Biofenoli e aromi dell'extravergine: recenti sviluppi metodologici ed analitici

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PROGETTO Ager AGROALIMENTARE E RICERCA | FONDAZIONI IN RETE PER LA RICERCA AGROALIMENTARE

COMPETiTiVE Claims for Olive oil to iMProvE The markeT ValuE of the products

Progetto ARISTOIL, Ragusa, 7 giugno 2018

Virtù salutistiche dell'Olio Extravergine:

Azione antiossidante su lipoproteine ematiche (EFSA)

Riduzione di fattori di rischio cardiovascolare (ipercolersterolemia, aterosclerosi)

Riduzione dell'ipertensione arteriosa (oleaceine)

Inibizione di eventi trombotici e micro-trombotici

Riduzione dello stress ossidativo e mantenimento dell'integrità cellulare (effetto anti-*ageing*)

Azione anti-infiammatoria (oleaocantale: ibuprofene-like)

Azioni positive rispetto a diabete ed obesità

Riduzione dell'incidenza del cancro ed attività antineoplastica

Prolungamento del senso di sazietà (acido oleico e endocannabinoidi, aromi)

Tutto ciò è attribuito a:

Acido Oleico (composizione in acidi grassi molto simile a quella del latte umano! Stabilità ossidativa, fluidità membrane, HDL/LDL, Effetto su endocannabinoidi e sazietà, etc …)

Biofenoli con spiccata azione biologica:

Oleocantale, con azione anti-infiammatoria simile all' ibuprofene

Oleacine, con azione ipotensiva

Secoridoidi amari, con azione di prevenzione delle malattie degenerative dell'apparato digerente (*H. Pilori*)

Idrossitirosolo con azione antiossidante e anti-apoptotica

Vitamina E, azione antiossidante e protezione cardiovascolare

Fitosteroli, squalene, con azione anti-colesterolo

Sostanze volatili (aroma) … e sazietà (obesità).

European Food Safety Authority

EFSA health claim on olive oil polyphenols (Commission Regulation (EU) 432/2012):

Olive oil polyphenols contribute to the protection of blood lipids from oxidative stress.

The claim may be used only for olive oil, containing at least 5 mg of hydroxytyrosol and its derivatives (e.g. oleuropein complex and tyrosol) per 20 g of olive oil (250 mg/kg).

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.

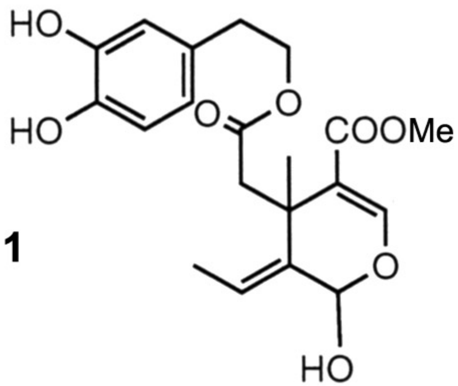
Progetto AGER 2 “COMPETiTiVE”

Claims of Olive oil to iMProvE The markeT ValuE

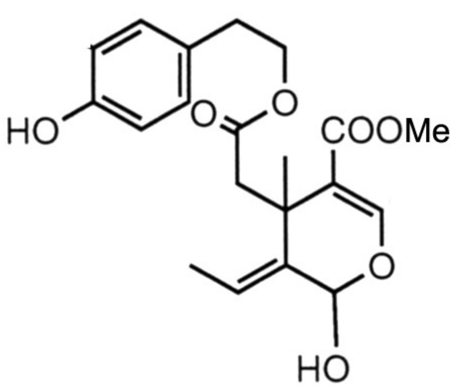
COMPETiTiVE

Claims for Olive oil to iMProvE The markeT ValuE of the product

2016-2020



1



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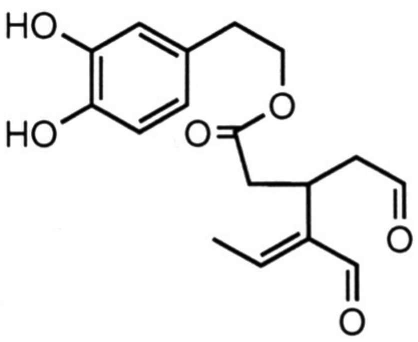

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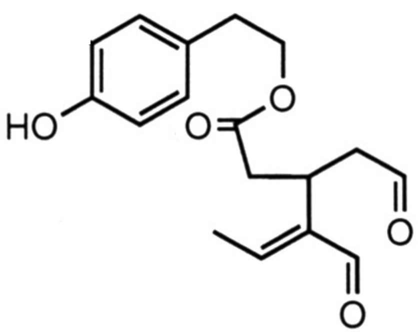

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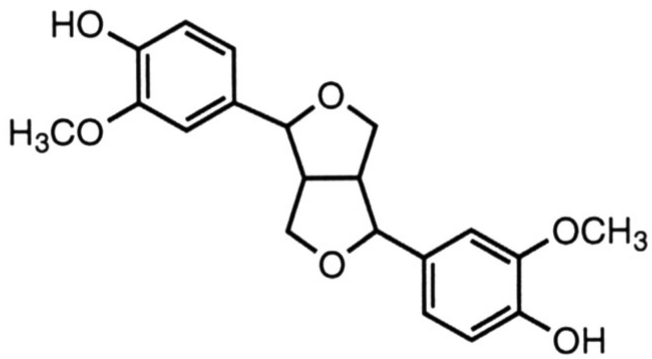
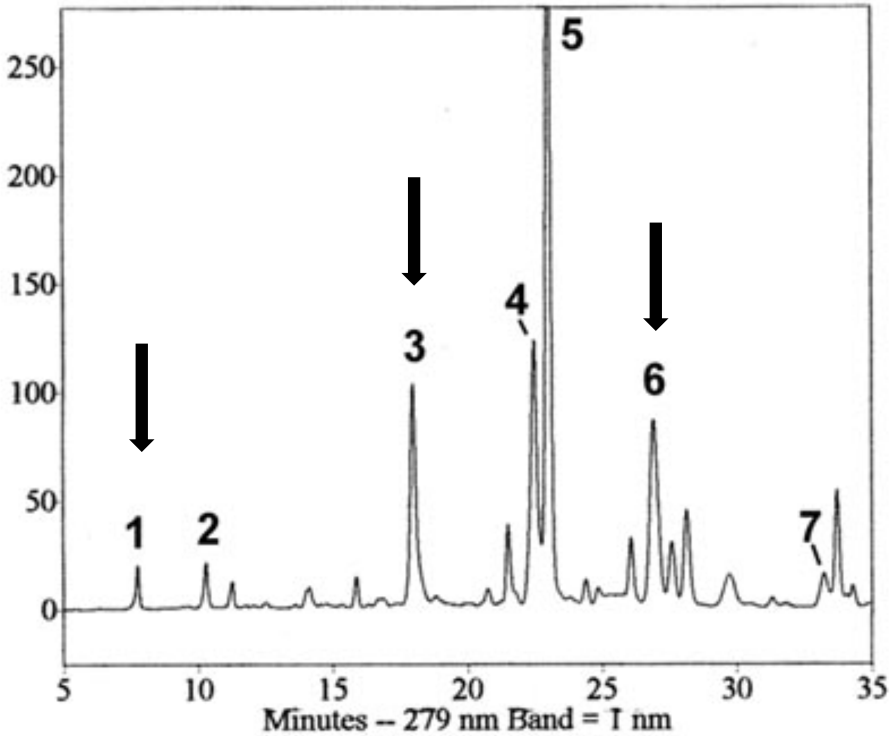


5

I composti biofenolici dell'olio extravergine di oliva:

nutraceutici …
… **amari!**



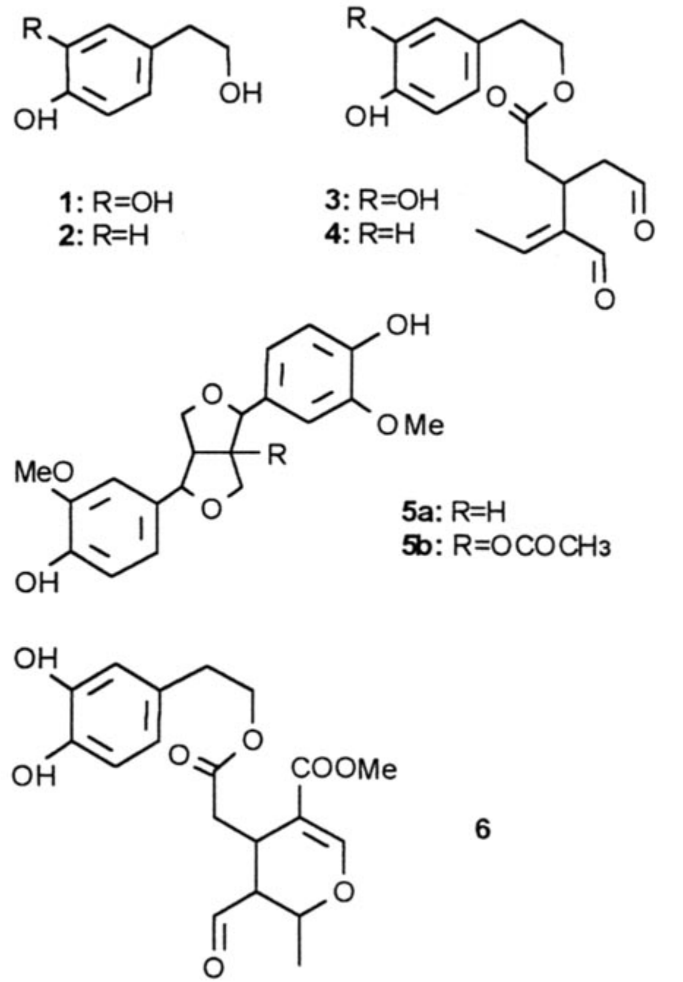
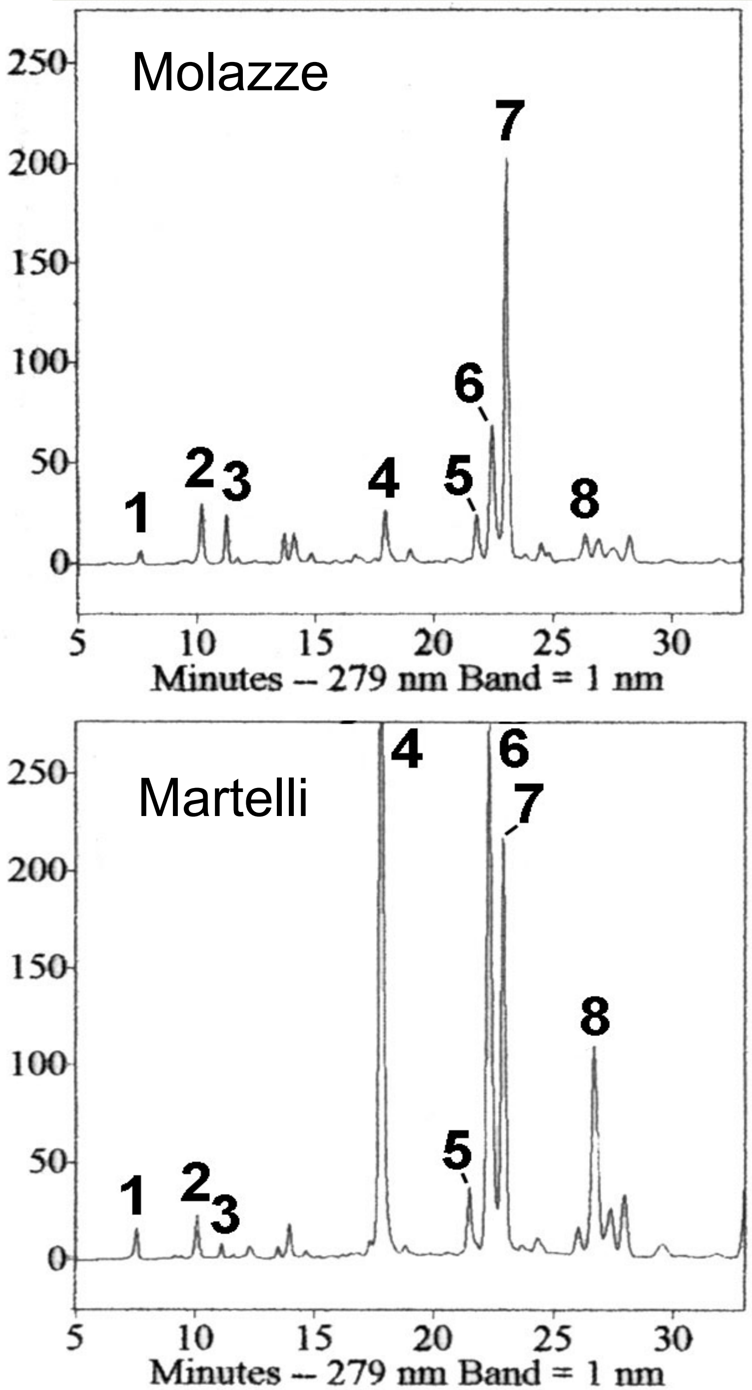


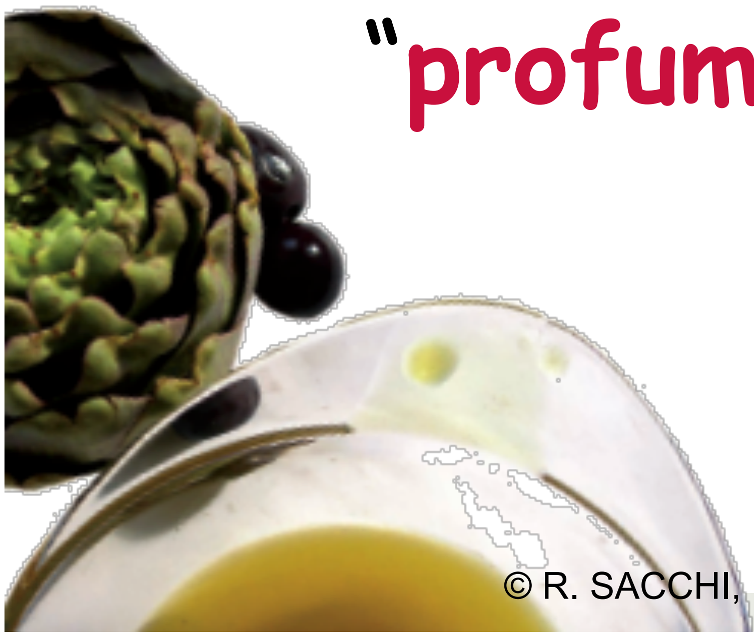
Figure 1. Chemical structures of the main phenolic compounds of virgin olive oil followed by HPLC: hydroxytyrosol (**1**), tyrosol (**2**), dialdehydic form of decarboxymethyl oleuropein aglycon (**3**), dialdehydic form of decarboxymethyl ligstroside aglycon (**4**), pinoresinol (**5a**), 1-acetoxypinoresinol (**5b**), and oleuropein aglycon (**6**).



