# Evaluation of Fatty Acid and Sterol Profiles California Olive Oil 2015/16 Season

Submitted to the
Olive Oil Commission of California

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UCDAVIS OLIVE CENTER
at the Robert Mondavi Institute

# Evaluation of Fatty Acid and Sterol Profiles, California Olive Oil, 2015/16 Season


## SUMMARY

At the request of the Olive Oil Commission of California (OOCC), the UC Davis Olive Center collected California olive oil samples produced in the 2015/16 Season and analyzed fatty acid and sterol profiles.

The study team collected 71 single-variety samples of olive oil 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 (Lara, Victoria, Australia) for retesting. Both laboratories agreed that 68 of 71 samples (96 percent) were within the fatty acid and sterol parameters required in California. Three samples (4 percent) were outside at least one fatty acid or sterol parameter.

The Commission may wish to recommend modifications to California olive oil standards so that fatty acid and sterol profile standards accommodate all olive oil produced in California and assess new and advanced methods to analyze olive oil purity with the potential to cost less, be more accurate, and minimize laboratory variability.


## BACKGROUND

The Olive Oil Commission of California requested the UC Davis Olive Center to collect data on the fatty acid and sterol profile of California olive oils from commercial samples. The Commission requested that the Olive Center collect at least 70 samples 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 United States Department of Agriculture (USDA).[1] Two of the key authenticity tests referenced in these standards are fatty acid profile and sterol profile.[2]

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. However, fatty acids and sterols also can be affected by factors unrelated to the authenticity of an oil, including geographical origin,[3] climate and altitude,[4] cultivar and harvest timing,[5,6] irrigation strategies[7], and processing techniques[8]. These factors can lead to an authentic olive oil failing to meet all of the parameters of standards for fatty acid and sterol profiles.

In this report, we summarized the results of 71 single-variety California olive oil from the 2015/16 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

In soliciting olive oil samples produced in the 2015/16 Season, the study team sought to maximize diversity in varieties and California counties. The study team collected 71 samples between November 2015 and February 2016. Samples were stored in a dark room at 22°C (71°F) prior to the sample being analyzed in January and February.

Figure 1 and Table 1 summarize the samples by harvest location, which totaled 20 counties and four regions. Figure 1 shows the number of samples from each county in red. Table 1 shows that 49 of the samples (69 percent) were from the Central Valley region, the area producing the largest volume of olive oil. Eight samples (11 percent) were from the Wine Country region, 7 samples (10 percent) were from the Central Coast region, and 7 samples (10 percent) were from the Desert region. Table 2 shows the samples by variety. Of the 24 olive varieties collected, the most-widely planted varieties (Arbequina, Arbosana, and Koroneiki) comprised 38 percent (27 of 71 samples).

