Olive Oil Commission of California
Educational Workshop

How to Produce, Evaluate & Protect Quality Extra Virgin Olive Oil

September 2018

Alexandra Kicenik Devarenne

Thank you to our hosts

McEvoy Ranch
and
Central Coast Olive Growers

And thank you to our contributors

- David Garci-Aguirre, Corto Olive
- Marcelo Berlanda, California Olive Ranch
- Claudia Guillaume & Leandro Ravetti, Modern Olives Laboratory
- Pablo Voitzuk, Consultant
- Samantha Dorsey, McEvoy Ranch

What is olive oil quality?

How do we measure olive oil quality?

Sensory

- Sensory is what it's all about in the end!
- We need to consider both of these:

  1) official panel test

  2)"Tastes good to me with my food!"
- It's important to understand both strengths and limitations of sensory analysis

The Official Panel Test

- **Required** to determine grade of virgin olive oil under CDFA, IOC and many other olive oil standards
- Currently our best instrument for detecting many defects
- Not very good at detecting carefully adulterated oils (refined or deodorized oils at modest percentages)
- Panel results can flag possible aging and other issues that are confirmed by chemical analysis

Olive oil standards apply to **quality** and **authenticity**

- Purity (authenticity) standards
  - Is it olive oil? Is it virgin olive oil or refined olive oil?
- Quality standards
  - Is it *good* olive oil? What is the grade: Extra Virgin, Virgin, Crude (Lampante)?

Note:

"**Virgin**" describes both

a grade of virgin olive oil and

the entire category of mechanically extracted natural olive oil

(i.e. not refined)

Olive oil standards are ***minimum*** standards

They describe an olive oil at the **end** of its useful life, not the beginning

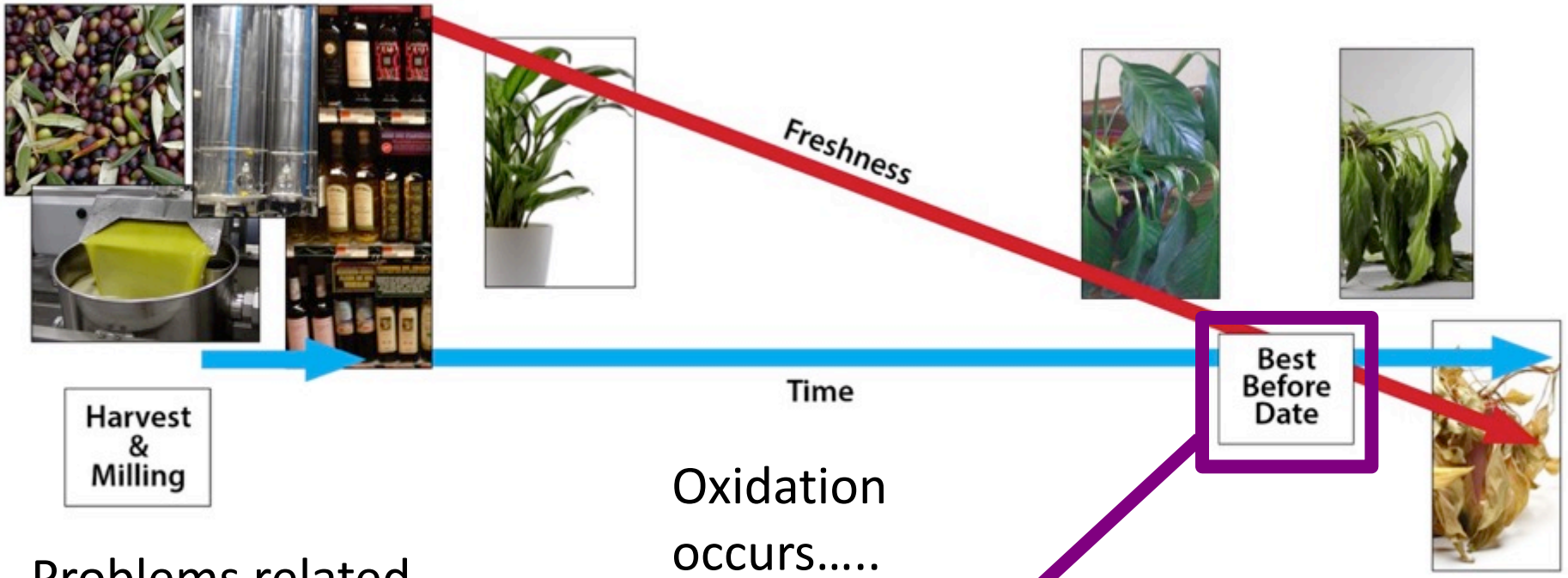
David's **D+ EVOO** example

- "Extra virgin" is defined by what it is not: i.e. defective
- Sensory parameters are rock bottom: no defects, fruitiness higher than zero
- The chemical quality parameters are also very lax. The results of all the off-shelf testing studies illustrate this: many of the failing oils pass the common chemical standards (we will address this in more detail later)

With thanks to David Garci-Aguirre

Olive oil is a dynamic product:
it changes over time

The Freshness Continuum



Problems related to fruit and processing occur

Oxidation occurs…..

“Minimum standard” numbers make sense

Minimum Quality Standards Being Used in the US

	USDA	Int'l Olive Council	Olive Oil Commission of California*	CA Olive Oil Council
Sensory— Median of defects Median of fruity	 MeD = 0 MeF > 0	 MeD = 0 MeF > 0	 MeD = 0 MeF > 0	 MeD = 0 MeF > 0
Free fatty acid	≤ 0.8	≤ 0.8	≤ 0.5	≤ 0.5
Peroxide value	≤ 20	≤ 20	≤ 15	≤ 15
UV K232	≤ 2.50	≤ 2.50	≤ 2.40	≤ 2.40
UV K270	≤ 0.22	≤ 0.22	≤ 0.22	≤ 0.22
PPP	–	–	≤ 17	–
1,2 DAGs	–	–	≥ 35	–

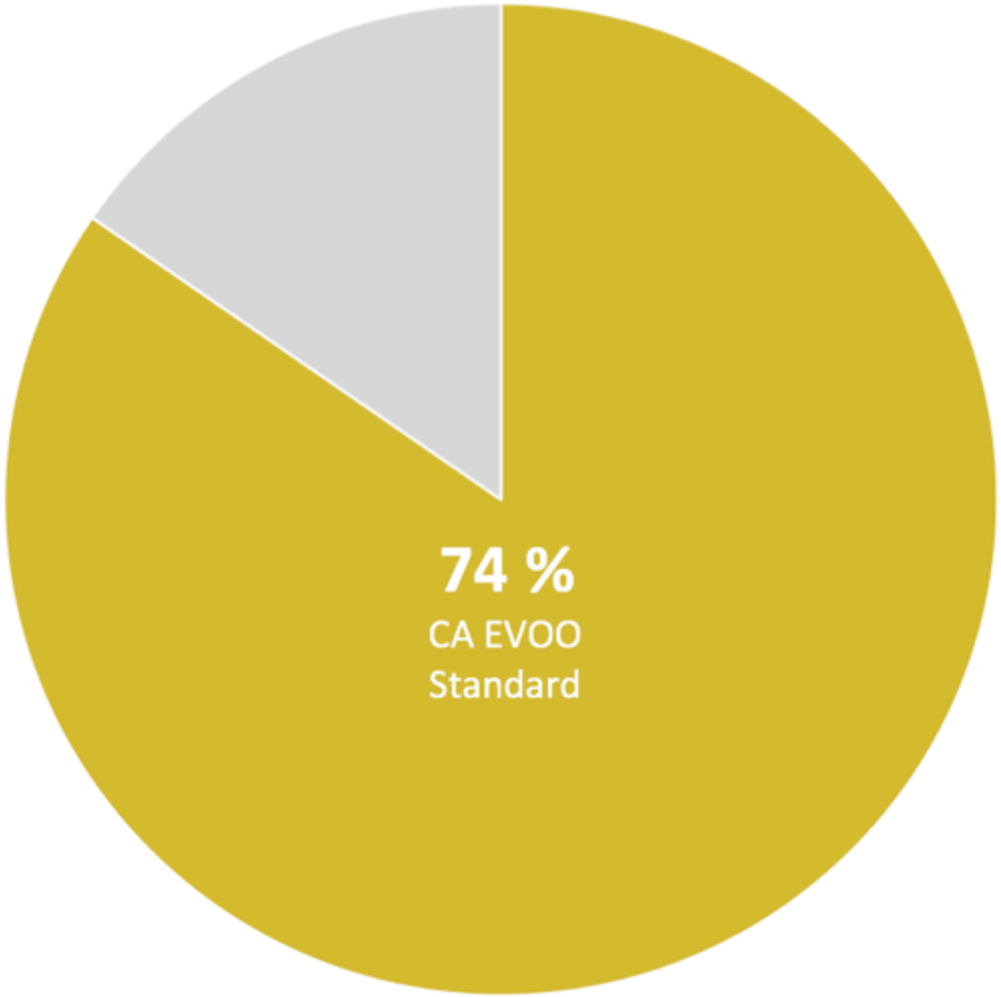
*OOCC **Mandatory** standard for producers of over 5,000 gal/year

If your olive oil is anywhere near the “standard” at production, you have a problem

