EVOO storage considerations

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About me

Edible oils chemistry

- Olive, canola, sunflower, safflower, peanut, avocado

ISO17025 – NATA accreditation

Adulteration testing

- International Olive Council (IOC)
- American Oil Chemists Society (AOCS)
- German Society for Fats and Oils

Technical committees

- IOC Chemistry experts meetings
- Standards Australia
- Australian Oilseeds Federation (AOF)
- United States Pharmacopeia

RIRDC/HIA

- Various olive research projects since 1997
- Harvest timing
- Irrigation
- Shelf life
- natural variation, composition
- effect of storage
- authentication
- contaminants

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Introduction

Incorrect storage, even for a short period of time can reduce the quality of olive oil, sometimes to a level where the oil can no longer be classified as extra virgin.

Major factors that affect extra virgin olive oil.

- Exposure to increased temperature
- Exposure to oxygen
- Exposure to light
- Time

Research projects

• RIRDC publication 12/024 – The effect of different temperatures, light and oxygen on the quality of olive oil.

https://www.agrifutures.com.au/wp-content/uploads/publications/12-024.pdf

• RIRDC publications 09/160 and 12/008 - The effect of storage in different types of containers

https://www.agrifutures.com.au/wp-content/uploads/publications/09-160.pdf

https://www.agrifutures.com.au/wp-content/uploads/publications/12-008.pdf

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The effect of different temperatures, light and oxygen on the quality of olive oil.

Project aim

Study a number of different storage conditions to determine effect on olive oil quality.

Oil types

Least stable

Low PP Low C18:2	Low PP Mid C18:2	Low PP High C18:2
Mid PP Low C18:2	Mid PP Mid C18:2	Mid PP High C18:2
High PP Low C18:2	High PP Mid C18:2	High PP High C18:2

Most stable

PP = total polyphenol content

C18:2 = linoleic acid content

Storage conditions

Oils stored for 3 years – analysed at regular intervals

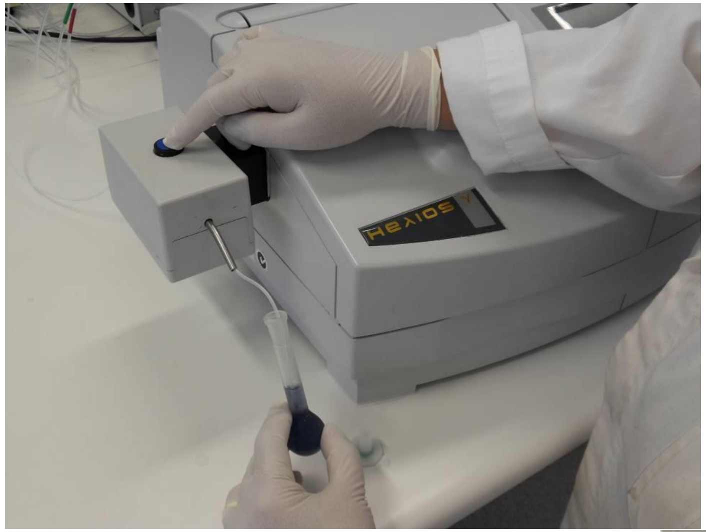
Temperature (stored in dark, closed)
- 15°C
- Room temperature (22°C)
- 37°C

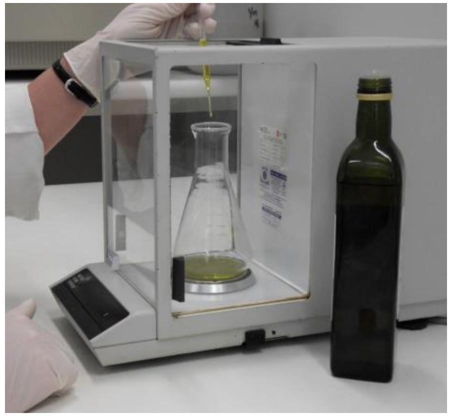
Oxygen (stored at room temp, in the dark)
- Open
- Closed

Light (stored at room temp, closed)
- Clear bottle, exposed to light
- Dark bottle, stored in darkness

Laboratory analysis

- Peroxide value
- UV absorbance
  - K232
  - K268
- Free fatty acids
- Total polyphenols
- α -Tocopherols
- Induction time (Rancimat)
- Pyropheophytins
- 1,2-diacylglycerols
- Fatty acid profile
- Chlorophyll
- Colour
- Sensory analysis





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Temperature

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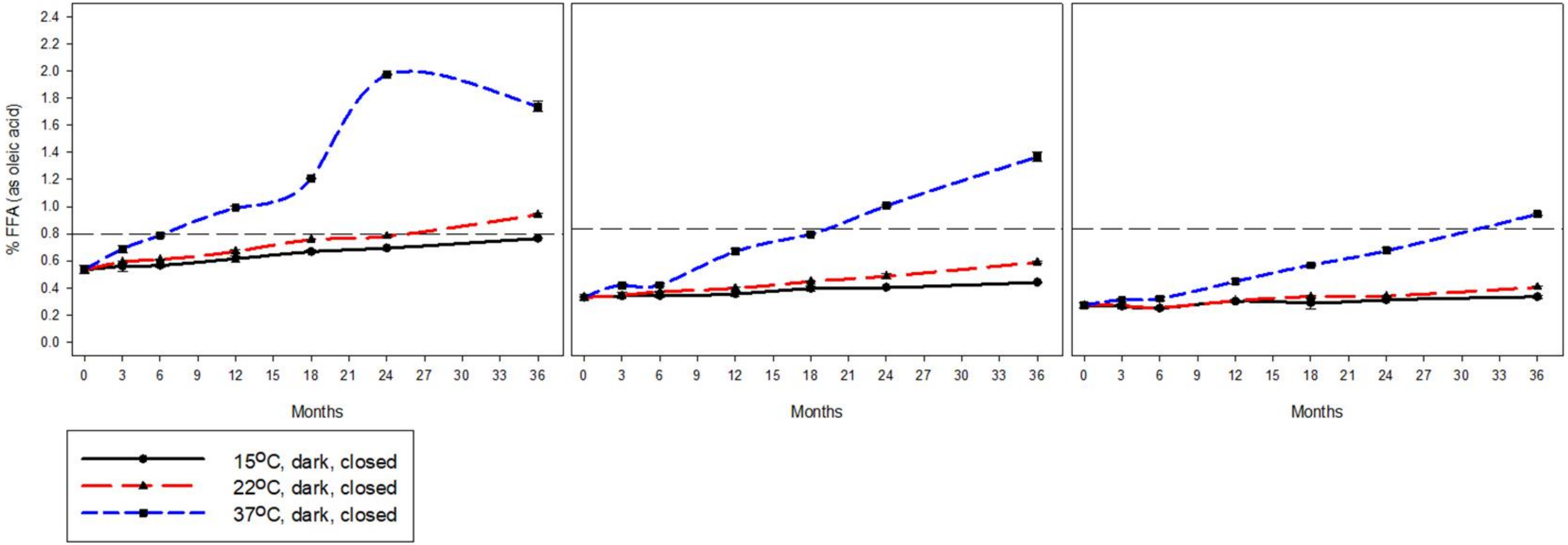
Free fatty acids

