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# OLIVE OIL: WHAT DO I BUY FOR MY FAMILY?

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There are so many different categories and brands that it is impossible to choose

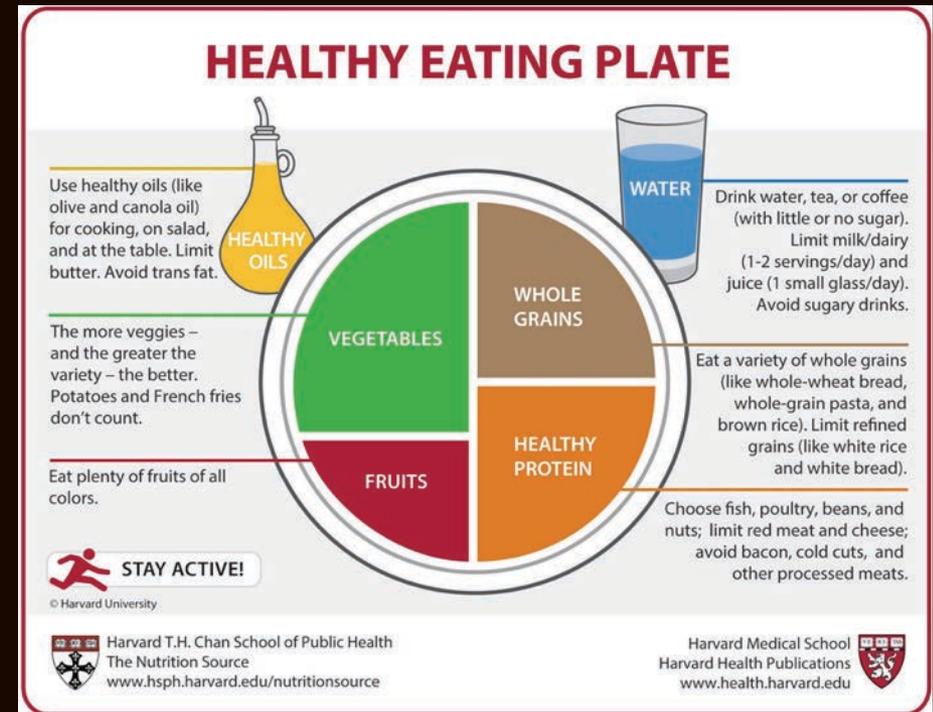
Only in Greece there are >500 different companies



- There are so many categories and varieties of Olive Oil on the market shelves, but they are not all equal.
- How science can guide the consumer looking for the healthiest oil.
- As a mother of four children and a woman that enjoys cooking I am seriously concerned for the olive oil quality I use in my kitchen

# 1. Olive oil vs other lipids

- FDA:
- Limited and not conclusive scientific evidence suggests that eating about 2 tablespoons (23 grams) of olive oil daily may reduce the risk of coronary heart disease due to the monounsaturated fat in olive oil. To achieve this possible benefit, olive oil is to replace a similar amount of saturated fat and not increase the total number of calories you eat in a day.
- EFSA:
- Replacing saturated fats in the diet with unsaturated fats contributes to the maintenance of normal blood cholesterol levels. Oleic acid is an unsaturated fat.
- Vitamin E contributes to the protection of cells from oxidative stress
- Olive oil polyphenols contribute to the protection of blood lipids from oxidative stress



The claim may be used only for olive oil which contains at least 5 mg of hydroxytyrosol and its derivatives (e.g. oleuropein complex and tyrosol) per 20 g of olive oil. In order to bear the claim information shall be given to the consumer that the beneficial effect is obtained with a daily intake of 20 g of olive oil.

## 2. Virgin or refined?

- Virgin means that the oil is obtained only with mechanical means.
- Refined means that it is obtained through an industrial chemical procedure aiming to reduce acidity, undesirable odors etc
- "Light" oils or "pure" oil or "classic" oil means a mixture of refined oil with a small amount of virgin (or extra virgin) ~5%.
- **Although a big portion of vitamin E is retained during refining the polyphenols are completely lost.**
- All olive oils based on refined oil, qualify for the health claim related to monounsaturated fatty acids and possibly for the vitamin E health claim but is impossible to have a health claim related to polyphenols
- One tablespoon of olive oil provides 10% of the daily dose of Vitamin E.

# Examples of refined olive oils with misleading (although legal) labels



It is a healthier alternative to butter, canola, vegetable and other cooking oils. This quality oil is ideal for high heat cooking like sautéing, frying and baking.

Nutrition Facts	Amount/serving	%DV*	Amount/serving	%DV*
	<b>Total Fat</b> 14g	<b>21%</b>	Cholest. 0mg	<b>0%</b>
Sat. Fat 2g	<b>9%</b>	Sodium 0mg	<b>0%</b>	
Trans Fat 0g		Total Carb. 0g	<b>0%</b>	
Polyunsat. Fat 2g		Protein 0g		
Monounsat. Fat 10g				

Serv. Size 1 tbsp (15ml)  
 Servings 34  
**Calories** 120  
 Fat Cal. 120

\*Percent Daily Values (DV) are based on a 2,000 calorie diet.

**INGREDIENTS:** OLIVE OIL - COMPOSED OF REFINED OLIVE OILS AND VIRGIN OLIVE OILS  
 Product contains select high quality olive oils from the countries indicated by the letters below.  
 IT=Italy, GR=Greece, ES=Spain, TN=Tunisia, TR=Turkey, MA=Morocco.

Best if Used By:  
**L1437T H2050 IT.ES**

PRODUCT MAY BECOME CLOUDY BELOW 50°F. THIS IS NORMAL AND WILL CLEAR WHEN AT ROOM TEMPERATURE. STORE TIGHTLY CAPPED IN A COOL, DARK PLACE.