Profili fenolici di oli ottenuti con diverso sistema di frangitura (molazze *vs* frangitore a martelli)

L'olio extravergine come "**alimento funzionale**" e "**profumo alimentare**"

SACCHI, Sirena d'Oro, 2008

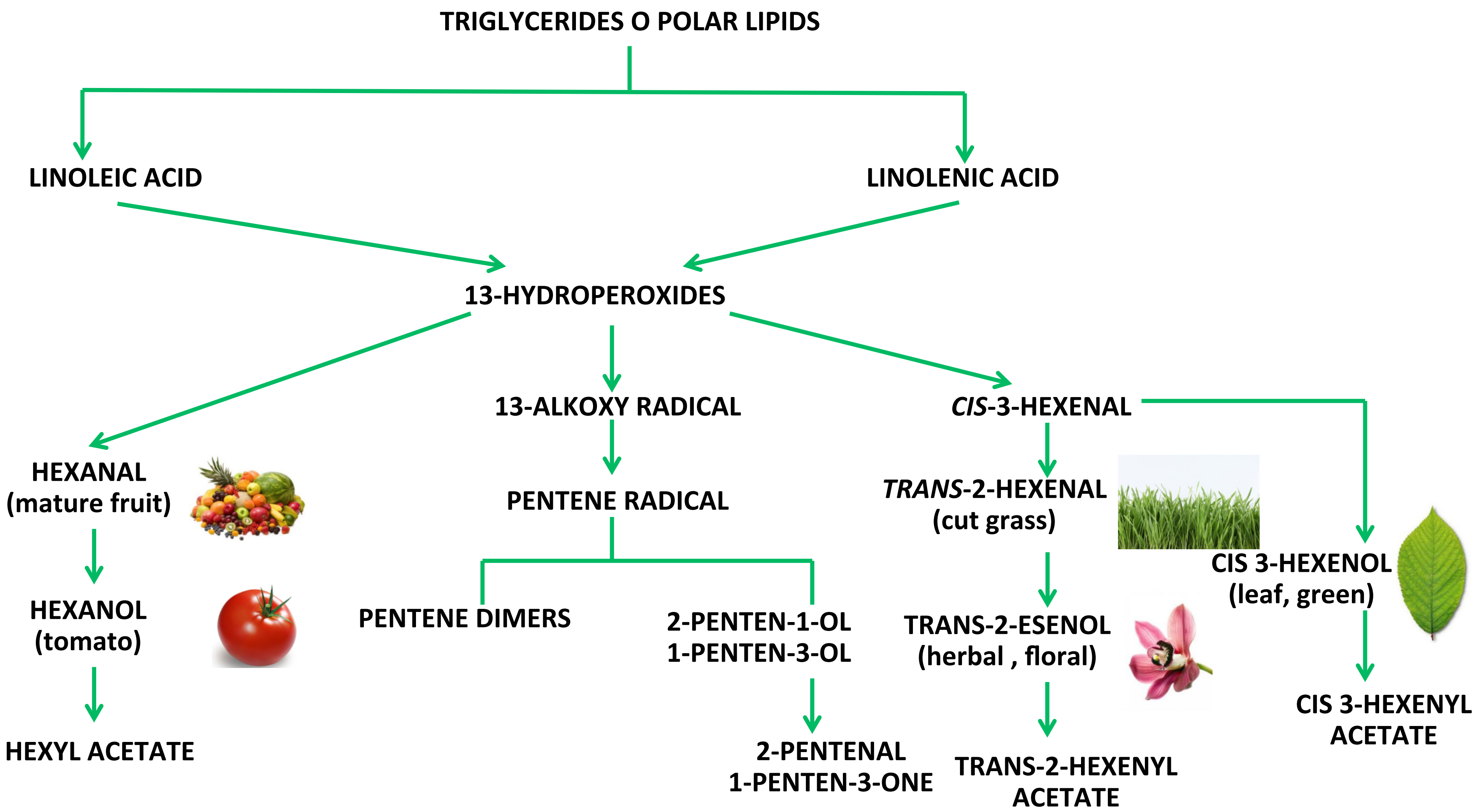


i) Individuazione delle **molecole volatili responsabili delle note sensoriali tipiche** degli OEVO

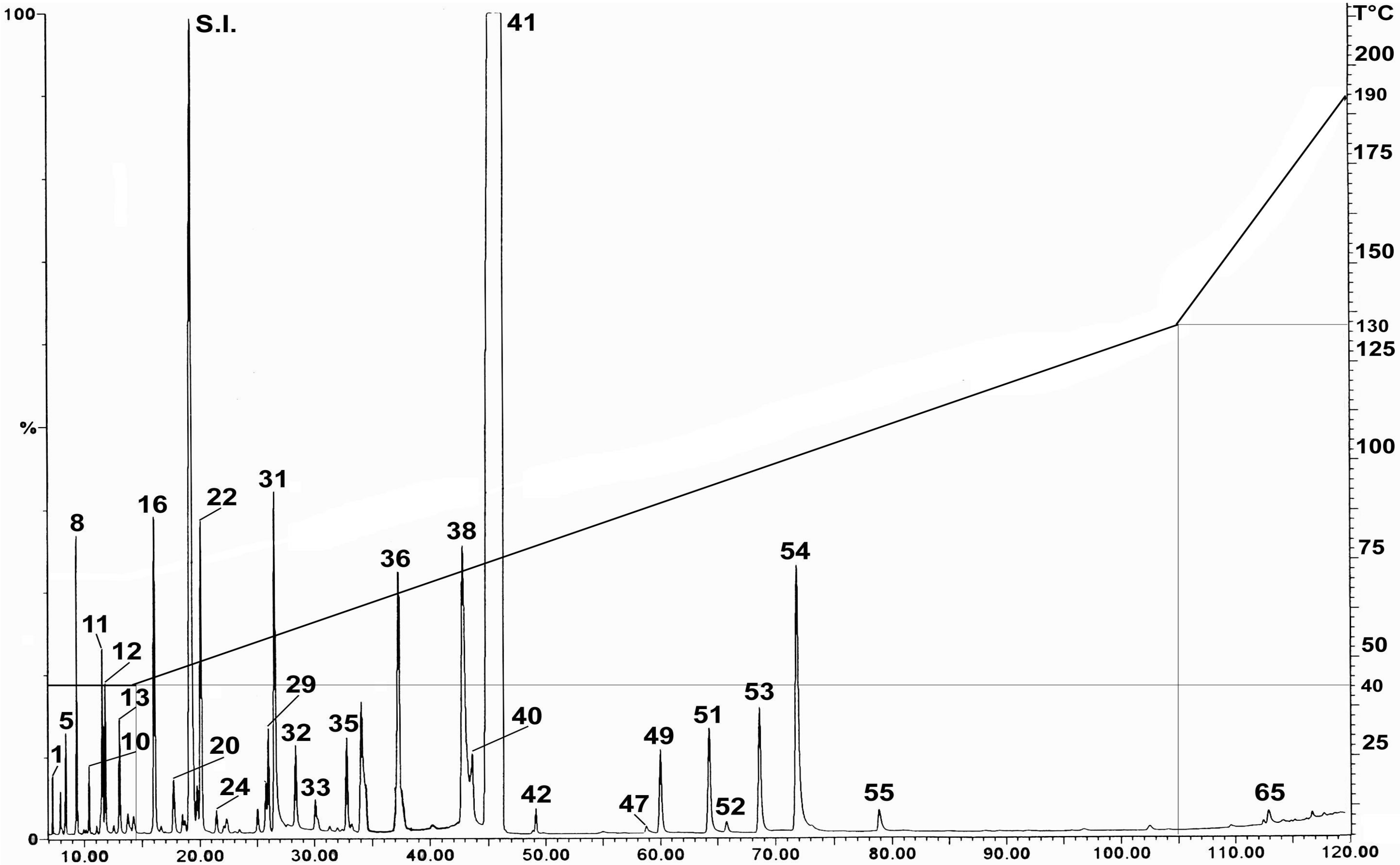
ii) **misura quantitativa accurata** dei composti volatili (SPME-GC/MS)

iii) espressione del loro **impatto odoroso** (OAV, serie aromatiche)

The origin of virgin olive oil fruity flavour: the Lipoxygenase (LOX) Pathway

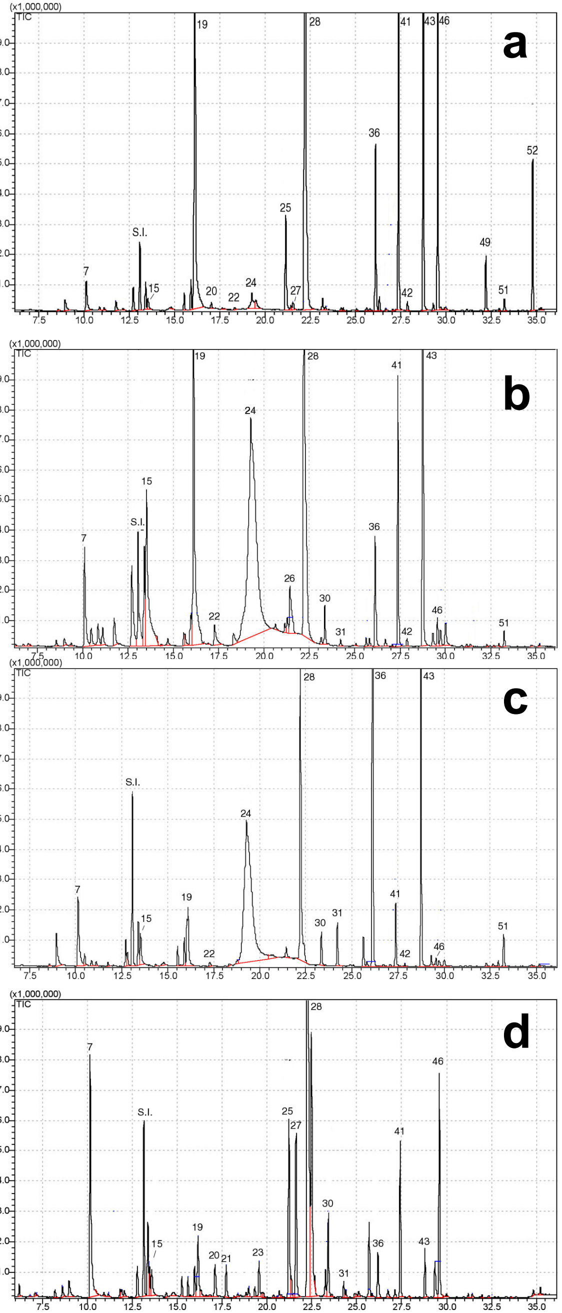


I composti volatili dell'olio (DHS-GC/MS)



Alcuni composti responsabili delle note verdi (LOX)

Picco	Composto	Descrittore (letteratura)
16	1-pentenil acetato	fruttato
31	esanale	mela, frutta
33	pentil acetato	frutta,banana,pera
38	*cis*-3-esenale	carciofo, verde, floreale
42	*trans,*2-esenale	mandorla amara, erba
43	esil acetato	frutta dolce
49	2-penten,1-olo	verde
51	esanolo	frutta, banana
52	*trans,*3-esen,1-olo	erba, verde
53	*cis,*3-esen,1-olo	foglia, verde
54	*cis*,2-esen,1-olo	erba, verde



SPME GC/MS chromatogram of the headspace of some oils:

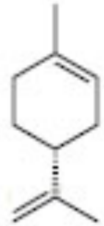
a) POD Bruzio,
b) Biancolilla monovarietal oil,
c) Ravece monovarietal oil,
d) Minucciola monovarietal oil.