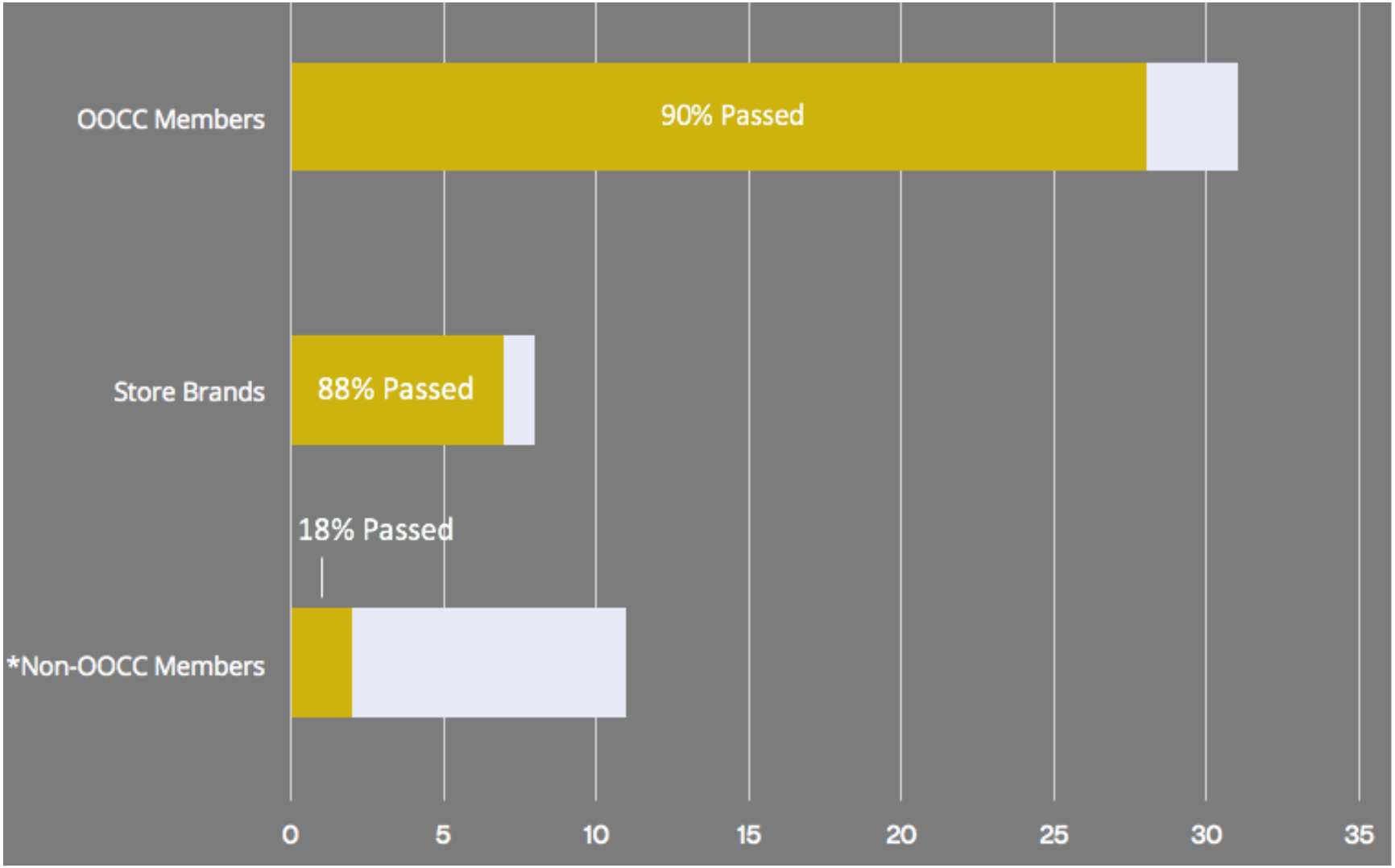
Evaluation of California Olive Oil Samples from Retail—A Quality Snapshot

- UCD Olive Center bought 50 samples of California olive oil that were 1 yr or more from harvest
- 40 samples from traditional food stores, 6 from warehouse/club stores, 3 from Amazon and 1 from a producer tasting room
- 62% were from Olive Oil Commission of CA members, 22% from non-OOCC producers, 16% store brands
- Tested—chemical and sensory—for compliance with CDFA standard

Results—At 1 year from harvest, 74% were still EVOO by CDFA Standard

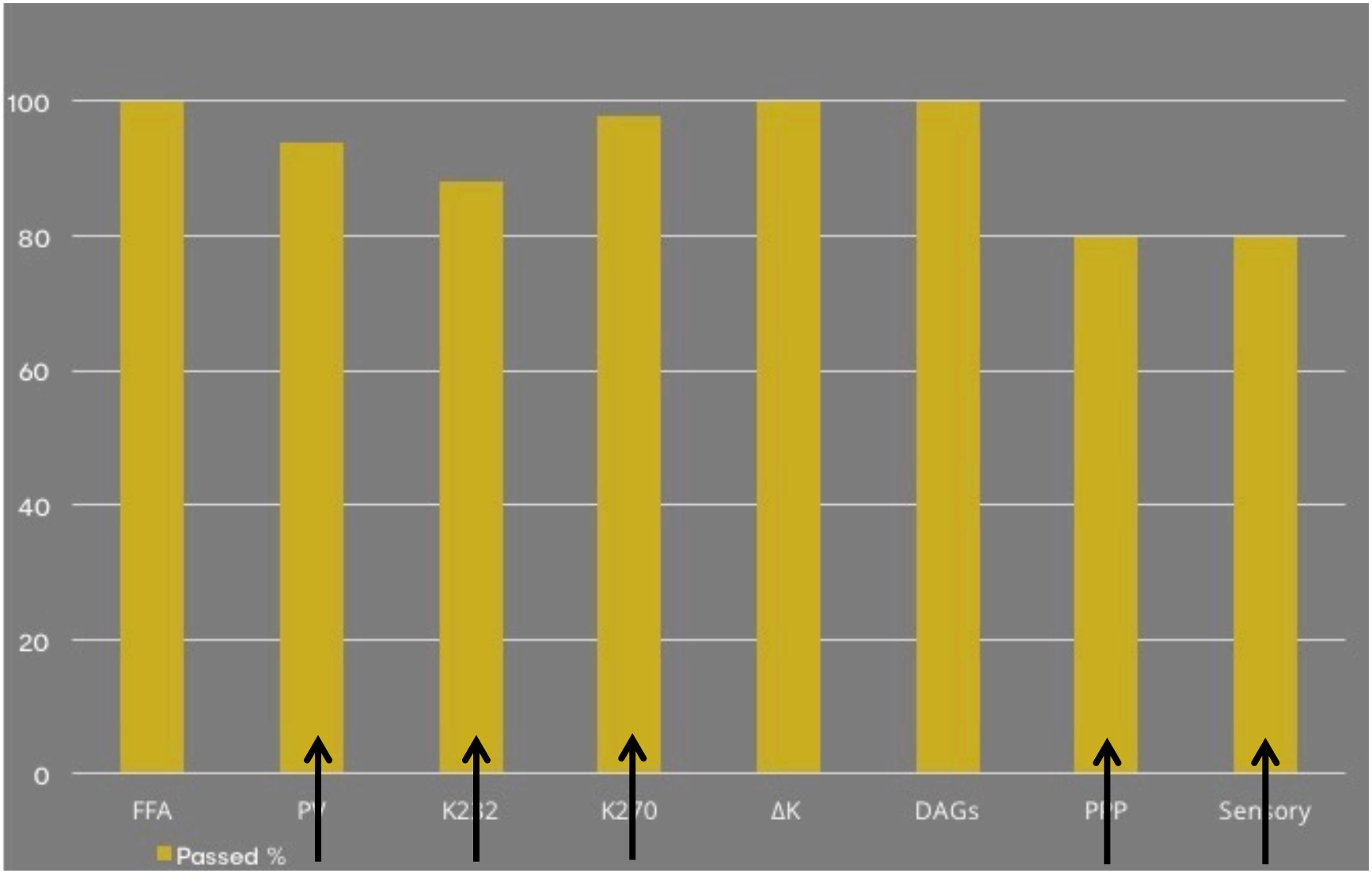


Breakdown of products passing



*Participation in the OOCC is mandatory for producers of 5,000 gallons or more per year. Olive oil brands in the non-OOCC category were from producers with less than 5,000 gallons per year who are not required to meet the OOCC standard.

Where did samples fail?



Olive Oil Testing: Sword or Plowshare?

- **The Sword**: testing to show compliance with a quality standard to protect consumers and ensure fair competition in the marketplace
- **The Plow**: testing to provide product knowledge that will elevate and protect your brand

Testing as Sword — Mighty Weapon

It's Extra Virgin Olive Oil Day – Is Your EVOO Real or Fake?

Larry Olmsted, CONTRIBUTOR
FULL BIO
Opinions expressed by Forbes Contributors are their own.