Warning:  
 Do not expose to open flame

All the above types of oils is impossible to contain any healthy polyphenols due to the chemical refinement. Unfortunately they have similar price with virgin olive oil

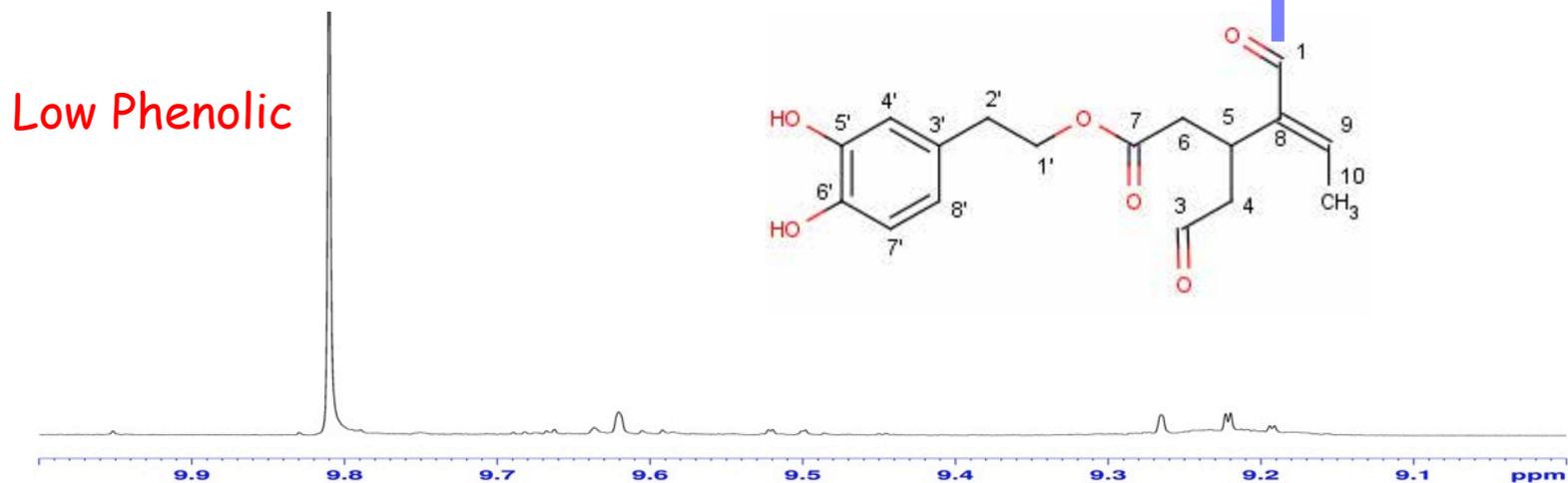
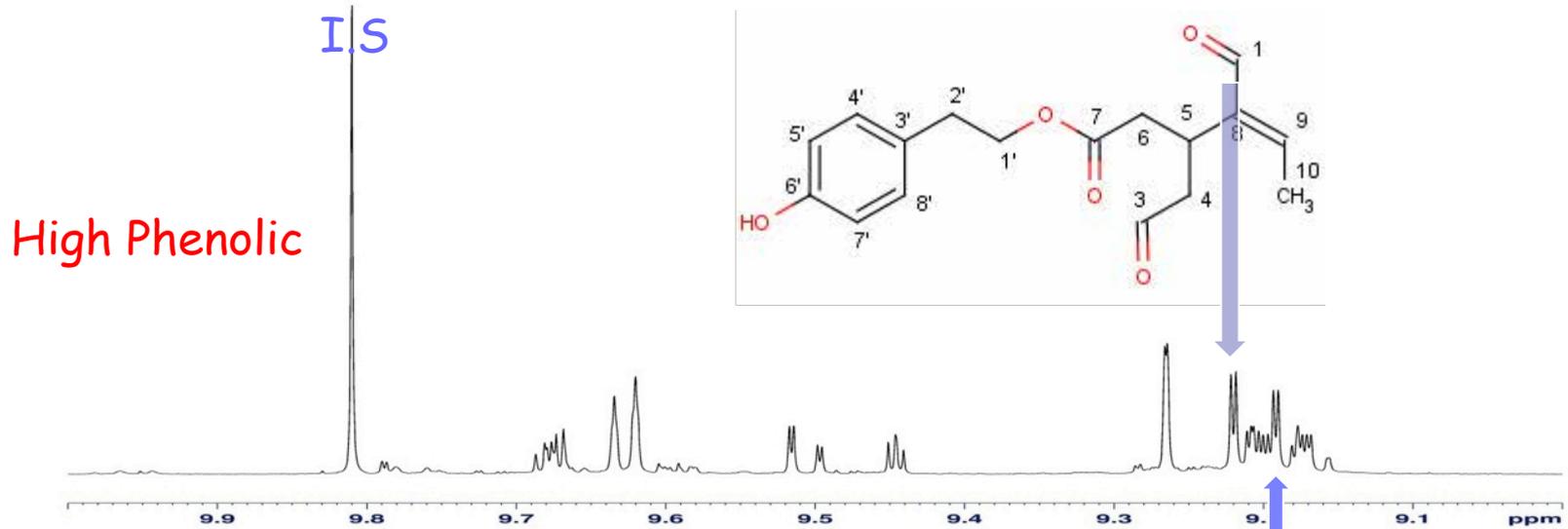
# 3. Virgin or extra virgin?