Peak identification of main volatile compounds:
7. ethanol, 15. 3 pentenone, 19. hexanal, 20. beta-pinene, 21. beta.-Phellandrene, 22. trans-2-pentenale, **23. beta.-Myrcene**, **24. cis-3-Hexenal**, **25. D-limonene**, 26. 3 methyl butanol, 27. Eucalyptol, 28. trans 2-hexenal, **30. beta-ocimene**, 31. n-Hexyl acetate, 36. cis 3 hexenil acetate, 41. hexanol, 42. trans 3 hexenol, 43. cis 3 hexenol, 46. trans 2 hexenol, 49. n-valeric acid cis-3-hexenyl ester, 51. Copaene, **52. beta-linalool**

Cv. Minucciola (Penisola Sorrentina): terpeni marcatori molecolari delle note aromatiche di erbe balsamiche (rosmarino, salvia, origano) (DHS-GC/MS)

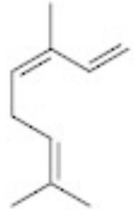
20. α-pinene

29. β-pinene

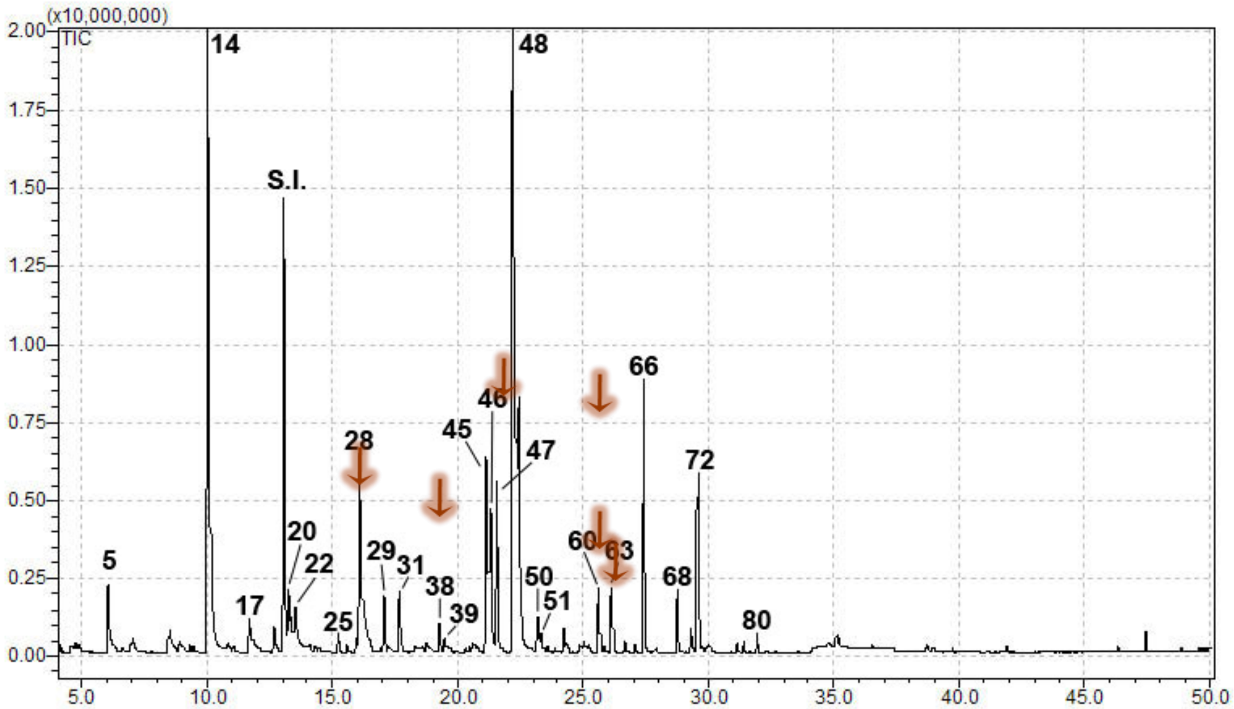


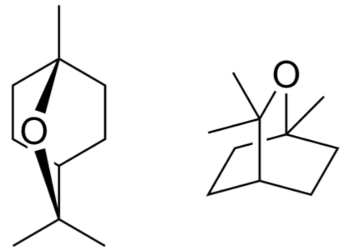
45. D-limonene

50. γ-terpinene



51. (Z)-β-ocimene





47. Eucaliptolo

Cis-3-hexenal and tomato leaf green flavour (molecole ‘soliste’ e ‘orchestre di odori’)

TRIGLYCERIDES O POLAR LIPIDS

LINOLEIC ACID

LINOLENIC ACID

13-HYDROPEROXIDES

HEXANAL
(mature fruit)

HEXANOL
(tomato)

HEXYL ACETATE

13-ALKOXY RADICAL

PENTENE RADICAL

PENTENE DIMERS

2-PENTEN-1-OL
1-PENTEN-3-OL

2-PENTENAL
1-PENTEN-3-ONE

CIS-3-HEXENAL
(Tomato leaf)

Isomerasi?

TRANS-2-HEXENAL
(cut grass, almond)

TRANS-2-ESENOL
(herbal , floral)

TRANS-2-HEXENYL
ACETATE

CIS 3-HEXENOL
(leaf, green)

CIS 3-HEXENYL
ACETATE

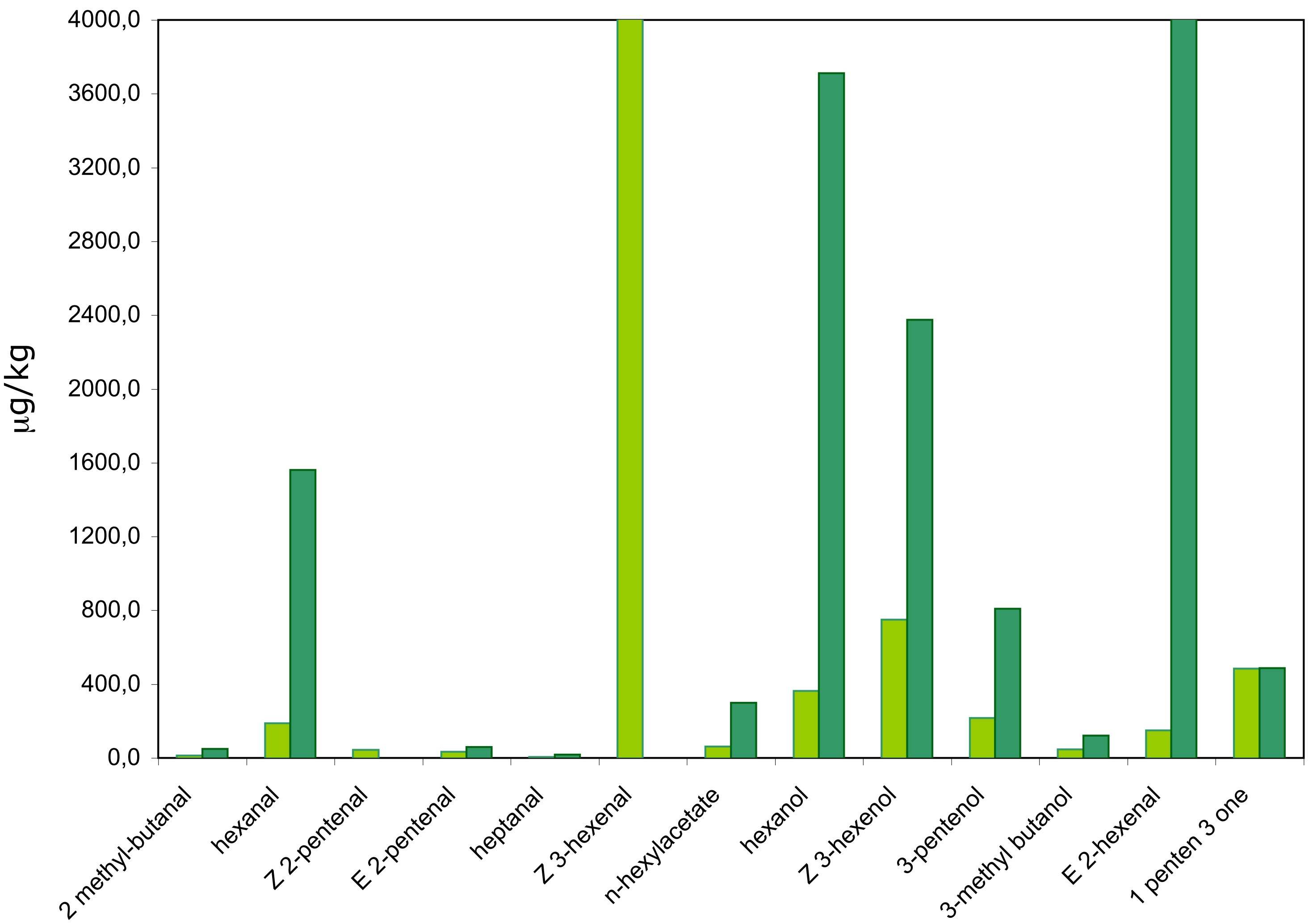
Valore Attività Odorosa (OAV):

Concentrazione molecola aromatica/
/Soglia di percezione

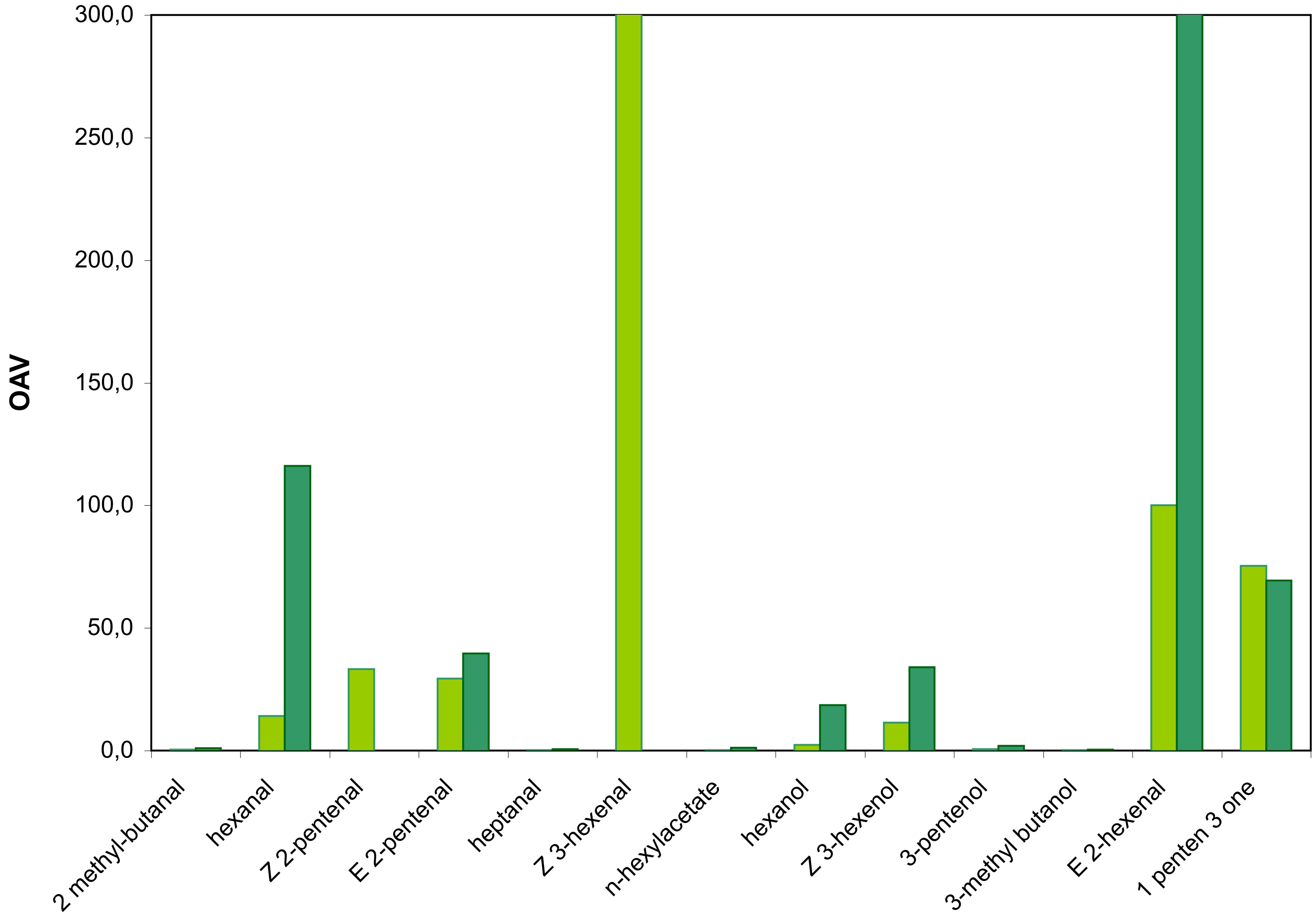
OAV> 1, molecola che contribuisce all'impatto odoroso

OAV < 1, molecola presente al di sotto della concentrazione-soglia (non percepita?)

