Australian Olive Oils (and Sterols)

Paul Miller
President emeritus AOA
Founder Extra Virgin Alliance
hortempm@bigpond.com

WORKSHOP ACEITE DE OLIVA 2016
Los esteroles en el aceite de oliva.
Barcelona
September 8 2016
Presentation Outline

• Australian olive oil data for sterols
• Information from Argentina and California
• Australian research results
• Observations and recommendations
Australian Data, sterols in olive oil

• Analyses were conducted by two Australian laboratories:
  • Australian Oils Research Laboratory (AORL), New South Wales Department of Primary Industries, Wagga Wagga, New South Wales, Australia
  • Modern Olives Laboratory Services, Boundary Bend Ltd, Lara, Victoria, Australia
• Data is from 1251 single variety olive oil analyses done between 2005 and 2014, representing all olive varieties and all regions of Australia
Australian Data, sterols in olive oil

- Data was presented to the Codex (Alimentarius) Fats and Oils Committee (CCFO) electronic working group on campesterol in olive oil
- Two standards and ranges are considered - from the IOC standard and the Australian Standard AS 5264-2011
- Note decision trees are also in the IOC standard and the EU regulation
- CCFO is considering how to deal with natural variations in campesterol
### Australian Data, sterols in olive oil

<table>
<thead>
<tr>
<th>Analyses 2005-2014</th>
<th>Cholesterol</th>
<th>Brassicasterol</th>
<th>Campesterol</th>
<th>Stigmasterol</th>
<th>D-7-Stigmastenol</th>
<th>β-Sitosterol</th>
<th>Total sterols</th>
</tr>
</thead>
<tbody>
<tr>
<td>IOC limits</td>
<td>0.0-0.5</td>
<td>0.0-0.1</td>
<td>0.0-4.0</td>
<td>&lt; Camp.</td>
<td>0.0-0.5</td>
<td>93.0-100.0</td>
<td>&gt; 1000</td>
</tr>
<tr>
<td>AS 5264-2011 limits</td>
<td>0.0-0.5</td>
<td>0.0-0.1</td>
<td><strong>0.0-4.8</strong></td>
<td><strong>0.0-1.9</strong></td>
<td>0.0-0.5</td>
<td><strong>92.5-100.0</strong></td>
<td>&gt; 1000</td>
</tr>
</tbody>
</table>

| MEAN               | 0.19        | 0.02           | 3.74        | 0.74         | 0.24            | 94.2         | 1644          |
| STANDARD DEVIATION | 0.13        | 0.02           | 0.62        | 0.26         | 0.10            | 0.7          | 316           |
| MAXIMUM            | 0.80        | 0.24           | 5.10        | 2.30         | 1.19            | 96.7         | 2862          |
| MINIMUM            | 0.00        | 0.00           | 1.88        | 0.00         | 0.00            | 91.9         | 707           |
| NUMBER OF SAMPLES  | 1251        | 1251           | 1251        | 1251         | 1251            | 1251         | 1251          |
| BELOW AS 5264-2011 | 0.0%        | 0.0%           | 0.0%        | 0.0%         | 0.0%            | 1.0%         | 1.8%          |
| ABOVE AS 5264-2011 | 0.5%        | 0.0%           | 1.1%        | 0.3%         | 0.4%            | 0.0%         | 0.0%          |
| BELOW IOC          | 0.0%        | 0.0%           | 0.0%        | 0.0%         | 0.0%            | **2.8%**     | 1.8%          |
| ABOVE IOC          | 0.5%        | 0.0%           | **31.4%**   | 0.0%         | 0.4%            | 0.0%         | 0.0%          |
### Australian Data, sterols in olive oil

<table>
<thead>
<tr>
<th>Analyses 2005-2014</th>
<th>Campesterol</th>
<th>β-Sitosterol</th>
</tr>
</thead>
<tbody>
<tr>
<td>IOC limits</td>
<td>0.0-4.0</td>
<td>93.0-100.0</td>
</tr>
<tr>
<td>AS 5264-2011 limits</td>
<td>0.0-4.8</td>
<td>92.5-100.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Statistic</th>
<th>Campesterol</th>
<th>β-Sitosterol</th>
</tr>
</thead>
<tbody>
<tr>
<td>MEAN</td>
<td>3.74</td>
<td>94.2</td>
</tr>
<tr>
<td>STANDARD DEVIATION</td>
<td>0.62</td>
<td>0.7</td>
</tr>
<tr>
<td>MAXIMUM</td>
<td>5.10</td>
<td>96.7</td>
</tr>
<tr>
<td>MINIMUM</td>
<td>1.88</td>
<td>91.9</td>
</tr>
<tr>
<td>NUMBER OF SAMPLES</td>
<td>1251</td>
<td>1251</td>
</tr>
<tr>
<td>BELOW AS 5264-2011</td>
<td>0.0%</td>
<td>1.0%</td>
</tr>
<tr>
<td>ABOVE AS 5264-2011</td>
<td>1.1%</td>
<td>0.0%</td>
</tr>
<tr>
<td>BELOW IOC</td>
<td>0.0%</td>
<td>2.8%</td>
</tr>
<tr>
<td>ABOVE IOC</td>
<td><strong>31.4%</strong></td>
<td>0.0%</td>
</tr>
</tbody>
</table>
Australian Data, sterols in olive oil