- The difference between virgin and extra virgin is mainly related to free acidity and taste
- EVOO <0.8%
- VOO <2%
- Although there is no direct relation between acidity and taste defects with the phenolic content most virgin oils come either from very late harvest olives or from not properly processed olives or from olives with high damage from the olive fly.
- Late harvest olives or not properly processed olives usually give oil with low phenolic content.
- Virgin olive oil is less possible to qualify for the health claim related to polyphenols (although it is not impossible)

## 4. Extra virgin or High phenolic?

- The definition of extra virgin is not directly related with phenolic content.
- An olive oil may be classified as extra virgin even with almost zero phenolic content.
- The extra virgin category should be segmented to High phenolic (>250 mg/Kg) and Low phenolic (without health claim)

# Comparison between extra virgin olive oil total extracts



# New index

- A series of new indexes for the characterization of extra virgin olive oils has been proposed
- D1= oleocanthal+oleacein level  
D2=oleocanthal/oleacein ratio
- D3 = sum of all healthy polyphenols
- D to remind UC Davis and the people there that encouraged us to complete this work

# A Key question

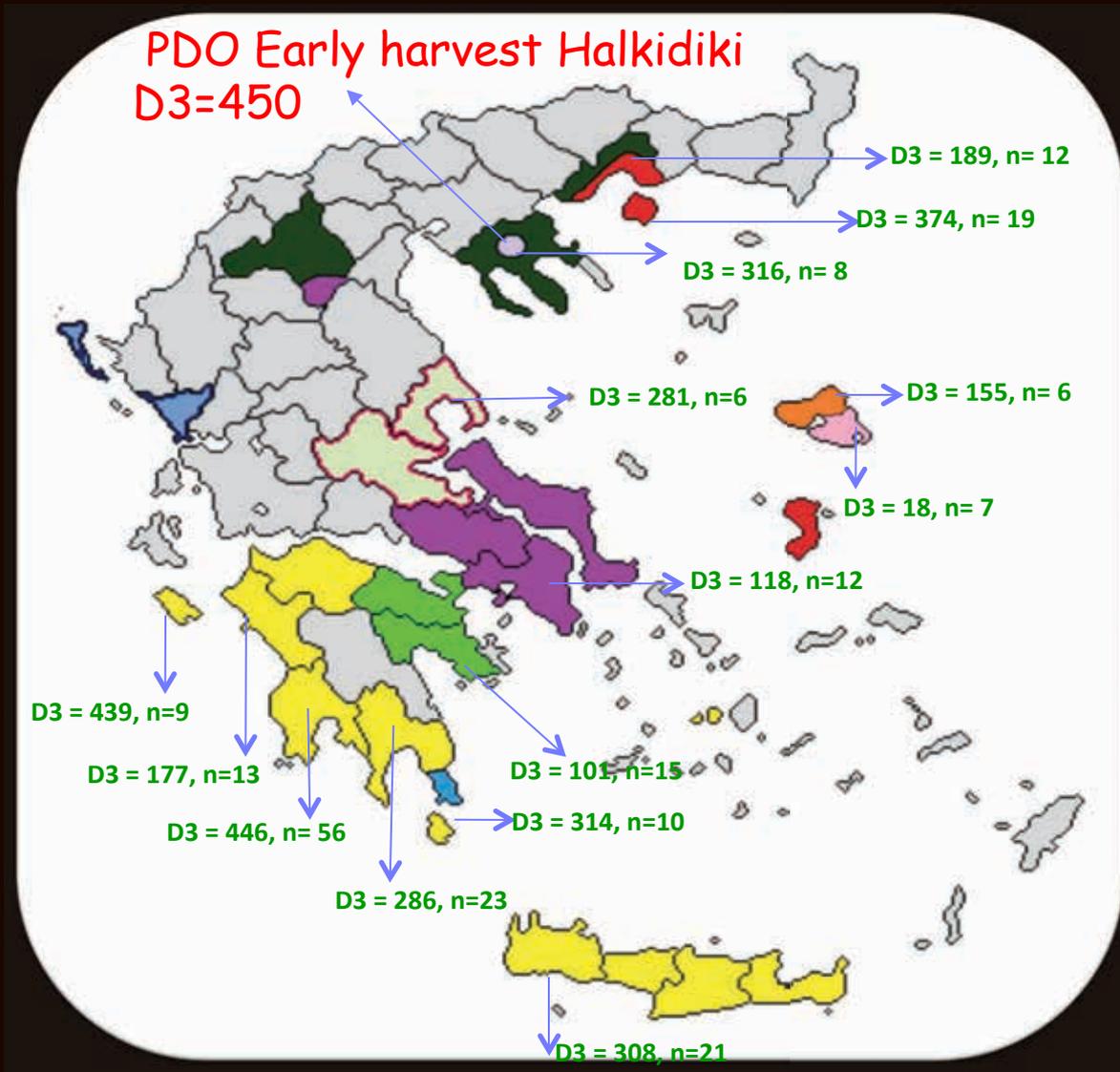
- What levels of specific polyphenols are high, moderate or low?
- The total phenolics method (Folin) cannot answer this question
- It was necessary to screen thousands of samples with the NMR method

# Example of phenolic content distribution in Greek EVOOs



Data from 2014-2015 and 2015-2016 season (1000 samples)

# POLYPHENOL MAP OF GREEK OLIVE OIL



- KORONEIKI
- HALKIDIKI
- THROUBA
- MEAGRITIKI
- LIANOLIA
- ATHENOLIA
- MANAKI
- AMFISSA
- KOLOVI
- ADRAMYTINI

# International Screening

- The method was applied to 110 commercial samples found in major Supermarkets in San Francisco area

# Geographic origin of commercial EVOO samples studied in UC Davis Olive center NOV-DEC 2013

- 48/110 California
  - 26/110 Italy
  - 12/110 Mediterranean mixtures
  - 11/110 Greece
  - 7/110 Spain
  - Morocco, Argentina, Chile, France
- 
- The most expensive was from Tuscany 120\$/litre. Nice taste and package but not health claim. Average price 15\$/litre.