Real Extra Vigrin Olive Oil is one of the world's greatest foods, delicious and healthy at [+]

Testing as Plow — **Valuable Tool**

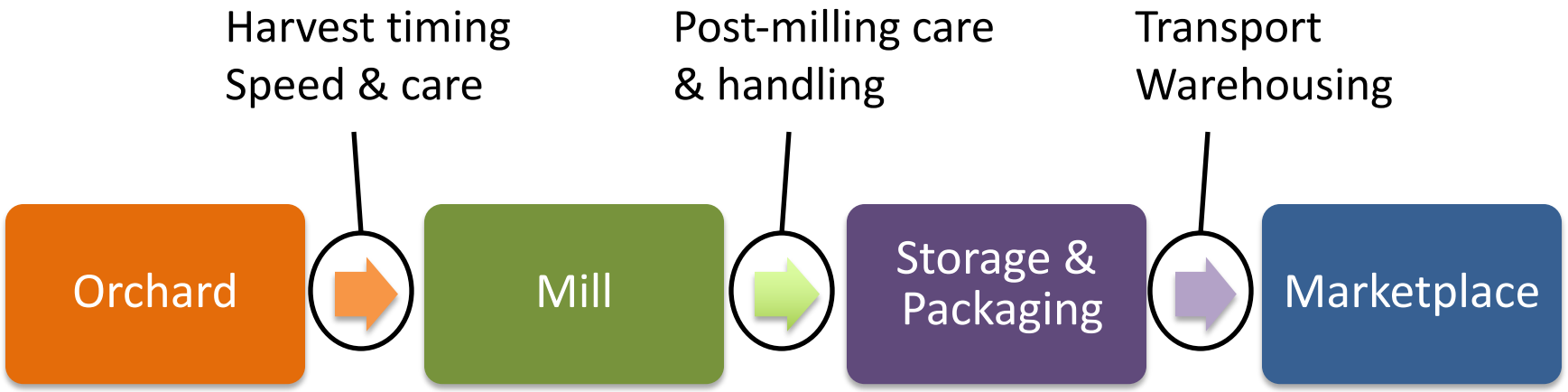
Example of a Minimum Quality Standard at
Production & **Best Before Date**

Test	Suggested Minimum at Production	Minimum at Best Before Date
Free acidity	≤ 0.3	≤ 0.5
Peroxide	≤ 10.0	≤ 15.0
Absorption UV K_{270}	≤ 0.14 (note some oils should be less than 0.12)	≤ 0.18
Absorption UV K_{232}	≤ 1.8	≤ 2.2
Pyropheophytin a	≤ 1	≤ 15
1-2 Diacylglycerols	≥90	≥ 40
Moisture	<0.2	<0.2
Insoluble impurities	<0.1	<0.1
Sensory evaluation	no defects; clear positive attributes with a fruitiness value >4.5	Must be free of sensory defects and have discernible positive attributes with a fruitiness value >2.5
		Extra Virgin Alliance

How do we produce **and deliver** quality?

The Road to Great Olive Oil

The Quality Journey



Location
Olive varieties
Cultural practices
Weather
Pest management

Prompt processing
Hygiene
Milling decisions
Miller's skill

Bulk storage
Packaging

Retailing/display
Quality product
Guidance for
enjoyment

Courtesy Alexandra Kicenik Devarenne

The raw materials of olive oil are made in the orchard

The flavor of olive oil is made in the mill

Orchard

The Orchard

Growing quality olives

- Pre-planting decisions include
  - Varieties
  - Harvest method
  - Organic/non-organic
- A super important topic, but our assumption today is that you already have trees in the ground!

Orchard management for quality

- Managing for quality, managing for yield
- Healthy beautiful fruit makes good olive oil
- A healthy tree is a more resistant tree
- Pest management
- Irrigation
- Fertilization
- Pruning

With thanks to Marcelo Berlanda

Pest management

- A healthy tree will better resist pests and disease
- **Adequate calcium** levels increase skin resistance to fungal disease (calcium is part of cell walls)
- **Boron deficiency** is associated with apical end rot (soft nose or monkey face)
- Water stress and nutrient deficiency can aggravate black scale problems
- MONITOR for pests so you can control effectively

With thanks to Marcelo Berlanda

Olive Fruit Fly

- OLFF damage is **devastating** to quality
- Monitor using **McPhail traps**, not yellow stickies
- **Monitor for stings starting early**
- Treatment options include Surround, GF-120 and Danitol
- **Be especially vigilant in cool summers and late season!**

Cultural Practices: Nutrition

- Do leaf analysis in July
- **Potassium** especially important for fruit quality and size and oil content
- **Calcium** also important
- **Avoid overfeeding nitrogen**; results in excessive energy to foliar growth and can produce bland oil

With thanks to Marcelo Berlanda
Photo: allganic.net

Cultural Practices: Irrigation

- Probably the cultural practice with the greatest influence on **flavor profile and phenol content**
- In irrigation you are seeking a balance between oil content and character
- **Insufficient** water = ↑ bitterness ↓ oil content
- **Excessive** water = ↓ bitterness/pungency ↓ extraction efficiency
- Correct irrigation will improve both yields and quality

With thanks to Marcelo Berlanda

Cultural Practices: Irrigation

- The vast majority of active olive roots are in the top 3 feet of soil so irrigating beyond that depth is a waste of water
- The most common irrigation mistake is watering too close to the trunk; emitters must be moved out as the tree grows to drop water on the drip line of the canopy.
- Maximize water usage by building soil organic matter. A rich, healthy soil will retain more water than a thin, exhausted soil

With thanks to Samantha Dorsey

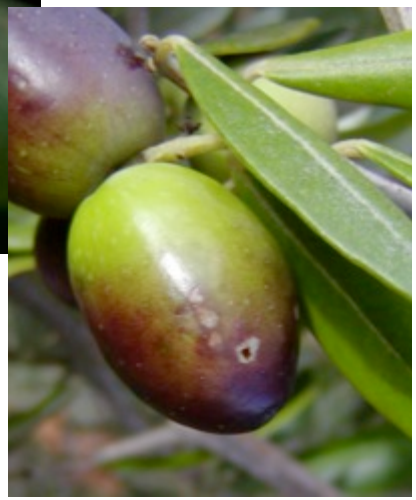
Cultural Practices: Pruning

- **Prune for good light interception. Olive trees need sunlight to make fruit and produce oil**
- A shaded fruit is smaller and has lower oil content than fruit exposed to the sun
- Prune to balance crop and manage yields: remove some crop during the “on” year to allow for better fruit size and higher oil content
- In years with potential frost damage, wait for fruit set to prune

With thanks to Marcelo Berlanda

Defects from the orchard

- **Grubby**—Olive fruit fly damage
- **Musty**– Olive fly damage or fungal disease
- **Frozen olives**—freezing temperatures before harvest



Good oil quality comes from beautiful healthy big fruit Anything that impacts that will impact quality

With thanks to Marcelo Berlanda

Harvest

Harvest timing and method are both important quality factors

Mechanical harvest

- The speed of mechanical harvest is a big advantage—allows fruit to go from grove to mill faster
- Efficiency of removal is important—mummies from previous year are deadly for quality
- Over-the-row has high efficiency, shakers somewhat less but can be good especially with loosening agents and certain cultivars
- Hand harvest can actually result in higher FFA levels because it can be so slow

With thanks to Marcelo Berlanda

We all know fast milling is important, but...

How fast is fast?

Time / temperature relationship

Allowable time between harvest and processing is related to several factors

- Hot weather / hot fruit = less time
- Hot weather / damaged fruit = **much less time**
- Ripe fruit = less time
- Cool weather / cool fruit = more time
- Cool weather / perfect green fruit = **lots more time**
- Moisture, air flow, volume, etc, are all factors

A few words about fusty

Protect fruit and oil quality by engaging with your miller early on!

- Start assessing your crop size in July
- Estimate harvest time and quantity—**book early, adjust later**
- Do the work to **learn how to estimate well** (and don't lie about quantities)
- To protect both grower and miller, test one week before est. harvest for **oil and moisture content** (target is 50-55% moisture; excellent extraction is 85%)