Least stable **Most stable**

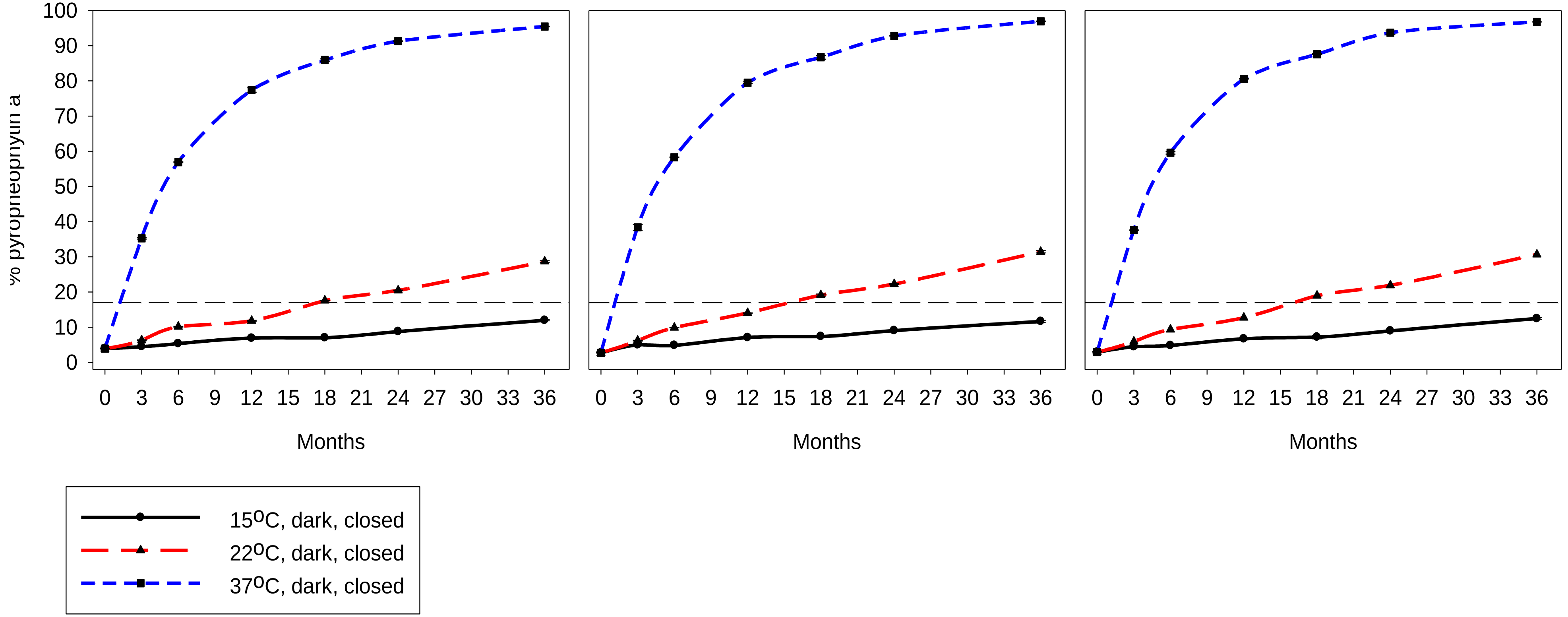


Hydrolysis – increases with temperature

AS-5264-2011 – < 0.8%

Pyropheophytin a

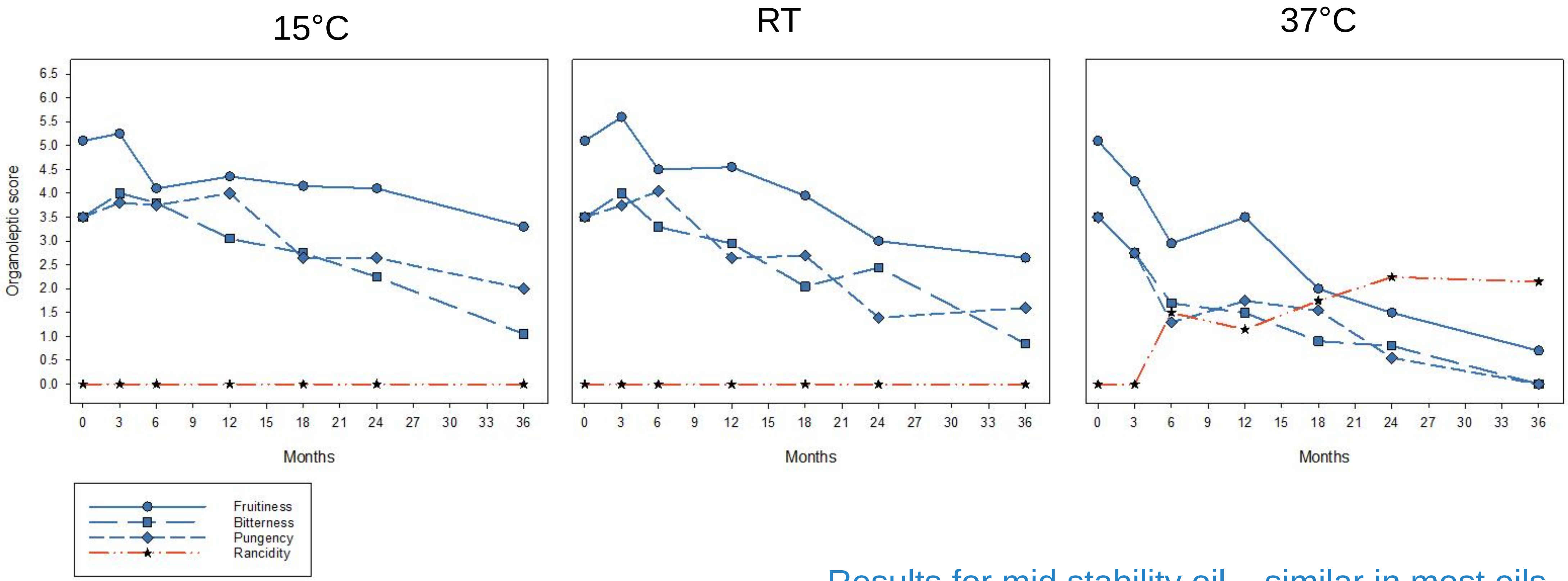
Least stable **Most stable**



- **Age**
- **Temperature**

AS-5264-2011 – < 17%

Sensory analysis



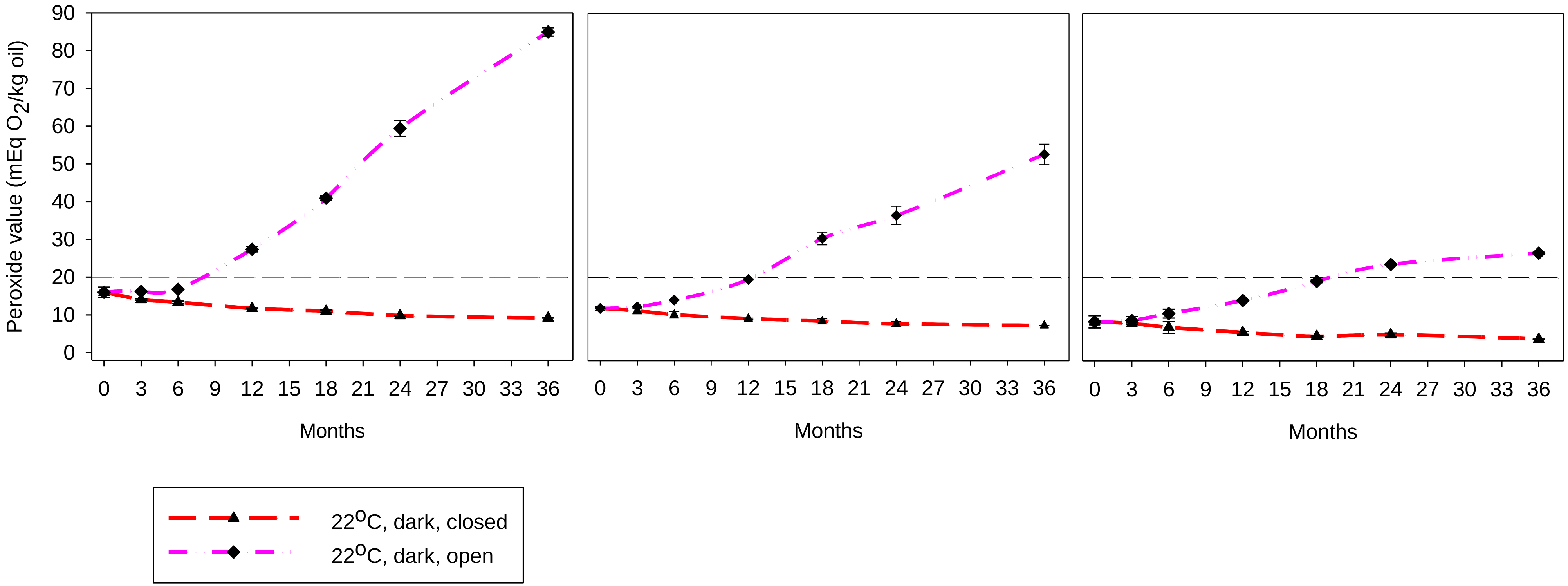
Results for mid stability oil – similar in most oils