# Comparison of supermarket samples

- Concentration range in California supermarket oil produced in 2012-2013
- Oleocanthal 0-402 mg/Kg (average 135 mg/Kg)
- Oleacein 0-320 mg/Kg (average 105 mg/Kg)
- D3= 10-941 mg/Kg (average 330 mg/Kg)

Oleocanthal: 680 mg/Kg  
Oleacein: 350 mg/Kg  
Oleuropein aglycon: 53 mg/Kg  
Ligstroside aglycon: 59 mg/Kg  
total hydroxytyrosol derivatives (D4): 403 mg/Kg  
**D3: 1142 mg/Kg**

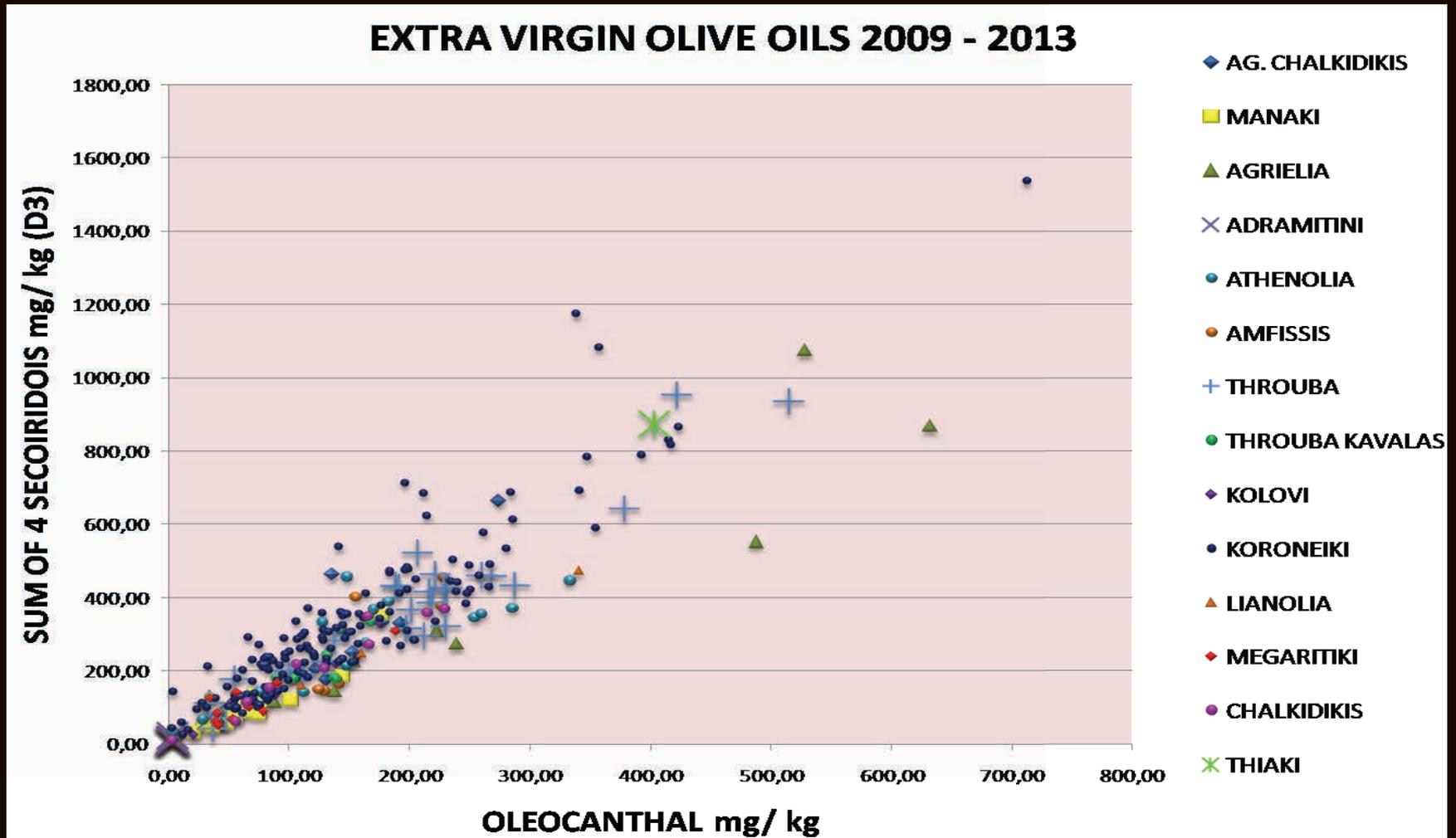


Values of  
the best  
Greek  
bottled  
EVOO  
2012-2013

## 5. High phenolic or high Oleocanthal?

- There is special interest in the market on High Oleocanthal oils due to the recently identified very interesting properties of this molecule.
- There is no official regulation about this although oleocanthal is included in the molecules of the EU health claim
- Its concentration presents wide variation among the different EVOOs

# Variation in olecanthal content in Greek Olive oils



# Main findings

- 1. There is a significant variation concerning the concentrations of oleocanthal and oleacein among the studied samples. Their concentration ranged from non-detectable **to 3076 mg/Kg** and the sum of the total healthy phenolics (index D3) **from 0 to 4970 mg/Kg (data from 2009 to September 2017)**.
- 2. There are olive varieties that independently from geographic origin and harvest time produce olive oil that contains phenolic compounds in low levels and other varieties that produce high levels.
- 3. There is positive correlation of high level olive oils with the early time of harvest.

