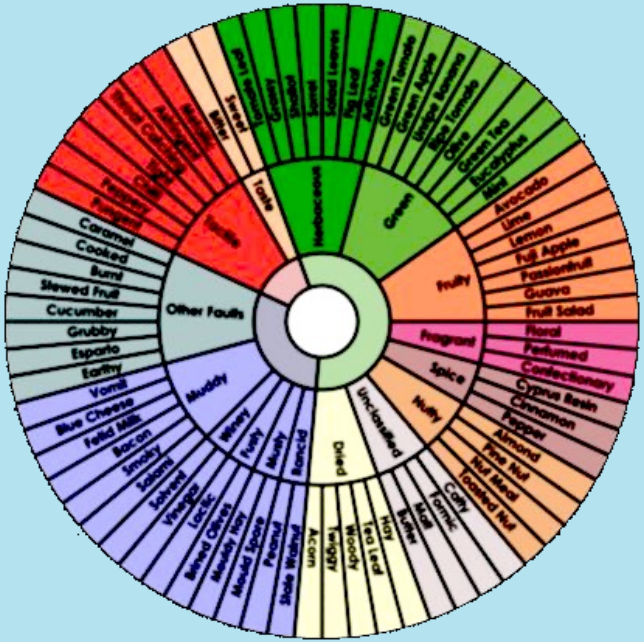
Olive Oil Times
EDUCATION LAB

Olive oil quality parameters and positive characteristics



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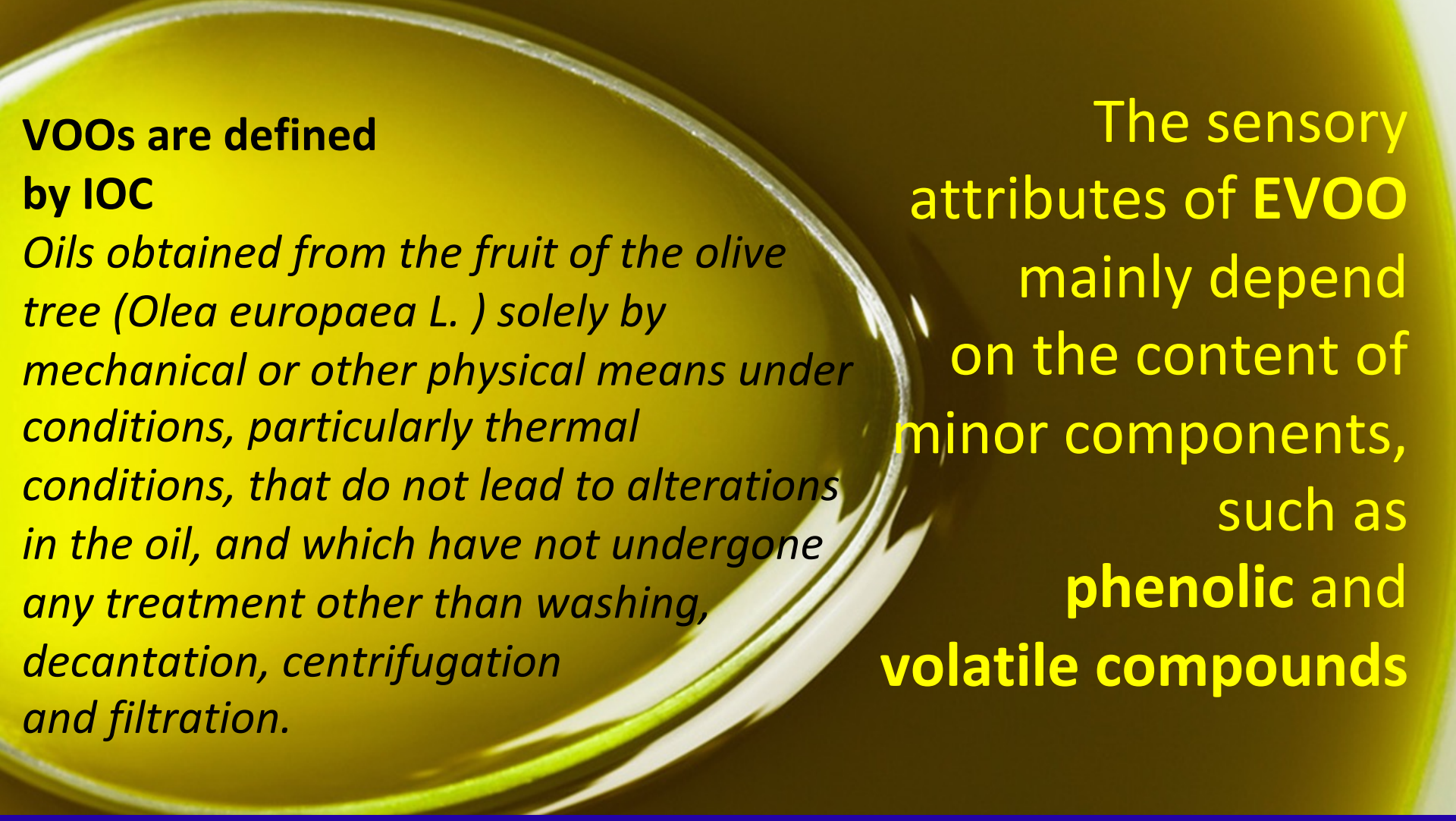


VOOs are defined by IOC

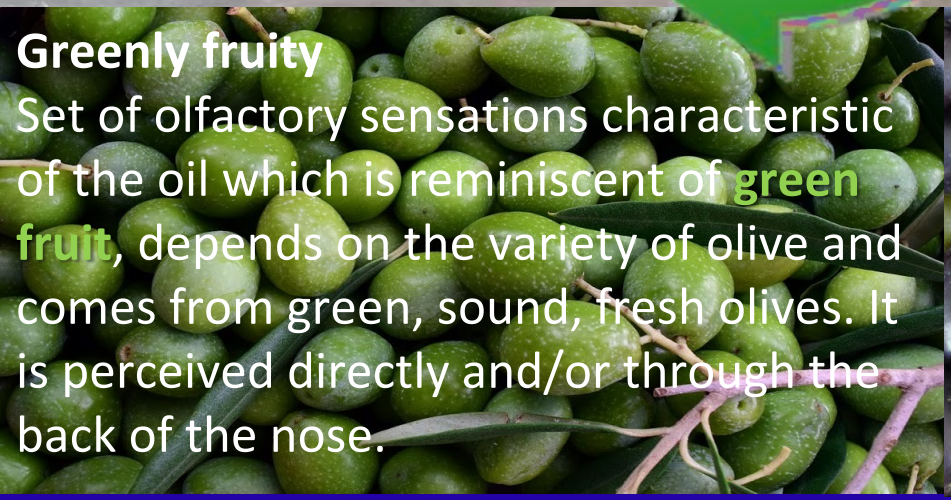
Oils obtained from the fruit of the olive tree (Olea europaea L.) solely by mechanical or other physical means under conditions, particularly thermal conditions, that do not lead to alterations in the oil, and which have not undergone any treatment other than washing, decantation, centrifugation and filtration.

The sensory attributes of **EVOO** mainly depend on the content of minor components, such as **phenolic** and **volatile compounds**

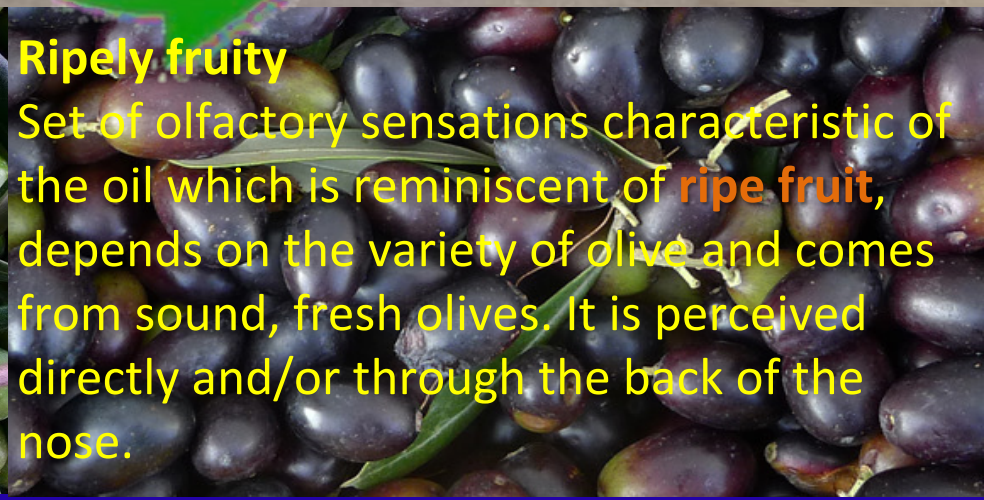

Superior category olive oil obtained directly from olives and solely by mechanical means
ROCIANO
Superior category olive oil obtained directly from olives and solely by mechanical means

Positive attributes

Fruity: set of olfactory sensations characteristic of the oil which depends on the variety of olive and comes from sound, fresh olives in which neither green or ripe fruitiness predominates.
It is perceived directly and/or through the back of the nose.



Greenly fruity
Set of olfactory sensations characteristic of the oil which is reminiscent of green fruit, depends on the variety of olive and comes from green, sound, fresh olives. It is perceived directly and/or through the back of the nose.