Oxygen

Peroxide value

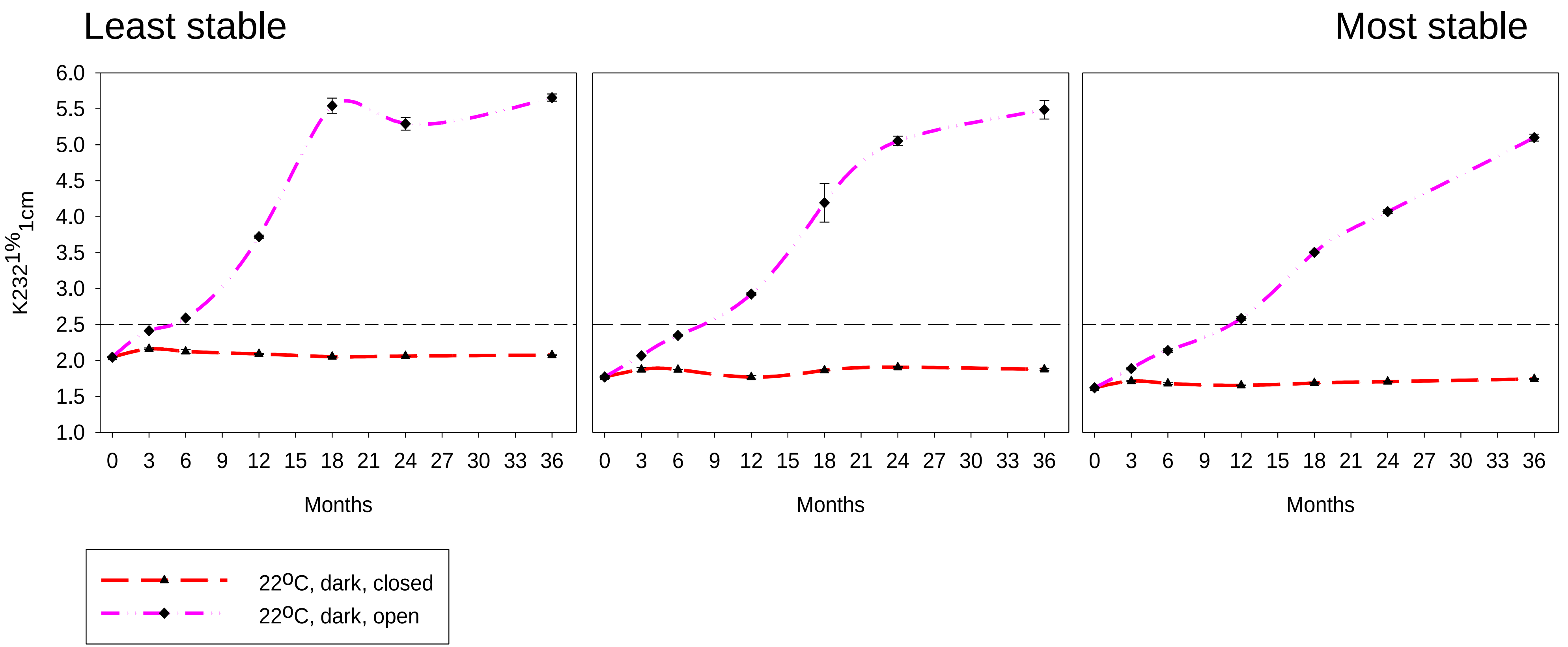
Least stable

Most stable



AS-5264-2011 – < 20 mEq O_2 /kg oil

UV absorbance K_{232}



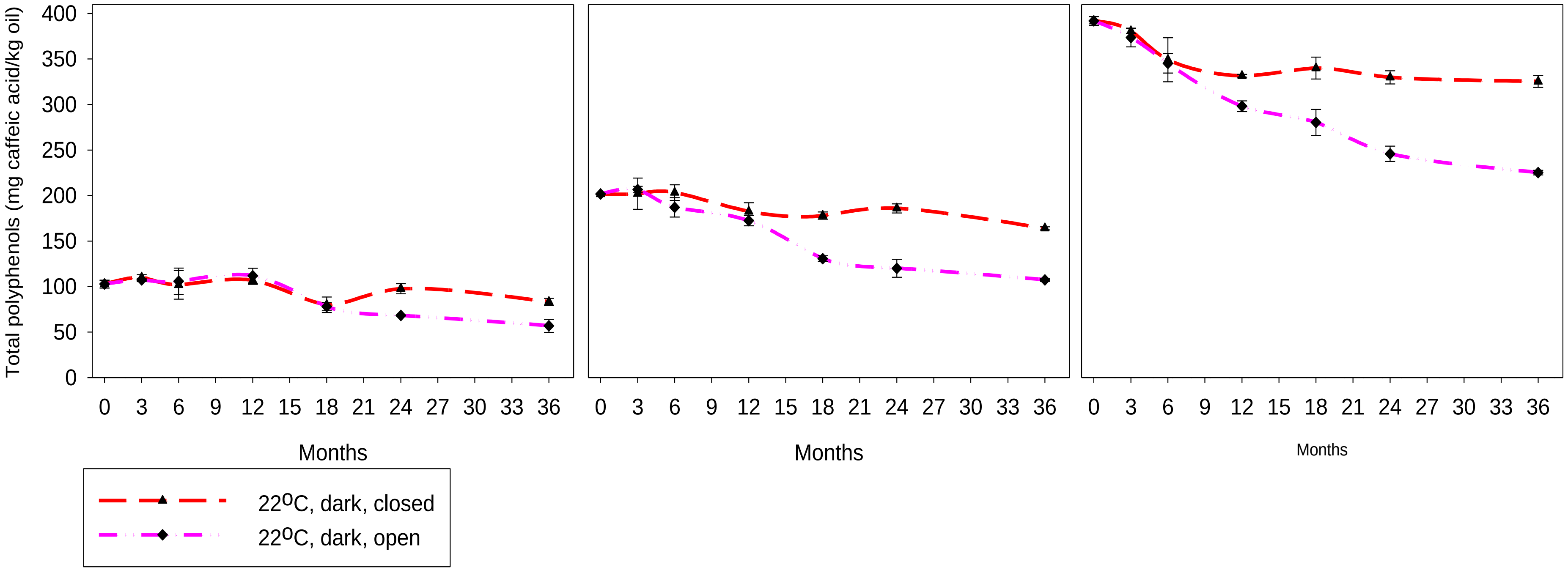
Similar pattern for K_{268}