# Some conclusions

- All extra virgin olive oils are not the same!!
- Some oils present a great potential as health protecting agents
- New indexes offering an estimation of the health related properties are proposed based on NMR quantitation.
- We now have easy tools to evaluate the healthy properties of olive oil

## 6. Is it necessary to be organic or bio?

- Comparison between EVOOs produced in certified organic or conventional orchards with the same variety, same harvest time and same olive mill have shown very small differences of the oil phenolic content
- The study needs to be repeated in more samples to give more reliable results.
- However it is always better to prefer an organic EVOO due to the absence of pesticides or insecticides residues

# 7. Is it better to be a P.D.O?

- There is no general rule.
- Some P.D.Os coming from narrow geographic origin and produced with strict limitations guarantee high levels of phenolics.
- Example: Early harvest Halkidiki (Agourelaiio). A recent study in 50 samples gave an average much higher than the EU limits
- A PDO product guarantees that it is not a blend of different countries and the quality control is more careful (or the quality characteristics more stable)

	Calories 120	Calories from Fat 120	% Daily Value*
<b>Total Fat</b>	14g		<b>22%</b>
Saturated Fat	2g		<b>10%</b>
Trans Fat	0g		
Polyunsaturated Fat	2g		
Monounsaturated Fat	10g		
<b>Cholesterol</b>	0mg		<b>0%</b>
<b>Sodium</b>	0mg		<b>0%</b>
<b>Total Carbohydrate</b>	0g		<b>0%</b>
<b>Protein</b>	0g		

Not a significant source of cholesterol, dietary fiber, sugar, vitamin A, vitamin C, calcium, and iron.

\* Percent Daily Values are based on a 2,000 calorie diet.

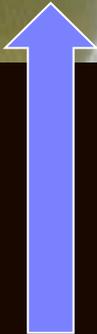
Packed in Italy with select extra virgin olive oils from Italy, Spain, Greece and Tunisia.

PDO = Protected Designation of Origin

## 8. Should the oil be unfiltered?

- Depending on the type of filter used the filtration procedure may remove very small or very big amounts of phenols.
- An unfiltered oil contains the total amount of the naturally produced phenols BUT it should be consumed in the first few months after production.
- If the sediment stays in contact with the olive oil for long times (>6 months) then it increases the risk for development of undesired odours and the initiation of hydrolytic reactions that decompose the healthy phenols.

# 20\$ for an olive oil without polyphenols?



Sediment

# Is a High phenolic EVOO only for salad?

- Olive oil phenolics like oleocanthal or oleacein are sensitive to heat, oxygen and water
- The consumption of olive oil in raw form as for example in salads (but not in premade dressings) guarantees that we will receive 100% of the phenols
- Olive oil phenolics are destroyed if they stay in contact with aqueous materials for long time
- The dressings should be prepared just before consumption



# New legislation in Greece



- Unfortunately not yet in the whole EU
- After 1/1/2018 in restaurants olive oil will be served in closed not-refillable bottles ~50 ml
- It will guarantee the high quality of served oil and will maintain higher levels of phenols. Phenols are sensitive to air especially during summer in transparent bottles

# What happens to the phenols during cooking?

- Although the phenols are sensitive to heat they are stable enough to cook with olive oil for at least 10-20 min at 100°C
- If the oil is added close the end of cooking the phenols will remain intact ~80%



# What happens to the phenols during frying?

- Although the phenols are sensitive to heat they are stable enough to fry with olive oil for at least 5 min at 160°C
- Even in that case about 30% of oleocanthal will survive.
- Another part of the phenols will be decomposed to free tyrosol or hydroxytyrosol that are absorbed by the fried food adding some healthy value

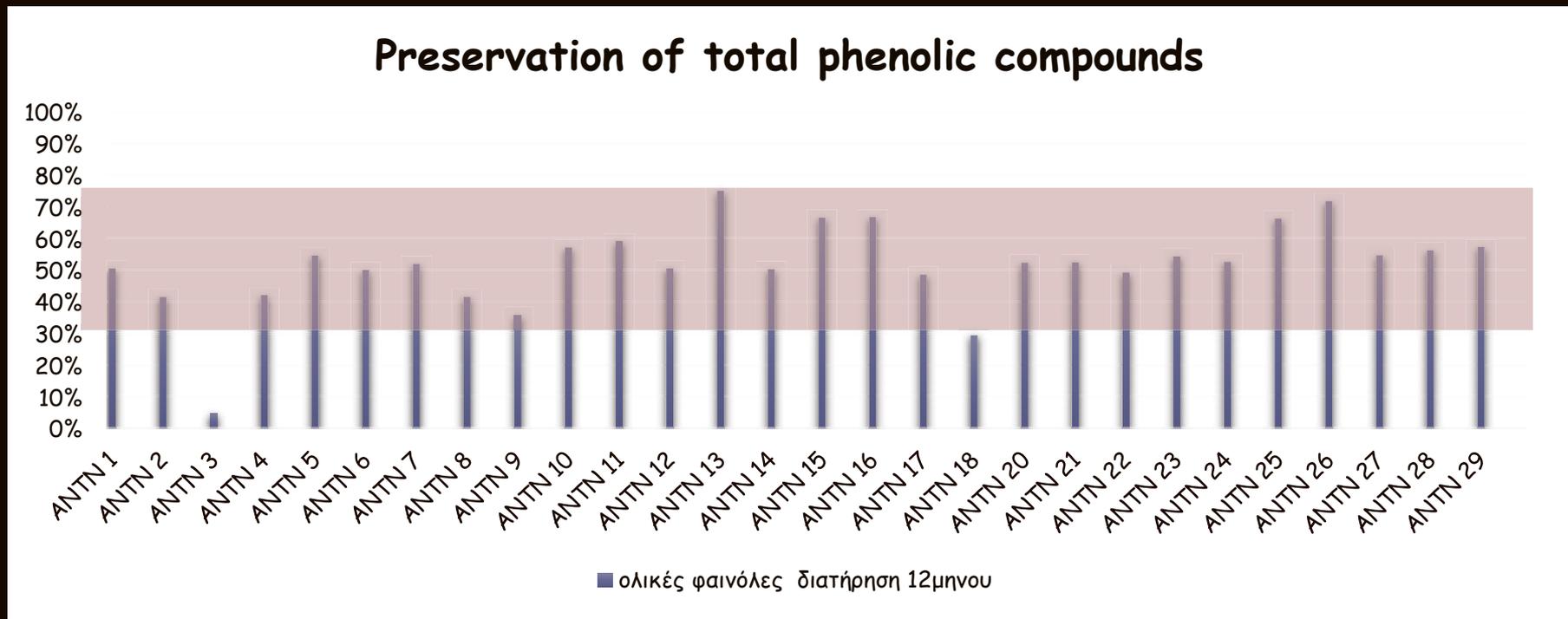


# What happens to my oil during storage at home?

- General rule: Avoid big containers which remain half empty for long time. The contact with oxygen is detrimental
- Don't forget: Olive oil is a fruit juice....
- 18 month study of 30 different EVOOs at  $-18^{\circ}\text{C}$ ,  $+4^{\circ}\text{C}$  and room temperature



