17:1)	Stearic Acid (C18:0)	Oleic Acid (C18:1)	Linoleic Acid (C18:2)	Linolenic Acid (C18:3)
USDA Standard		***7.5-20.0***	***0.3-3.5***	***≤0.3***	***0.5-5.0***	***55.0-83.0***	***3.5-21.0***	***≤1.5***
Aglandau (1)	Desert	17.8	1.2	0.2	2.7	62.9	13.6	0.7
Arbequina (11)	Central Valley	16.9±1.1	1.7±0.3	0.2±0.1	2.0±0.4	66.8±1.2	11.0±1.4	0.5±0.1
	Desert	15.7	1.1	0.1	2.2	68.6	11.1	0.6
Arbosana (6)	Central Valley	15.3±1.3	1.5±0.1	0.3±0.1	2.1±0.1	71.3±0.9	7.4±1.1	0.6±0.1
Oliana (1)	Central Valley	16.2	2.2	0.1	1.6	67.8	10.5	0.8
SHD Cross 1 (1)	Central Valley	16.5	1.6	0.3	1.9	61.1	16.8	0.9
SHD Cross 2 (1)	Central Valley	15.3	1.3	0.5	2.3	65.2	13.5	0.6
SHD Cross 3 (1)	Central Valley	14.5	1.6	0.1	1.9	73.4	7.0	0.7
Ascolano (1)	Central Valley	15.6	0.9	0.3	2	72.7	6.9	0.6
Bouteillau (1)	Desert	15.3	0.8	0.1	2.8	63.0	16.2	1.0
Calletier (1)	Desert	16.0	0.6	0.1	3.1	67.0	11.6	0.7
Chemlali (1)	Desert	18.8	2.4	0.1	4.4	62.2	10.2	1.2
Coratina (4)	Central Valley	15.4±3.1	0.6±0.1	0.1±0.0	2.0±0.1	72±3.6	8.2±0.6	0.9±0.1
	Desert	18.7	2.3	0.1	4.4	62.5	10.1	1.2
	Wine Country	10.3	0.3	0.1	2.3	79.3	6.3	0.5
Empeltre (1)	Desert	17.8	1.6	0.0	1.8	61.5	15.6	1.1
Itrana (1)	Desert	15.8	0.8	0.1	2.4	66.8	12.5	0.7
Koroneiki (3)	Central Valley	13.3±0.5	0.8±0.2	0.1±0.0	2.5±0.2	75.8±1.5	6.1±1.7	0.6±0.1
Manzanillo (2)	Central Valley	13.2	0.6	0.1	1.9	74.5	7.7	1.0
	Wine Country	13.3	0.6	0.1	2.4	74.8	7.3	0.6
Maurino (1)	Central Valley	15.7	1.1	0.1	2.2	69.9	9.7	0.6
Mission (2)	Central Valley	12.8	0.7	0.1	2.4	73	9.6	0.9
	Wine Country	12.7	0.7	0.1	2.5	74.8	7.8	0.6
Moraiolo (1)	Wine Country	14.4	0.7	0.1	2	74.1	7.5	0.5
Nocella de Belice (1)	Desert	9.2	0.3	0.1	2.8	72.4	13.5	0.7
Picual (2)	Central Valley	15.8±3.4	1.4±0.3	0.1±0.0	2.2±0.4	75.1±4.1	3.7±0.3	0.9±0.2
Picudo-N40 (1)	Desert	12.1	0.4	0.0	3.6	75.2	7.0	0.7
Taggiasca (2)	Desert	14.2	0.6	0.0	2.9	67.3	13.5	0.8
	Wine Country	13.3	0.8	0.1	2.9	73.2	8.7	0.5

Table 4 shows the values and standard deviations (calculated when multiple samples are from the same region) of key sterols. The data shows that:

- the Oliana sample exceeded the campesterol parameter standard and its apparent β-sitosterol was lower than the minimum limit in the standard;
- SHD Cross 1 and SHD Cross 2 had similar sterol profiles, with relatively low campesterol and higher total sterols (> 2000); and
- overall, campesterol levels tended to correlate negatively with apparent β-sitosterol and total sterols levels but positively with stigmasterol levels.