With thanks to David Garci-Aguirre

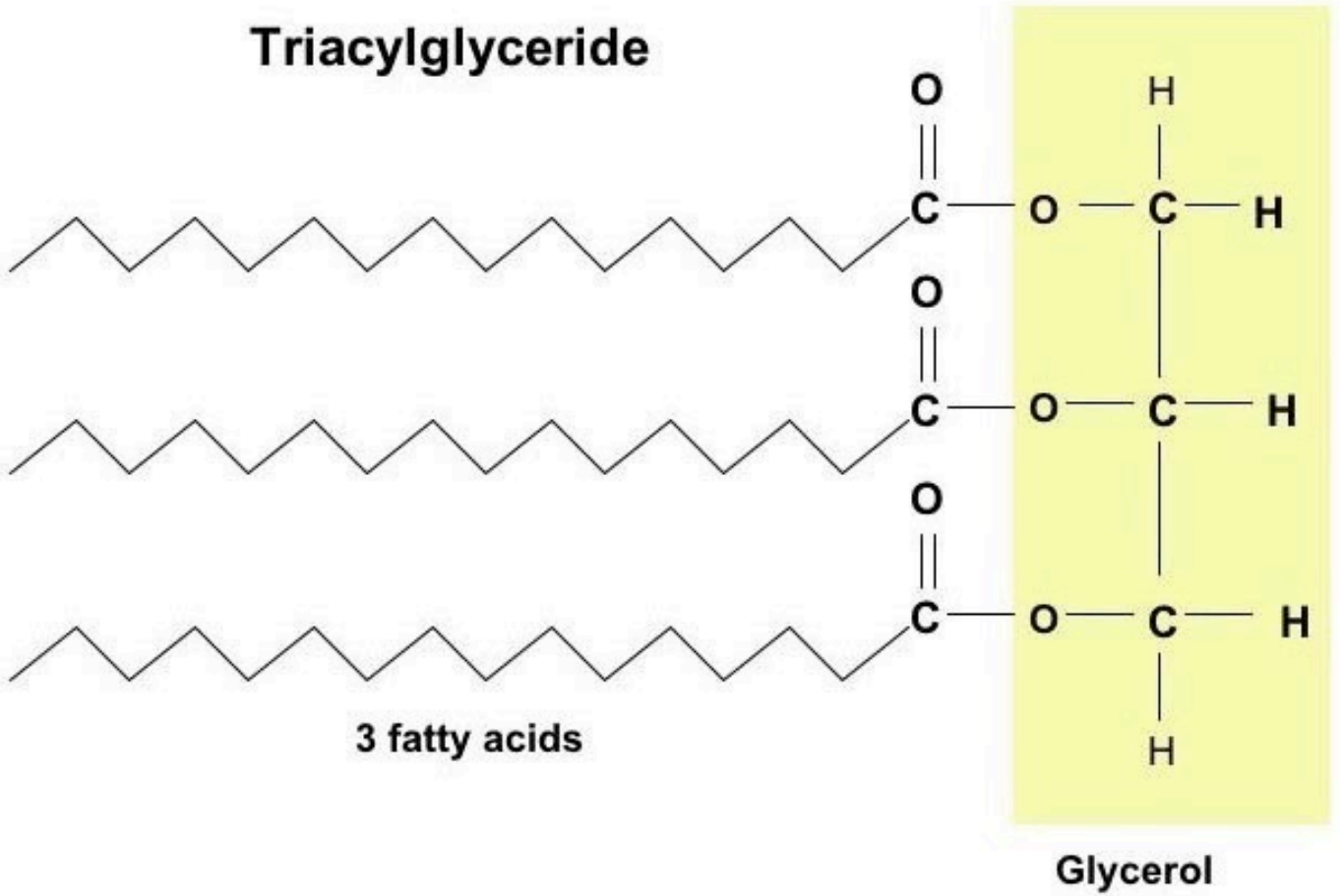
Harvest timing

- **Critical element for olive oil style and can also impact quality**
- It is a fallacy to say that greener is always better; it depends on the style of olive oil you want to make (and what sells for you)
- All other things being equal, greener higher phenol oils will tend to have a longer shelf life, but **phenols are not a guarantee of "bulletproof" durability**

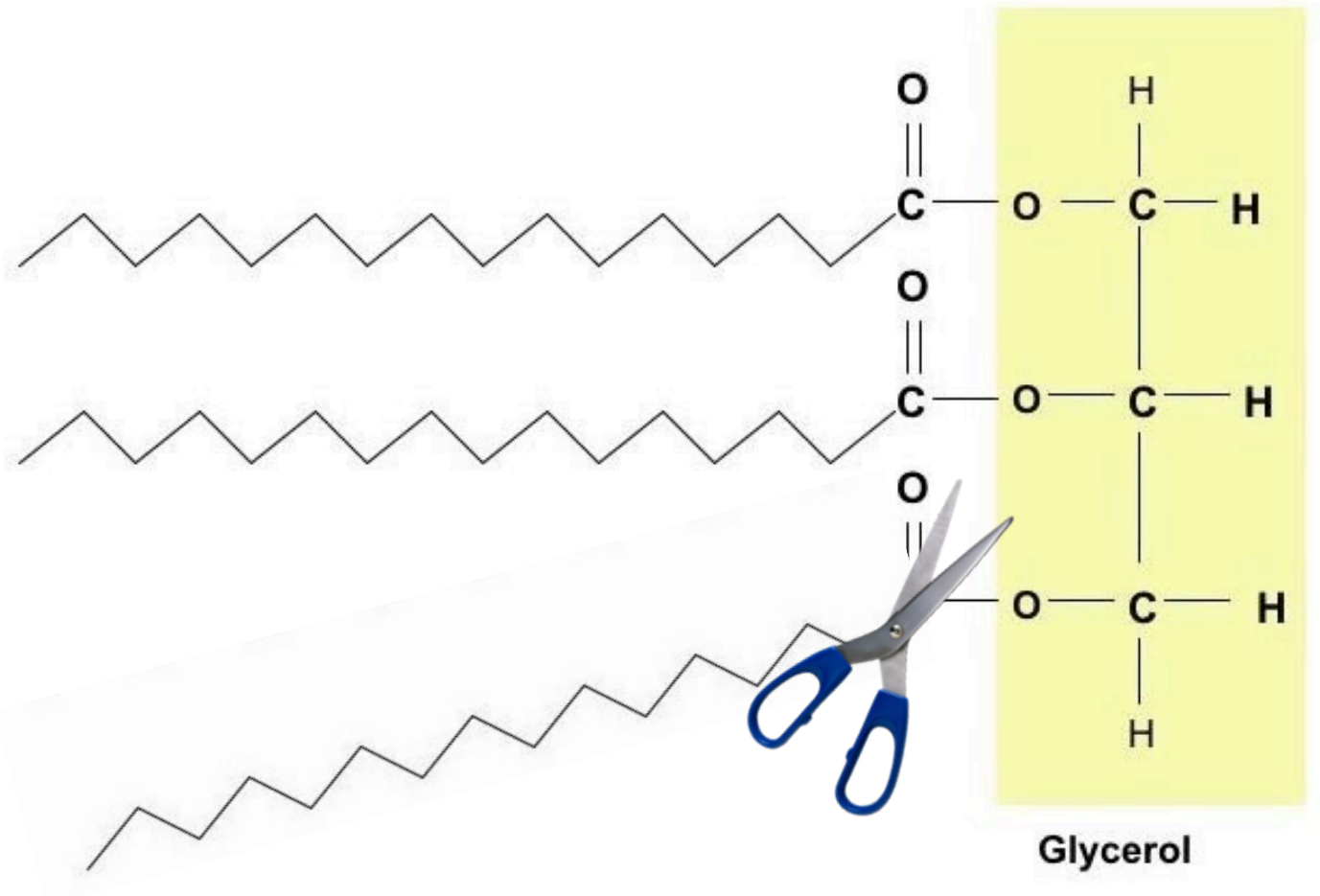
Chemistry – Unit #1
Finding fermentation:
free fatty acids and more

With thanks to Leandro Ravetti
And Claudia Guillaume

Free fatty acids form from triacylglycerides



Fatty acids break away from the glycerol due to **hydrolysis***



* Oxidation breaks at the double bond but doesn't release the fatty acid chain

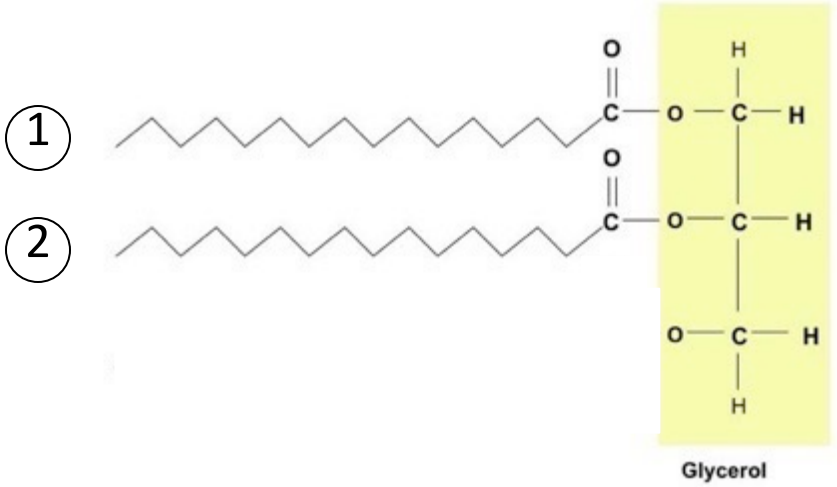
Free fatty acids (FFA)

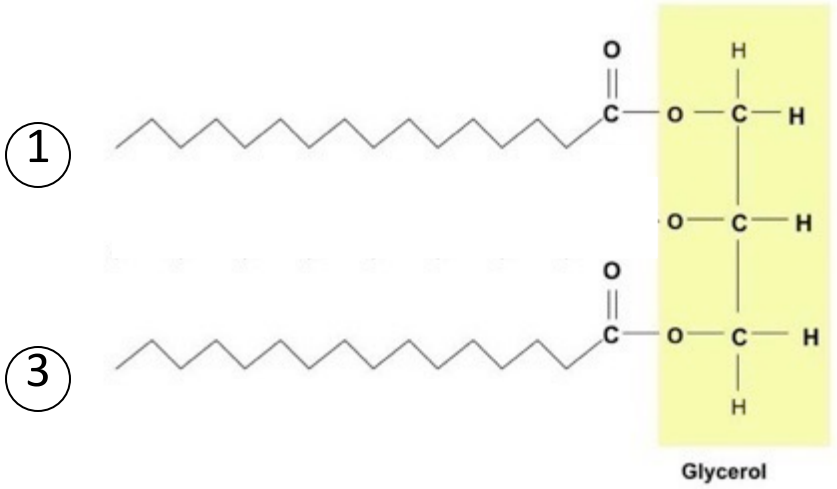
- Expressed as a percent (%) FFA based on oleic acid (dominant FA in olive oil at 55-83%)
  - IOC standard 0.8%; CDFA, COOC level 0.5%
- **Mostly indicative of fermentation**
- Tells us about the **quality of the fruit,** and also about processing/storage
- Delay between harvest and milling (fusty); sediment in tanks from poor hygiene or inadequate racking or filtration (muddy sediment); sediment in bottles