# What happens in total phenolic compounds concentration during storage for 12 months in closed bottles at room temperature



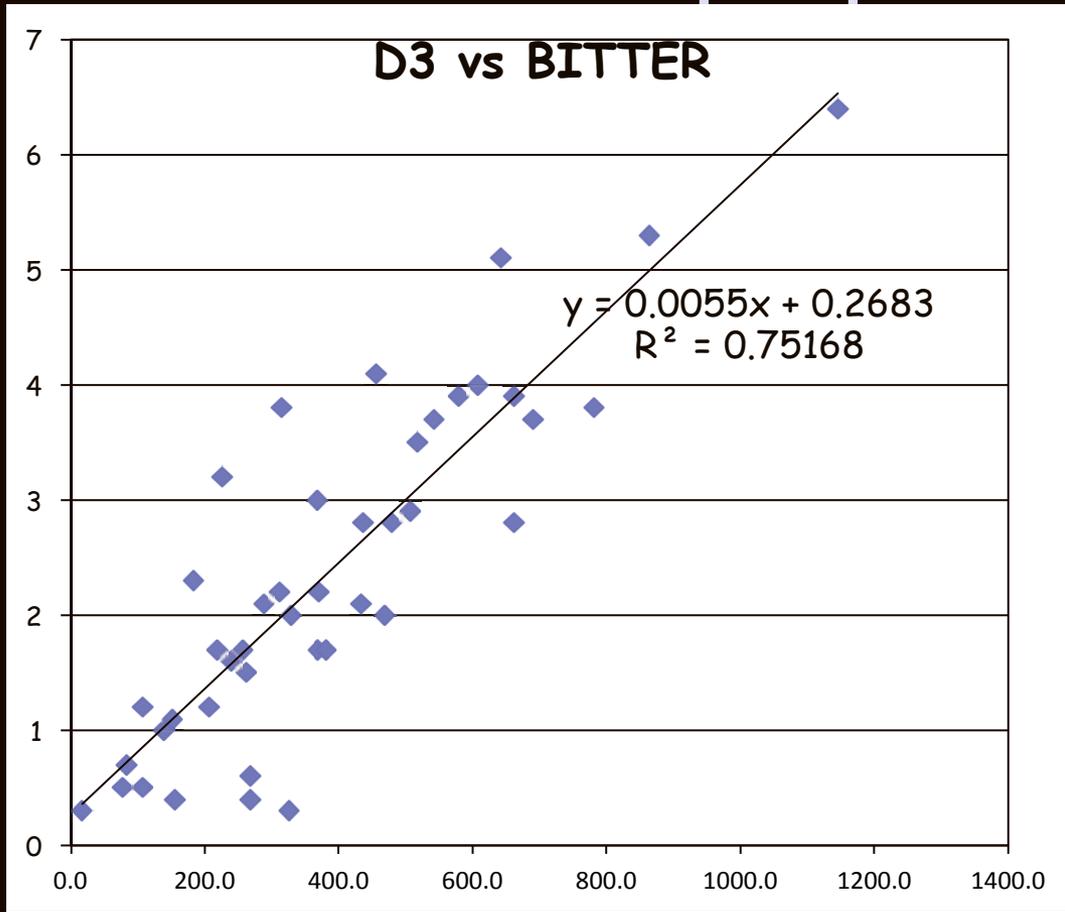
Average survival rate 54% (40-75%)

In the fridge (+4°C) the average survival rate becomes 85%

# How do I recognize a good high phenolic EVOO?

- Is green color an indication? NO
- We have analyzed numerous samples from green unripe olives where the phenols have been lost due to inappropriate treatment in the olive mill
- Is density or viscosity? NO
- Is flavor? Green fruity notes are good indications. Needs experience and is not quantitative
- Is taste?
- YES

# The phenolic content is related with bitter and pungent organoleptic properties

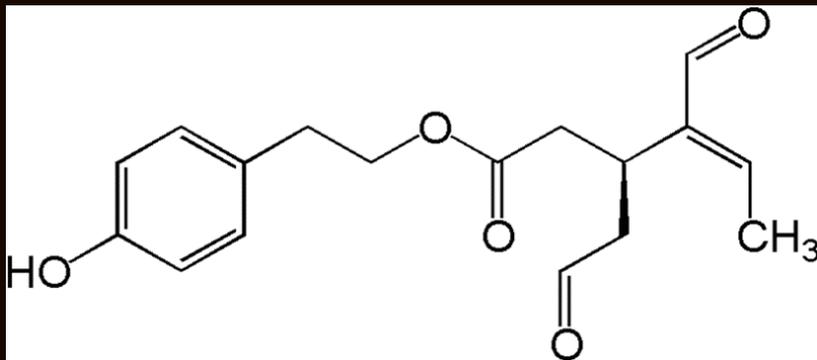


- We correlated the sensory evaluation results with the D3 and we were able to predict the bitterness and pungency based on the oleocanthal and oleacein content for EVOO.