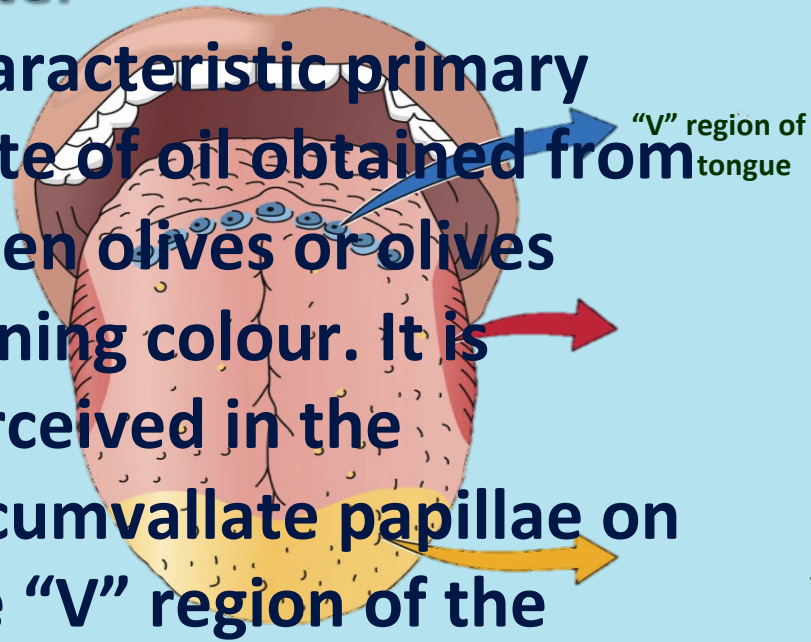


Ripely fruity
Set of olfactory sensations characteristic of the oil which is reminiscent of ripe fruit, depends on the variety of olive and comes from sound, fresh olives. It is perceived directly and/or through the back of the nose.

Positive attributes

Bitter

Characteristic primary taste of oil obtained from green olives or olives turning colour. It is perceived in the circumvallate papillae on the “V” region of the tongue.



Pungent

Biting tactile sensation characteristic of oils produced at the start of the crop year, primarily from olives that are still unripe. It can be perceived throughout the whole of the mouth cavity, particularly in the throat.

Positive or **negative** sensory descriptors of EVOO have been related to **volatile** and **phenol** profiles, which are responsible for aroma and taste, respectively.

The characteristic taste of EVOO (**bitterness** and **pungency**) that are related to important **health benefits**.

The main chemical, biochemical and technological processes responsible for the positive descriptors of EVOO are summarized in this class.

Aromas and flavors depend upon a multifaceted series of sensory responses including tastes - sweet, sour, salty, bitter and umami - olfactory responses, which **involve** a virtually **unlimited number of descriptors**, and the additional oral sensory sensations mediating coolness, astringency and pressure, referred to as chemisthesis mediated through the trigeminal system.

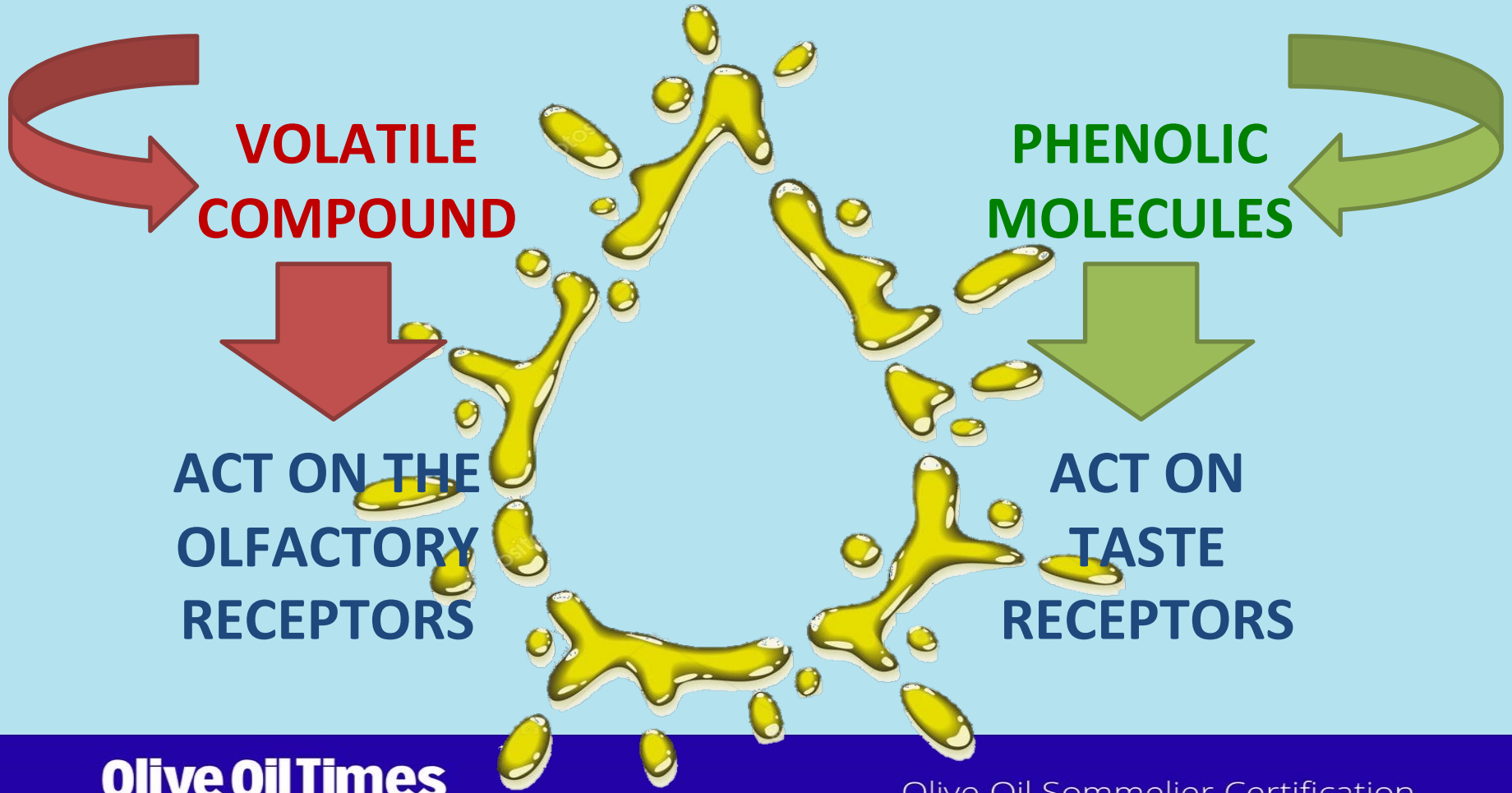
!!! The volatile compounds and the non-volatiles are held back by the matrix during the process of mechanical extraction from olive fruits (Olea europea L.) !!!.

Organoleptic assessment.

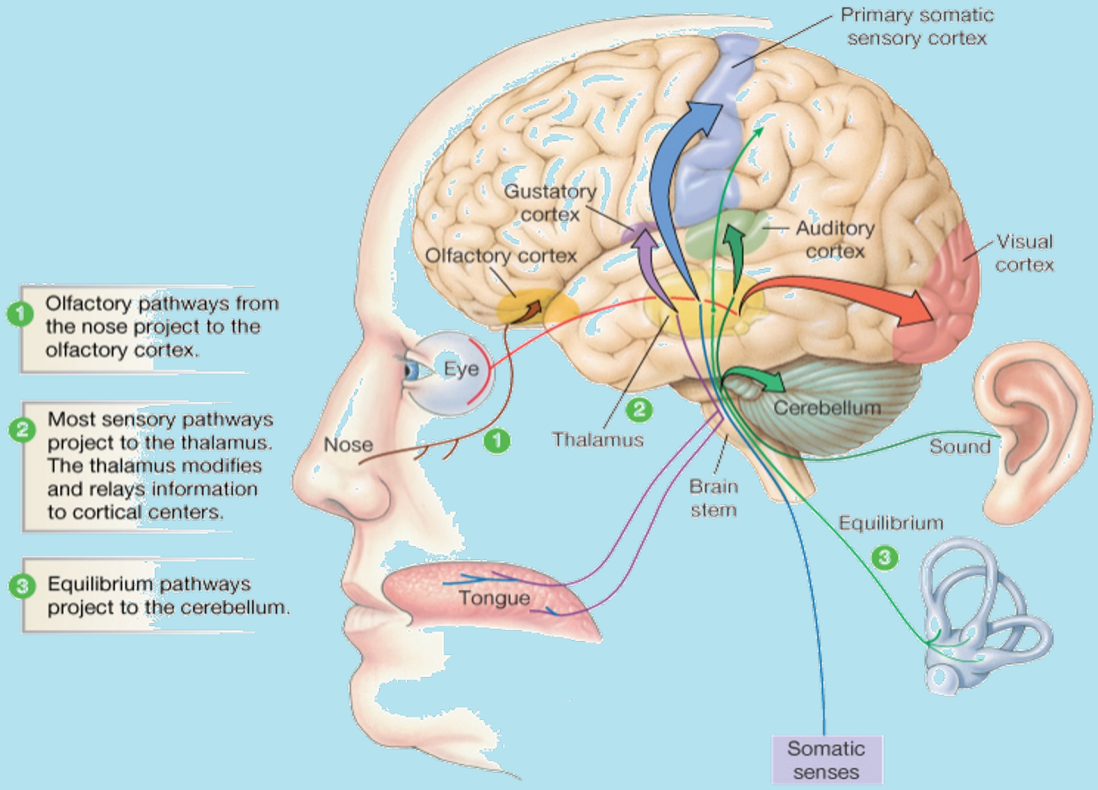
Trained tasting panels **are able to assess** the oils to determine the levels of **positive attributes** (fruitiness, bitterness and pungency). **Negative attributes** (poor quality fruit, incorrect processing or issues arising during storage) can be also be determined by **sensory panels**.

It has been found that aldehydes are mainly responsible for these “off” flavours in olive oil while other volatiles compound, as well as polyphenolic compounds, have a significant role in determining the complex sensory qualities of olive oil.