Table 4. Average sterol profile by variety in each region

Variety (#)	Region	Chole-sterol	Brassica-sterol	Campe-sterol	Stigma-sterol	Delta-7-stigmastenol	Apparent *B*-sitosterol	Total Sterols
USDA Standard		***≤0.5***	***≤0.1***	***≤4.5***	***≤Campesterol***	***≤0.5***	***≥93.0***	***≥1000***
Aglandau (1)	Desert	0.1	0.0	2.9	0.6	0.0	94.8	2008
Arbequina (11)	Central Valley	0.1±0.0	0.0±0.0	3.5±0.1	0.8±0.1	0.1±0.0	94.3±0.3	1556±109
	Desert	0.1	0.0	3.1	1.1	0.1	94.3	1548
Arbosana (6)	Central Valley	0.1±0.0	0.0±0.0	3.6±0.2	0.8±0.3	0.1±0.0	94.5±0.5	1799±151
Oliana (1)	Central Valley	0.2	0.0	5.5	1.3	0.2	92.3	1100
SHD Cross 1 (1)	Central Valley	0.2	0.0	3.4	1.1	0.1	94.5	2140
SHD Cross 2 (1)	Central Valley	0.1	0.0	3.7	0.9	0.2	94.0	2350
SHD Cross 3 (1)	Central Valley	0.1	0.0	3.5	0.9	0.1	94.8	1700
Ascolano (1)	Central Valley	0.2	0.2	3.0	1.0	0.4	94.0	1339
Bouteillau (1)	Desert	0.1	0.0	2.7	1.1	0.1	94.8	1936
Calletier (1)	Desert	0.1	0.0	3.5	0.6	0.1	94.6	1791
Chemlali (1)	Desert	0.1	0.0	3.2	0.6	0.1	95.1	1896
Coratina (4)	Central Valley	0.3±0.1	0.1±0.0	3.5±0.6	0.6±0.1	0.2±0.1	94.9±0.4	1270±78
	Desert	0.1	0.0	3.5	1.6	0.2	93.9	2641
	Wine Country	0.1	0.0	3.1	0.6	0.1	95.1	1239
Empeltre (1)	Desert	0.1	0.0	2.8	1	0.1	95.1	2103
Itrana (1)	Desert	0.1	0.0	3.1	0.7	0.0	94.7	1866
Koroneiki (3)	Central Valley	0.2±0.1	0.0±0.1	4.4±0.5	0.7±0.1	0.3±0.1	93.3±0.9	1041±142
Manzanillo (2)	Central Valley	0.2	0.1	3.0	0.5	0.2	95.2	1325
	Wine Country	0.1	0.0	3.9	0.6	0.1	94.4	1588
Maurino (1)	Central Valley	0.1	0.0	3.1	0.4	0.1	95.0	1469
Mission (2)	Central Valley	0.1	0.0	0.0	0.7	0.1	95.4	1879
	Wine Country	0.1	0.0	3.2	0.4	0.1	95.2	1508
Moraiolo (1)	Wine Country	0.1	0.0	3.1	0.5	0.1	95.0	1113
Nocella de Belice (1)	Desert	0.1	0.0	4.1	0.5	0.1	94.1	1558
Picual (2)	Central Valley	0.1±0.1	0.1±0.1	3.0±0.0	1.0±0.2	0.2±0.2	94.9±0.1	1612±88
Picudo-N40 (1)	Desert	0.1	0.0	4	0.5	0.1	94.3	1242
Taggiasca (2)	Desert	0.1	0.0	2.9	1	0.1	94.6	1980
	Wine Country	0.1	0.0	2.6	0.6	0.1	94.6	1304

Table 5 shows that five of the 47 samples (11 percent) were outside at least one USDA fatty acid or sterol parameter. All five outlier samples were from varieties used in the SHD system in the Central Valley region:

- three out of five samples (varieties of Arbequina, Arbosana, and SHD Cross 2) were outside the heptadecenoic acid parameter (California standard ≤ 0.3%). Arbosana from San Joaquin County exceeded the heptadecenoic acid parameter in the 2014/15 harvest season; and
- the Oliana sample was outside two sterol parameters and a Koroneiki sample from Madera County was outside three sterol parameters. In past studies, Koroneiki samples from Madera County did not meet at least one sterol parameter in the 2014/15 and 2017/18 harvest seasons [9b][9e].