Ravece ( ) vs Coratina ( )



OAV, Ravece ( ) vs Coratina ( )



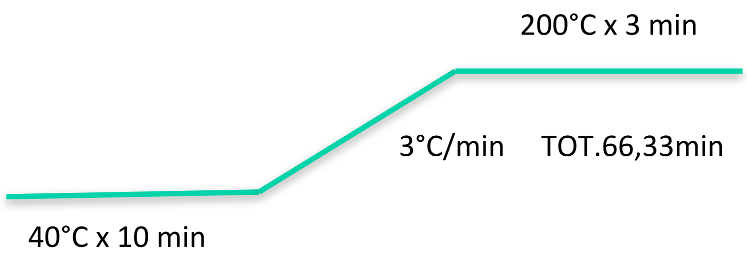
SPME-GC/MS Analysis of Volatiles

Extraction of volatile compound by analysis of the dynamic head space(SPME):
-2g sample of oil in VIAL 20 mL +10 µL of S.I.(Isobutyl Acetate) for 10min at 40°C

-the fiber is inserted (DVB/CAR/PDMS=grey 1cm) for adsorbiment of volatile compounds for 40 min at 40°C

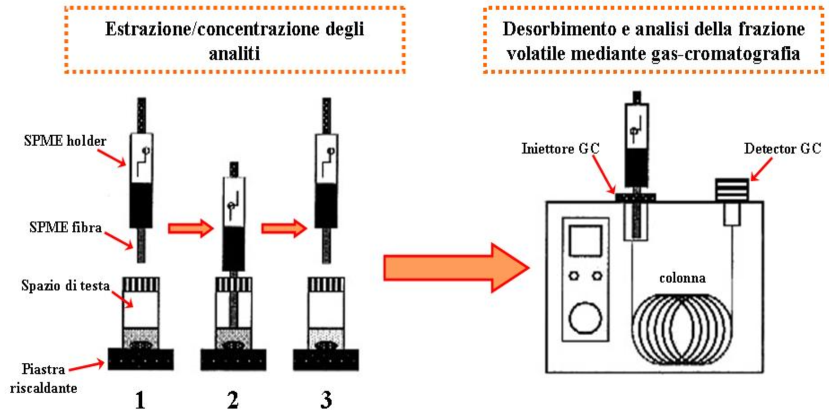
(Romero et al.,2015)

Analysis GC/MS:
Flow= He 0.9 mL/min
Splitless

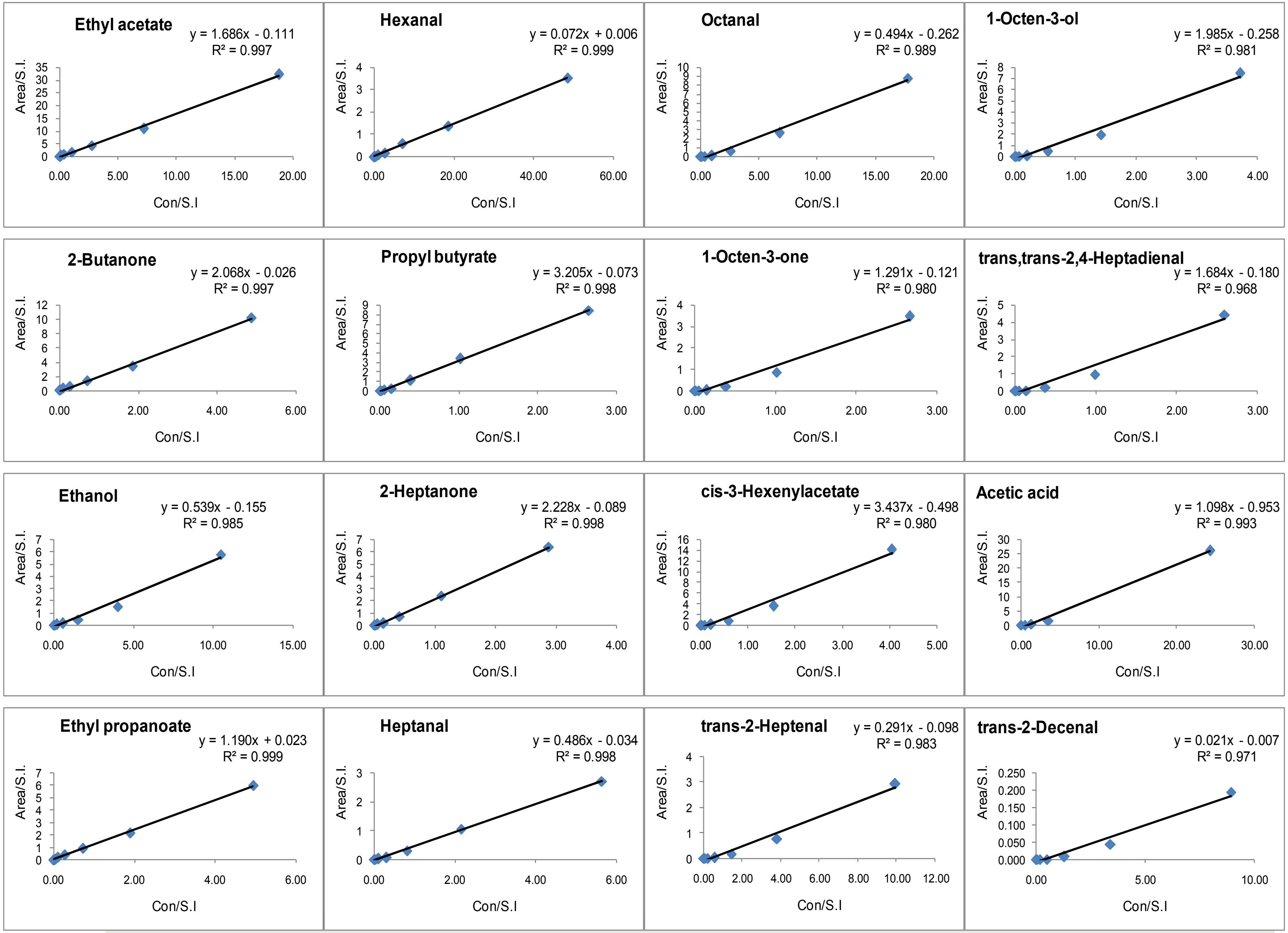


INJECTOR 300°C → 270°C
GC/MS INTERFACE 280°C → 250°C
MS SOURCE 180°C
QUADRUPOLE 150°C
MASS RANGE 40-300

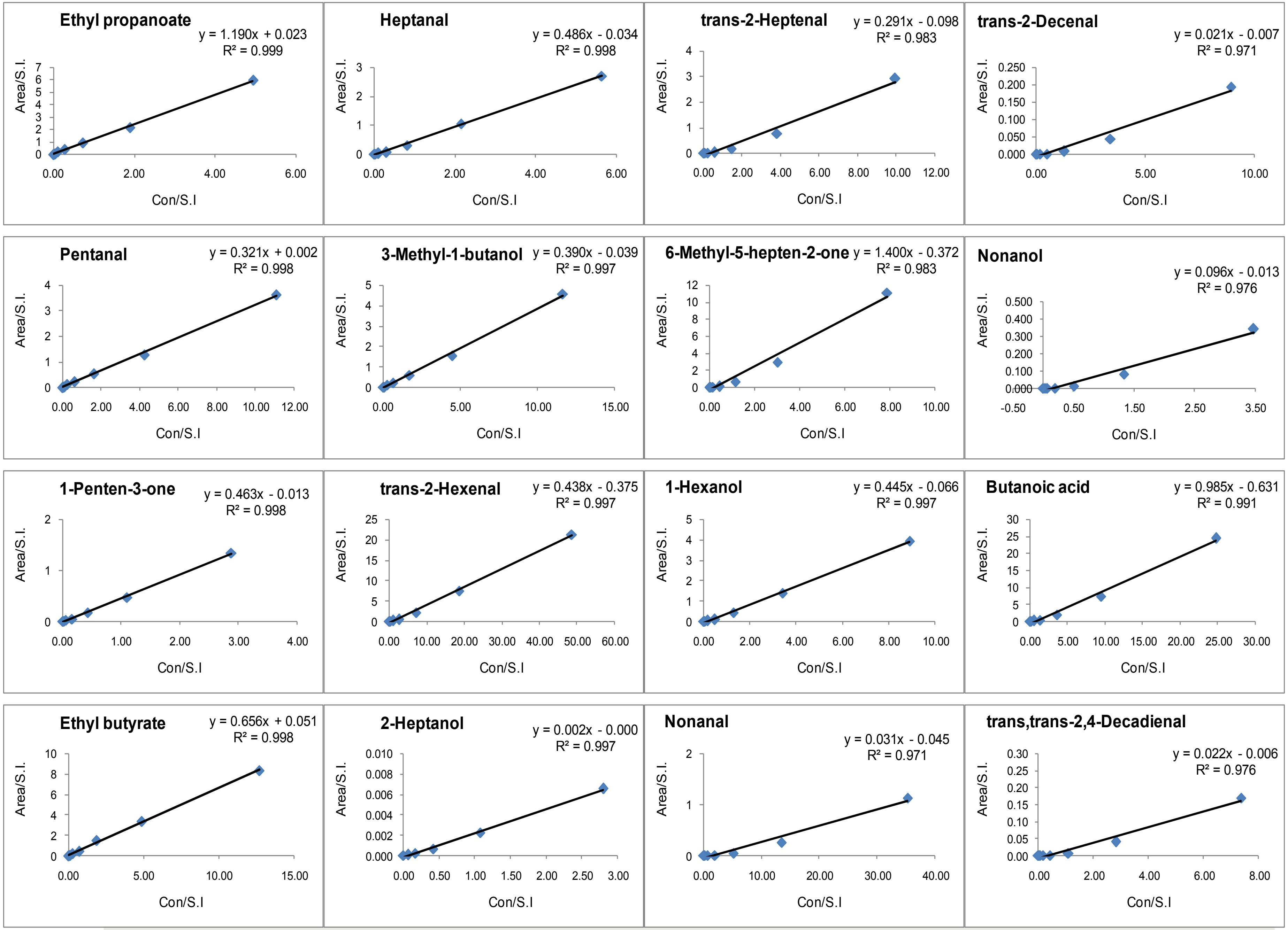
COLOMN:
WAX 60m x 0.25mm
0.25µm



(Morales *et al.*,2005)



Ethyl acetate
y = 1.686x - 0.111
R² = 0.997
Hexanal
y = 0.072x + 0.006
R² = 0.999
Octanal
y = 0.494x - 0.262
R² = 0.989
1-Octen-3-ol
y = 1.985x - 0.258
R² = 0.981
2-Butanone
y = 2.068x - 0.026
R² = 0.997
Propyl butyrate
y = 3.205x - 0.073
R² = 0.998
1-Octen-3-one
y = 1.291x - 0.121
R² = 0.980
trans,trans-2,4-Heptadienal
y = 1.684x - 0.180
R² = 0.968
Ethanol
y = 0.539x - 0.155
R² = 0.985
2-Heptanone
y = 2.228x - 0.089
R² = 0.998
cis-3-Hexenylacetate
y = 3.437x - 0.498
R² = 0.980
Acetic acid
y = 1.098x - 0.953
R² = 0.993
Ethyl propanoate
y = 1.190x + 0.023
R² = 0.999
Heptanal
y = 0.486x - 0.034
R² = 0.998
trans-2-Heptenal
y = 0.291x - 0.098
R² = 0.983
trans-2-Decenal
y = 0.021x - 0.007
R² = 0.971
Area/S.I.
Con/S.I


Ethyl propanoate
y = 1.190x + 0.023
R² = 0.999
Heptanal
y = 0.486x - 0.034
R² = 0.998
trans-2-Heptenal
y = 0.291x - 0.098
R² = 0.983
trans-2-Decenal
y = 0.021x - 0.007
R² = 0.971
Pentanal
y = 0.321x + 0.002
R² = 0.998
3-Methyl-1-butanol
y = 0.390x - 0.039
R² = 0.997
6-Methyl-5-hepten-2-one
y = 1.400x - 0.372
R² = 0.983
Nonanol
y = 0.096x - 0.013
R² = 0.976
1-Penten-3-one
y = 0.463x - 0.013
R² = 0.998
trans-2-Hexenal
y = 0.438x - 0.375
R² = 0.997
1-Hexanol
y = 0.445x - 0.066
R² = 0.997
Butanoic acid
y = 0.985x - 0.631
R² = 0.991
Ethyl butyrate
y = 0.656x + 0.051
R² = 0.998
2-Heptanol
y = 0.002x - 0.000
R² = 0.997
Nonanal
y = 0.031x - 0.045
R² = 0.971
trans,trans-2,4-Decadienal
y = 0.022x - 0.006
R² = 0.976
Area/S.I.
Con/S.I

‘Serie Odorose’

Somma degli OAV (concentrazione/soglia) dei composti volatili con simile descrittore di odore