**Figure 1. Sample distribution by California counties and regions**

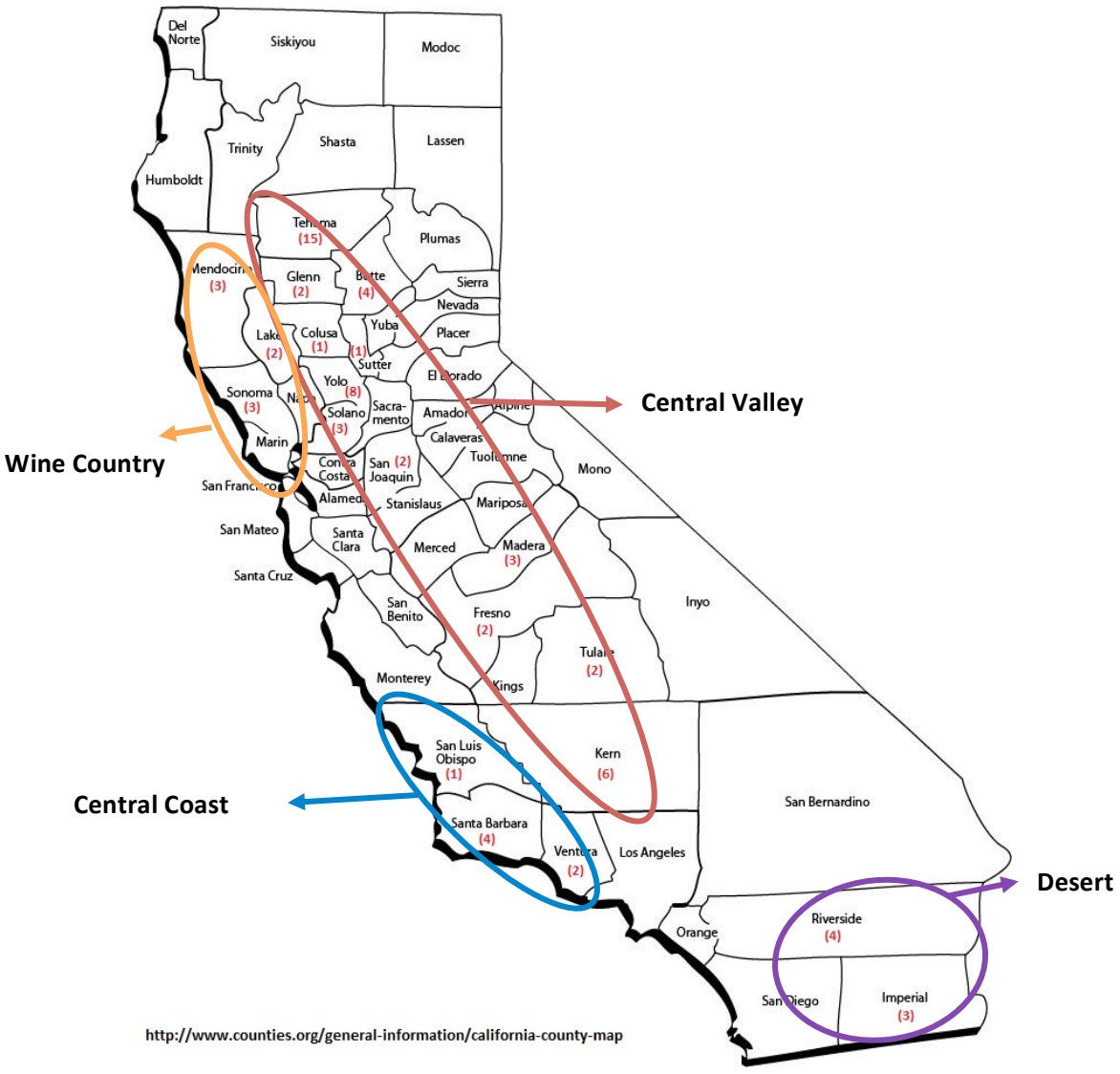

**Table 1. Samples by harvest location**

| CODE | VARIETY | COUNTY (# SAMPLES) |
|---|---|---|
| *CENTRAL VALLEY REGION – 49 SAMPLES (69%)* | | |
| **1** | Arbequina | Butte (4) |
| **2** | Arbosana | |
| **3** | Manzanillo | |
| **4** | Mission | |
| **5** | Arbequina | Colusa (1) |
| **6** | Arbequina | Fresno (2) |
| **7** | Arbosana | |
| **8** | Arbequina | Glenn (2) |
| **9** | Koroneiki | |
| **13** | Ascolano | Kern (6) |
| **14** | Coratina | |
| **15** | Frantoio | |
| **16** | Maurino | |
| **17** | Nocellara del Belice | |
| **18** | Picual | |
| **21** | Arbequina | Madera (3) |
| **22** | Arbosana | |
| **23** | Koroneiki | |
| **31** | Arbequina | San Joaquin (2) |
| **32** | Arbosana | |
| **44** | Arbequina | Sutter (1) |
| **45** | Arbequina | Tehama (15) |
| **46** | Arbosana | |
| **47** | Ascolano | |
| **48** | Barnea | |
| **49** | Coratina | |
| **50** | Favolosa | |
| **51** | Hojiblanca | |
| **52** | Koroneiki | |
| **53** | Leccino | |
| **54** | Manzanillo | |
| **55** | Moraiolo | |
| **56** | Pendolino | |
| **57** | Picual | |
| **58** | Sevillano | |
| **59** | Taggiasca | |
| **38** | Frantoio | Solano (3) |
| **39** | Pendolino | |
| **40** | Taggiasca | |
| **60** | Arbosana | Tulare (2) |
| **61** | Koroneiki | |
| **64** | Arbequina | Yolo (8) |
| **65** | Arbosana | |
| **66** | Koroneiki | |
| **67** | Leccino | |
| **68** | Mission | |
| **69** | Pendolino | |
| **70** | Picual | |
| **71** | Taggiasca | |