Table 5. Samples that were outside fatty acid or sterol standards

Code	County	Region	Variety	Lab	Campesterol	Apparent B-sitosterol	Total Sterols	Heptadecenoic Acid (C17:1)
USDA Standard					≤4.5	≥93.0	≥1000	≤0.3
5	Madera	Central Valley	Koroneiki	UCD	4.8 (0.05)[1]	92.9 (0.20)[1]	845 (101)[1]	
				MO	4.9 (0.25)[2]	92.3 (0.25)[2]	877 (113)[2]	
34	Yolo	Central Valley	Arbosana	Third-party				0.4
37	Butte	Central Valley	SHD Cross 2	Third-party				0.5
39	Butte	Central Valley	Oliana	Third-party	5.5	92.3		
41	Mixed counties	Central Valley	Arbequina	Third-party				0.4

[1] UC Davis (UCD) lab provides standard deviation (SD) to quantify the amount of variation or dispersion of replicates.
[2] Modern Olives (MO) lab provides uncertainty (U) to characterize the dispersion of the values attributed to a measured quantity.

SUMMARY FROM PAST FIVE SEASONS

The research team combined the data for 308 olive oil samples analyzed over five harvest seasons (2014/15 Season to 2018/19 Season).

SHD varieties comprised the largest proportion of the five-year sample set, with Arbequina at 20 percent, Arbosana at 11 percent and Koroneiki at 11 percent for a total of 42 percent; followed by Mission and Picual each at 6 percent; and Ascolano, Coratina, Frantoio, Leccino, Manzanillo and Taggiasca each at 4 percent. The other 22 percent were comprised of 30 varieties.

Seventy percent of samples came from the Central Valley, 15 percent from the Desert, 11 percent from Wine Country and 4 percent from the South Coast. All oil samples were directly sourced from California producers except in 2014/15 when 20 of the 50 samples analyzed that season were produced on Abencor bench-scale equipment from fresh olives that were shipped to UC Davis laboratory, and in 2018/19, in which fatty acid and sterol data from 17 lots were provided by two producers.

In total, 11 percent (33 of 308 samples) were outside the standard for fatty acid and/or sterol parameters. Regionally the Desert had the highest rate of samples outside of fatty acid and/or sterol parameters at 29 percent (13 of 45 samples) and Imperial County was the source of 11 of the 13 outlying samples. Over the past five years Arbequina and Arbosana samples from the Desert have had consistently high palmitic acid, palmitoleic acid, linoleic acid, and low oleic acid [9], which is consistent with several studies [11]. High campesterol and low apparent β-sitosterol were also detected among some of those samples.

The Central Valley was the source of nine percent (19 of 217 samples) of outlying samples. Just one of 35 Wine Country samples (three percent) did not meet a sterol parameter.

Eighty-two percent (27 of 33 samples) of the ouliers were SHD varieties, as summarized in Table 6. Koroneiki accounts for 15 of the 33 samples (45 percent). Koroneiki samples failed in all three regions and was the only variety that was outside standards in each of the five past seasons. Five-year data consistently shows that elevated campesterol and low apparent β-sitosterol were likely in Koroneiki samples from the Desert and Central Valley regions. These findings were consistent with previous research in Australia, Argentina, Spain and Palestine [12].

While less than two percent (5 of 308 samples) have exceeded the limit of heptadecenoic acid (California standard ≤ 0.3%) over the past five seasons, 25 percent (78 out of 308 samples) had values equal or above the limit, including 65 samples from the Central Valley region. The International Olive Council raised the limit to 0.60% in 2016, following several studies in multiple countries showing that olive oil often equaled or exceeded the 0.3% maximum [13].

Table 6. Samples outside the USDA Standard of fatty acid and/or sterol profile from 2014/15 to 2018/19 harvest seasons