AS-5264-2011 – < 2.50

Total polyphenols

Least stable

Most stable



Similar pattern for α-tocopherol

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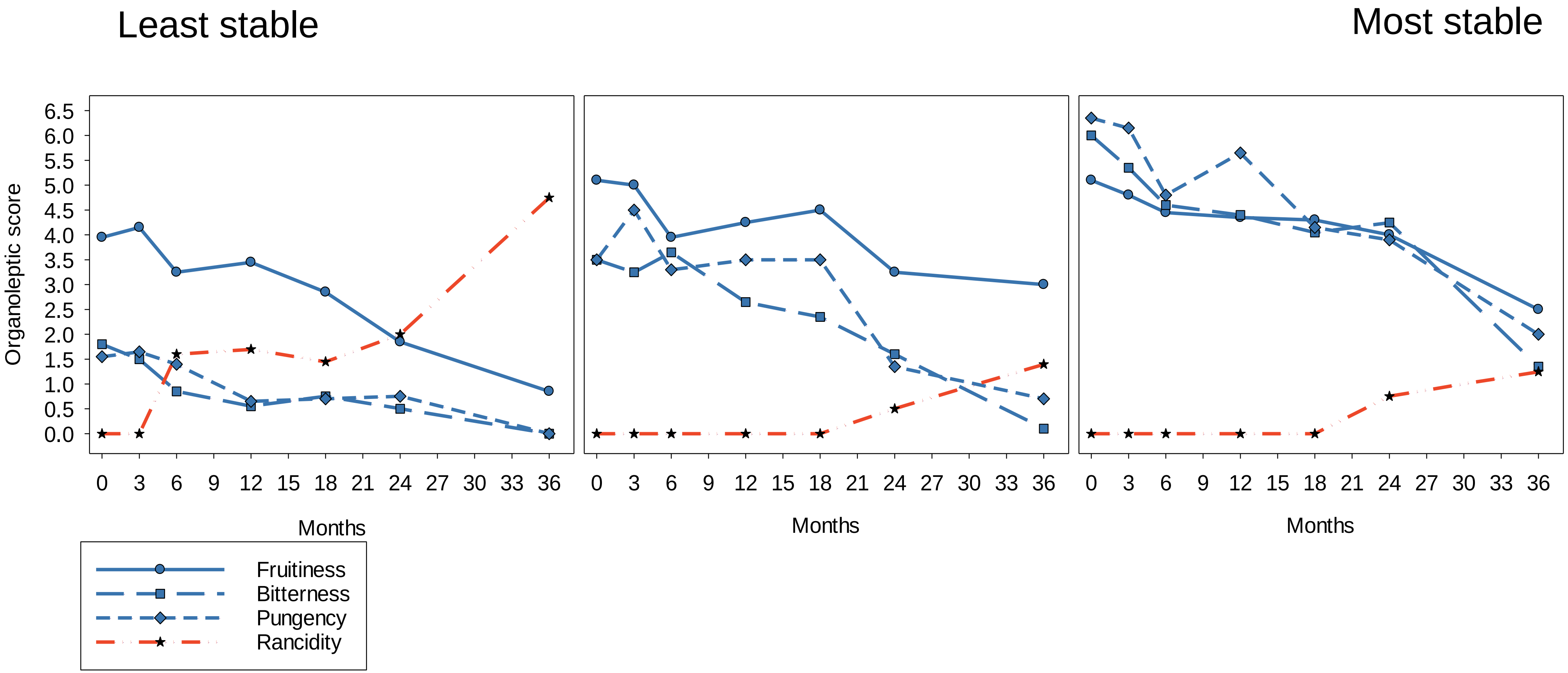
Sensory analysis