IN EVOO, AROMAS AND FLAVORS DEPENDS:



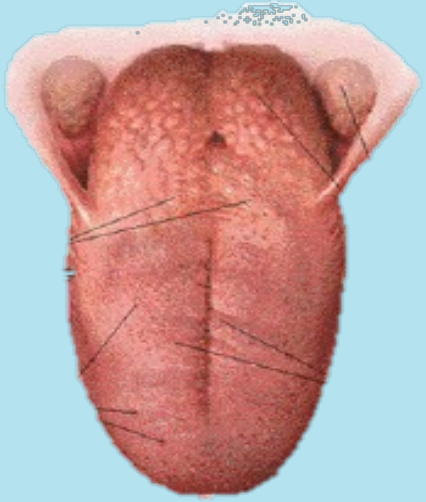
OLFACTORY RECEPTORS



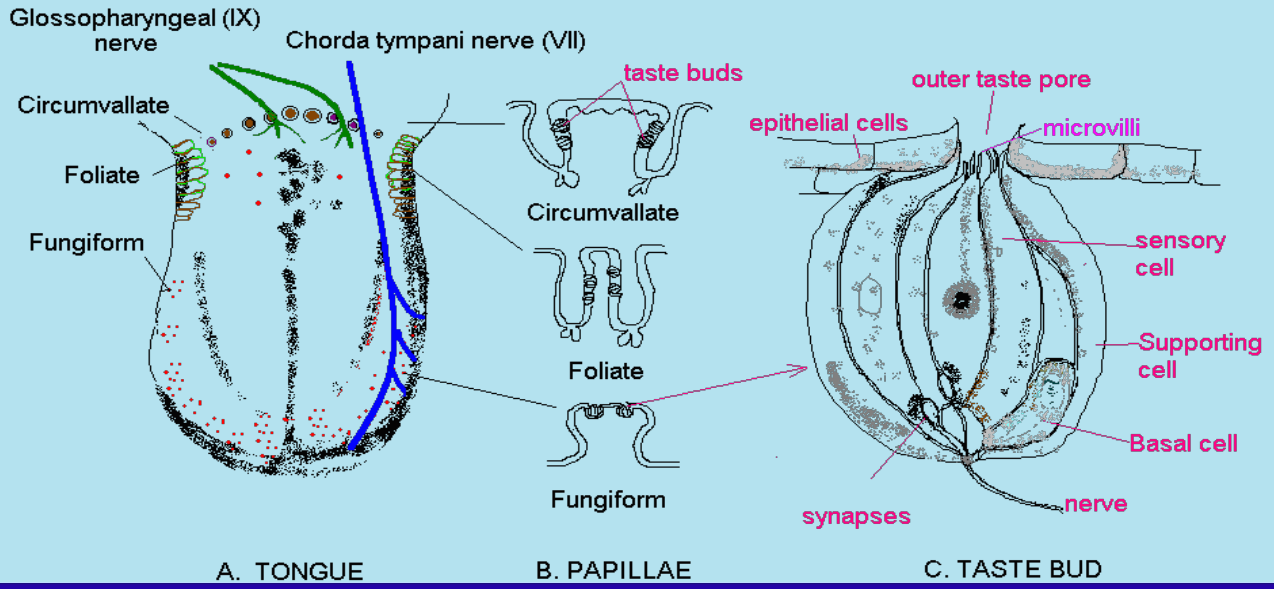
The **volatile compounds (VC)**, working on olfactive receptors, are responsible of **EVOO's aroma** instead.

Even olive oil's defects depend on volatile and phenolic compounds, but we'll discuss this topic elsewhere.

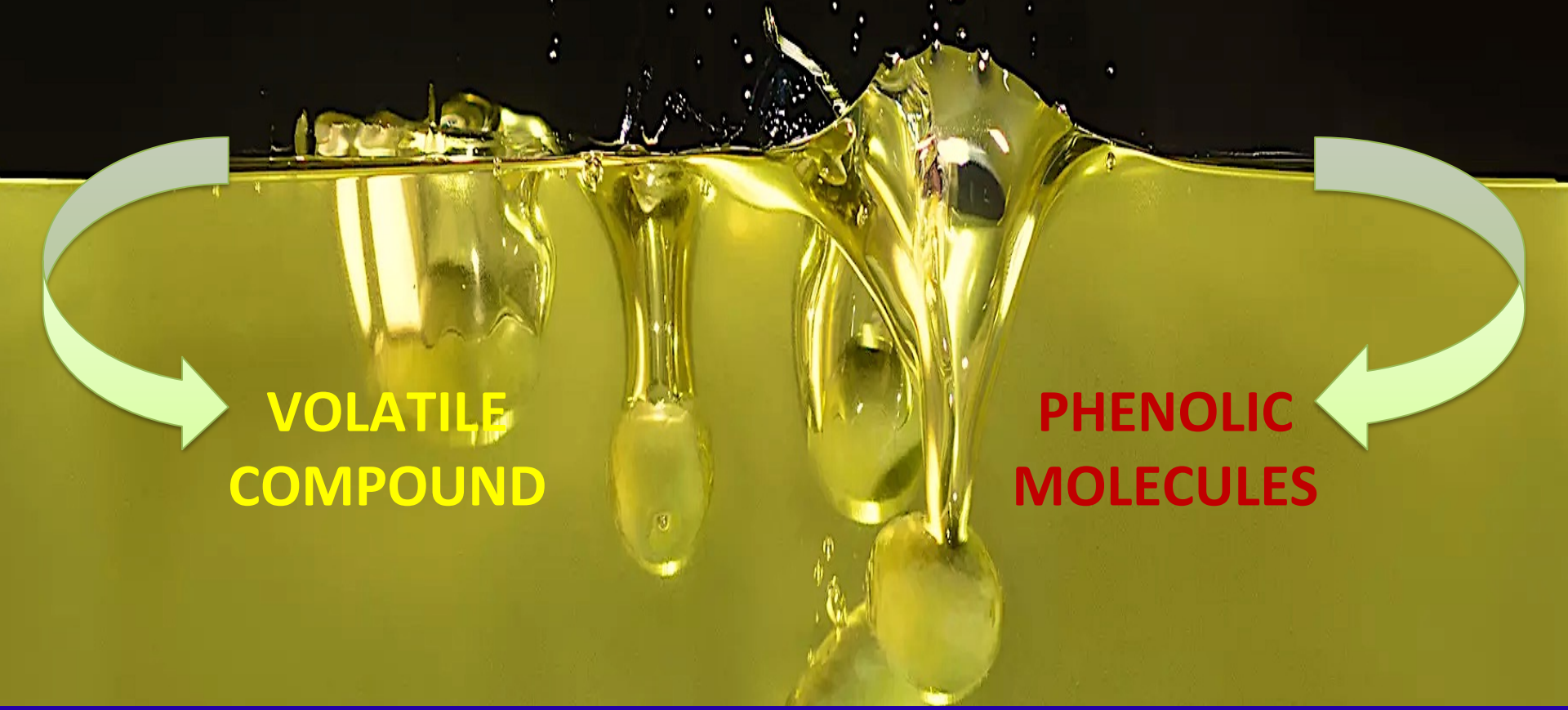
TASTE RECEPTORS



The **non-volatile substances** like the **phenolic** ones, stimulate the taste buds and the free terminations of trigeminal nerves, **producing a taste sensations** (bitter sensation first, then a serie of stingy, pungency, astringent, metallic sensations).



IN EVOO, AROMAS AND FLAVORS DEPENDS ON TWO MAJOR CLASSES OF COMPOUNDS:

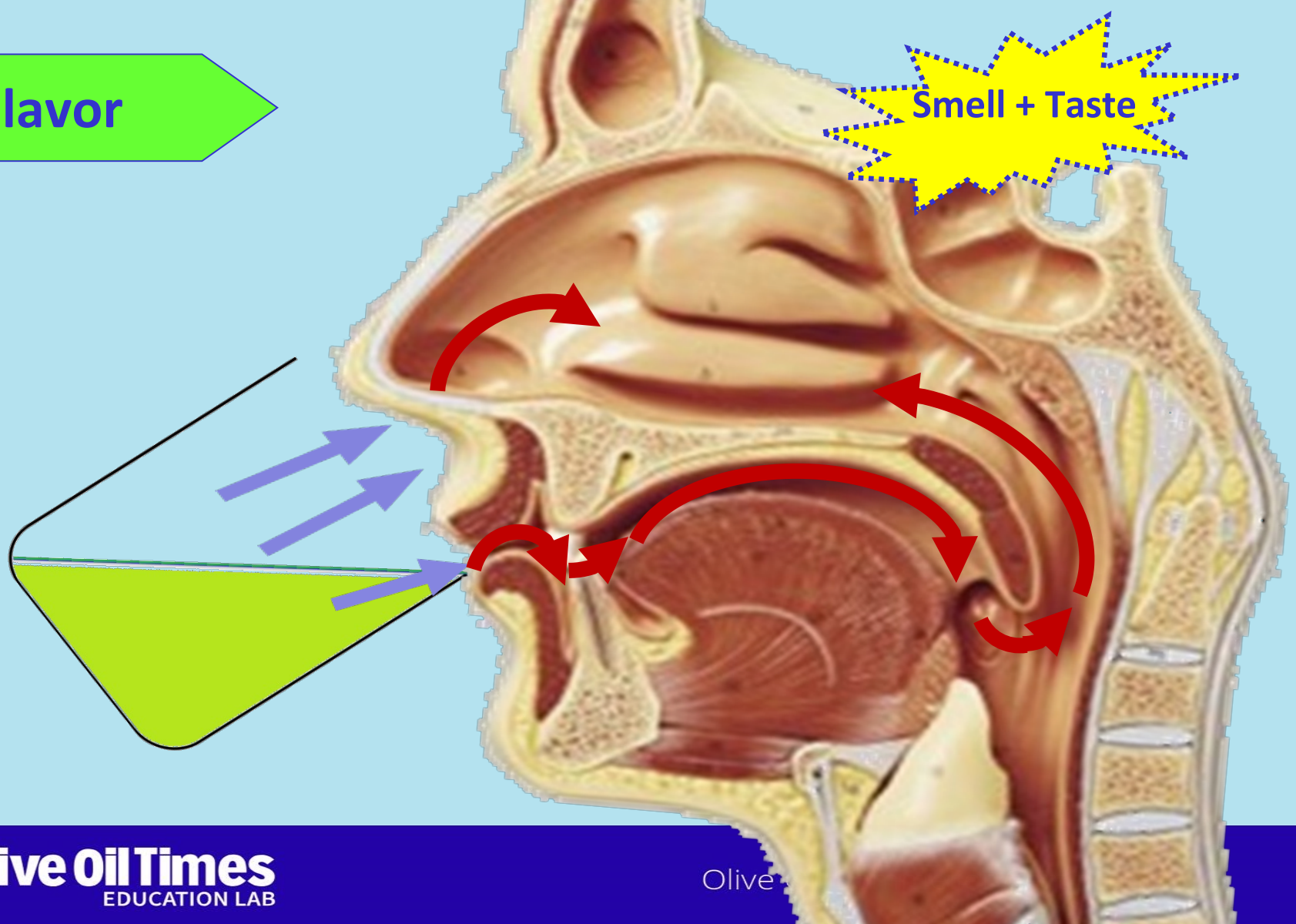


VC:

Low molecular weight molecules (**<300 kDa**) that vaporize at room temperature, creating aromas.