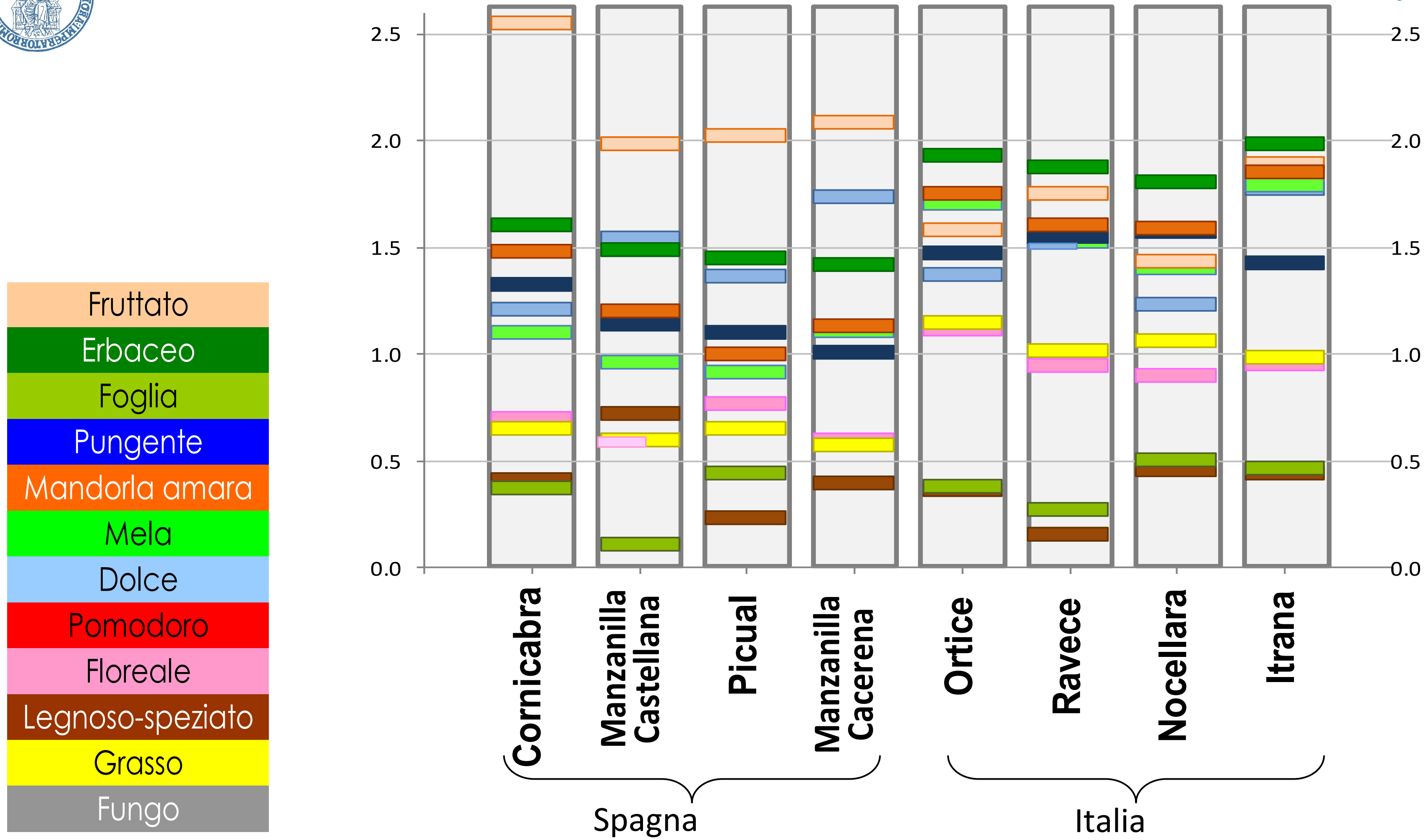
Odour threshold → Odour Activity Value (OAV)

↓

Σ OAV
delle molecole volatili con simile descrittore olfattivo

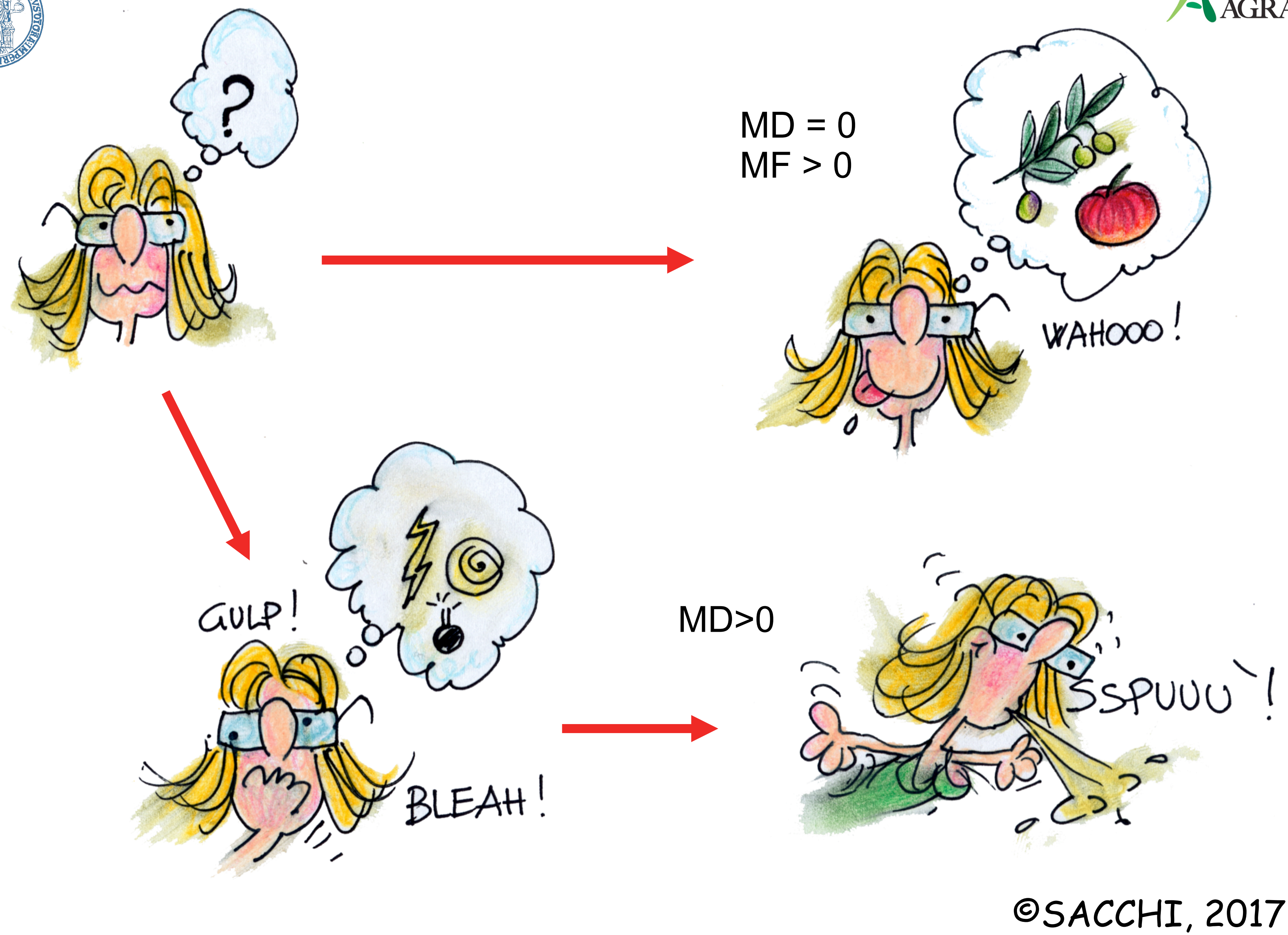
← **‘ODORANT SERIES’ VALUES**

Questo procedimento consente una **maggiore correlazione tra le sostanze volatili misurate strumentalmente e l’analisi sensoriale**.



Serie odorose rappresentate come "codici a barre" (log mediana) dell'aroma degli 'OEVO.

iv) Applicazioni nella misura delle molecole volatili responsabili delle **note positive (fruttato di oliva)** e dei **difetti sensoriali** degli OEVO (qualche esempio)


?
MD = 0
MF > 0
WAHOOO!
GULP!
BLEAH!
MD>0
SSPUUU'!
©SACCHI, 2017

‘Serie odorose’ dei pregi e difetti sensoriali

Rancido

- Octan-2-ol
- Pentanal
- Hexanal
- Heptanal
- E-2-Heptenal
- Octanal
- 6-Methyl-5-hepten-2-one
- Nonanal
- 2,4-Heptadienal
- Decanal
- E-2-Decenal
- Nonanol
- 2,4-Decadienal
- Butanoic acid
- Hexanoic acid
- Heptanoic acid
- Octanoic acid
- Nonanoic acid

Riscaldo

- Ethyl acetate
- Butan-2-one
- Butyl acetate
- Ethyl propanoate
- Propyl butanoate
- 2-Heptanone
- Ethyl butanoate
- Hexanal
- 3-Methyl-1-butanol
- Butanoic acid
- Pentanoic acid

Avvinato

- Ethyl acetate
- Ethanol
- 3-Methyl-1-butanol
- Acetic acid
- Pentanoic acid
- Hexanoic acid

Muffa

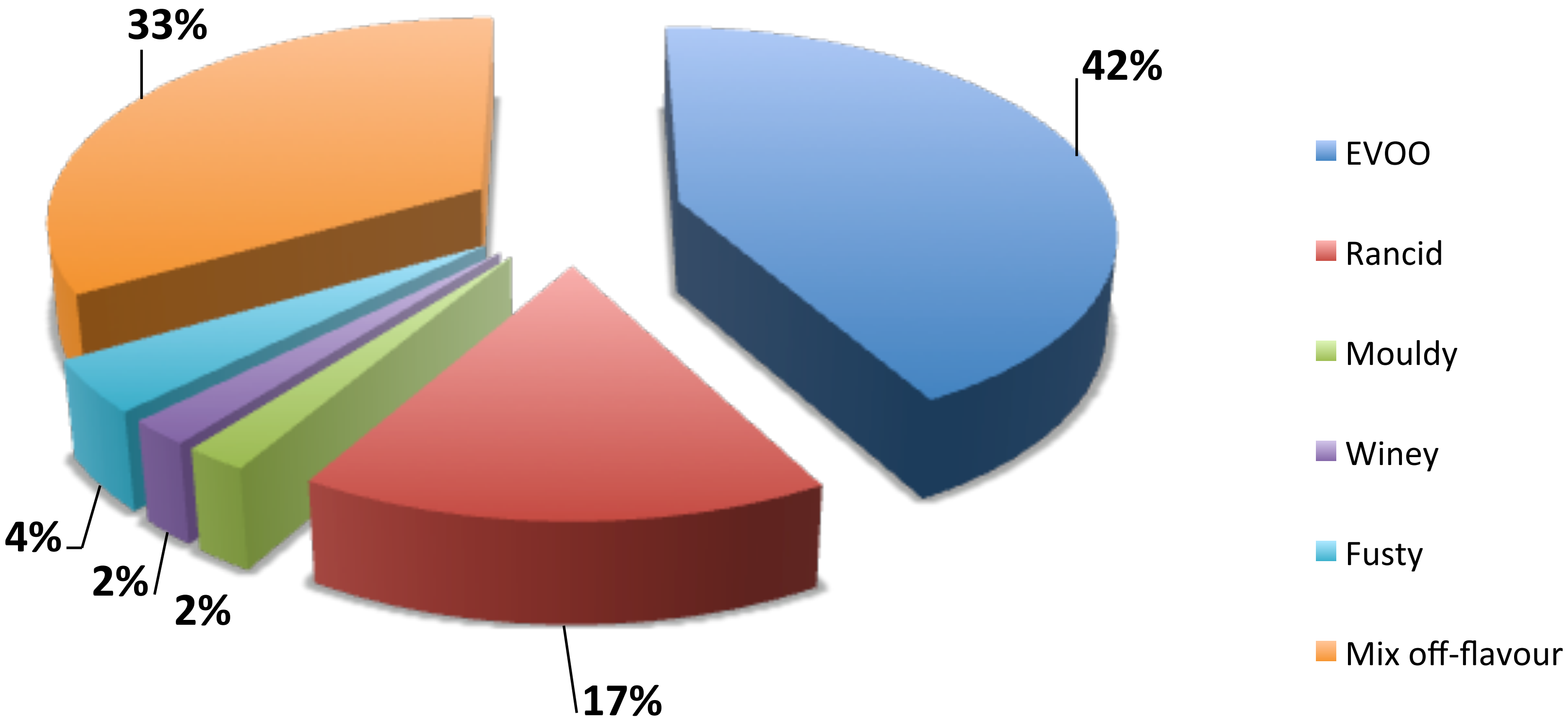
- Octan-2-one
- 1-Octen-3-one
- 2-Heptanol
- 2-Octanol
- 1-Octen-3-ol