Oil samples exposed to oxygen

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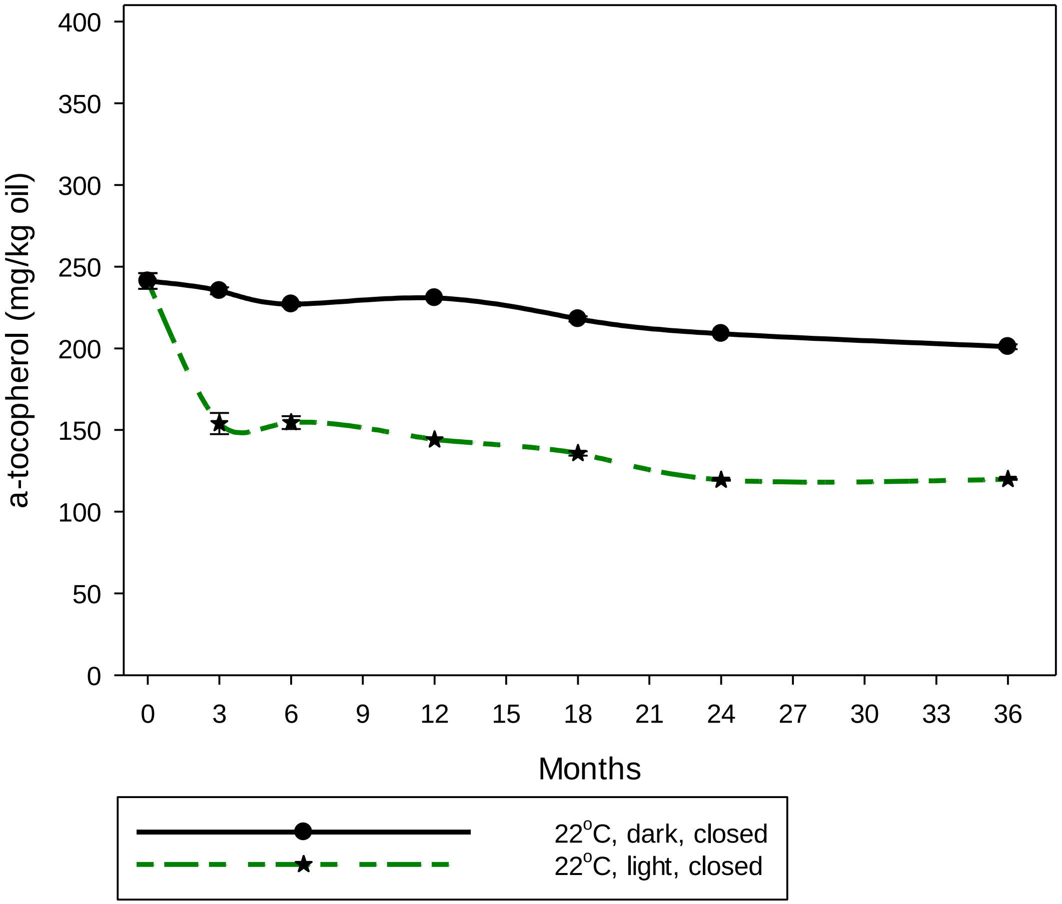
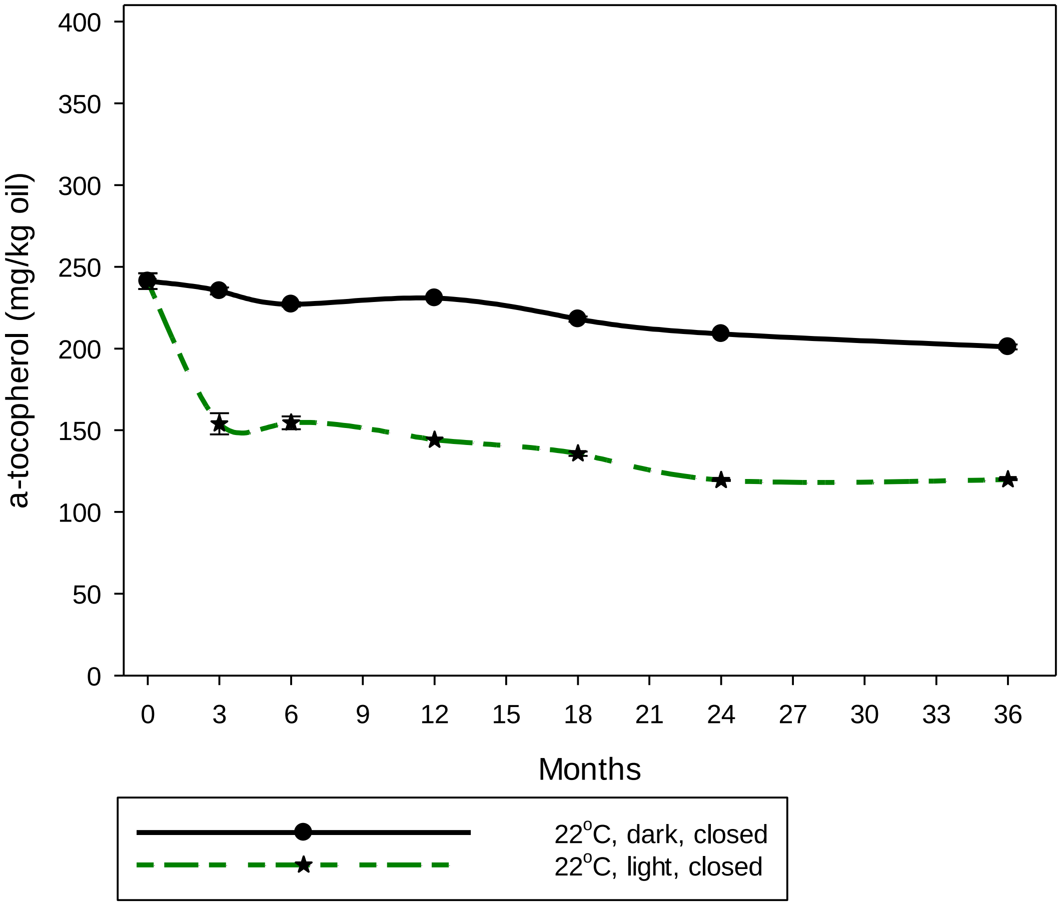
Light