The volatile compounds determine the flavor of the olive oil (**Flavor = Smell + Taste**).

Flavor



VC can be: Aldehydes, Alcohols, Esters, Hydrocarbons, Ketones, Furans and Others (Table n. 1). Major VC in olive oil are C5 and C6 volatile compounds.

VOLATILE COMPOUND > 250

PHENOLIC MOLECULES

FLAVOR= SMELL+TASTE

VC can be: Aldehydes, Alcohols, Esters, Hydrocarbons, Ketones, Furans and Others (Table n. 1). Major VC in olive oil are C5 and C6 volatile compounds.

VOLATILE COMPOUND > 250

FLAVOR= SMELL+TASTE

Table n. 1 - Odour and sensory descriptors of volatile compounds in virgin olive oil.

Compounds	*Correlated attributes*
Acetaldehyde	Pungent, Sweet
Pentanal	Woody, Bitter, Oily, Pungent
trans-2-Pentenal	Green, Bitter almond, Apple
Hexanal	Green, Sweet, Apple, Grassy, Green & ripe fruit, Herbal, Sweet almond
cis-3-Hexenal	Green, Leaf-like, Herbal, Artichoke, Floral, Cut grass
trans-3-Hexenal	Artichoke, Green, Flowers
trans-2-Hexenal	Bitter almonds, Fruity, Green, Apple-like, Green astringent, Fresh herbal, Cut grass, Fruity, Almond, Bitter, Pungent
cis-2-Hexenal	Bitter, Pungent
trans-2-Octenal	Herbaceous, spicy
Pentanol	Fruity, Strong, Sticky, Balsamic
3-Penten-2-ol	Perfumery, Woody
2-Penten-1-ol	Green, Herbal, Banana
trans-2-Hexen-1-ol	Green grass, Fruity, Tomato, Sweet, Flowery, Leaves
cis-3-Hexen-1-ol	Green, Leaf-like, Cut grass, Banana
cis-2-Hexenol	Green, Herbal, Cut grass, Sweet, Tomato
6-Methyl-5-hepten-3-ol	Perfumey, Nutty
Ethyl acetate	Sticky, Sweet
Butyl acetate	Green, Fruity, Pungent, Sweet
Hexyl acetate	Green, Fruity, Sweet
cis-3-Hexenyl acetate	Banana-like, Green, Green leaves, Fruity
Ethyl butanoate	Cheesy, Fruity, Sweet
Pentyl (Amyl) acetate	Fruits, Banana, Sweet, Pear
Propyl butanoate	Pineapple, Sharp
Ethyl cyclohexylcarboxylate	Fruity, Aromatic
Butan-2-one	Ethereal, Fruity
1-Penten-3-one	Green, Pungent, Tomato, Sweet, Strawberry
Heptan-2-one	Sweet, Fruity
6-Methyl-5-hepten-2-one	Pungent, Green
1-Octen-3-one	Mushroom-like, Mushroom, Mould, Pungent, Metallic
cis-1,5-Octadien-3-one	Geranium-like
trans-b-Damascenone	Boiled apple-like
4-Methoxy-2-methyl-2-butanethiol	Black currant-like, Catty
Guaiacol	Phenolic, Burnt
1,3-Hexadien-5-yne	Green

VC don’t really appear in the olive **until the ripening stage**. Researchers have identified more than 250 volatile compounds that contribute either **positively** or **negatively** to the sensory attributes of olive oil.

The identification of the **VC** causing the flavor it's the **key for quality control.** The **VC** formed during the processing of olive fruit contribute a combined sensation of smell and taste, commonly called **flavor**.

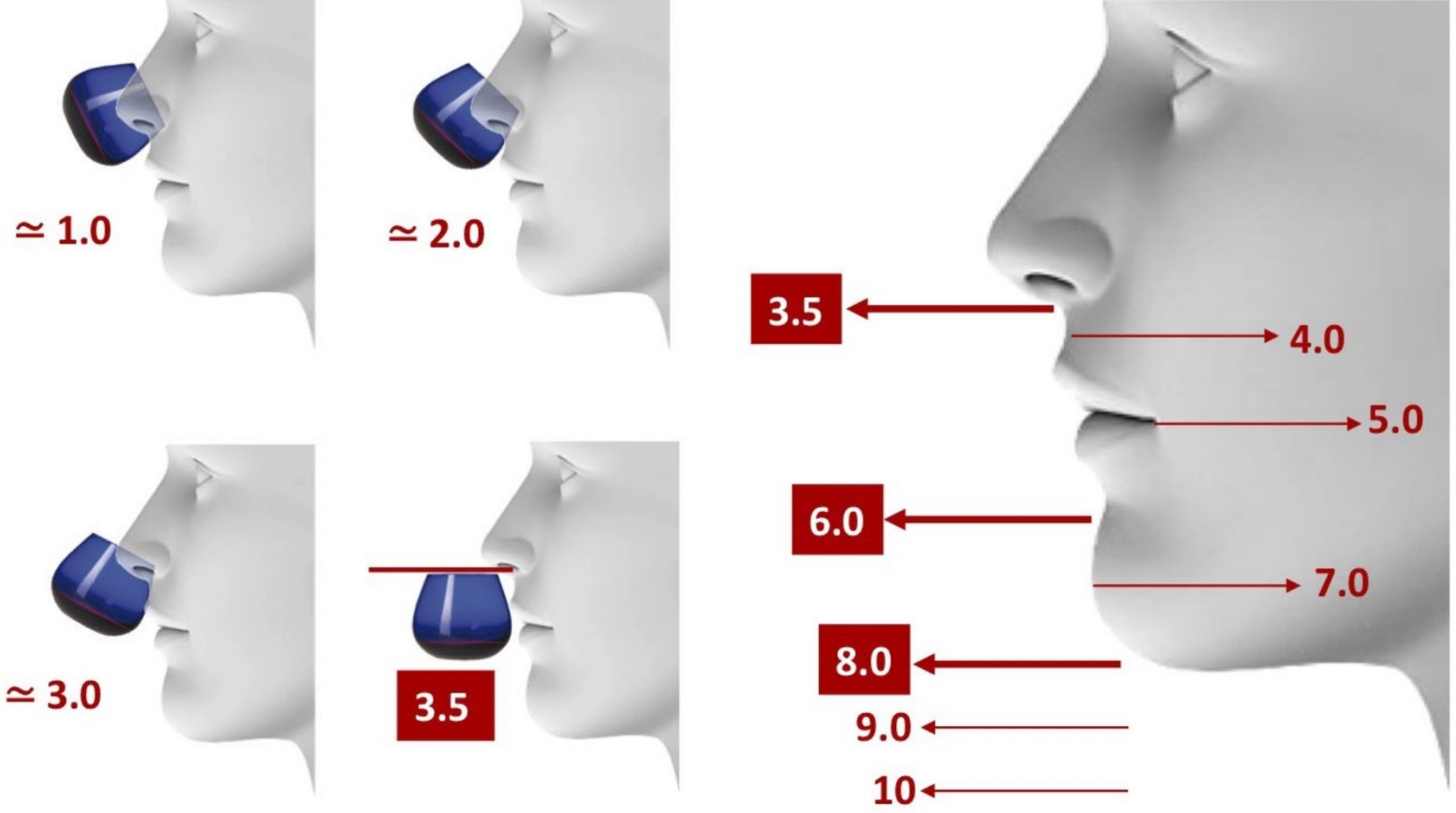
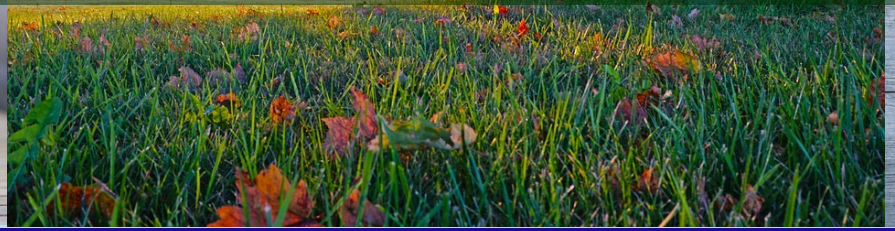


Figure 1. Reference example of the use of the 10-cm scale of the profile sheet for attributes intensities perceived only by nasal pathway.

CONSUMER

The most remarkable sensory perceptions are: **green** (leaves, grass, cut grass, herbal, tomato, artichoke), **sweet** (almond, pine nut), **fruity** (green olives, ripe olives), **fruit** (apple, banana, pineapple, citrus, ripe fruit), **floral**, **spicy**, **balsamic**, **bitter** and **pungent**. The **green** sensory perception is of great importance!



VC: THEIR PRESENCE DEPENDS ON WHAT?