3-Methyl-1-butanol

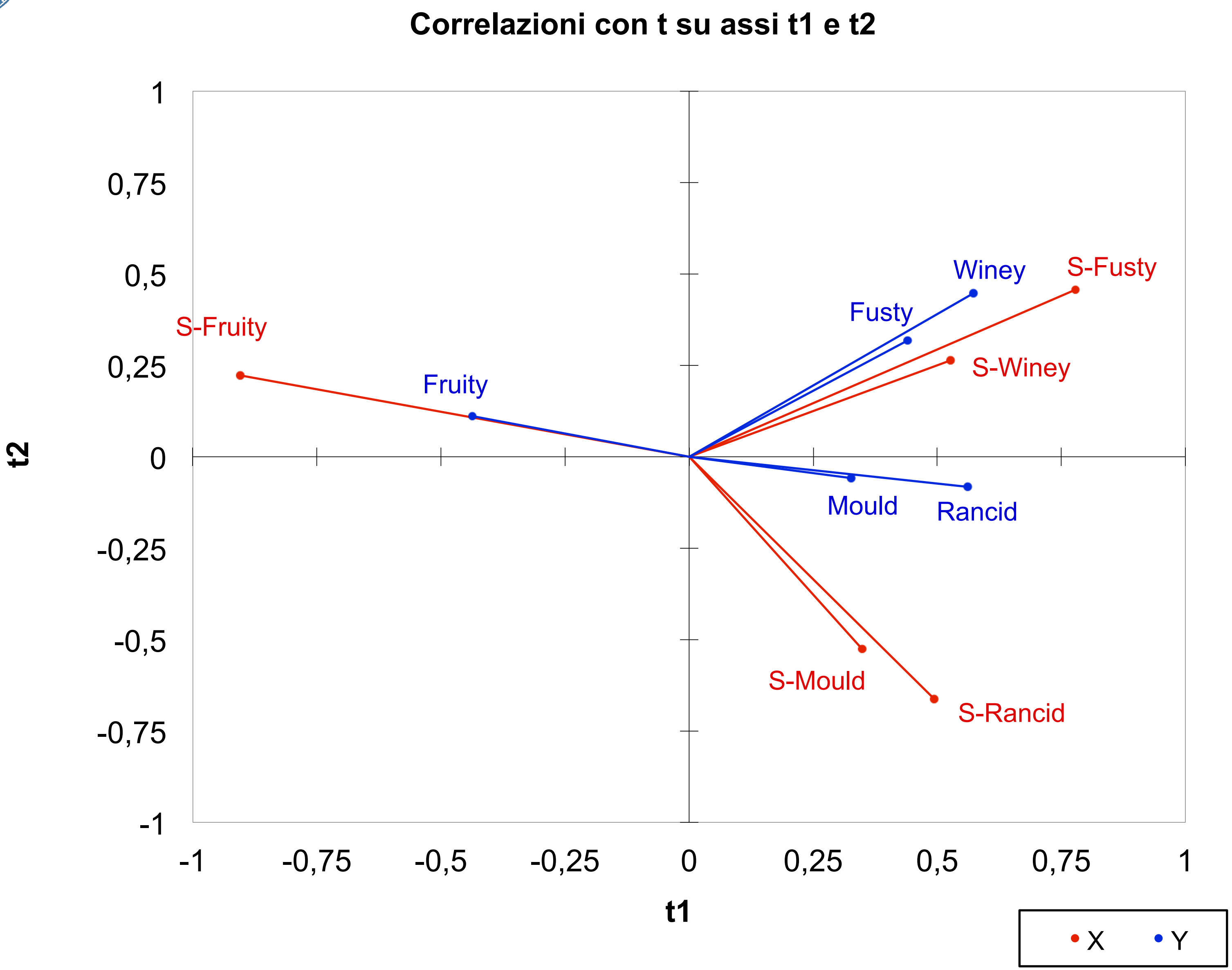
Fruttato - Verde

- 1-Penten-3-one
- E-2-Hexanal
- 1-Hexanol
- 3-Hexenyl acetate

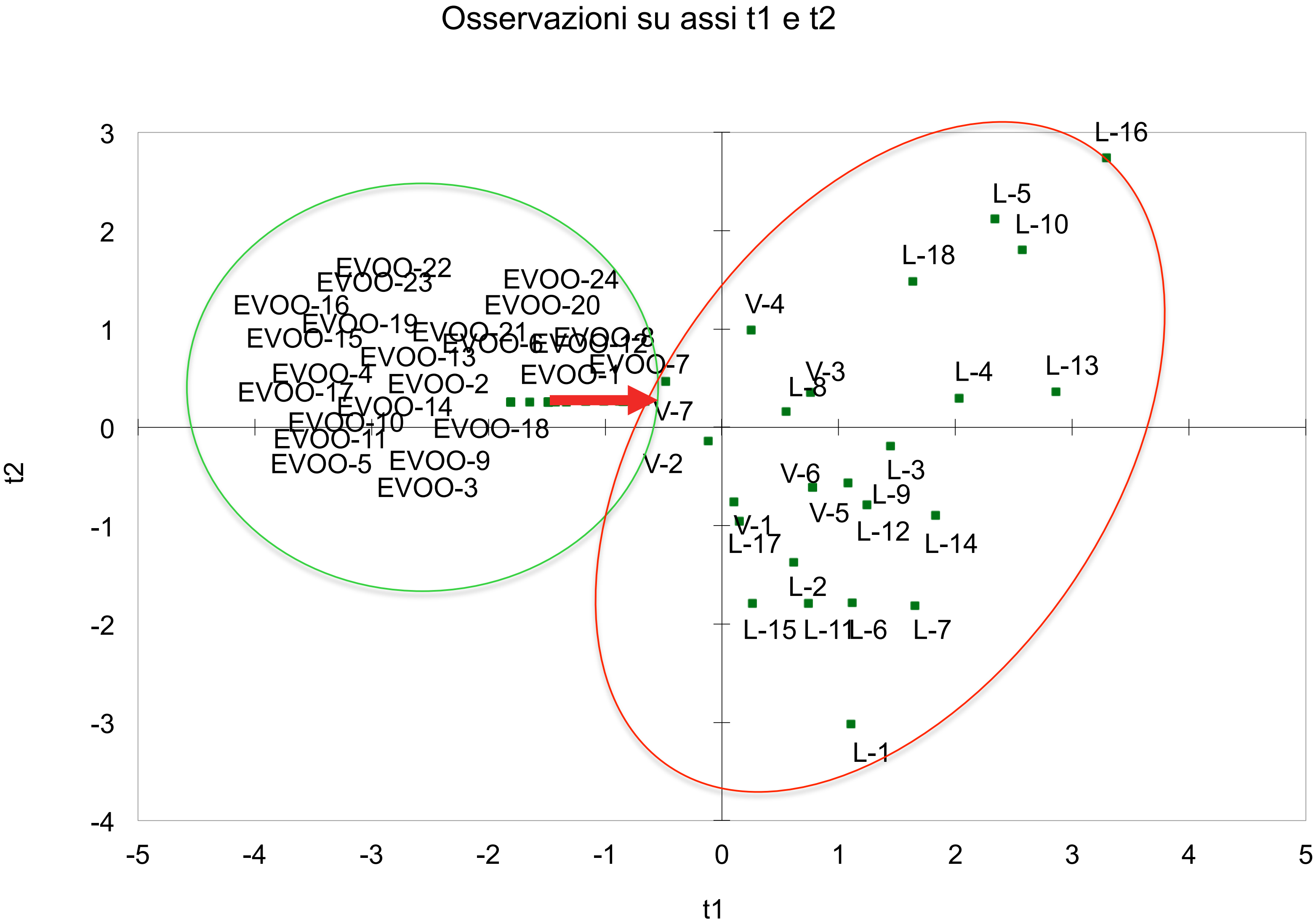
Sensory properties of 49 olive oil samples used to validate the model

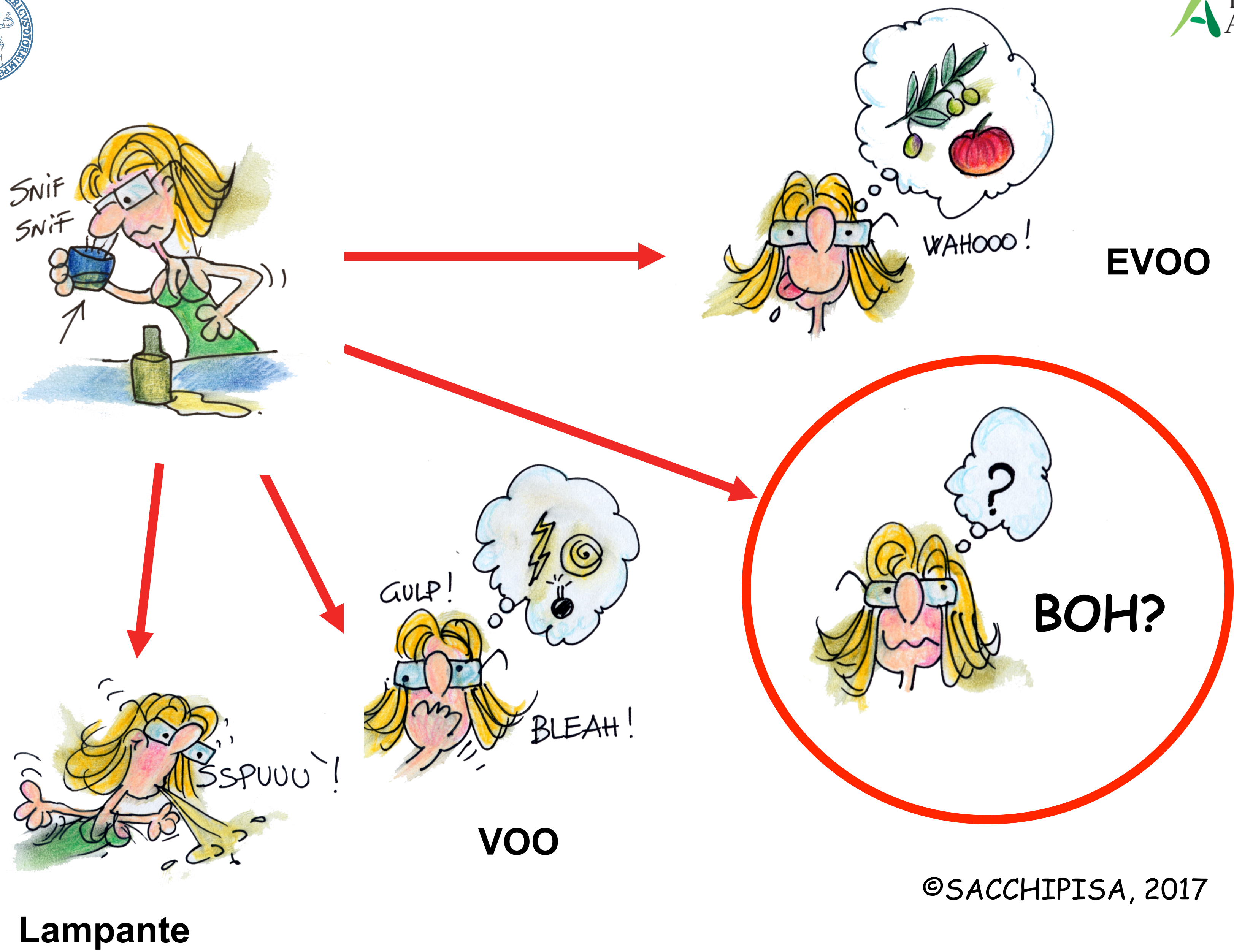


PLS Analysis of aromatic series (X) *vs* sensory values (Y)

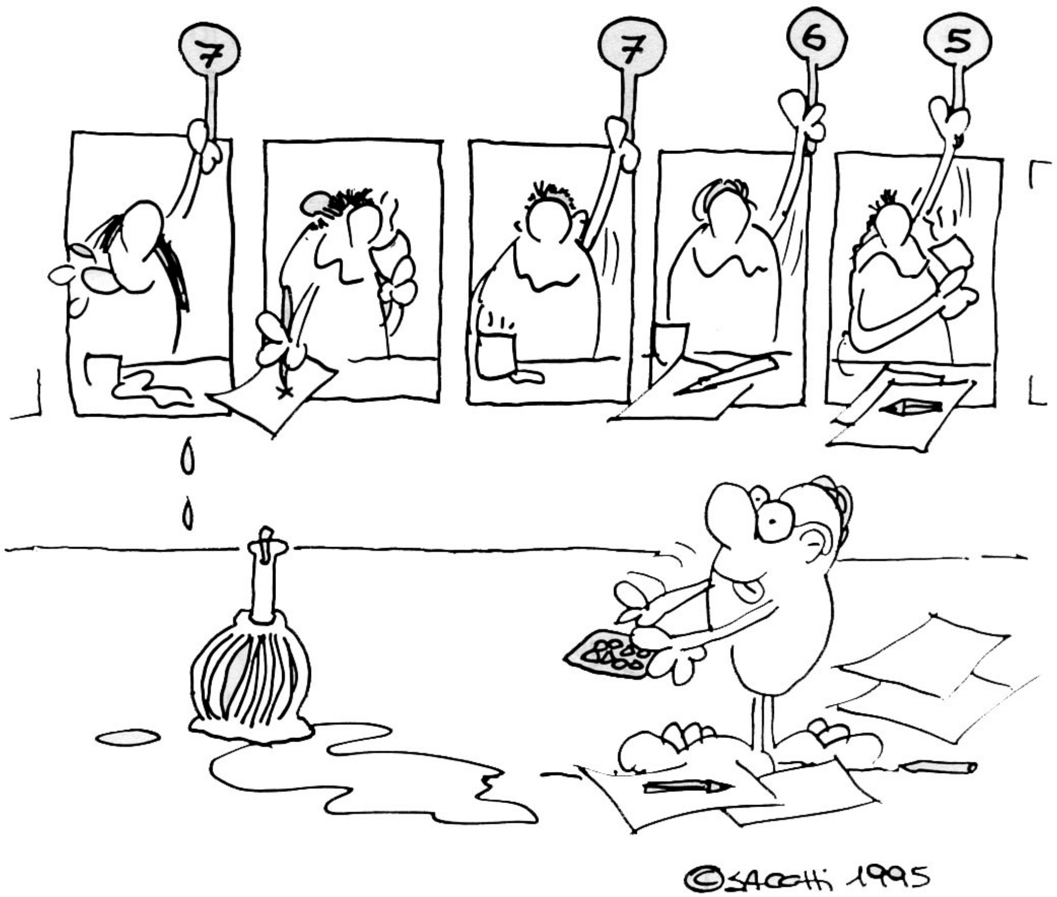


PLS of aromatic series (X) *vs* sensory values (Y) (samples).




SNIF
SNIF
WAHOOO!
EVOO
BOH?
GULP!
BLEAH!
SSPUUU!
VOO
Lampante
©SACCHIPISA, 2017

Panel test



T1 MD=0 **EXTRA VERGINE** → T2 MD>0 **VERGINE**

Durante la *shelf-life* si può osserva una progressiva riduzione delle intensità del fruttato e delle note verdi, con possibile rilevazione di difetti non percepiti sugli oli appena prodotti.