| CODE | VARIETY | COUNTY (# SAMPLES) |
|---|---|---|
| *WINE COUNTRY REGION – 8 SAMPLES (11%)* | | |
| **19** | Allegra | Lake (2) |
| **20** | Mission | |
| **24** | Frantoio | Mendocino (3) |
| **25** | Leccino | |
| **26** | Moraiolo | |
| **41** | Coratina | Sonoma (3) |
| **42** | Frantoio | |
| **43** | Moraiolo | |
| *CENTRAL COAST REGION – 7 SAMPLES (10%)* | | |
| **33** | Arbequina | San Luis Obispo (1) |
| **34** | Arbosana | Santa Barbara (4) |
| **35** | Lucca | |
| **36** | Manzanillo | |
| **37** | Taggiasca | |
| **62** | Arbequina | Ventura (2) |
| **63** | Mission | |
| *DESERT REGION – 7 SAMPLES (10%)* | | |
| **10** | Arbequina | Imperial (3) |
| **11** | Arbosana | |
| **12** | Koroneiki | |
| **27** | Chemlali | Riverside (4) |
| **28** | Dolce | |
| **29** | Grignon | |
| **30** | Mission | |

## Table 2. Samples by variety

| CODE | VARIETY (# SAMPLES) | HARVEST COUNTY | REGION |
|---|---|---|---|
| **19** | Allegra (1) | Lake | Wine Country |
| **1** | Arbequina (12) | Butte | Central Valley |
| **5** | | Colusa | |
| **6** | | Fresno | |
| **8** | | Glenn | |
| **21** | | Madera | |
| **31** | | San Joaquin | |
| **44** | | Sutter | |
| **45** | | Tehama | |
| **64** | | Yolo | |
| **33** | | San Luis Obispo | Central Coast |
| **62** | | Ventura | |
| **10** | | Imperial | Desert |
| **2** | Arbosana (9) | Butte | Central Valley |
| **7** | | Fresno | |
| **22** | | Madera | |
| **32** | | San Joaquin | |
| **46** | | Tehama | |
| **60** | | Tulare | Central Valley |
| **65** | | Yolo | |
| **34** | | Santa Barbara | Central Coast |
| **11** | | Imperial | Desert |
| **13** | Ascolano (2) | Kern | Central Valley |
| **47** | | Tehama | |
| **48** | Barnea (1) | Tehama | Central Valley |