AGRONOMIC FACTORS

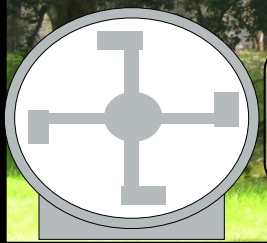
- CULTIVAR
- FARMING SYSTEM
- HARVESTING
- FRUIT MATURITY

CLIMATIC-ENVIRONMENTAL FACTORS

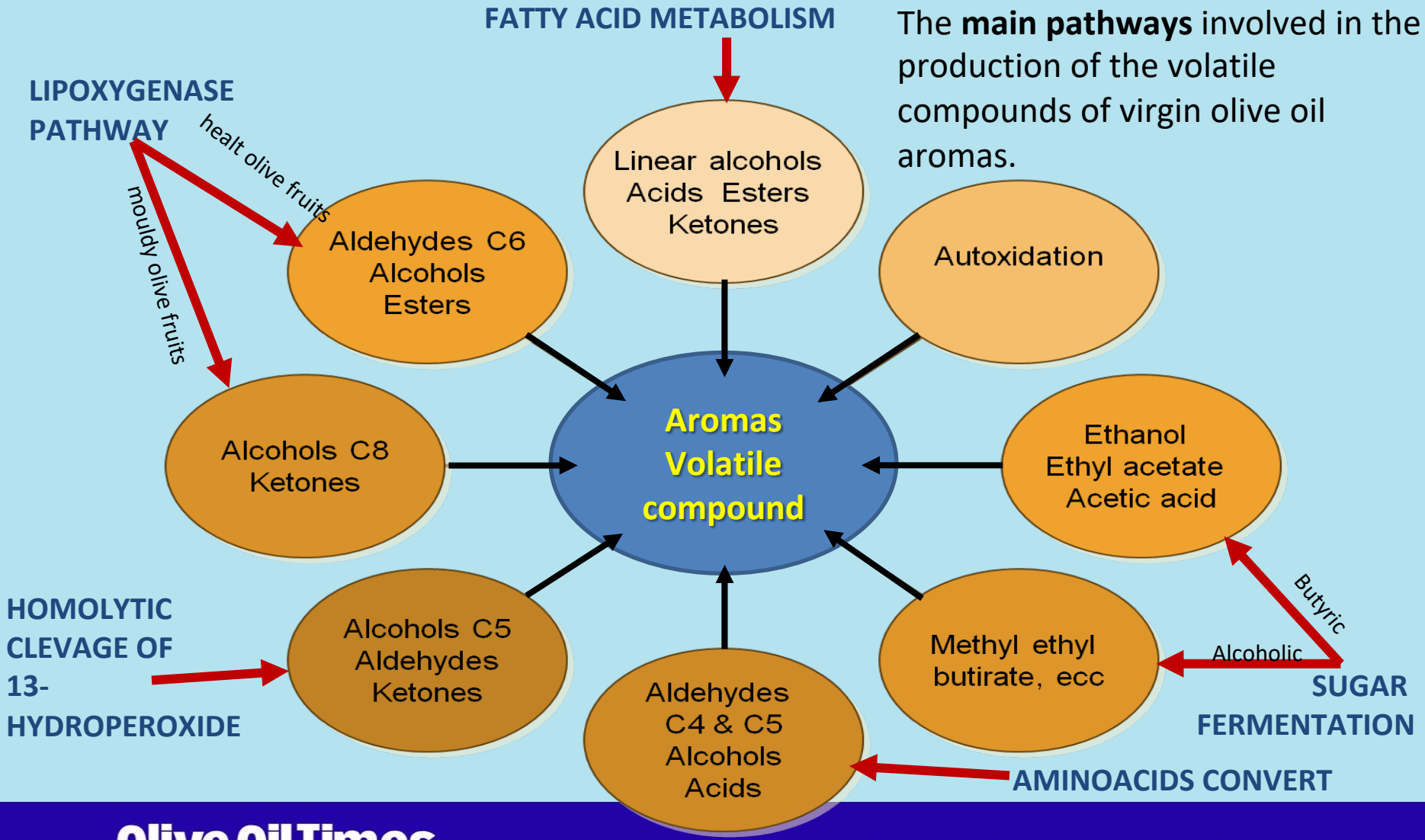
GEOGRAPHIC REGION

PROCESSING METHODS

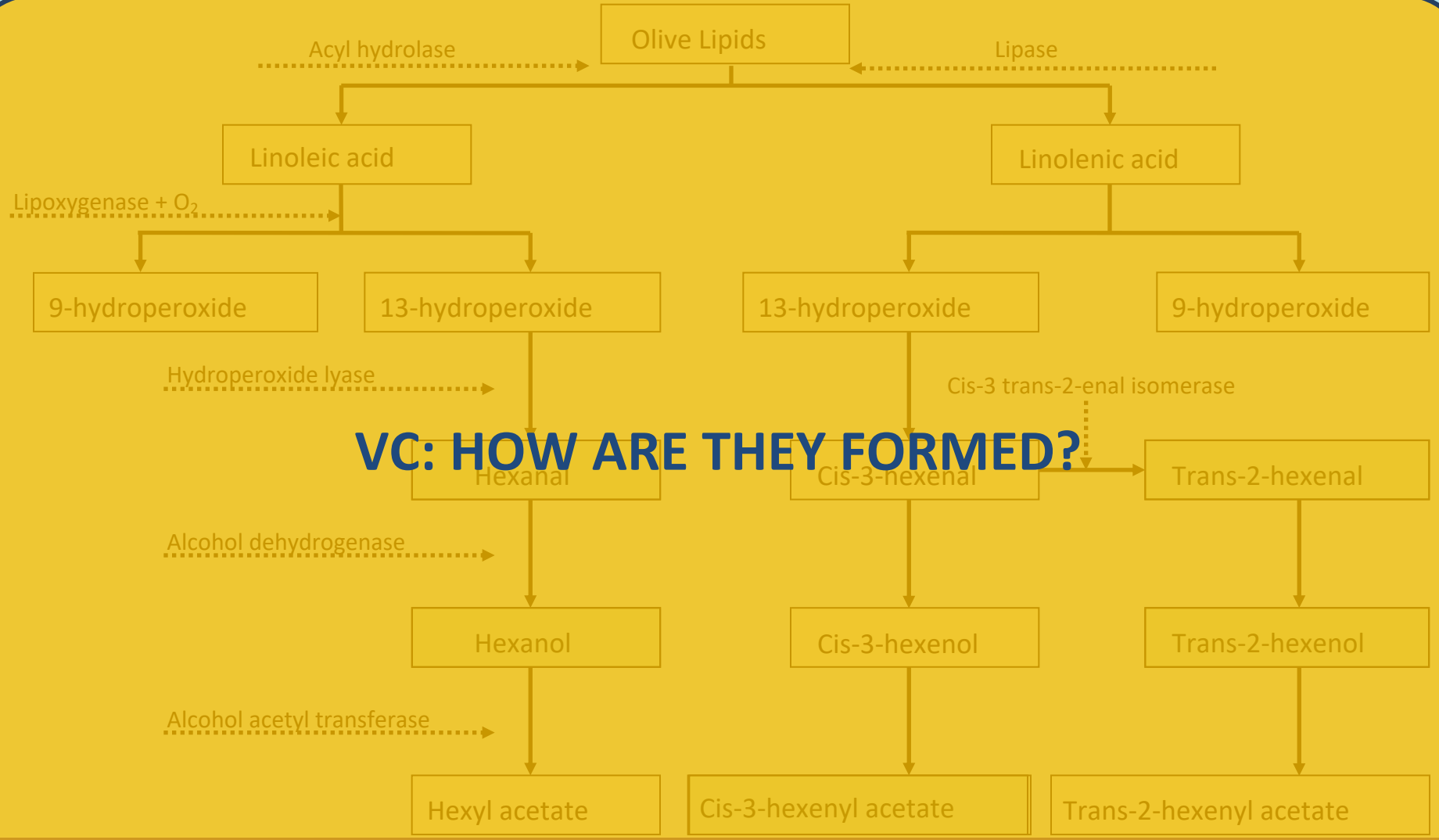
- CRUSHING
- MALAXATION (T&T)
- STORAGE

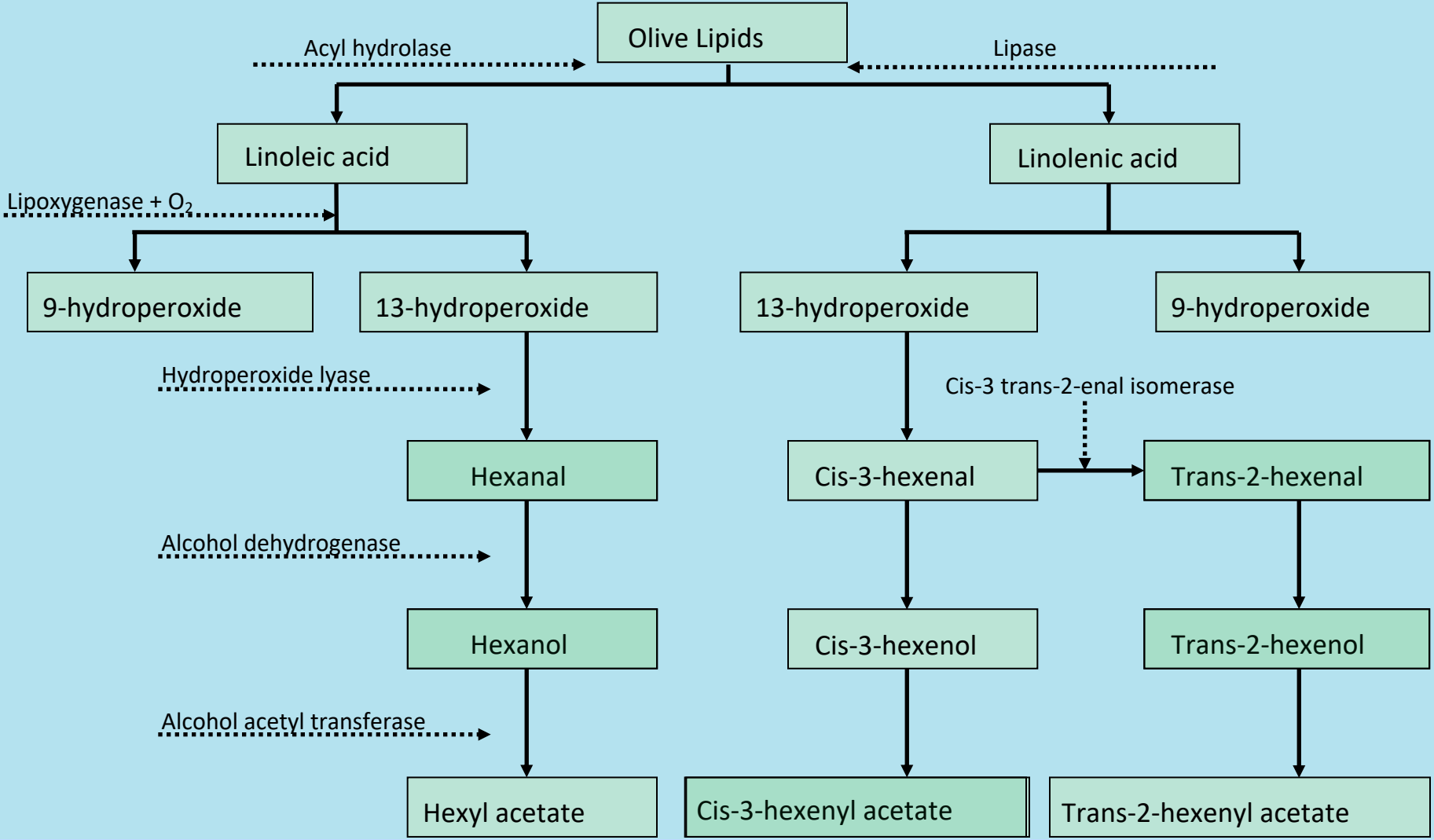


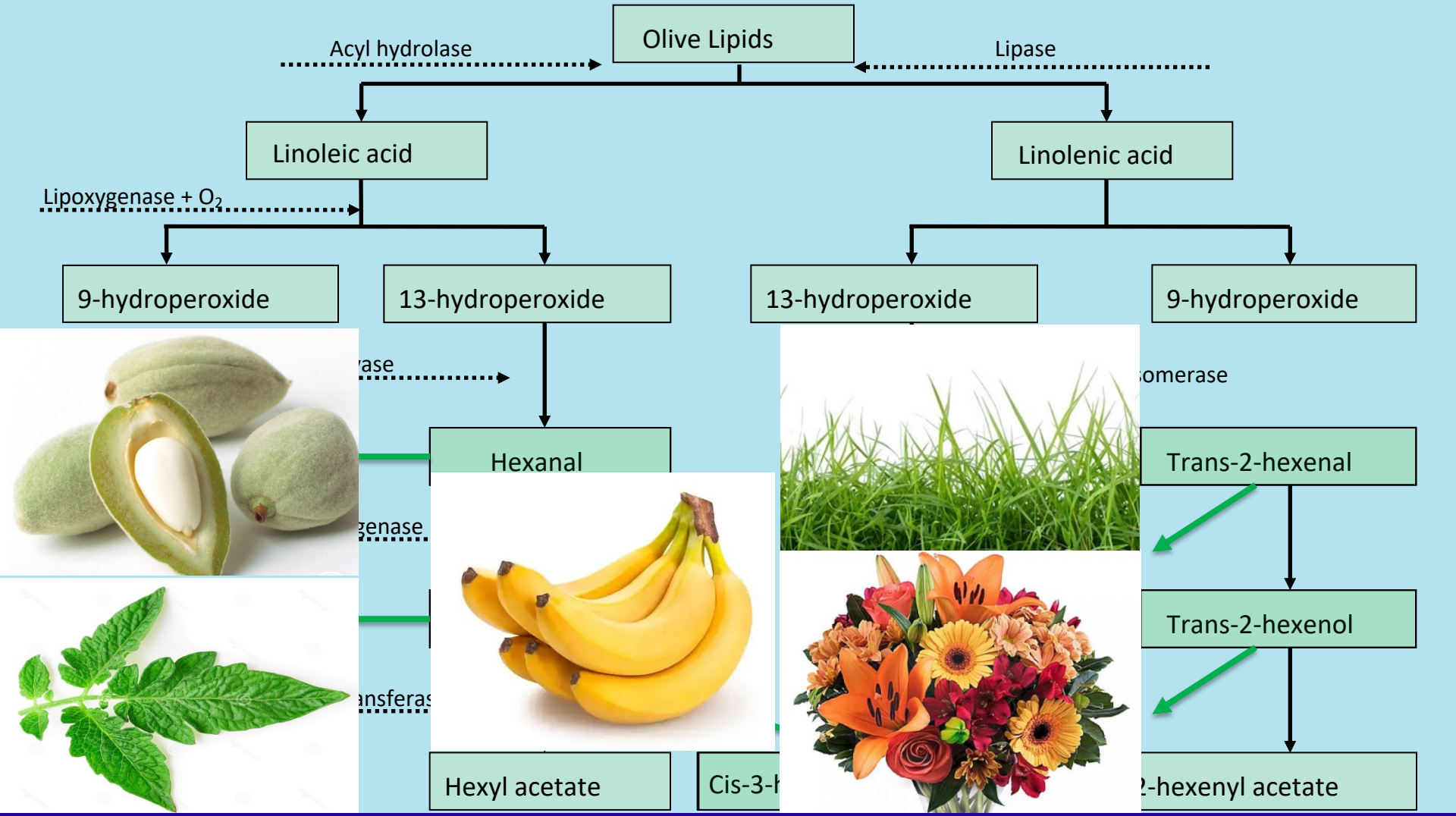
The **main pathways** involved in the production of the volatile compounds of virgin olive oil aromas.



VC: HOW ARE THEY FORMED?




Olive Lipids
Acyl hydrolase
Lipase
Linoleic acid
Linolenic acid
Lipoxygenase + O_2
9-hydroperoxide
13-hydroperoxide
13-hydroperoxide
9-hydroperoxide
Hydroperoxide lyase
Cis-3 trans-2-enal isomerase