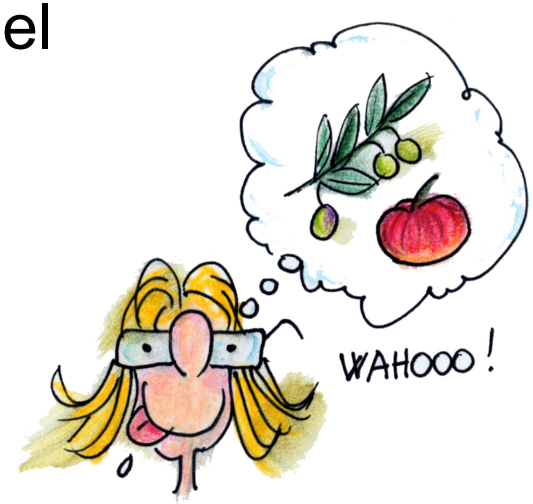
t1 — t2 — t3

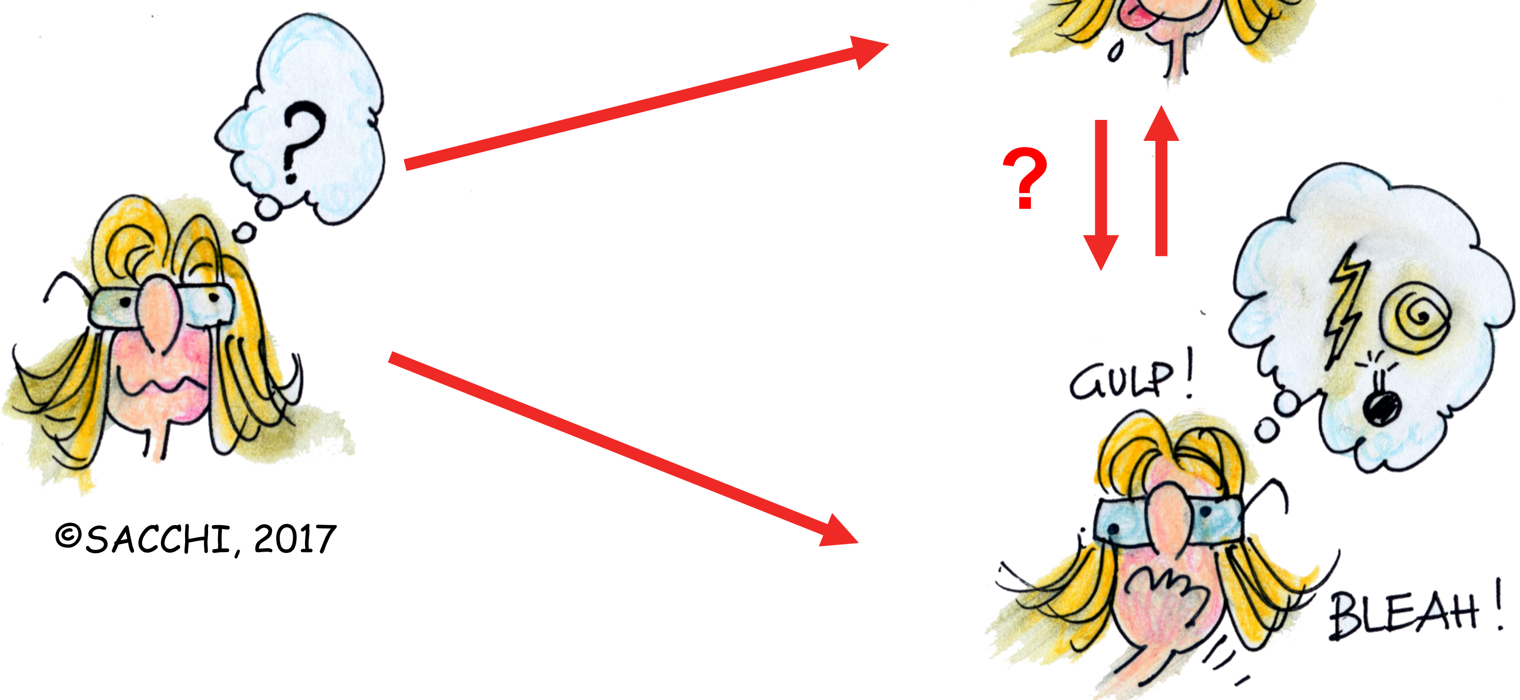
EVOO — **EVOO/VOO** — **VOO**!

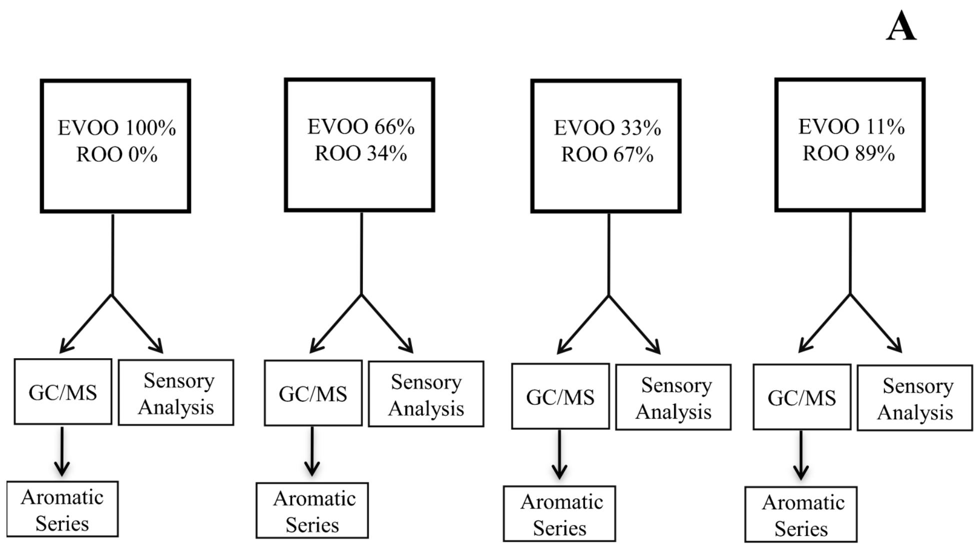
v) **effetti antagonistici e sinergici tra molecole volatili** nella percezione dei pregi e difetti dell'olio (aromi 'verdi' e difetti fermentativi)?

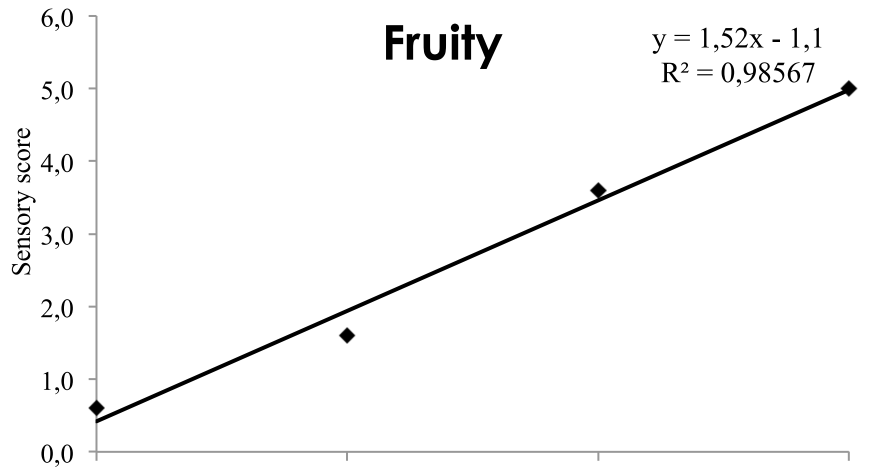
La presenza di difetti può influire sulla percezione dell’intensità del ‘fruttato’?

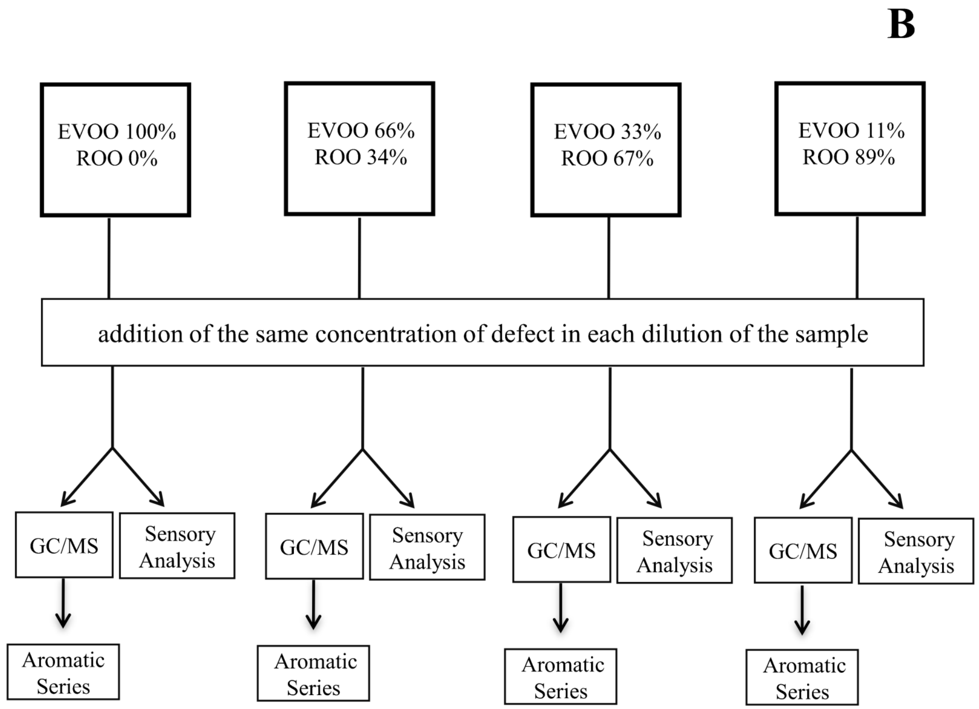
E l’intesità del ‘fruttato’ può mascherare i difetti?

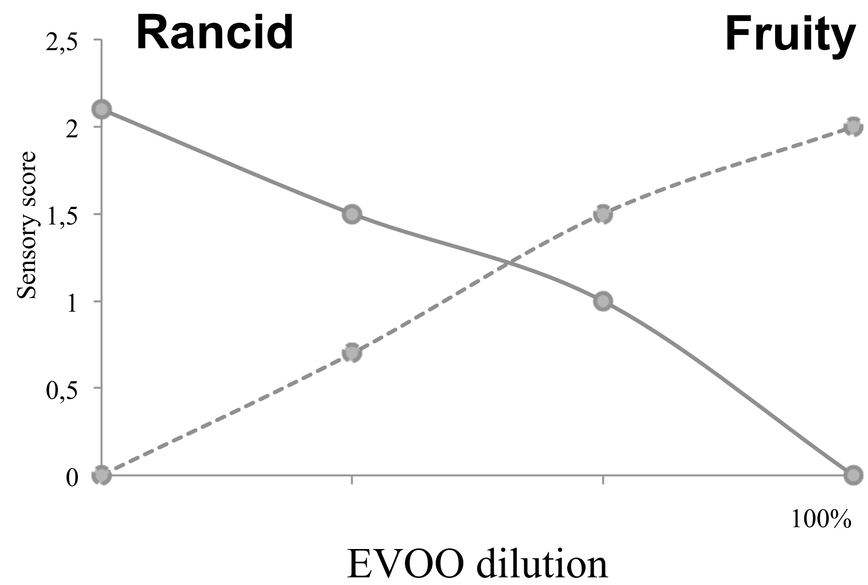




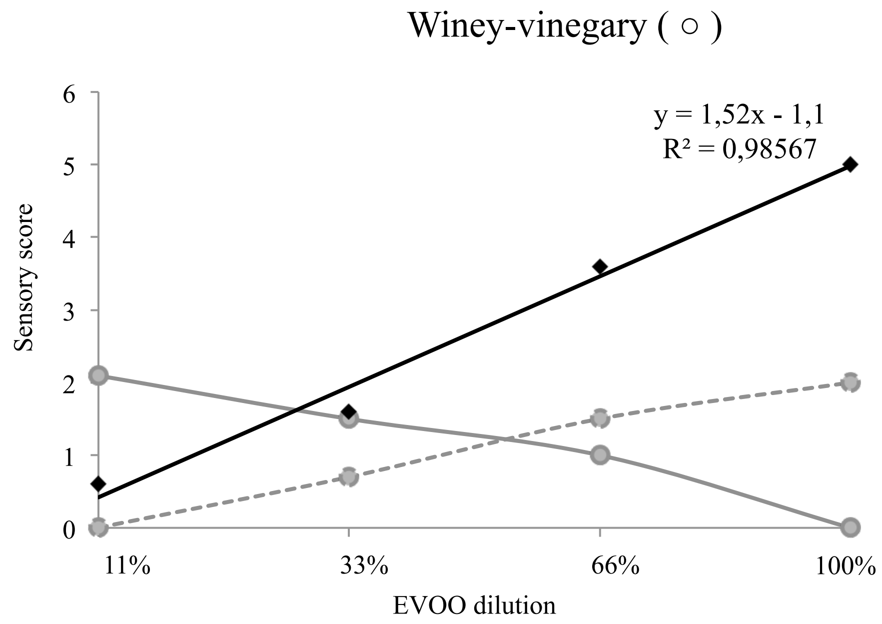

A
EVOO 100%
ROO 0%
EVOO 66%
ROO 34%
EVOO 33%
ROO 67%
EVOO 11%
ROO 89%
GC/MS
Sensory Analysis
Aromatic Series