| CODE | VARIETY | HARVEST COUNTY | REGION |
|---|---|---|---|
| 27 | Chemlali (1) | Riverside | Desert |
| 14 | Coratina (3) | Kern | Central Valley |
| 49 | | Tehama | |
| 41 | | Sonoma | Wine Country |
| 28 | Dolce (1) | Riverside | Desert |
| 50 | Favolosa (1) | Tehama | Central Valley |
| 15 | Frantoio (4) | Kern | Central Valley |
| 24 | | Mendocino | Wine Country |
| 38 | | Solano | |
| 42 | | Sonoma | |
| 29 | Grignon | Riverside | Desert |
| 51 | Hojiblanca | Tehama | Central Valley |
| 9 | Koroneiki (6) | Glenn | Central Valley |
| 23 | | Madera | |
| 52 | | Tehama | |
| 61 | | Tulare | |
| 66 | | Yolo | |
| 12 | | Imperial | Desert |
| 53 | Leccino (3) | Tehama | Central Valley |
| 67 | | Yolo | |
| 25 | | Mendocino | Wine Country |
| 35 | Lucca (1) | Santa Barbara | Central Coast |
| 3 | Manzanillo (3) | Butte | Central Valley |
| 54 | | Tehama | |
| 36 | | Santa Barbara | Central Coast |
| 16 | Maurino (1) | Kern | Central Valley |
| 4 | Mission (5) | Butte | Central Valley |
| 68 | | Yolo | |
| 20 | | Lake | Wine Country |
| 63 | | Ventura | Central Coast |
| 30 | | Riverside | Desert |
| 55 | Moraiolo (3) | Tehama | Central Valley |
| 26 | | Mendocino | Wine Country |
| 43 | | Sonoma | |
| 17 | Nocellara del Belice (1) | Kern | Central Valley |
| 56 | Pendolino (3) | Tehama | Central Valley |
| 69 | | Yolo | |
| 39 | | Solano | |
| 18 | Picual (3) | Kern | Central Valley |
| 57 | | Tehama | |
| 70 | | Yolo | |
| 58 | Sevillano (1) | Tehama | Central Valley |
| 59 | Taggiasca (4) | Tehama | Central Valley |
| 71 | | Yolo | |
| 37 | | Solano | |
| 40 | | Santa Barbara | Central Coast |

Samples that did not meet one or more fatty acid or sterol parameters at the UC Davis laboratory were sent to Modern Olives laboratory (Lara, Victoria, Australia) for retesting. Both laboratories used the same analytical methods specified by the International Olive Council.[10] This report considers a sample to not be within a fatty acid or sterol parameter only if the data from both laboratories agreed. Margin of errors for each parameter was taken into consideration, especially for samples that were near the borderline of allowable limits.

**RESULTS AND DISCUSSION**

Test results indicate that 68 of 71 samples (96 percent) were within the parameters for fatty acid and sterol profiles required of California olive oil, similar to the 97 percent rate for 30 commercial samples analyzed from the 2014-15 season.

The average value and standard deviation of key fatty acids and sterols are shown in Tables 3 and 4. Super-high-density (SHD) varieties (Arbequina, Arbosana and Koroneiki) from the Desert region had higher levels of palmitic acid, palmitoleic acid, linolenic acid and linolenic acid; and a lower level of oleic acid than the same varietals from other regions. These varieties also had higher levels of campesterol, stigmasterol, delta-7-stigmastenol and total sterols; and a lower level of apparent B-sitosterol from the Desert region than other regions. Overall, regardless of the difference in varieties and regions, oleic acid level tended to correlate negatively with palmitic acid and linoleic acid. Similarly, campesterol level tended to correlate negatively with apparent B-sitosterol but positively with stigmasterol.

As shown in Table 5, three of the 71 samples (four percent) were found by both the UC Davis and Modern Olives laboratories to be outside at least one USDA fatty acid or sterol parameter. Two of the three samples came from the emerging Desert region and one came from the Central Valley, which is most widely planted olive region in California. All three samples outside the parameters were of SHD varieties.