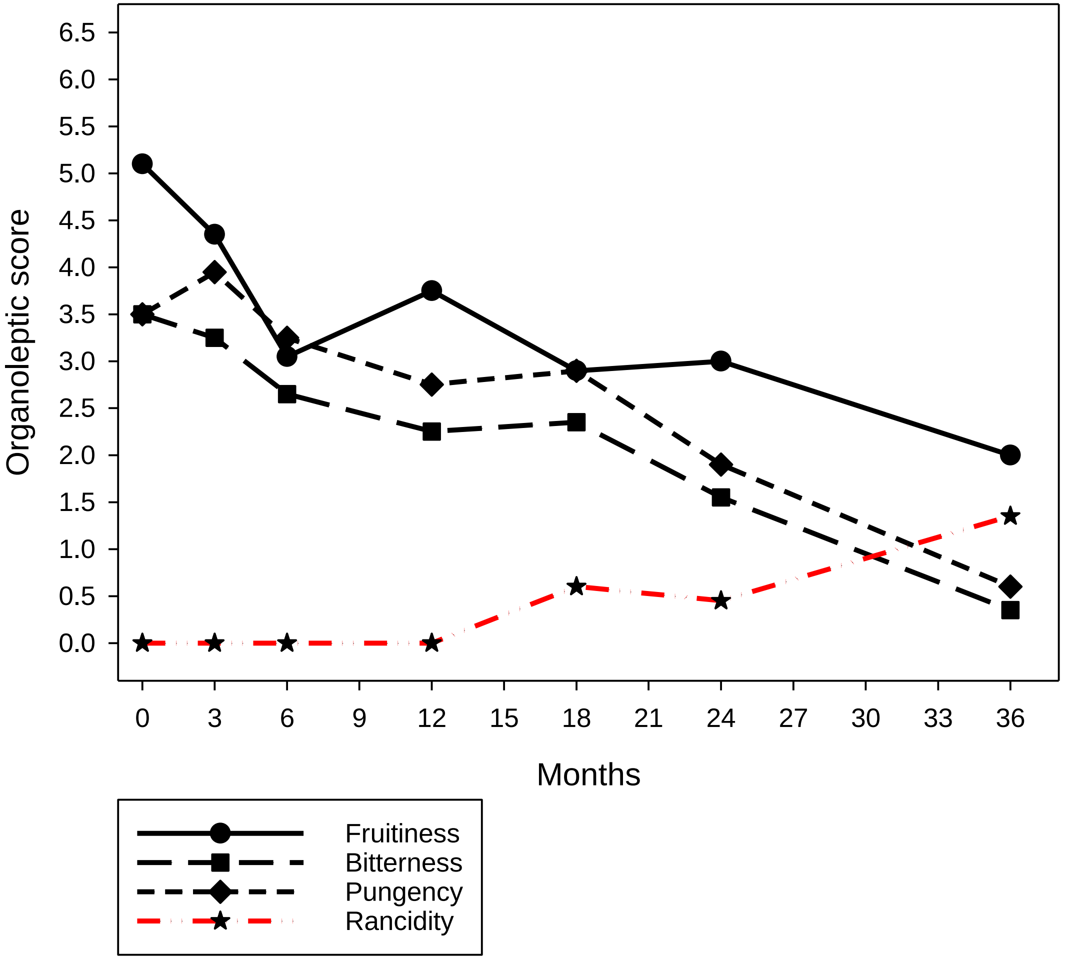
α-tocopherol



α-tocopherol and sensory analysis



Oil sample exposed to light



Storage Container Project

Storage Container Project

Oxygen & Temperature

Gas transmission
rates of various polymers @ 80% R.H

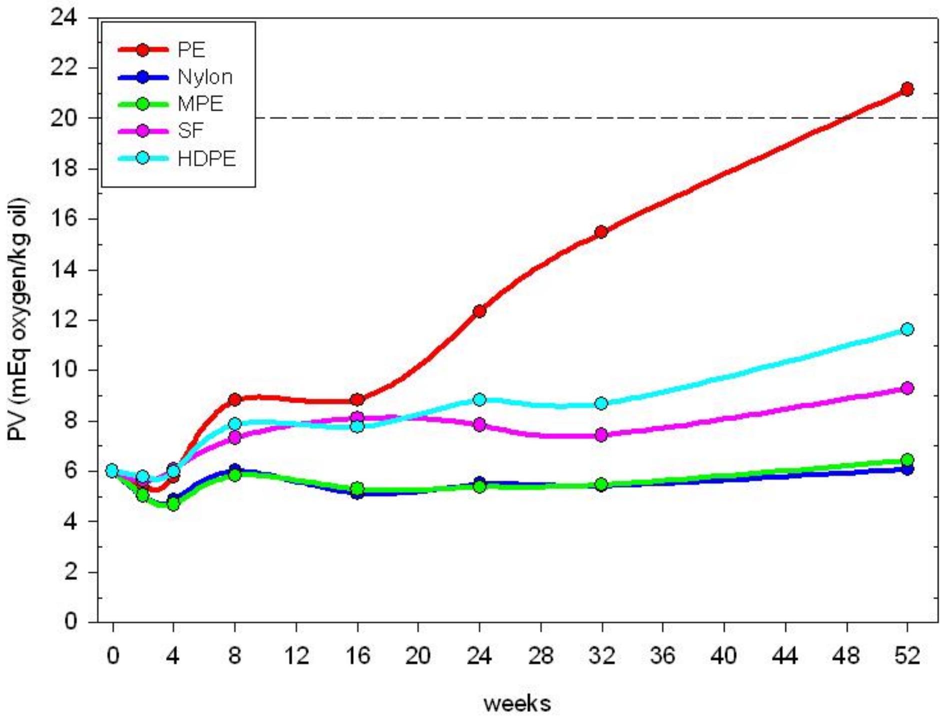
sourced from Flextank website,
www.flextank.com.au/technical.htm

Polymer	Oxygen cc of O_2 per sqm per 24hr per atm for 1mm of thickness	
	25°C	35°C
EVOH Barrier (i.e. "EVAL F")	0.021	0.051
PVDC Barrier ("Saran")	0.058	0.17
Oriented Nylon 6 ("Cryovac")	0.64	1.3
Unoriented Nylon (food/dairy pouch)	1.6	3.1
Oriented PET (i.e. bottle grade)	0.90	2.0
Unoriented PET (un-metallized)	1.8	4.0
Metallized PET (25-50µ for wine)	~2.0	-
H.D. Polyethylene (S.G. 0.96)	58	111
M.D Polyethylene (S.G. 0.935)	117	190
L.D. Polyethylene (S.G. 0.92)	215	289
Polystyrene (high impact)	101	-
PVC (unoriented)	6.5	-