Diacylglycerols (DAGs)
Quality of fruit and processing

Diacylglycerols (DAGs)

- 1,2 form is prevalent in good oil from healthy fruit
- 1,3 form dominates in poorly made or preserved oil; also naturally increases over time
- Expressed as a number out of 100 **(higher is better)**





Diacylglycerols (DAGs)

- DAGs show good performance as indicator of initial quality of the oil—several studies have shown correlation between DAGs and sensory
- DAGs decrease an average of 23% per year, not influenced by variety or growing environment but in higher acidity oils DAGs decrease faster
- DAGs decrease faster at higher temperatures
- Good quality fruit properly milled should have DAGs above 90

Pyropheophytin a and 1,2-Diacyl-glycerols Over Time Under Different Storage Conditions in Natural Olive Oils, C. Guillaume, Ch. Gertz, L. Ravetti, J Am Oil Chem Soc (2014)

The Mill

The Mill

- Choices made in the mill will determine the characteristics of your oil—**quality is not just the absence of defects, it is the presence of positive attributes**
- Develop a relationship with your miller. Pay attention, go through the process, understand how your olives are being processed

With thanks to David Garci-Aguirre

Critical points in the mill—Crushing

- Crusher type, grid size, crusher speed: all these will impact efficiency and the character of the oil
- The Crusher should be “tuned” for the fruit condition (moisture and fat content, variety, maturity etc.), and the desired oil characteristics.
- High Moisture = larger grids, slower crusher speeds (avoid emulsion)
- Faster rotation speeds for low maturity fruit can increase efficiency and phenols content

With thanks to David Garci-Aguirre

Malaxation—What's happening in there?

- **Physical**–tiny oil droplets are coalescing in the first step of separation
- **Biochemical activity**–chemical reactions occurring: aromas are being created
- **Transfer**–phenols and other compounds move from water to oil fraction of the paste

Critical points—Malaxation

- All equipment is different—learn your equipment!
- **Time—**As short as possible but allow for adequate coalescence. Approx. 20-65 minutes
- **Temperature—**As cold as possible but allow for adequate coalescence. Typically 75–82 ºF
- **Atmosphere—**Some oxygen is required for aroma but excessive oxidation will lead to defects

With thanks to David Garci-Aguirre

Critical quality points—Separation

- Avoid inadequate separation
  —Proper crushing and malaxation
  —Proper feed rate for your decanter
- Reduce dissolved oxygen (backpressure valve on oil discharge pump of separator to ensure prime)
- Monitor oil temperature—keep as close to milling temp as possible
- Water content in oil—suspended moisture remaining in the oil is very damaging

With thanks to David Garci-Aguirre

Dissolved Oxygen: An Underestimated Threat

- Minimizing the amount of oxygen introduced during milling will help protect your oil
- The worst offender is the vertical separator
- With good fruit and milling, your peroxide value will give you an idea of how much oxygen you are picking up

Defects of processing

- **Fusty** (piled fruit; long delay)
- **Winey**: Aerobic fermentation forming acetic acid, yeast, ethyl acetate & ethanol
- **Musty** (mold on fruit from storage before processing)
- **Rancidity** (dirty equipment)
- **Burnt/cooked** (high heat in malaxation)
- **Vegetable water/Dirty** (poor separation / oil cleaning)

Positives of processing

- Excellent complex aroma
- Clean, fresh flavor and mouth feel
- Balance of attributes: fruitiness, bitterness, pungency, astringency
- Low PV, high DAGs, low PPP, low FFA
- Good shelf life

Chemistry – Unit #2:
Oxidation
(or “Oxygen Never Sleeps”)

With thanks to Leandro Ravetti
And Claudia Guillaume

Oxidation

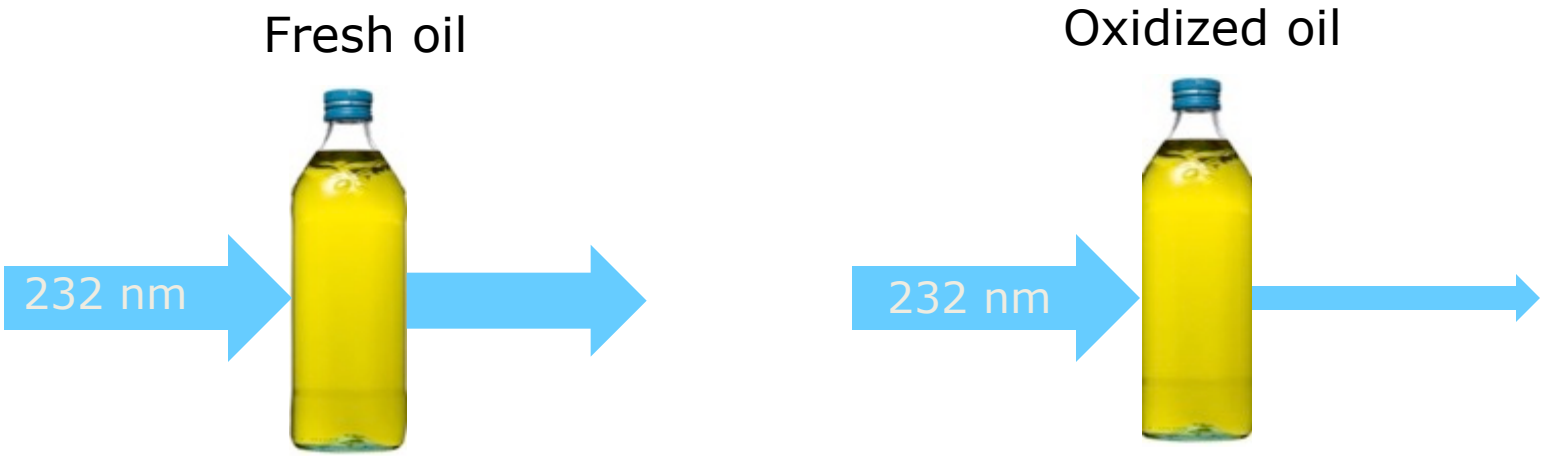
- Oxidation in olive oil begins when unsaturated fatty acids are exposed to air causing peroxides to form
- These peroxides form secondary oxidation products such as aldehydes and ketones. These volatile secondary oxidation products smell rancid
- **The speed with which oxidation occurs is influenced by temperature, light and oxygen**

Peroxide value (PV)

- PV indicates the presence of peroxides—primary oxidation products; a **good indicator of the oxidative *potential* of the oil**
- Useful at time of production to indicate the life span of the oil – level over 12 meq/kg = poor shelf life
- High PV indicates exposure to oxygen in processing, bottling or storage
- **Cycles up and down over the life of the oil so it is not a good way to track oxidation after production**

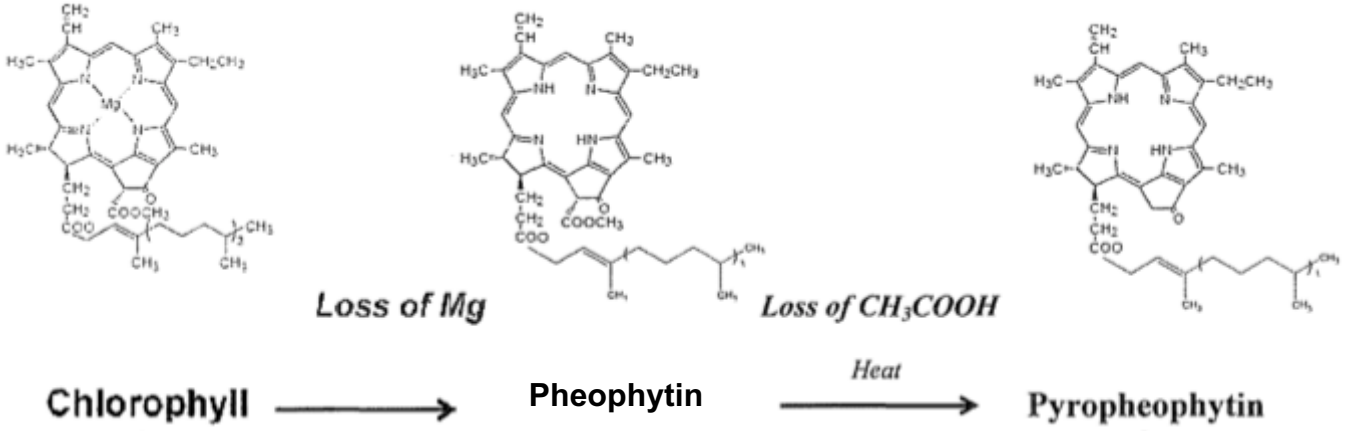
Ultraviolet Absorbency (UV)

- Measures the amount of UV light absorbed at certain wavelengths; oxidized oil absorbs more UV at 232 nm and 270 nm
- K_{232} is a good indicator of early oxidation; K_{270} good for advanced oxidation (or presence of refined oil)