- Sample #10, an Arbequina oil from Imperial County, was outside the parameters for palmitic acid, oleic acid, linoleic acid and campesterol. These results are consistent with the Olive Center's data from previous years for Arbequina from desert regions,[8, 9] as well as research in Australia and Argentina.[11] Hot climates are associated with lower levels of oleic acid while cooler climates are associated with higher levels of oleic acid.[11a] Hot climates also tend to correlate with elevated palmitic acid and polyunsaturated linoleic acid.[11b]

- A Koroneiki sample (#12) from the same desert area was outside the parameters for campesterol, which is consistent with desert samples in the Center's previous study[8] as well as research in Australia and Argentina.[11]

- An additional Koroneiki sample (#9) from Glenn County in the Central Valley was outside the parameters for total sterols, which is consistent for this variety with previous research in the United States and Australia.[8, 9, 11b]

## Table 3. Fatty acid profile by variety

| | | PERCENTAGE OF TOTAL FATTY ACIDS | | | | | |
|---|---|---|---|---|---|---|---|
| **VARIETY** | **REGION** | **Palmitic Acid C16:0** | **Palmitoleic Acid C16:1** | **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* | *0.5-5.0* | *55.0-83.0* | *3.5-21.0* | *≤1.5* |
| Allegra | Wine Country* | 12.5 | 0.5 | 1.7 | 74.1 | 9.4 | 0.8 |
| Arbequina | Central Valley | 17.8±1.2 | 1.5±0.4 | 2.1±0.2 | 65.5±3.8 | 11.2±2.4 | 0.6±0.1 |
| | Central Coast | 15.4±2.4 | 1.1±0.5 | 2.5±0.8 | 69.3±6.6 | 10±4.6 | 0.6±0.1 |
| | Desert* | 21.3 | 3.3 | 2.0 | 47.4 | 23.8 | 1.0 |
| Arbosana | Central Valley | 17.3±1.1 | 1.7±0.4 | 2.3±0.2 | 67.7±3.4 | 8.9±2.2 | 0.7±0.1 |
| | Central Coast* | 16.0 | 1.1 | 2.8 | 70.8 | 7.0 | 0.7 |
| | Desert* | 19.6 | 2.3 | 2.5 | 58.5 | 14.5 | 1.1 |
| Ascolano | Central Valley | 17.7±1.8 | 1.4±0.4 | 2.1±0.1 | 63.1±5.8 | 13.4±3.4 | 0.8±0.2 |
| Barnea | Central Valley* | 13.8 | 0.8 | 2.6 | 69.7 | 11.5 | 0.6 |
| Chemlali | Desert* | 18.8 | 2.0 | 2.4 | 59.6 | 15.3 | 0.8 |