Harvest Season	Variety	Harvest County	Region	Palmitic Acid (C16:0)	Palmit-oleic Acid (C16:1)	Hepta-decenoic Acid (C17:1)	Oleic Acid (C18:1)	Linoleic Acid (C18:2)	Linolenic Acid (C18:3)	Campe-sterol	Apparent B-sitosterol	Total Sterols
	USDA Standard			7.5-20.0%	0.3-3.5%	≤0.3%	55.0-83.0%	3.5-21.0%	≤1.5%	≤4.5	≥93.0	≥1000
2014/15 Harvest Season	Arbequina (A)	Imperial	Desert	22.7	4.0		44.0			5.6	91.9	
	Arbosana (A)	Imperial	Desert				53.3			4.8	92.2	
	Picual (A)	Imperial	Desert		3.8							
	Leccino (A)	Imperial	Desert				46.6	27.6	2.3			
	Picual (A)	Yolo						3.4				
	Arbosana (A)	Riverside	Desert	22.0	4.0		44.3	24.8				
	Arbequina (A)	Riverside	Desert	23.4	4.6		37.7	30.3		5.0	92.8	
	Koroneiki (A)	Tehama	Central Valley									791
	Koroneiki	Madera	Central Valley								92.7	
	Arbosana	San Joaquin	Central Valley			0.4						
2015/16 Harvest Season	Arbequina	Imperial	Desert	21.3 (0.1)			47.4 (0.1)	23.8 (0.0)		5.5 (0.1)		
	Koroneiki	Imperial	Desert							5.1 (0.1)		
	Koroneiki	Glenn	Central Valley									892 (105)
2016/17 Harvest Season	Arbequina	Imperial	Desert	21.2 (0.01)			49.3 (0.02)	23 (0.03)		5.0 (0.20)	92.7 (0.26)	
	Koroneiki	Imperial	Desert							5.0 (0.20)	92.3 (0.26)	
	Koroneiki	Imperial	Desert							5.0 (0.20)	92.2 (0.26)	
	Koroneiki	Imperial	Desert							5.1 (0.20)	91.9 (0.26)	
	Koroneiki	Tehama	Central Valley									980 (146.09)
	Koroneiki	Yolo	Central Valley									846 (146.09)
	Koroneiki	Napa	Wine Country									918 (146.09)
	Nocellara del Belice	Kern	Central Valley							4.7 (0.20)	91.9 (0.26)	
	Pendolino	Kern	Central Valley	20.0 (0.01)					2.0 (0.003)			
2017/18 Harvest Season	Koroneiki	Imperial	Desert							4.9 (0.20)	92.5 (0.20)	
	Koroneiki	Madera	Central Valley							4.8 (0.20)	92.9 (0.20)	1018 (146)
	Koroneiki	San Joaquin	Central Valley							4.7 (0.20)		

	Koroneiki	San Joaquin	Central Valley							4.8 (0.20)		
	Koroneiki x Arbosana (9805-01)	Butte	Central Valley							5.1 (0.20)	92.4 (0.20)	
	Don Carlo	Tehama	Central Valley							5.5 (0.20)	92.5 (0.20)	
2018/19 Harvest Season	Koroneiki	Madera	Central Valley							4.9 (0.25)	92.3 (0.25)	877 (113)
	Arbosana	Yolo	Central Valley			0.4						
	SHD Cross 2	Butte	Central Valley			0.5						
	Oliana	Butte	Central Valley							5.5	92.3	
	Arbequina	Multiple	Central Valley			0.4						

CONCLUSIONS AND RECOMMENDATIONS

- Of 47 samples collected and analyzed in the 2018/19 harvest season, 89 percent (42 samples) were within the fatty acid and sterol profile parameters required of California olive oil while 11 percent (five samples) were outside at least one fatty acid or sterol parameter, which is the same percentage as the five-year average.
- All 2018/19 samples that were outside fatty and /or sterol parameters were from super-high-density varieties, which was consistent with the results from previous seasons. Specifically, of 33 samples that have been outside fatty acid and sterol parameters over the past five seasons, 85 percent (28 samples) were from SHD varieties.
- Of 308 samples analyzed over the past five seasons, 78 samples (25 percent) had heptadecenoic acid values of at least 0.3% (California standard ≤ 0.3%), including 65 samples from the Central Valley. The commission may want to recommend to the CDFA that the standard for heptadecenoic acid be increased to ≤ 0.60%, consistent with a revision adopted by the International Olive Council and European Union in 2016.
- Our finding that some legitimate olive oil is outside fatty acid or sterol profile standards is consistent with California data from previous seasons [8-9][13], as well as similar research in Australia, Chile, Argentina, Palestine, New Zealand, Italy, Spain and Tunisia [11-12][14]. The commission may want to recommend modifications to California olive oil standards so that fatty acid and sterol profile standards accommodate all olive oil produced in California.

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