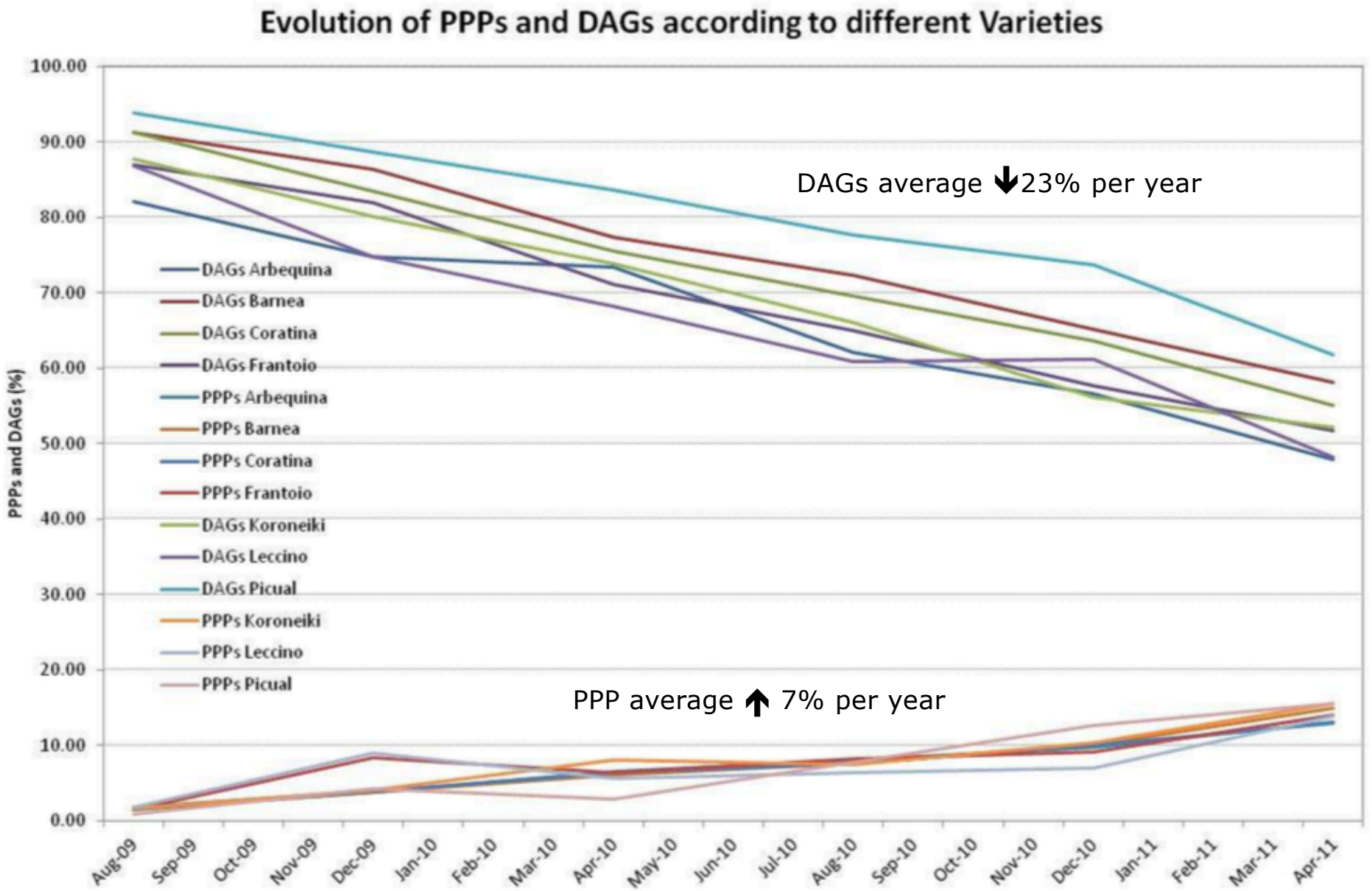


Pyropheophytin (PPP)

- Chlorophyll breaks down first into pheophytins, then pyropheophytins
- High PPP levels indicate age, light and/or temperature injury
- Good for monitoring aging: they increase at an average of 7% per year. Also a flag for deodorized oil



DAGs & PPP as Aging Indicators

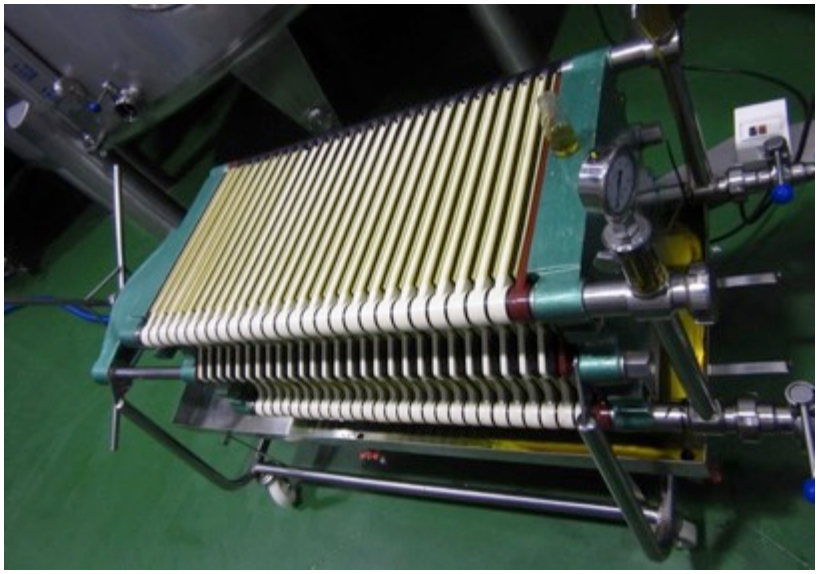


Evaluation of New Analytical Methods to Detect Lower Quality Oils, C Guillaume, presentation 2 May 2012

Indicators of Aging in Olive Oil

- DAGs and PPP change steadily over time, but both can accelerate due to storage conditions
  - PPP especially sensitive to light exposure
  - Both affected by temperature
- UV—K_{232} more useful in early life of oil; K_{270} better indicator of advanced oxidation. Readings can be affected by phenol content
- **No single test is definitive—tests must be evaluated in relation to each other**

Post Milling Care & Handling

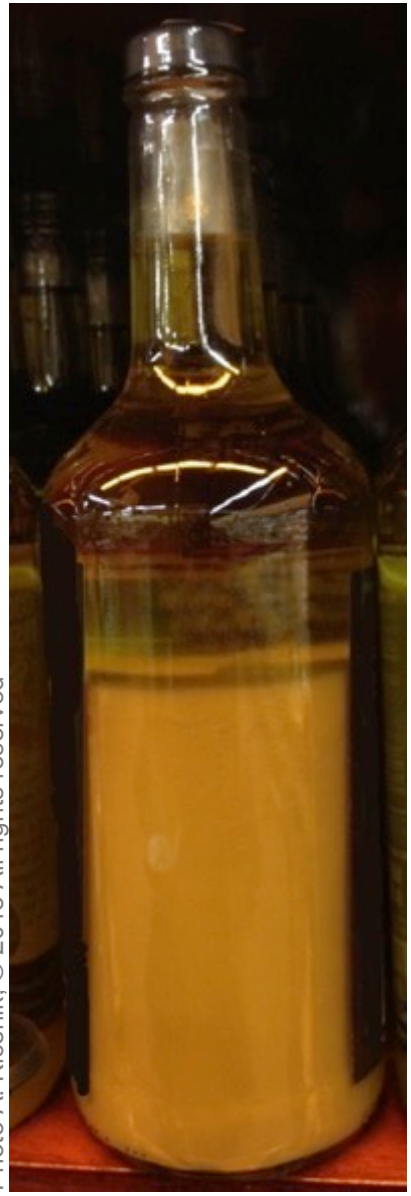


To filter or to rack...

Fine particles that are suspended in an extra virgin olive oil contain water and enzymes that may impair oil stability and ruin its sensory profile.

—*The Extra Virgin Olive Oil Handbook*

Claudio Peri, University of Milan



Unfiltered is not better

- Sediment in the bottle is a risk factor for oil quality since the sediment can ferment and cause defective flavors. **Cloudy, unfiltered oil—such as *olio nuovo*—must be regarded as highly perishable, with a very short shelf life**
- The sooner oil is away from water and sediment, the better

The case for filtration

- There is research and anecdotal evidence showing that there is a slight loss of flavor and phenols when freshly-made oil is filtered
- *But* anecdotal evidence and research also show that **properly filtered oil is more flavorful than unfiltered just weeks later** because of the reduced biochemical activity in filtered oil
- **Prompt filtration can contribute to better quality preservation over time.** It has become standard for premium producers in the Mediterranean
- Skillful racking can also produce excellent oils with good shelf life, but there is more room for error