Hexanal
Cis-3-hexenal
Trans-2-hexenal
Alcohol dehydrogenase
Hexanol
Cis-3-hexenol
Trans-2-hexenol
Alcohol acetyl transferase
Hexyl acetate
Cis-3-hexenyl acetate
Trans-2-hexenyl acetate


Olive Lipids
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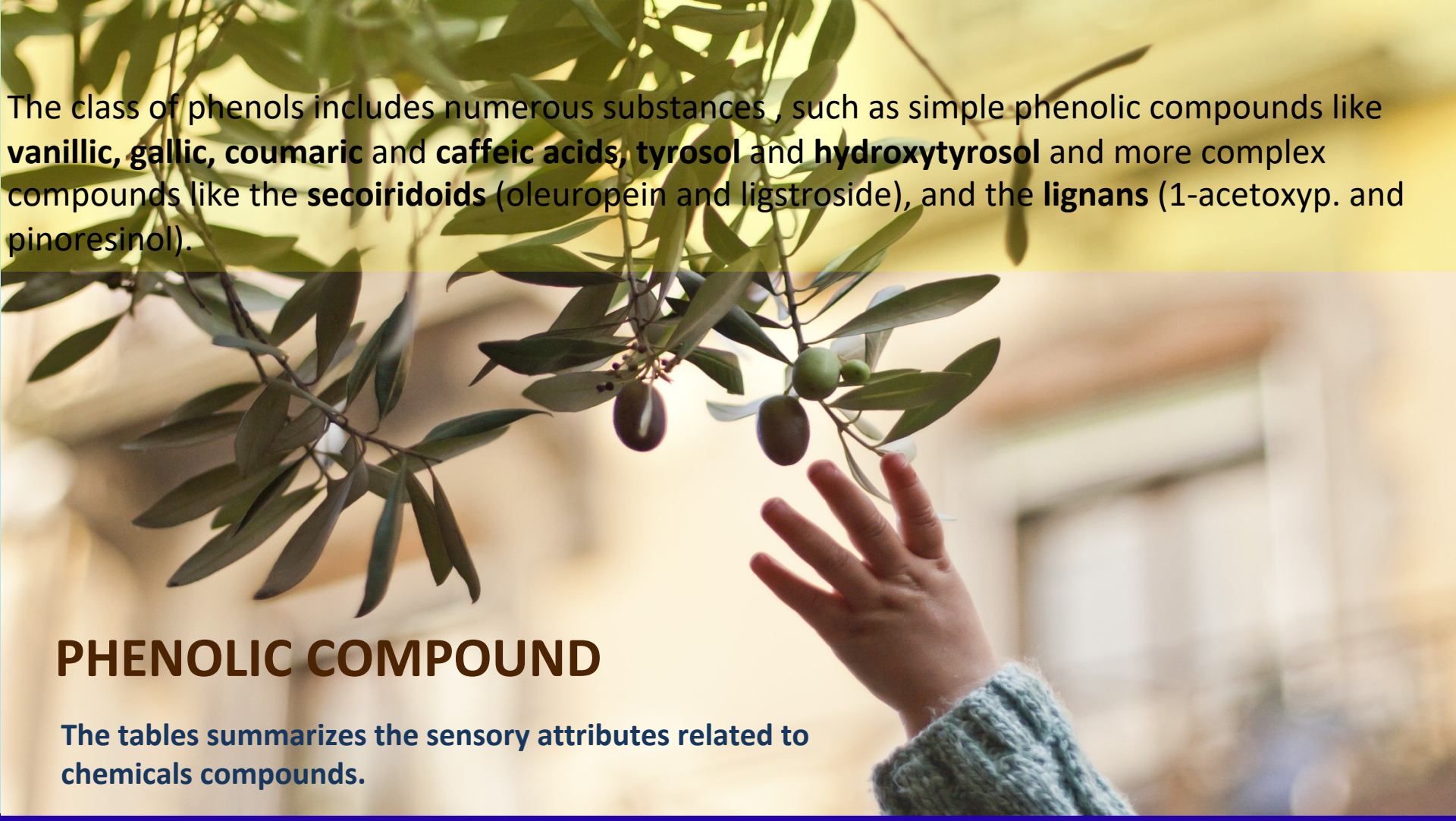
13-hydroperoxide
9-hydroperoxide
Hexanal
Trans-2-hexenal
Trans-2-hexenol
Hexyl acetate
Cis-3-h
2-hexenyl acetate



The class of phenols includes numerous substances , such as simple phenolic compounds like **vanillic, gallic, coumaric** and **caffeic acids, tyrosol** and **hydroxytyrosol** and more complex compounds like the **secoiridoids** (oleuropein and ligstroside), and the **lignans** (1-acetoxyp. and pinoresinol).