# Oleocanthal and pungent

- Oleocanthal can activate the TRPA-1 receptor in the oropharyngeal cavity and give a stinging feeling. At higher levels it leads to cough
- This feeling is described as pungency

- This is the most reliable way to identify a good quality oil
- It does not exist in refined oils or low quality oils obtained from very mature olives



# Bitterness

- The bitter sensation in the base of the tongue is related mainly with oleacein and especially with the closed ring form of oleuropein aglycon
- Extreme bitterness is not desirable
- Some varieties produce big quantities of oleuropein aglycon giving very bitter oils

# Need for certified EVOOs with polyphenol health claim

- Organoleptic evaluation is not enough
- The health claim can be certified by precise measurement of all the phenols included in the health claim regulation using expensive laboratory methods like the qNMR
- To make things easier we invented a new colorimetric reaction "the ARISTOLEO test" that can offer direct identification of the high phenolic EVOOs
- The ARISTOLEO test can give quantitative measurement of the oleocanthal and oleacein content with the ARISTOMETRO device



# Aristoleo test

We developed a cheap and simple colorimetric test with which anybody can measure the levels of oleocanthal and oleacein and to evaluate the quality of olive oil.

A small quantity of olive oil is mixed with a specific reagent and after some time later a color appears. The intensity of the color (from light yellow to green) is selectively related with the concentration of oleocanthal and oleacein .

The test is protected with a Greek patent and is already commercially available in Greece, Italy, Spain and Cyprus.

# ARISTOLEO

A method created to provide an easier and faster way to measure the sum of oleocanthal and oleacein in olive oil