| Coratina | Central Valley | 14.3±1.6 | 0.5±0.1 | 2.4±0.1 | 71.4±4.7 | 9.4±3.1 | 0.8±0.1 |
| | Wine Country* | 10.1 | 0.3 | 2.4 | 77.2 | 8.4 | 0.6 |
| Dolce | Desert* | 11.8 | 0.6 | 2.2 | 71.9 | 11.6 | 1.0 |
| Favolosa | Central Valley* | 15.6 | 1.1 | 1.8 | 66.1 | 13.2 | 1.1 |
| Frantoio | Central Valley | 16.2±0.8 | 1.1±0.3 | 2.1±0.2 | 66±3.1 | 12.6±2.3 | 1.0±0.0 |
| | Wine Country | 12.9±0.7 | 0.7±0.1 | 2.6±0.0 | 75±0.3 | 7.3±0.2 | 0.6±0.2 |
| Grignon | Desert* | 13.9 | 0.9 | 2.3 | 68.3 | 13.0 | 0.8 |
| Hojiblanca | Central Valley* | 14.6 | 1.2 | 2.4 | 75.2 | 5.0 | 0.7 |
| Koroneiki | Central Valley | 14.8±0.9 | 0.9±0.2 | 2.7±0.4 | 72.1±3.0 | 7.7±2.2 | 0.7±0.1 |
| | Desert* | 15.5 | 1.2 | 3.1 | 67.8 | 10.0 | 1.1 |
| Leccino | Central Valley | 16.3±0.1 | 1.1±0.1 | 2.2±0.1 | 68.3±4.1 | 8.9±1.8 | 0.7±0.1 |
| | Wine Country* | 15.2 | 1.0 | 2.8 | 70.8 | 8.8 | 0.6 |
| Lucca | Central Coast* | 15.0 | 0.9 | 2.0 | 67.0 | 13.2 | 0.8 |
| Manzanillo | Central Valley | 15.2±0.9 | 1.2±0.3 | 3.7±0.2 | 70.3±3.8 | 7.4±3 | 0.7±0.1 |
| | Central Coast* | 15.7 | 1.2 | 2.6 | 70.5 | 8.1 | 0.7 |
| Maurino | Central Valley* | 15.4 | 0.6 | 2.3 | 68.1 | 11.6 | 0.9 |
| Mission | Central Valley | 12.2±0.1 | 0.7±0.0 | 2.3±0.2 | 71.6±0.6 | 11.4±0.4 | 1.0±0.0 |
| | Central Coast* | 13.5 | 0.8 | 2.3 | 69.6 | 11.6 | 1.3 |
| | Desert* | 12.0 | 0.6 | 2.2 | 69.6 | 13.5 | 1.2 |
| | Wine Country* | 11.6 | 0.6 | 2.4 | 71.1 | 12.7 | 0.9 |
| Moraiolo | Central Valley* | 18.0 | 1.0 | 2.1 | 65.1 | 12.2 | 0.9 |
| | Wine Country | 15.3±0.5 | 0.8±0.1 | 2.3±0.2 | 71.1±0.3 | 9.1±0.8 | 0.6±0.0 |
| Nocellara | Central Valley* | 16.7 | 1.7 | 2.3 | 62.2 | 15.0 | 1.1 |
| Pendolino | Central Valley | 17±1.1 | 1±0.2 | 2±0.2 | 68.2±2.0 | 10±1 | 0.9±0.3 |
| Picual | Central Valley | 15.4±1.2 | 1.5±0.5 | 2.5±0.2 | 73.0±3.0 | 5.8±1.3 | 0.9±0.2 |
| Sevillano | Central Valley* | 15.5 | 0.8 | 2.4 | 68.6 | 10.0 | 1.2 |
| Taggiasca | Central Valley | 15.3±0.9 | 1.1±0.2 | 2.3±0.5 | 67.5±2.4 | 12.1±1.8 | 0.8±0.0 |
| | Central Coast* | 14.2 | 0.9 | 2.2 | 70.3 | 10.9 | 0.6 |