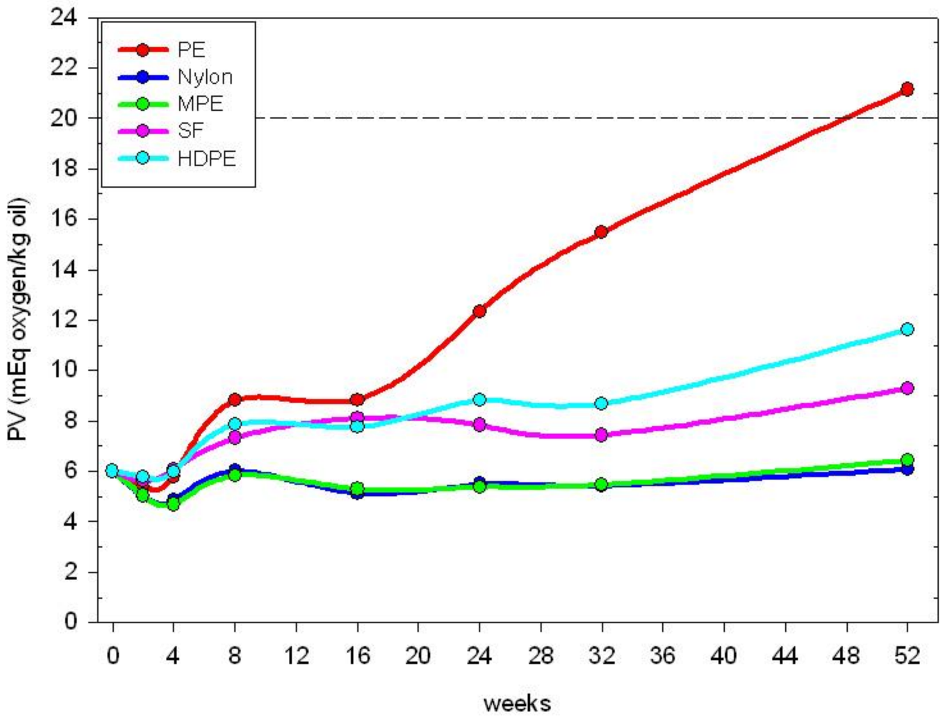
Container types

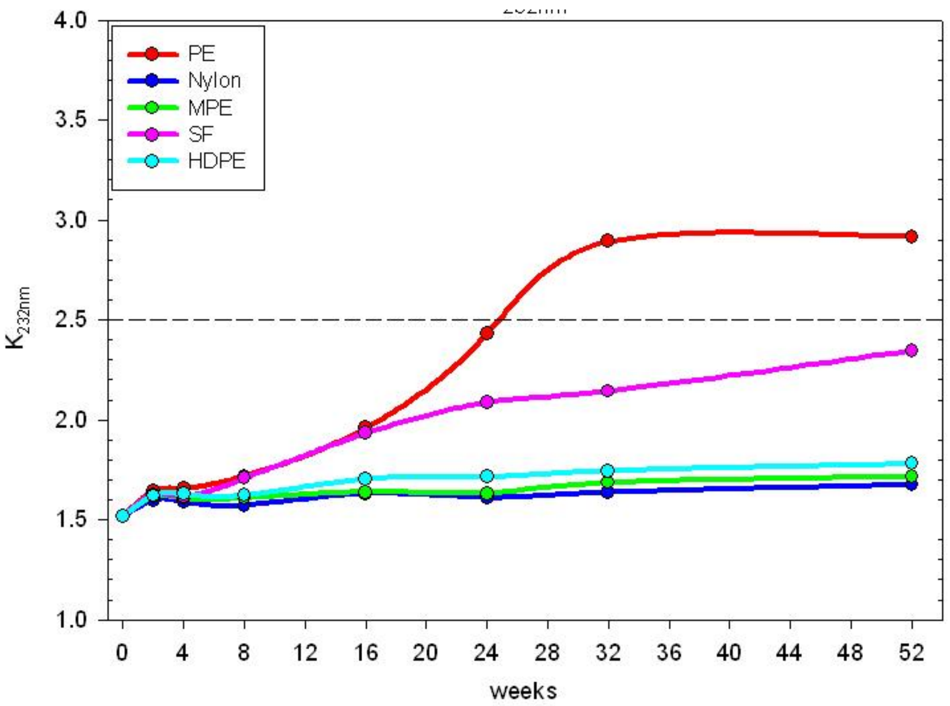
	Product Description	Volume (L)
PE	Polyethylene - clear	20 L
Nylon	Nylon co-extrusion laminate - clear	20 L
MPE	Metallised polyester - silver	20 L
SF	Silver Foil	20 L
HDPE	HDPE with UV filter Rigid white plastic storage container	20 L

Peroxide value



Peroxide value and UV absorbance K_{232}





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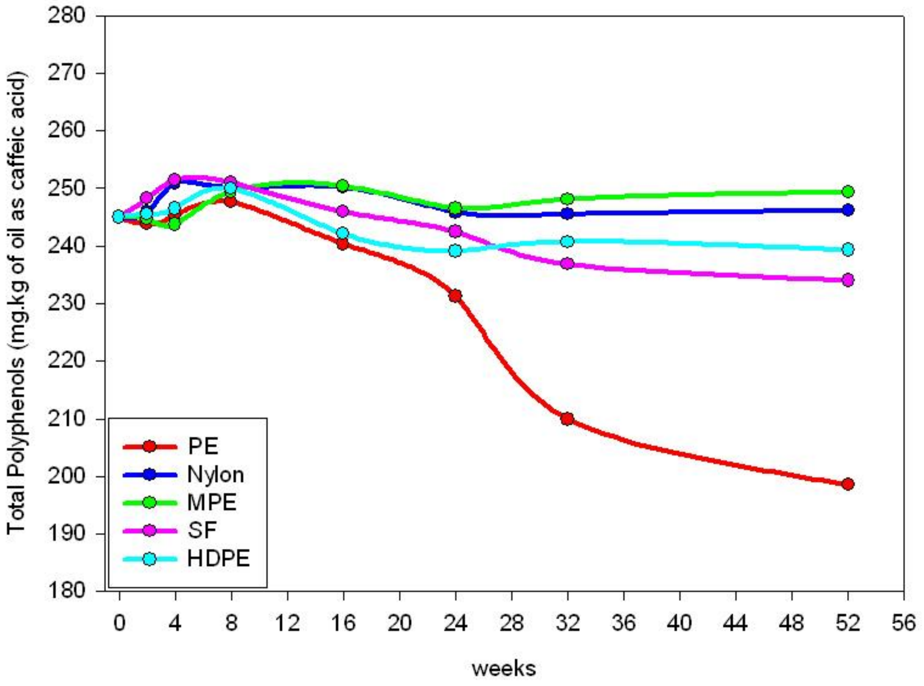
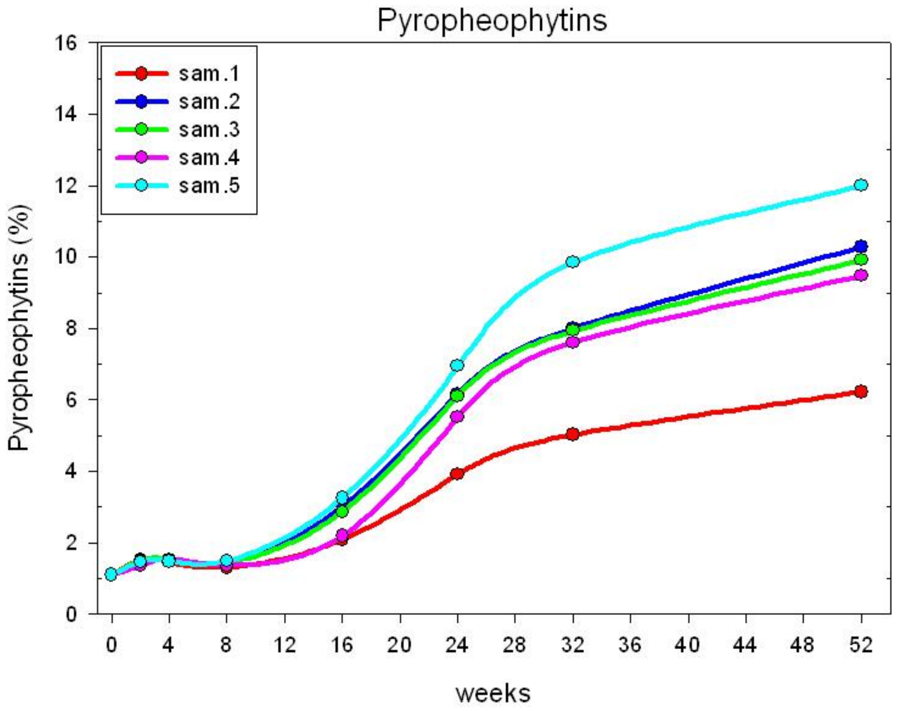
Total polyphenols