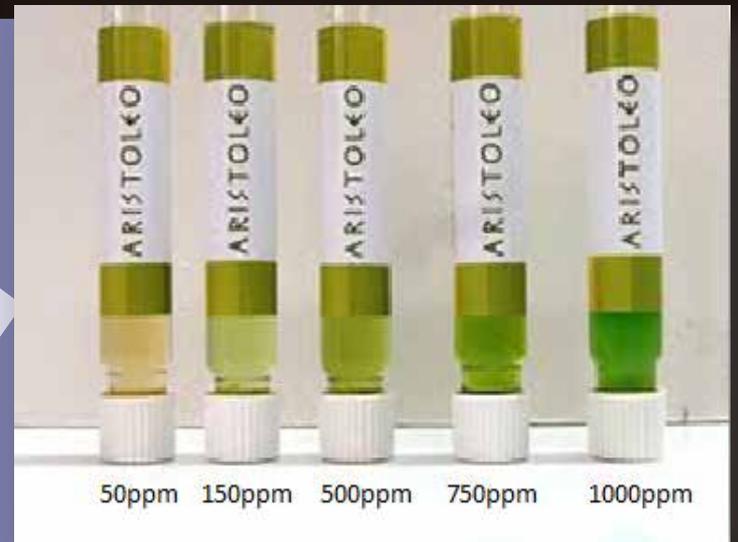
7,5ml olive oil

1,5ml special reagent

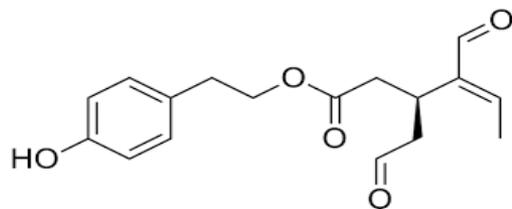
Shake and wait for 1 min

1,5ml aqueous solution

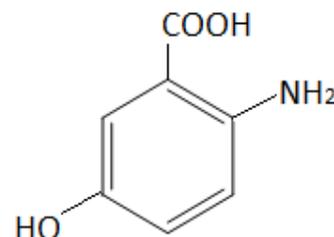
Shake and wait for 45min



# THE MELLIYOU-MAGIATIS REACTION MECHANISM



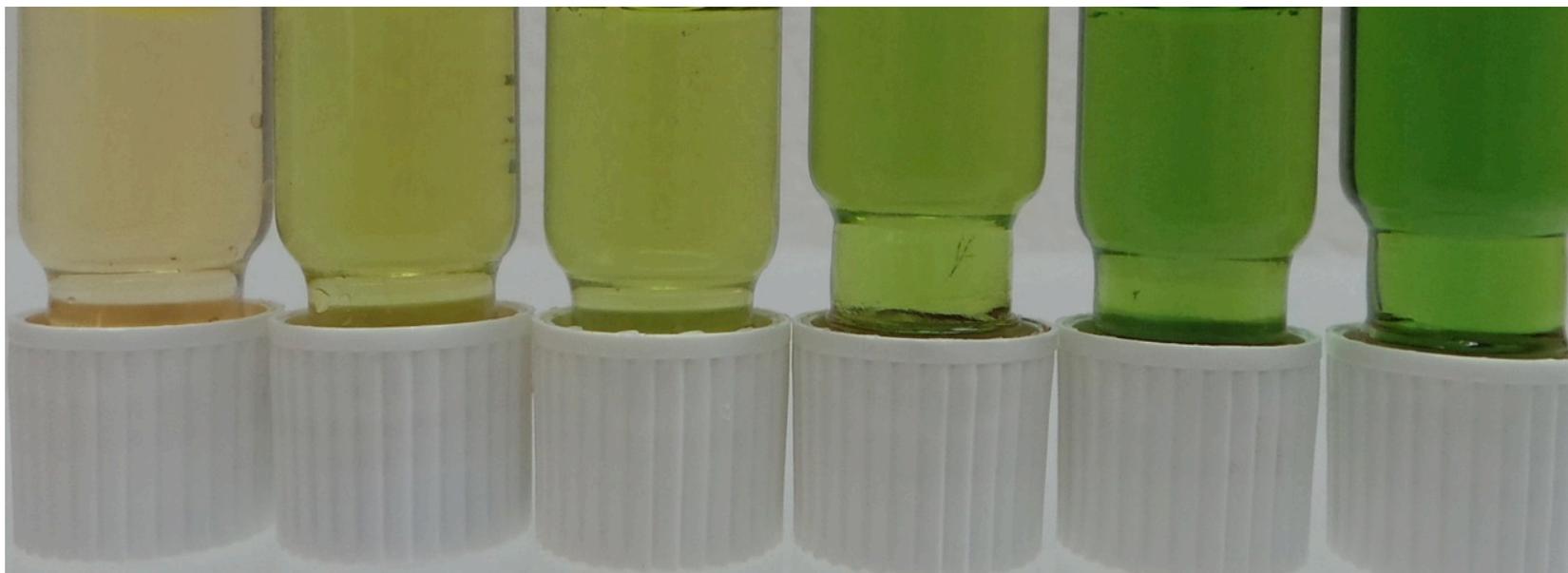
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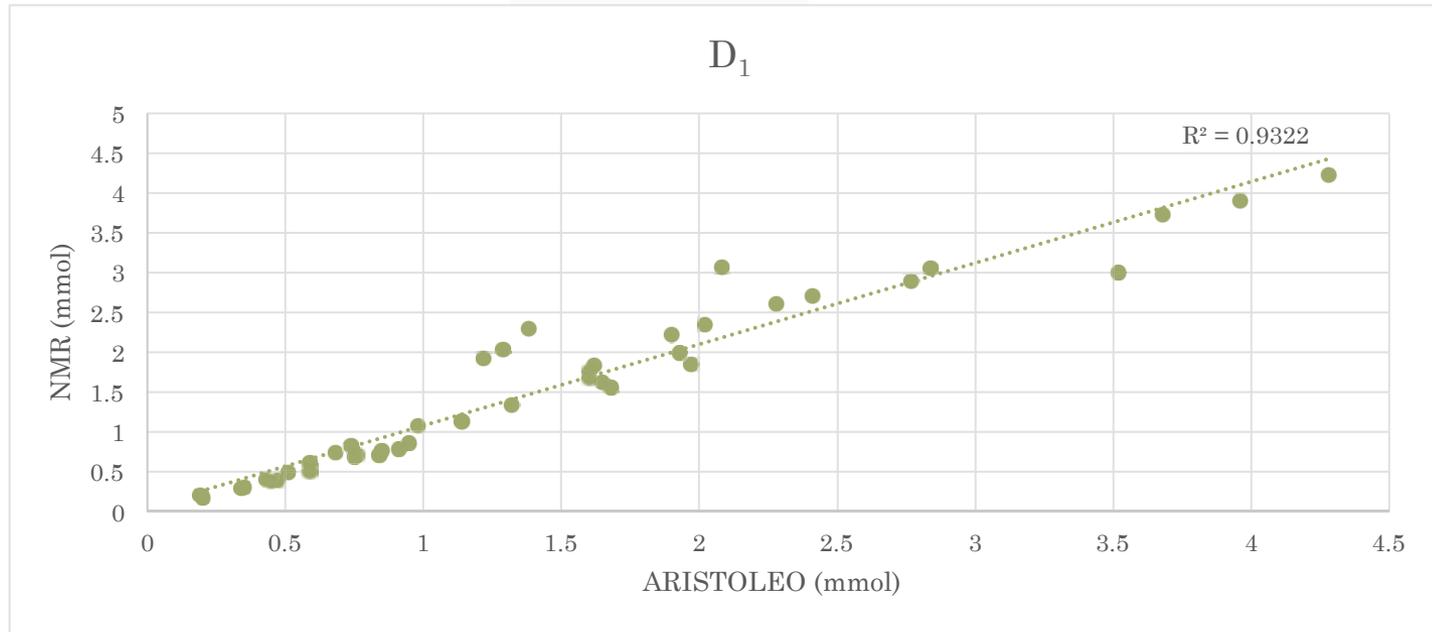
p-hydroxy anthranilic acid



water soluble chromophore



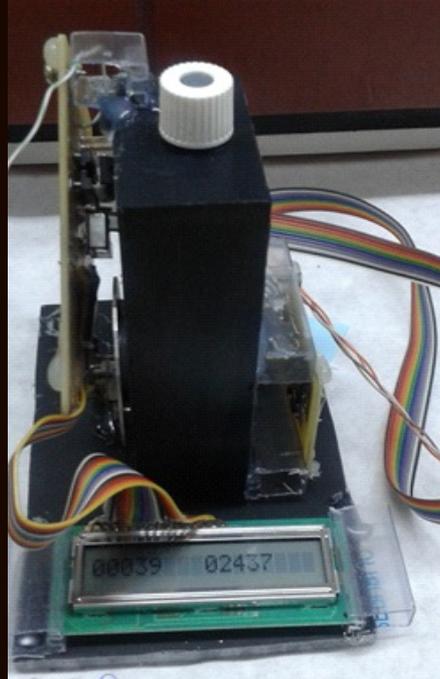
# COMPARISON NMR VS QUANTITATIVE ARISTOLEO FOR D1 = OLEOCANTAL +OLEACEIN)



Correlation between ARISTOLEO -NMR



# Aristometro™



Direct measurement of the oleocanthal and oleacein concentration

Application of the ARISTOLEO kit instructions

After 45 min the tube is placed in the ARISTOMETRO

The absorbance is measured in 1 sec

Automatic transformation to concentration

# WORLD OLIVE CENTER for health

- Non-profit organization
- Offers certification to all interested producers concerning the health claim
- Organizes competitions and offer awards: **GOLD, SILVER, BRONZE** depending on the phenolic content
- Will organize international research projects related to olive oil and health



# THE OLYMPIA HEALTH & NUTRITION AWARDS



The World Olive Center for health offers distinctive stickers: **GOLD, SILVER, BRONZE** depending on the phenolic content that are used on the label

Our target is to make the **OLYMPIA** award seal on the bottle the most easily identifiable marker of a healthy olive oil

So everybody now will know what olive oil to choose!

# THANKS TO

- Prokopios MAGIATIS
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