PHENOLIC COMPOUND

The tables summarizes the sensory attributes related to chemicals compounds.

MANY FACTORS COMPLICATE THE TASK OF ANALYZING AROMA.

IN EVOO, AROMAS AND FLAVORS DEPENDS:

VOLATILE COMPOUND

PHENOLIC MOLECULES

MANY FACTORS COMPLICATE THE TASK OF ANALYZING AROMA.

IN EVOO, AROMAS AND FLAVORS DEPENDS:

Table n. 2 - Phenolic compound and taste perceptions in virgin olive oil.

	Compounds	*Correlated attributes*
Phenolic acids	Benzoic, Cinnamics, Vanillic, Gallic, Coumaric and Caffeic acids	
Flavons	Luteolin, Apigenin, Quercitin	
Lignans	Pinoresinol & Acetoxypinoresinol	
Phenyl-ethy alcohol	Hydroxytyrosol, Tyrosol	Bitter
Secoiridoids	All Oleuropein and Ligstroside derivates (except Hydroxytyrosol & Tyrosol)	
	Aglycon derivatives of Oleuropein & Ligstroside	Pungency
	Dialdehydic forms of Ligstroside aglycon	Burning sensation
	Dialdehydic forms of Oleuropein aglycon	Little burning sensation
	Oleocanthal	Pungent
	Aldehydic and Dialdehydic forms of Oleuropein aglycon	Bitterness
	Aldehydic forms of Oleuropein aglycon	Bitterness
	3,4-DHPEA-EDA	Bitter
	3,4-DHPEA-EA	Bitter
	p-HPEA-EDA	Bitter, Pungent, Astringent

PHENOLIC MOLECULES

Sensory Qualities, Taste Thresholds, and Tentative Identifications of Components Isolated from Extra Virgin Olive Oils

main component (tentative identification[a])	sensory qualities
hydroxytyrosol[b]	[b]
tyrosol	sticking astringency, not bitter
deacetoxy-oleuropein aglycon (dialdehydic form)	astringent, bitter, burning/stinging/numbing mostly on tongue (not nearly as strong as that experienced with peak 9)
derivative of oleuropein aglycon	bitter, sour, astringent, sweet, cooling, peppery (tingling tongue)
not identified	bitter, astringent (dry teeth)
derivative of oleuropein aglycon	bitter, astringent, bit burning
deacetoxy-ligstroside aglycon (dialdehydic form)	strong burning mostly at the back of throat, slightly bitter, astringent
isomer of ligstroside aglycon	astringent, bit burning, bitter
isomer of ligstroside aglycon	dry mouth, not bitter
derivative of oleuropein aglycon	bitter, astringent, salt
isomer of oleuropein aglycon	very bitter, very astringent
hydrophobic polyphenols (fractions 70–90)	strong bitter, astringent
very hydrophobic polyphenols (fractions 90–120)	astringent, bitter, bit sour, bit burning, salt

Correlations between phenolic compounds and taste perceptions and related references.

Short name	Common name	Sensory description
3,4-DHPEA-EDA	decarboxymethyl oleuropein aglycon	main compound responsible for bitter taste
3,4-DHPEA-EA	oleuropein aglycon	main compound responsible for bitter taste
p-HPEA-EDA	decarboxymethyl ligstroside aglycon	main compound responsible for bitter and pungent notes
3,4-DHPEA-EDA	decarboxymethyl oleuropein aglycon	high positive correlation between these compounds and bitterness intensity of olive oil
3,4-DHPEA-EA	oleuropein aglycon	
p-HPEA-EDA	decarboxymethyl ligstroside aglycon	
p-HPEA-EDA	decarboxymethyl ligstroside aglycon	main compound responsible for the pungent sensation on back of the tongue
3,4-DHPEA-EA	oleuropein aglycon	a highly significant correlation with bitter taste of olive oil
3,4-DHPEA-EA	oleuropein aglycon	positive correlation between this compound and bitterness and pungency intensity of several Spanish and Italian olive oils
Secoiridoids	all oleuropein and ligstroside derivatives considered except for hydroxytyrosol and tyrosol	relevant predictors of the static and dynamic analysis for bitterness and pungency
p-HPEA-EDA	decarboxymethyl ligstroside aglycon	effective only for predicting pungency

PC: THEIR PRESENCE DEPENDS ON WHAT?

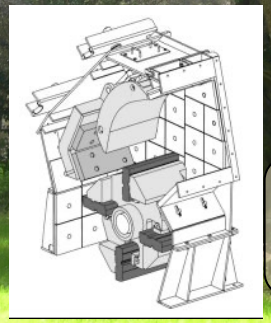
AGRONOMIC FACTORS

- CULTIVAR
- FARMING SYSTEM
- PLANT HEALTH
- HARVESTING
- FRUIT MATURITY

CLIMATIC-ENVIRONMENTAL FACTORS

- GEOGRAPHIC REGION

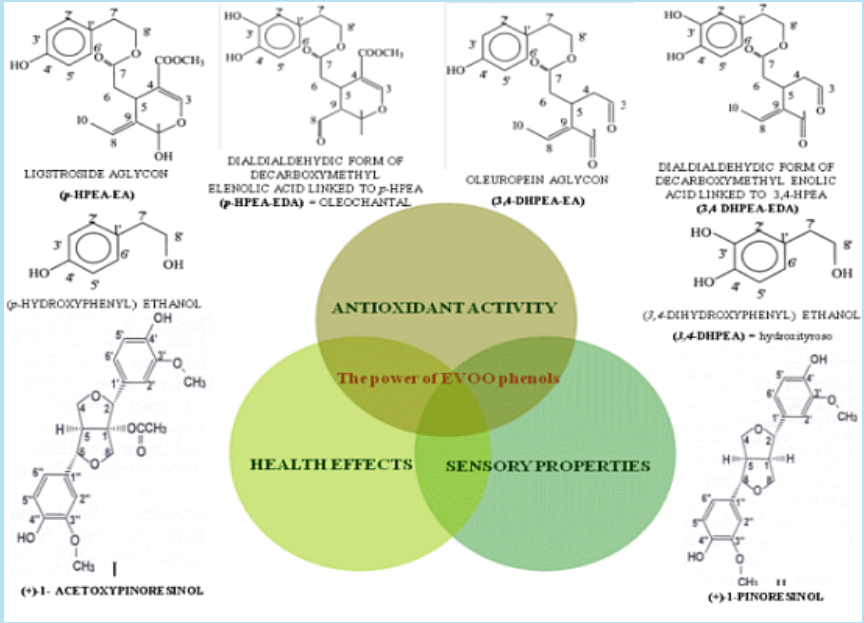
PROCESSING METHODS



- CRUSHING

- CENTRIFUGATION
- STORAGE

Effects of harvest & processing methods on the level of volatile compound, phenolic molecules & sensory characteristics



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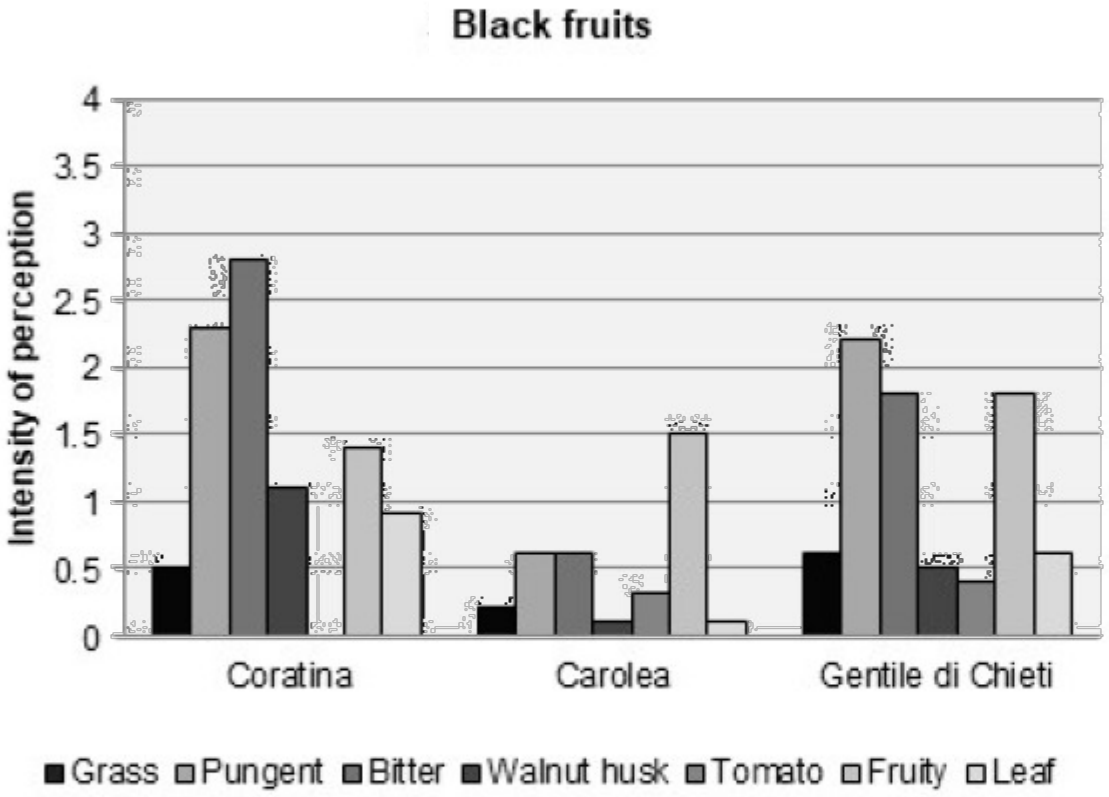
Fruit Maturity & Harvest