* Only one sample available of this variety from this region

## Table 4. Sterol profile by variety

| | | PERCENTAGE OF TOTAL STEROLS | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **VARIETY** | **REGION** | **Cholesterol** | **Brassicasterol** | **Campesterol** | **Stigmasterol** | **Delta-7-stigmastenol** | **Apparent B-sitosterol** | **Total Sterols** |
| *USDA Standard* | | *≤0.5* | *≤0.1* | *≤4.5* | *<campesterol* | *≤0.5* | *≥ 93.0* | *≥ 1000* |
| Allegra | Wine Country* | 0.1 | 0.0 | 2.5 | 0.4 | 0.0 | 96.5 | 1348 |
| Arbequina | Central Valley | 0.1±0.0 | 0.0±0.0 | 3.8±0.2 | 0.9±0.1 | 0.2±0.1 | 94.3±0.6 | 1325±262 |
| | Central Coast | 0.1±0.0 | 0.0±0.0 | 3.4±0.3 | 0.6±0.1 | 0.1±0.1 | 95±0.2 | 1249±324 |
| | Desert* | 0.1 | 0.0 | 5.5 | 1.5 | 0.5 | 91.9 | 2609 |
| Arbosana | Central Valley | 0.1±0.0 | 0.0±0.0.1 | 3.8±0.3 | 1.0±0.1 | 0.1±0.1 | 94.3±0.5 | 1501±400 |
| | Central Coast* | 0.1 | 0.0 | 3.9 | 0.8 | 0.0 | 94.5 | 1412 |
| | Desert* | 0.1 | 0.0 | 4.4 | 1.5 | 0.2 | 93.4 | 2584 |
| Ascolano | Central Valley | 0.1±0.0 | 0.0±0.0 | 2.9±0.2 | 1.1±0.2 | 0.0±0.0 | 95.5±0.5 | 2002±445 |
| Barnea | Central Valley* | 0.1 | 0.0 | 4.3 | 0.6 | 0.1 | 94.5 | 1362 |
| Chemlali | Desert* | 0.1 | 0.0 | 3.1 | 0.6 | 0.1 | 95.7 | 2251 |
| Coratina | Central Valley | 0.2±0.2 | 0.0±0.0 | 3.2±0.5 | 0.7±0.2 | 0.1±0.0 | 95.4±0.8 | 1129±115 |
| | Wine Country* | 0.1 | 0.0 | 2.7 | 0.4 | 0.2 | 95.4 | 1025 |
| Dolce | Desert* | 0.0 | 0.0 | 2.6 | 1.5 | 0.1 | 95.3 | 2038 |
| Favolosa | Central Valley* | 0.1 | 0.0 | 2.5 | 1.5 | 0.1 | 95.5 | 1519 |
| Frantoio | Central Valley | 0.1±0.0 | 0.0±0.0 | 3.7±0.2 | 0.7±0.1 | 0.3±0.1 | 94.6±0.0 | 1827±179 |
| | Wine Country | 0.1±0.0 | 0.0±0.0 | 3.1±0.3 | 0.4±0.0 | 0.2±0.0 | 95.1±0.1 | 1165±135 |
| Grignon | Desert* | 0.1 | 0.0 | 2.6 | 1.8 | 0.1 | 94.7 | 1916 |
| Hojiblanca | Central Valley* | 0.1 | 0.0 | 2.9 | 0.7 | 0.1 | 95.7 | 1285 |
| Koroneiki | Central Valley | 0.2±0.1 | 0.0±0.0 | 4.2±0.4 | 0.8±0.2 | 0.3±0.4 | 93.8±1.3 | 1147±203 |
| | Desert* | 0.1 | 0.0 | 5.1 | 1.6 | 1.0 | 91.7 | 1796 |
| Leccino | Central Valley | 0.1±0.0 | 0.0±0.0 | 3.0±0.2 | 0.9±0.3 | 0.2±0.1 | 94.8±0.6 | 1496±269 |
| | Wine Country* | 0.1 | 0.0 | 3.0 | 0.6 | 0.3 | 94.8 | 1310 |
| Lucca | Central Coast* | 0.2 | 0.0 | 3.3 | 0.5 | 0.3 | 95.0 | 1253 |
| Manzanillo | Central Valley | 0.1±0.0 | 0.0±0.0 | 2.5±0.3 | 1.0±0.4 | 0.1±0.0 | 95.8±0.8 | 1131±15 |
| | Central Coast* | 0.2 | 0.0 | 3.0 | 0.7 | 0.1 | 95.5 | 1024 |
| Maurino | Central Valley* | 0.3 | 0.0 | 3.5 | 0.9 | 0.1 | 94.8 | 1245 |
| Mission | Central Valley | 0.1±0.0 | 0.0±0.0 | 2.9±0.4 | 0.5±0.0 | 0.1±0.0 | 95.3±1.2 | 1808±306 |
| | Central Coast* | 0.1 | 0.0 | 2.9 | 0.4 | 0.1 | 96.0 | 1961 |
| | Desert* | 0.0 | 0.0 | 2.9 | 1.4 | 0.0 | 95.2 | 2063 |
| | Wine Country* | 0.0 | 0.0 | 2.6 | 0.6 | 0.0 | 96.3 | 1817 |
| Moraiolo | Central Valley* | 0.1 | 0.0 | 2.7 | 0.5 | 0.2 | 95.8 | 1426 |
| | Wine Country | 0.1±0.0 | 0.0±0.0 | 2.7±0.2 | 0.4±0.0 | 0.2±0.0 | 95.5±0.1 | 1202±9 |
| Nocellara | Central Valley* | 0.1 | 0.0 | 4.5 | 1.6 | 0.1 | 93.1 | 1450 |
| Pendolino | Central Valley | 0.1±0.0 | 0.0±0.0 | 2.9±0.3 | 0.6±0.1 | 0.3±0.1 | 95.4±0.3 | 1325±160 |
| Picual | Central Valley | 0.1±0.0 | 0.0±0.0 | 2.8±0.0 | 0.9±0.2 | 0.1±0.0 | 95.6±0.2 | 1482±471 |
| Sevillano | Central Valley* | 0.1 | 0.0 | 2.6 | 1.1 | 0.1 | 95.9 | 1527 |
| Taggiasca | Central Valley | 0.1±0.0 | 0.0±0.0 | 3.1±0.1 | 0.6±0.1 | 0.3±0.2 | 95.2±0.3 | 1481±91 |
| | Central Coast* | 0.1 | 0.0 | 2.7 | 0.7 | 0.3 | 94.1 | 1131 |