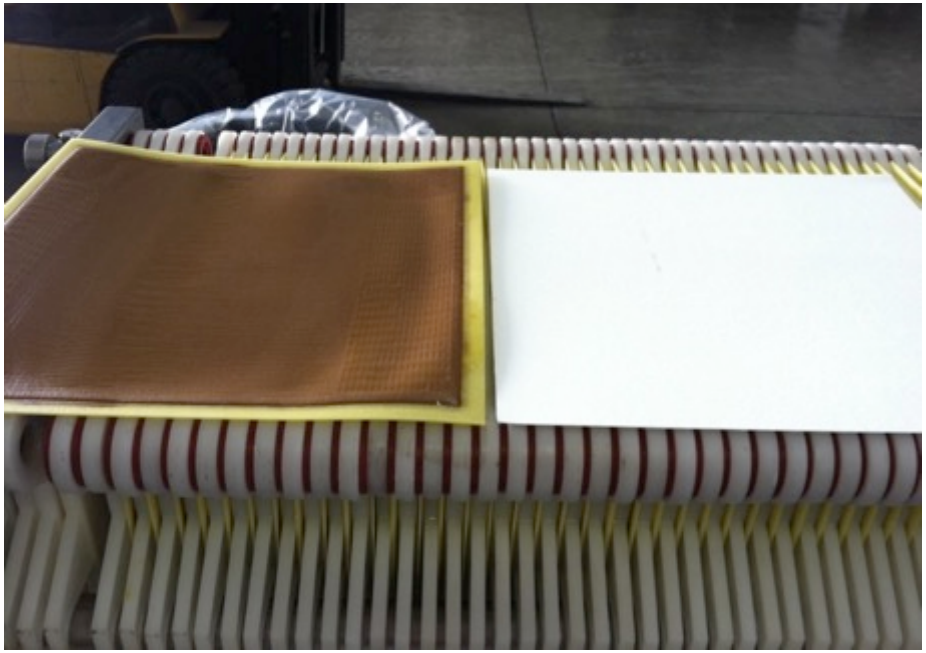
Filtration tips

- Optimal results achieved with immediate filtration (or within 24 hrs); prevents enzymatic activity triggering negative processes
- Waiting for some sedimentation is not a good idea
- Filtering while bottling can be counter-productive, re-mixing sediments that have already been deposited in the bottom of the tanks

Courtesy of Pablo Voitzuk

Filtration tips

- IOC EVOO standard moisture content < 0.2% for a good shelf life. Filtration provides that
- Moisture content is an important test (CDFA standard calls for ≤ 0.2%)
- Quality EVOO producers favor cellulose for filtration media



Courtesy of Pablo Voitzuk

Filtration tips

- A number of plates—as in a wine filter—makes sure that both sediments and vegetable water are trapped
- There are different sizes of filters in the market, from 30 (and less) to 50 plates
- Better if filter comes with a pump which has been tested for optimal pressure and has a fixed pressure
- Filter efficacy varies according to the mill (if it has a final separator or not), cultivars and cleanliness of each olive oil

Courtesy of Pablo Voitzuk

Filtration tips

- Most producers use 2/3 of one kind of paper for sediments (in Italian, “sgrossante), and 1/3 of a tighter paper for catching smaller sediments and to add brightness (“brillantante”) to the oil (filtration makes the oil greener and brighter)
- The most widely used for sediments is of 9.0 microns (measure of the openings; larger numbers indicate coarser media)

Courtesy of Pablo Voitzuk

Filtration tips

- Small productions can benefit from pre-filters, which contribute to paper savings. Pre-filters are a series of tubes with screens of progressively tinier holes. They catch a great deal of sediment

Courtesy of Pablo Voitzuk

Filtration tips

- Filters with rolls offer immediate protection, allowing filtering as the oil exits the final separator or the decanter (in the case of the mill working without a final separator)
- Volume of paper is smaller compared to a plate filter, so it's recommended to move the paper within minutes of use to prevent saturation and reduce moisture

Courtesy of Pablo Voitzuk

Filtration tips

- Only 7-8% phenol loss takes place during filtration. Those are phenols that are water-soluble. As a trade off, filtration offers protection to the most important phenols, the fat-soluble ones—a good transaction
- In terms of organoleptic characteristics, filtered oils are cleaner and leaner, gaining elegance with filtration. Keep in mind that filtration removes what is not olive oil
- Perfumes and flavors get more defined and crisper

Courtesy of Pablo Voitzuk

Filtration tips

- A premise for a good olive oil is to age gracefully and to last, at least, from harvest to harvest
- Filtration alone does not guarantee that good shelf life, though without it, it's way more difficult to achieve. Racking does quite a partial job, leaving plenty of sediments and a higher moisture content

Courtesy of Pablo Voitzuk

There are many considerations that go into the decision whether to filter or to rack; do some investigation to determine the right choice for your situation

Avoiding oxygen exposure

- Transferring oil should be done with as little agitation as possible
- Pumps should be **positive displacement pumps**—avoid centrifugal and centripetal pumps
- A large pump going slowly is better than a small pump running fast
- Never cascade oil into a container

With thanks to David Garci-Aguirre

Avoid contamination

- Oil picks up odors very easily. Fumes, dirty equipment and poor containers can ruin your oil
- Be aware of the components of hoses and seals. Plastic contamination is a problem: phthalates can leach from plastics
- **Seals and fittings:** Avoid reactive metals, EPDM, rubber. Look for silicone, Viton, Buna-N rubber

With thanks to David Garci-Aguirre

Storage & Packaging

Storage & Packaging

- Conditions in bulk storage and package have a huge effect on the quality of the product that reaches your consumer
- All olive oil deteriorates over time, but **the speed with which this happens is greatly dependent on conservation practices**
- Make a good product? ***Deliver*** **a good product!**

Avoiding oxygen exposure—Part II

- Inert gas—nitrogen or argon—in the headspace
- **The "argon blanket" is a myth**—you must use 3–5 x the volume of the headspace of inert gas to displace the air and maintain contact with the oil. Also replenish every 1-2 weeks
- **Avoid dissolved air** in the tank as well as the bottle
- **Inert Gas**:
  - **Sparging**: bubbling inert gas through oil,
  - **Topping**: inert gas directly into headspace
  - **Stripping**: micro bubbles (carbonator) of gas in piping to lower DO and PV and other practices

With thanks to David Garci-Aguirre

Storing olive oil

- Good storage protects olive oil from heat, air and light
- Stainless steel tanks are the best option; stainless steel should be 304 or 316
- Plastic totes are a poor choice–not a good oxygen or light barrier, hard to clean
- High-oxygen-barrier IBC bag-in-box liners are an interim solution

With thanks to David Garci-Aguirre

Chemistry – Unit #3
Best Before Dates: Protection for the Consumer and the Producer

With thanks to Leandro Ravetti
And Claudia Guillaume

Best Before Date (BBD)

- The BBD is your **assurance to the consumer** that the product will maintain its quality as labeled (i.e. “Extra Virgin”) under proper storage conditions until that date
  - **5.31 Shelf Life.** A date on the container that signifies the end of the period during which the intact package of oil, if stored in accordance with stated storage conditions, will retain any specified qualities for which express or implied claims have been made. (CDFA)
- It **protects the producer** by setting a reasonable shelf life—**your product isn’t expected to remain Extra Virgin forever**
- Base your **BBD on technical information** (required under CDFA Grade & Labeling Standards 11.3.9)

Shelf life

- Influenced by:
  - **Oil quality:** initial quality of the fruit and of the processing (indicated by low free acidity, low peroxide value, high DAGs)
  - **Fatty acid profile of the oil**: levels of various monounsaturated/polyunsaturated fats
  - **Antioxidant content:** phenols, tocopherols, etc
  - **Conservation methods:** inert gas in tanks and bottles, temperature control, light protection, etc.

Predicting Shelf Life

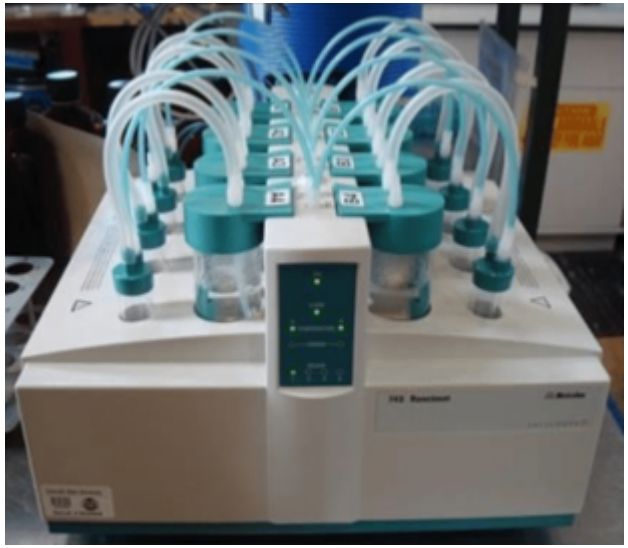
- Testing **at the time of production** can give you valuable information about the shelf life potential of the oil; you need a baseline for comparisons later on
- Experience—monitor and track your oil quality over time. **Keep records**
- Caution: high phenol levels do not make an oil invincible; there are plenty of rancid high phenol oils out there

Predicting Shelf Life

- **Peroxide Value:** useful at production as an indicator of primary oxidation products; think of it as an indication of *oxidation potential*. Aim for PV < 7 at production
- **PPP and UV:** look for PPP close to 0, UV K232 < 1.8 and K270 < .12
- **FFA and DAGs:** these indicators of fruit quality and good processing should be low (FFA < 0.3) and high (DAGs > 90)

Rancimat Testing (Induction Time)

- Sort of a “stress test” for olive oil
- Subjects the oil to heat and air until it goes off (as indicated by rancidity volatiles)
- At 110 ºC, 1 hour = 1 month



BBD calculations

Modern Olives Laboratory has done extensive work with BBD predictions and developed the following BBD prediction model