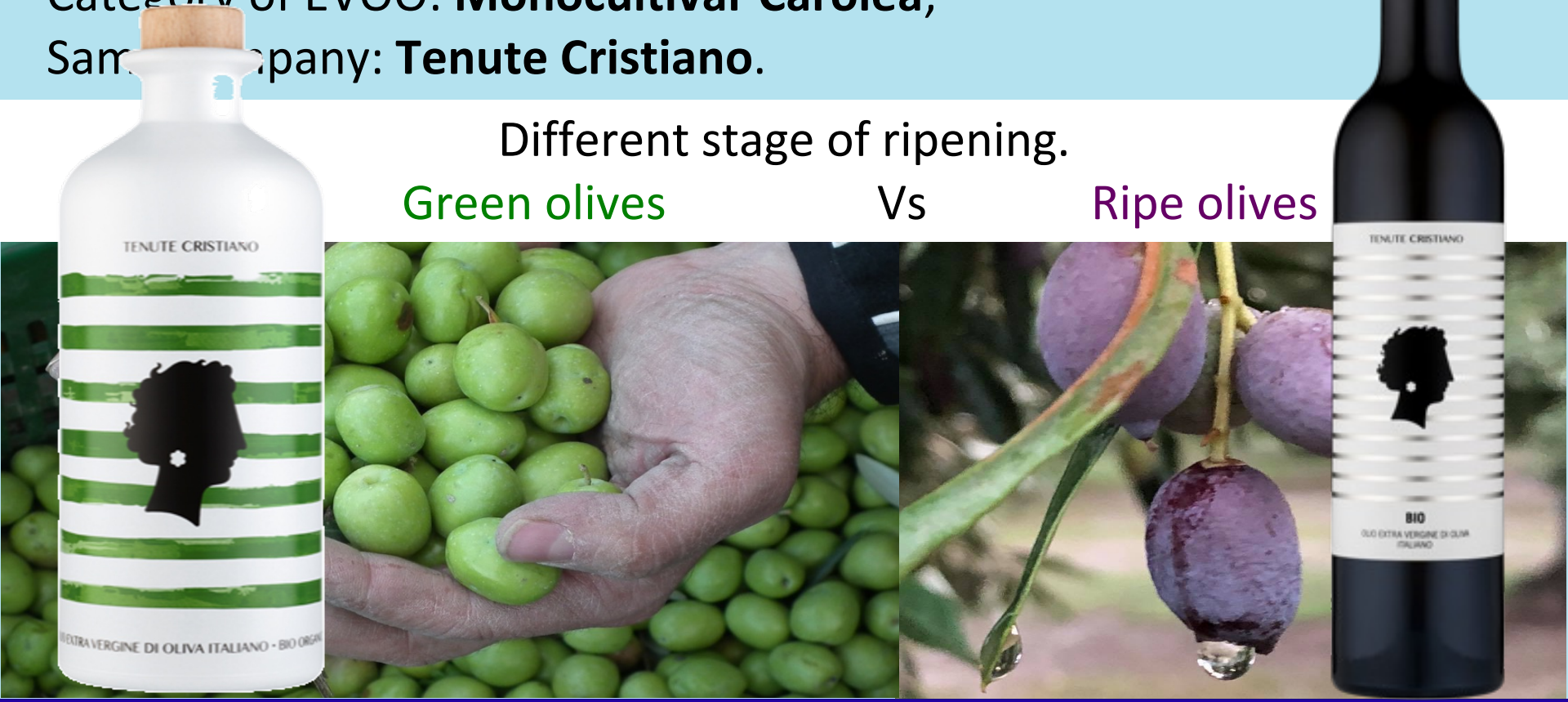
Fruit Maturity & Harvest

Category of EVOO: **Monocultivar Carolea**;

Sam[illegible]pany: **Tenute Cristiano**.

Different stage of ripening.

Green olives Vs Ripe olives



Storage – Shelf Life

Same producer & olive variety

2022 Harvest Vs 2023 Harvest

Nitrogen or Argon

Cultivar & Geographic region

Same olive variety - different areas

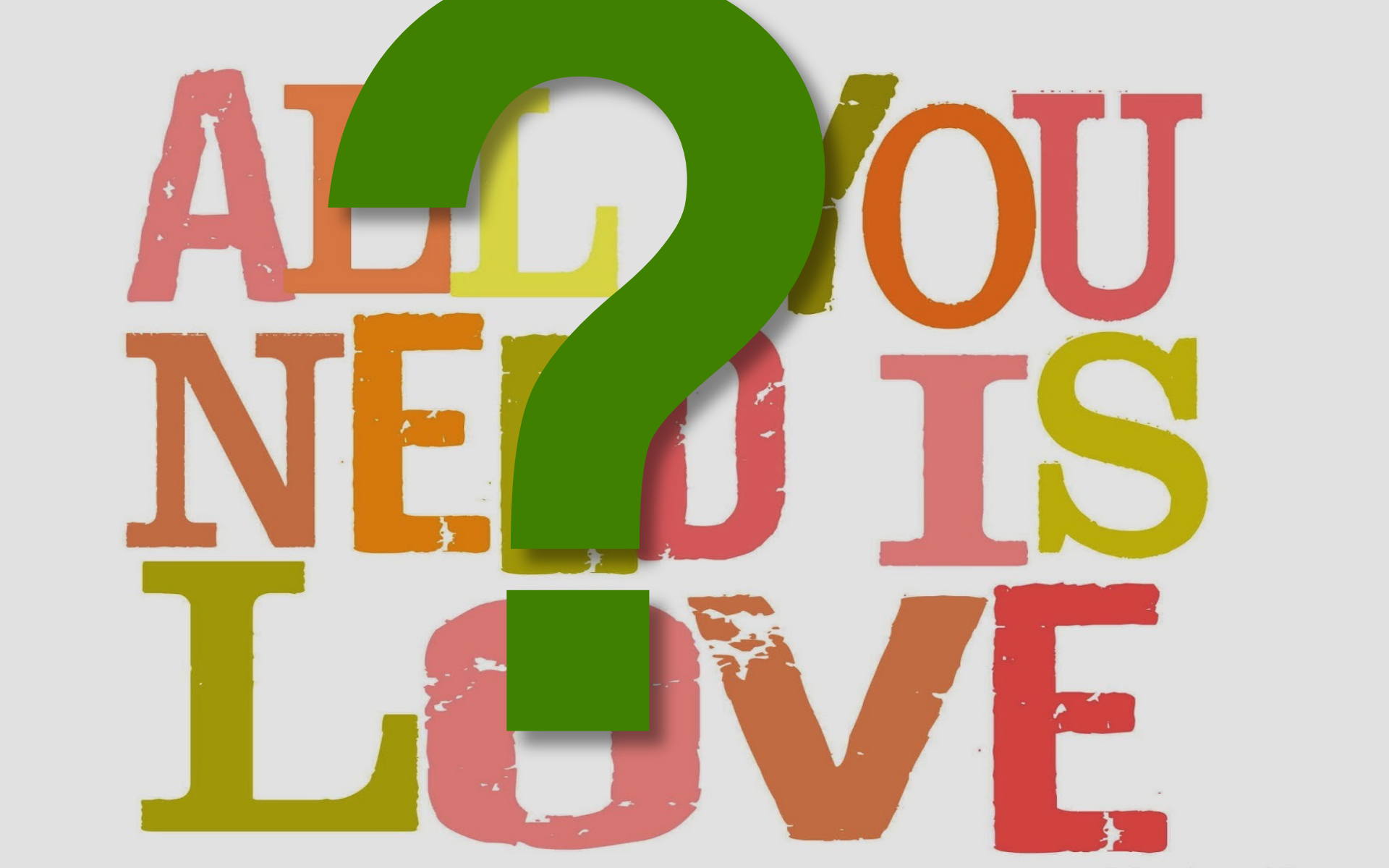
Composizione fenolica (mg/kg) di olio EVO Cv. Frantoio da due differenti aree mediterranee.

	Spagna	*Italia*
3,4 DHPEA	0,6 ± 0,0	2,8 ± 1,3
p-HPEA	2,8 ± 2,9	3,4 ± 0,9
3,4 DHPEA-EDA	52,0 ± 14,1	427,1 ± 31,6
p-HPEA-EDA	21,9 ± 14,2	108,7 ± 12,5
(+)-1-Acetossipinoresinolo	5,8 ± 6,2	19,5 ± 3,7
(+)-Pinoresinolo	15,0 ± 1,6	20,3 ± 6,1
3,4 DHPEA-EA	17,9 ± 18,4	110,1 ± 12,2
Polifenoli totali	116,0 ± 9,7	692,0 ± 53,2

Cultivar & Area

Same olive variety
(Frantoio)
on different part of the World
(Italy & Brazil)

FRANTOIO Italy
(Campania)
Vs
FRANTOIO Brazil
(Rio Grande so Sur)


ALL YOU
NEED IS
LOVE

#AllYouNeedIsEVOO

#AntonioLauro

#ThankYouVeryMuch

Thanks for your attention

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