* Only one sample available of this variety from this region

**Table 5. Samples that were outside fatty acid and/or sterol profile standards**

| CODE | COUNTY | VARIETY | LAB | PALMITIC ACID (C16:0) | OLEIC ACID (C18:1) | LINOLEIC ACID (C18:2) | TOTAL STEROLS | CAMPE-STEROL |
|---|---|---|---|---|---|---|---|---|
| | | *USDA Standard* | | *7.5 – 20* | *55.0 – 83.0* | *3.5 – 21* | *≥1000* | *≤4.5* |
| **10** | Imperial | Arbequina | UC Davis | 22.8 (0.0) | 46.8 (0.1) | 23.2 (0.0) | | 5.3 (0.0) |
| | | | Mod. Olives | 21.3 (0.1) | 47.4 (0.1) | 23.8 (0.0) | | 5.5 (0.1) |
| **12** | Imperial | Koroneiki | UC Davis | | | | | 4.9 (0.0) |
| | | | Mod. Olives | | | | | 5.1 (0.1) |
| **9** | Glenn | Koroneiki | UC Davis | | | | 808 (108) | |
| | | | Mod. Olives | | | | 892 (105) | |

NOTE: Laboratory margin of error in parentheses

## CONCLUSIONS AND RECOMMENDATIONS

- 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] as well as similar research in Australia, Chile, Argentina, New Zealand, Spain and Tunisia.[11, 12] The commission may wish to recommend modifications to California olive oil standards so that fatty acid and sterol profile standards accommodate all olive oil produced in California.

- Fatty acid and sterol profile analysis have shortcomings as tools for assessing olive oil purity. These tests are time-consuming and expensive, and cannot always reliably prove olive oil authenticity. The commission may wish to investigate new and advanced methods with the potential to cost less, be more accurate, and minimize laboratory variability. For example: multicomponent analysis may be a useful tool once the database is established. Using oils of known type, variety and origin, we can categorize the instrumental reading into different groups. These groups can then be used to differentiate type, variety and origin of the unknown samples. In addition, there is an on-going research effort on the DNA analysis of olive oil and has had a great advancement in recent years. It shows promising results on identifying the presence of other oil (such as sunflower or soybean) and identifying variety and origin.

[1] CDFA has adopted standards for some, but not all, olive oil fatty acids and sterols. For those elements of fatty acid and sterol profiles not in CDFA standards, California producers observe USDA standards, which are referenced in California state law. 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; California Health and Safety Code, Division 104, Part 6, Chapter 9; and United States Department of Agriculture (2010), United States Standards for Grades of Olive Oil and Olive-Pomace Oil, *Federal Register.*

[2] 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.

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