Pyropheophytin a



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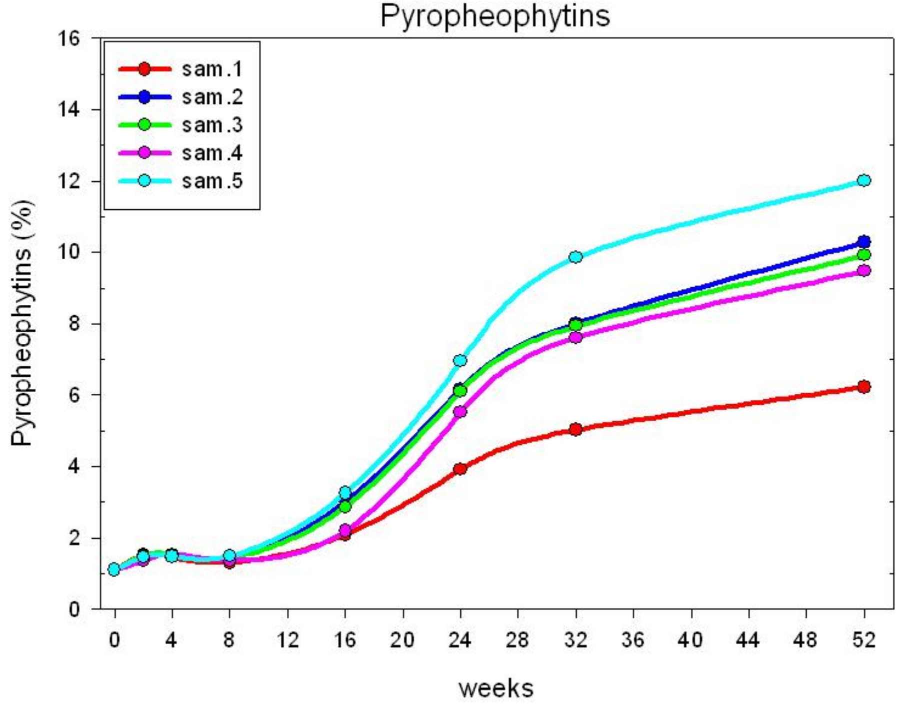
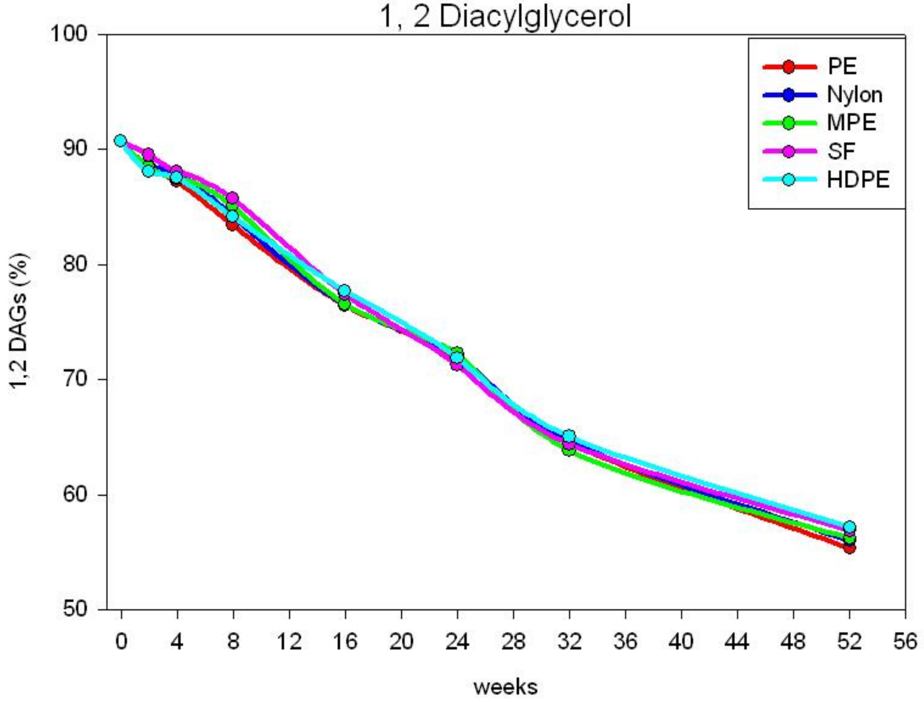
Pyropheophytin a and 1,2-DAGs





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So……. EVOO storage considerations?

Keep oil as cool as possible

- Constant temperature – room temperature or slightly lower
- Avoid high temperatures even for short periods of time
- Talk to distributers, retailers about storage

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- headspace – fill container as much as possible
- Inert gas - nitrogen

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Limit light exposure

- Dark or opaque containers
- Store in dark

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Bulk storage

- Check container construction materials with suppliers
- Gas transmission rates as low as possible

Subsequent research

Storage Conditions

Sanmartin C, et al. (2018), The effects of packaging and storage temperature on the shelf-life of extra virgin olive oil. Heliyon. Nov 1;4(11):e00888. doi: 10.1016/

- Italy
- Stored at 6°C and 26°C
- Changes in volatile compounds, detection of rancidity at higher temperatures

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Guillaume, C., Gertz, C. & Ravetti, L. (2014). Pyropheophytin *a* and 1,2-Diacyl-glycerols Over Time Under Different Storage Conditions in Natural Olive Oils. *J Am Oil Chem Soc* **91,** 697–709. https://doi.org/10.1007/s11746-014-2415-4

- Australia
- 20°C and 30°C
- Increase in PPP, decrease in DAGs over time
- PPP and DAGs influenced by temperature
- Sensory defects associated with storage temperatures

Subsequent research

Storage Containers

Sonia Esposto et al (2021), Overall quality evolution of extra virgin olive oil exposed to light for 10 months in different containers, Food Chemistry, **351**, doi.org/10.1016/j.foodchem.2021.129297.

- Italy
- green glass (GG), ultraviolet-grade absorbing glass (UVAGG), and multilayered packaging (MLP).
- Similar to results from our studies - MLP showed less degradation $\rightarrow$ less light, oxygen

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Gargouri B, Zribi A, Bouaziz, M(2015). Effect of containers on the quality of Chemlali olive oil during storage. J Food Sci Technol. 1948-59. doi: 10.1007/s13197-014-1273-2.

- Tunisia
- green glass (GG), polyethylene, tin
- Similar to results from our studies - polyethylene storage $\rightarrow$ oxidation $\rightarrow$ increased PV, UV, rancidity

Future research

New Technologies

Gas Chromatography – Mass Spectrometry (GC-MS)

Liquid Chromatography – Mass Spectrometry (LC-MS)

Nuclear magnetic resonance (NMR)

Electron Paramagnetic Resonance (EPR)

Future research

New Technologies

Gas Chromatography – Mass Spectrometry (GC-MS)
Liquid Chromatography – Mass Spectrometry (LC-MS)
Nuclear magnetic resonance (NMR)
Electron Paramagnetic Resonance (EPR)

- Mass spectra
- Marker bands
- Chemical fingerprints
- Chemometrics and metabolomics
- Databases and software to determine current status and predict likely outcomes.
- Remove the need for long drawn out studies

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- Donna Seberry
- Janelle Rowland
- Veronica Woodbury

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