- Hours of induction time at 110 °C x 1 = expected shelf life (in months)
- (17.0% - PPPs) / 0.6% = expected shelf life (in months)
- (DAGs – 35.0%) / FFA factor = expected shelf life (in months)
  - FFA factor = 1.7% (if FFA < 0.4%); 2.1% (if 0.4% < FFA < 0.6%); 2.5% (if FFA > 0.6%)
- **Use the lowest of these results as BBD**

The BBD Calculator

Your BBD

Induction Time Method	Rancimat Hrs @ 110 C	26.7	Shelf Life in month	**26.70**
PPP Method (limit 17)	PPP test result	1.4	Shelf Life in months	**26.00**
DAGs Method (limit 35)	Enter FFA Factor	1.7		
	DAGs test result	92.5	Shelf Life in months	**33.82**

FFA factor = 1.7% (if FFA < 0.4%); 2.1% (if 0.4% < FFA < 0.6%); 2.5% (if FFA > 0.6%)

Developed by Claudia Guillaume & Leandro Ravetti
Modern Olives Laboratory

For most extra virgin olive oils, the oil should remain EV for 2 years from production with good conservation practices

Very mild oils can have significantly shorter shelf life

Good packaging

- Protects the oil from air and UV light
  - Dark glass (best color is amber, blue is not good, green is middling
  - Tins (good for light protection)
  - Bag-in-box (best for combined oxygen and light protection)

Good packaging

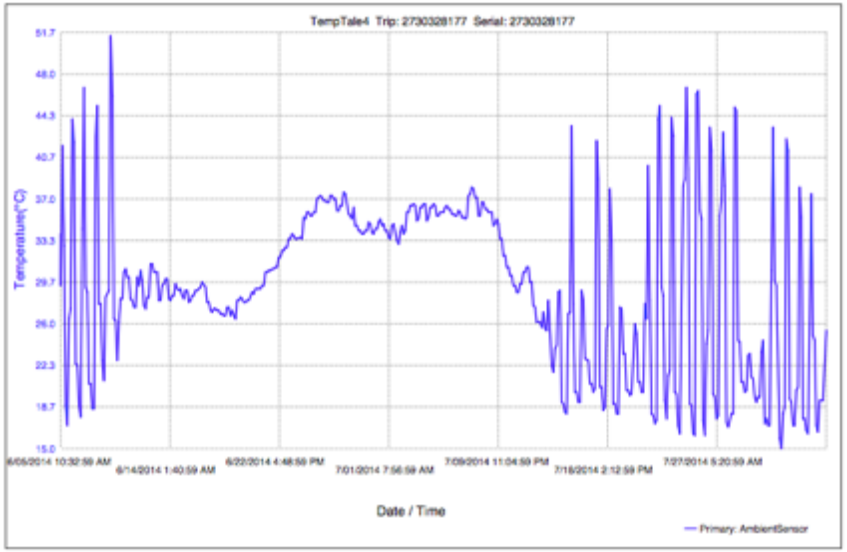
- **Dissolved oxygen again: don't lock a fox in the henhouse**
- Sparging and topping with inert gas
- Avoid bubbles and agitation
- Consider just-in-time bottling

Oil storage defects

- **Rancidity** (oxidized—heat, air, light, time)
- **Dirty** (spends time in contact with sediment)
- **Muddy sediment** (anaerobic fermentation of sediments in tank or bottle)
  Metallic, Plastic (contamination from containers)

Rancid

Transport
&
Warehousing



Protecting Oil in Storage & Transport

The better the temperature control, the longer good oil quality will be preserved

Storage and Shipping Temperatures for Super-Premium Olive Oil

Characterization	Degrees C	Degrees F	Elapsed time	Comments
Danger	<12	<53.6	hours	May cause crystallization and damage
Alert	12-15	53.6 to 59	>1 week	Correct the situation promptly
Optimum	15 to 17	59 to 62.6	1 year	Best quality
Alert	17-21	62.6 to 69.8	>1 week	Correct the situation promptly
Hazard	21-24	69.8 to 75.2	>48 hours	Oil quality will be compromised
Alarm	24-28	75.2 to 82.4	>4 hours	Oil quality will be compromised
Danger	>28	>82.4	minutes	Oil damage occurs rapidly

* Storage recommendations for Association 3E from Dr Claudio Peri, author *Extra Virgin Olive Oil Handbook*, Wiley & Sons 2014

Marketplace

Retailing & Display

- In a conventional supply chain, the custodianship of the oil may pass to the distributor and then the retailer, but the producer needs to remain engaged
- All the hard work of the producer is for naught if the supply chain doesn’t care for quality
- Shorter chains allow for greater control

Display conditions

- 9 days of abusive treatment
- Harvest Fall 2011, bottled Summer 2012, BBD Dec 2013, tested June 2013
- Subjected to air, sunlight, heat ± 88° F
- In panel test, went from extra virgin to very rancid

Retailing guidelines

- **First In First Out is essential**. Check up on the shelf if you can, and test/taste for quality
- Warehouse and storeroom **temperatures**: aim for cellar temperatures — 59 to 63 ^{o}F — or at the very least avoid high temperatures
- Minimize exposure to UV light in displays, especially sun and fluorescents. **Top shelf is NOT the place to put your best EV olive oils!**

Remember that testing is not a weapon, it is one of your most valuable tools

An example of dynamic parameters (German retail sector)

	1,2-Diacylglycerides	Pyropheophytines
Jan. – February**	min. 78 %	max. 1,5 %
March	min. 70 %	max. 3 %
April – May	min. 65 %	max. 4 %
June	min. 58 %	max. 6 %
July	min. 56 %	max. 7 %
August	min. 54 %	max. 8 %
September	min. 52 %	max. 9 %
October – December	min. 50 %	max. 10 %
January *	min. 60 %	max. 5 %

* Unter Vorbehalt, falls Zumischen neuer Ernte erfolgt / In case of blending new crop

** 100 % neue Ernte / new crop

Some test results from Shelf Life study

SAMPLE #	HARVEST YEAR	FFA	PV	K_{232}	K_{270}	ΔK	DAGs	PPP	INDUCTION TIME*	SENSORY DEFECTS	GRADE
		≤0.5 *≤1.0* *>1.0*	*≤15* *≤20* *>20*	*≤2.40* *≤2.60* *>2.60*	*≤0.22* *≤0.25* *>0.25*	*≤0.01* *≤0.01* *≤0.01*	*≥35* *N/A* *N/A*	*≤17* *N/A* *N/A*		*MeD=0.0* *0.0<MeD≤2.5* *MeD>2.5*	*Extra Virgin* *Virgin* *Crude*
1	2015	0.16	20.0	2.80	0.16	0.00	55	12	4.4	Rancid: 1.1, 0.4	Crude
30	2015	0.26	12.4	2.69	0.20	0.00	37	39	8.2	Rancid: 2.6, 2.9; Fusty: 0.4, 0.5	Crude
4	2015	0.15	6.6	1.73	0.12	0.00	54	18	9.2		Virgin
11	2015	0.27	11.1	2.60	0.21	0.00	39	39	9.3	Rancid: 2.7, 2.6; Fusty: 1.6, 1.0	Crude
20	2014	0.24	19.2	2.88	0.27	0.00	36	42	4.7	Rancid: 2.6, 1.9; Fusty: 0.7, 0.8	Crude
21	2015	0.14	10.4	2.20	0.15	0.00	74	7	9.9		Extra Virgin
26	2015	0.31	6.3	2.25	0.19	0.00	45	12	15.5		Extra Virgin

With thanks to Leandro Ravetti for analysis

The Primary Quality Tests

Free fatty acids	Breakdown of trigylcerols	Fruit aging or oxidation
Peroxide value	Presence of reactive form of oxygen	Oxidation in processing, bottling, storage
UV 232	Oil oxidation	Heat, light, air, time
UV 270	Severe oil oxidation	Heat, light, air, time; flag for refined oil
Pyropheophytin a (PPP)	Breakdown products of chlorophyll	Light, heat, time; flag for deodorized oil
Diacylglycerols (DAGs)	Breakdown of trigylcerols	Poor fruit quality, aging
Sensory Analysis	Defects of flavor	Fermentation, oxidation, cross-contamination, etc

To-do list

- Get your oils tested at production for benchmarking
- **Test DAGs and PPP** if at all possible
- Examine your practices with a critical eye looking for oxygen exposure, etc
- Keep records of everything—orchard practices, maturity at harvest, processing decisions, storage conditions—everything
- Monitor during the life of the product

What's it all about?

- Consumer satisfaction means a fresh-tasting, delicious product
- Packaging should be attractive, convenient and *non-drip*
- Great labels provide guidance about oil flavor; you need to get your oil to the right buyer for the right use

Olive Oil Commission of California

- Mandatory over 5,000 gal, voluntary under 5,000 gal
- Not a marketing association; standards and research
- Operates under the CDFA and has the weight of law
- Meetings are open to public, regardless of membership
- Voluntary membership available for producers under 5,000 gallons

Voluntary OOCC Membership

1) Mandatory sampling and testing by the OOCC of up to six (6) lots of olive oil

2) Mandatory testing by handler of all oil produced for PV, FFA, UV and Organoleptic parameters

3) Adherence to the OOCC Grade and Labeling Standards

4) Mandatory reporting as required by the OOCC

5) Assessment payment of $0.14 per gallon of olive oil produced

We are all California

Thank you to

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And thank you!

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