• The key natural variant outside traditional norms is campesterol
• When campesterol levels are high in olive oils, the same oils tend to exhibit lower apparent \(\beta\)-sitosterol levels
Data from Argentina and USA

Sources

• Argentina – Carelli, A. 2008 Olive Oil Chemistry in Argentina, AOCS Hot Topic session, AOCS 2008 Seattle USA

• USA - Evaluation of Fatty Acid and Sterol Profiles, California Olive Oil, 2014/15 Season, Olive Oil Commission of California
Data from Argentina

• With regard to percentages of campesterol, oils from the varieties Arbequina (3.8-5.3), Arauco (4.2-4.5) and Barnea (4.4-5.0) had levels above the international norms (require less than 4.0%)

• As usual when campesterol levels are high in olive oils, the same oils tend to exhibit lower apparent β-sitosterol levels than traditional norms
Data from California

- Some olive oils from the varieties Arbequina and Arbosana have levels of campesterol above international norms
- These cases also exhibit apparent $\beta$-sitosterol levels lower than international norms
- Some samples of the variety Koroneiki have total sterols lower than international norms
Australian Research Results

• Sources:

• **The Natural Chemistry of Australian Olive Oil**, Rural Industries Research and Development Corporation, *2007*, *Publication No. 06/132*

• **Sterols in Australian Olive Oil, The effects of technological and biological factors**, Rural Industries Research and Development Corporation, *2010*, *Publication No. 10/173*
Australian Research Results

• The 2007 work showed that olive oils from the varieties Barnea and Koroneiki grown in Australia could have campesterol levels above the international norms

• In addition, some olive oils from the varieties Coratina, Pendolino and Koroneiki had levels of total sterols below international norms
Australian Research Results

• The 2010 work is a comprehensive evaluation of the horticultural and processing factors influencing sterols in olive oils as well as biochemical and genetic factors

• This work examined oils made from fruit (and parts of fruit) of the varieties Frantoio, Barnea and Picual
Australian Research Results

The 2010 work found that:

- Sterol composition in olives and olive oils is influenced by genetic factors – variety has a major influence in particular on levels of campesterol, stigmasterol, apparent β-sitosterol and total sterols.
Australian Research Results

The 2010 work found that:

• Processing practices affected the concentrations of triterpene dialcohols and stigmasterol in olive oils

• The same compounds were found in higher concentrations in oils extracted from olive seeds and the skin/outer flesh of olive fruits than from the flesh of olives
Australian Research Results

The 2010 work found that:

- Horticultural factors can influence the sterol composition of olive oils, in particular \( \beta \)-sitosterol, sitostanol, \( \Delta 5 \)-avenasterol and \( \Delta 7 \)-avenasterol can be affected by irrigation, fruit maturity and fruit size.

- The campesterol/stigmasterol ratio has some potential to be used as an indicator of olive oil quality.
Observations and recommendations

• Since 2005 a lot of work has been done on olive oil sterols ($$ resources)

• This work has mostly been done in consideration of international standards such as those of Codex Alimentarius

• It has also been done because international trade has been affected by the natural variation in olive oil (outside international norms) of the levels of certain sterols – e.g. oils from Argentina, Israel and Australia
Observations and recommendations

• The only sterol that I have seen used after analysis to detect and pursue olive oil fraud is brassicasterol (a strong indicator of the presence of rapeseed or canola oil)

• I have never seen campesterol used for this purpose (and would welcome any examples)

• Despite this, year after year the argument against increasing campesterol levels in standards (e.g. from 4.0 to 4.8 %) is the “increased risk of fraud”
Observations and recommendations

• I am aware of the levels of campesterol and \( \Delta 7 \)-stigmastenol – when exceeding international norms - being used to discount olive oils by olive oil traders both importing into Europe and within Europe.
Observations and recommendations

• We need descriptive ranges of the components of olive oil like sterols in international norms and they must accommodate the natural variations in olive oils from around the world.

• Such variations are likely to increase as olive oil is made from olives in more and more countries from new varieties and in a greater range of climates.
Observations and recommendations

• The detection of fraud is an important function of olive oil analyses
• The sterol analysis is one of the most expensive analyses of olive oil
• Other analyses that are used for this purpose may be cheaper and/or more effective than sterol analysis – this should be considered with regard to research on olive oil analyses and the development of olive oil standards and regulations
Thank you