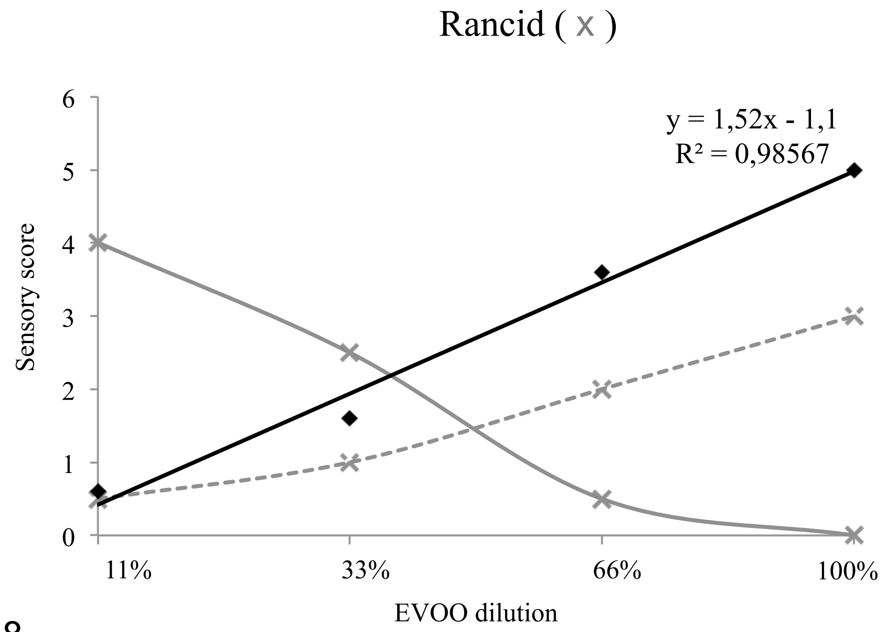

Fruity
y = 1,52x - 1,1
R² = 0,98567
Sensory score
6,0
5,0
4,0
3,0
2,0
1,0
0,0

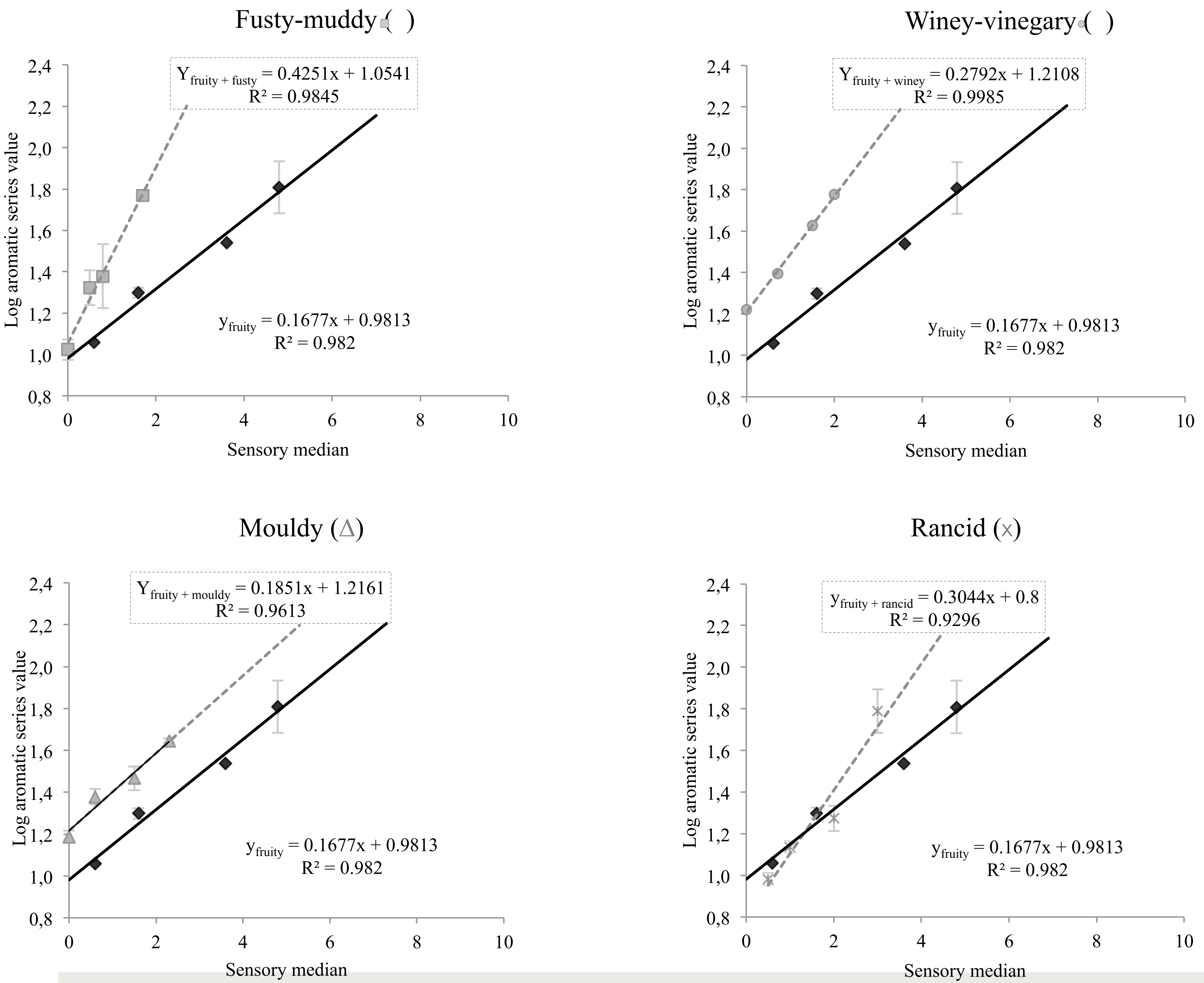

B
EVOO 100%
ROO 0%
EVOO 66%
ROO 34%
EVOO 33%
ROO 67%
EVOO 11%
ROO 89%
addition of the same concentration of defect in each dilution of the sample
GC/MS
Sensory Analysis
Aromatic Series


Rancid
Fruity
Sensory score
2,5
2
1,5
1
0,5
0
100%
EVOO dilution

Nella risposta sensoriale si verifica un **meccanismo di antagonismo** tra intensità percepite della nota fruttata e dei difetti, con un **effetto di mascheramento** reciproco (riduzione delle intensità percepite).



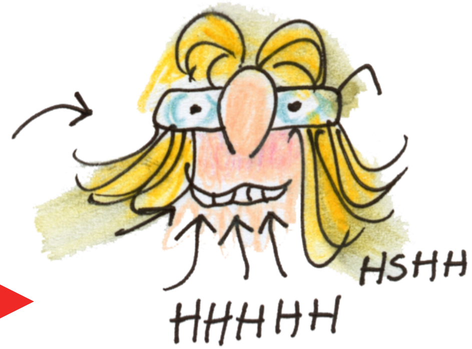




Fusty-muddy ( )
Y fruity + fusty = 0.4251x + 1.0541
R² = 0.9845
y fruity = 0.1677x + 0.9813
R² = 0.982
Winey-vinegary ( )
Y fruity + winey = 0.2792x + 1.2108
R² = 0.9985
y fruity = 0.1677x + 0.9813
R² = 0.982
Mouldy (Δ)
Y fruity + mouldy = 0.1851x + 1.2161
R² = 0.9613
y fruity = 0.1677x + 0.9813
R² = 0.982
Rancid (x)
y fruity + rancid = 0.3044x + 0.8
R² = 0.9296
y fruity = 0.1677x + 0.9813
R² = 0.982
Log aromatic series value
Sensory median

ODORE
(ortonasale)

AROMA
(retronasale)



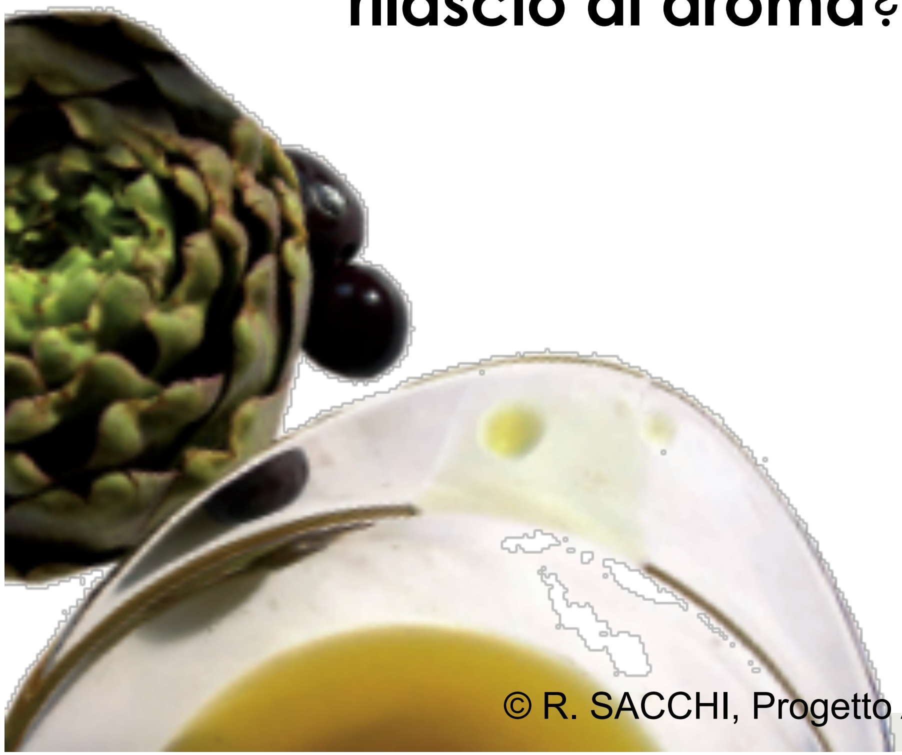
INTERAZIONI
MOLECOLE VOLATILI-**BIOFENOLI?**

INTERAZIONI
AROMA-**SALIVA-BIOFENOLI?**

vi) Interazioni aromi-saliva, saliva-fenoli e saliva-fenoli-aromi (percezione retronasale):

L'interazione con la saliva come influenza il rilascio di aroma?

Le sostanze fenoliche possono influire sul rilascio di aroma?



In vitro Retro-nasal Aroma Simulation (RAS)

SPME-GC/MS analysis (*Van Ruth et al., 2000*)…

SPME: (DVB/CAR/PDMS) (50/30 µm thickness, coating phase), 2 cm length.

Temperature: 50 °C (2min) up to 220 °C (20min) Rate: 3°C/min.

Ion source/Analyzer: EI 70 eV (230 °C)/ Quadrupole (150 °C)

Column: Supelcowax-10 (60m, 0.32mm, 0.5 ɰm; Supelco Co.)

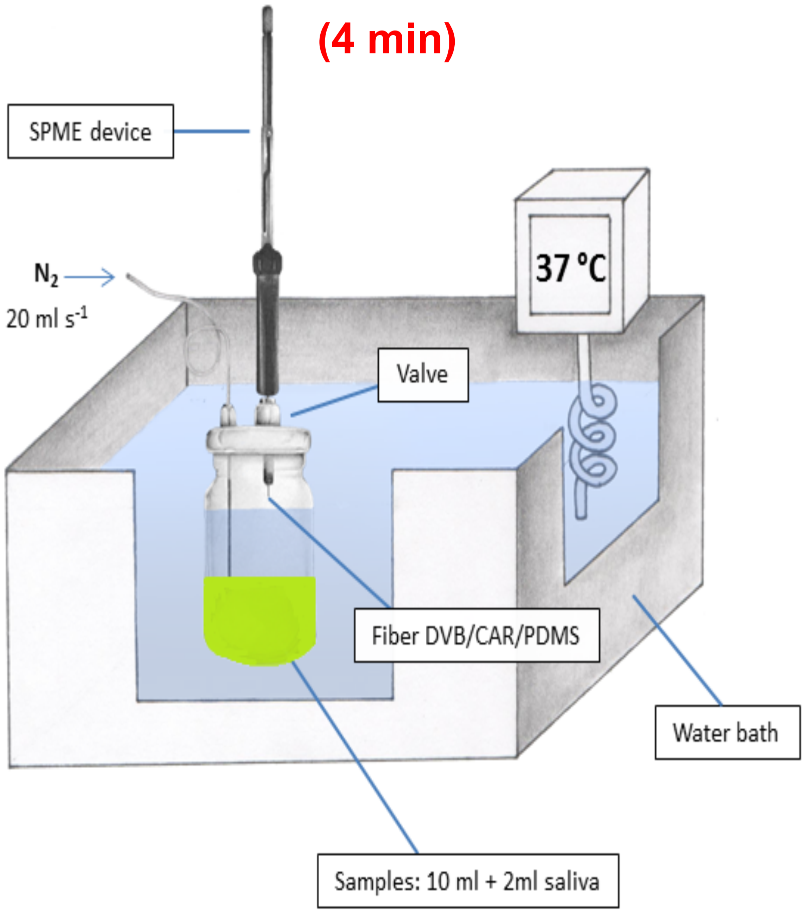
Instruments: GC/MS: QP5050A GC + 5973N MS (Agilent Technologies) GC: 4890D (Agilent Technologies)

Injector: Split-splitless open at 11' and close at 25' (250°C)

Statistical analysis: Tukey test, *p*<0.05 using XLSTAT (version 2009.3.02), using a packet add-in software for Microsoft Excel (Addinsoft Corp., Paris, France).

… coupled with RAS to simulate the retronasal aroma release

(4 min)



L’effetto della saliva sul rilascio di aroma dell’OEVO dipende anche dalla variabilità individuale, da diverse condizioni fisiologiche anche nello stesso individuo e, ad esempio, **dal BMI** (normopeso, NW; sovrappeso, OW; obesi, O).

(Genovese et al, 2018, *J.Sci.Food.Agric*)

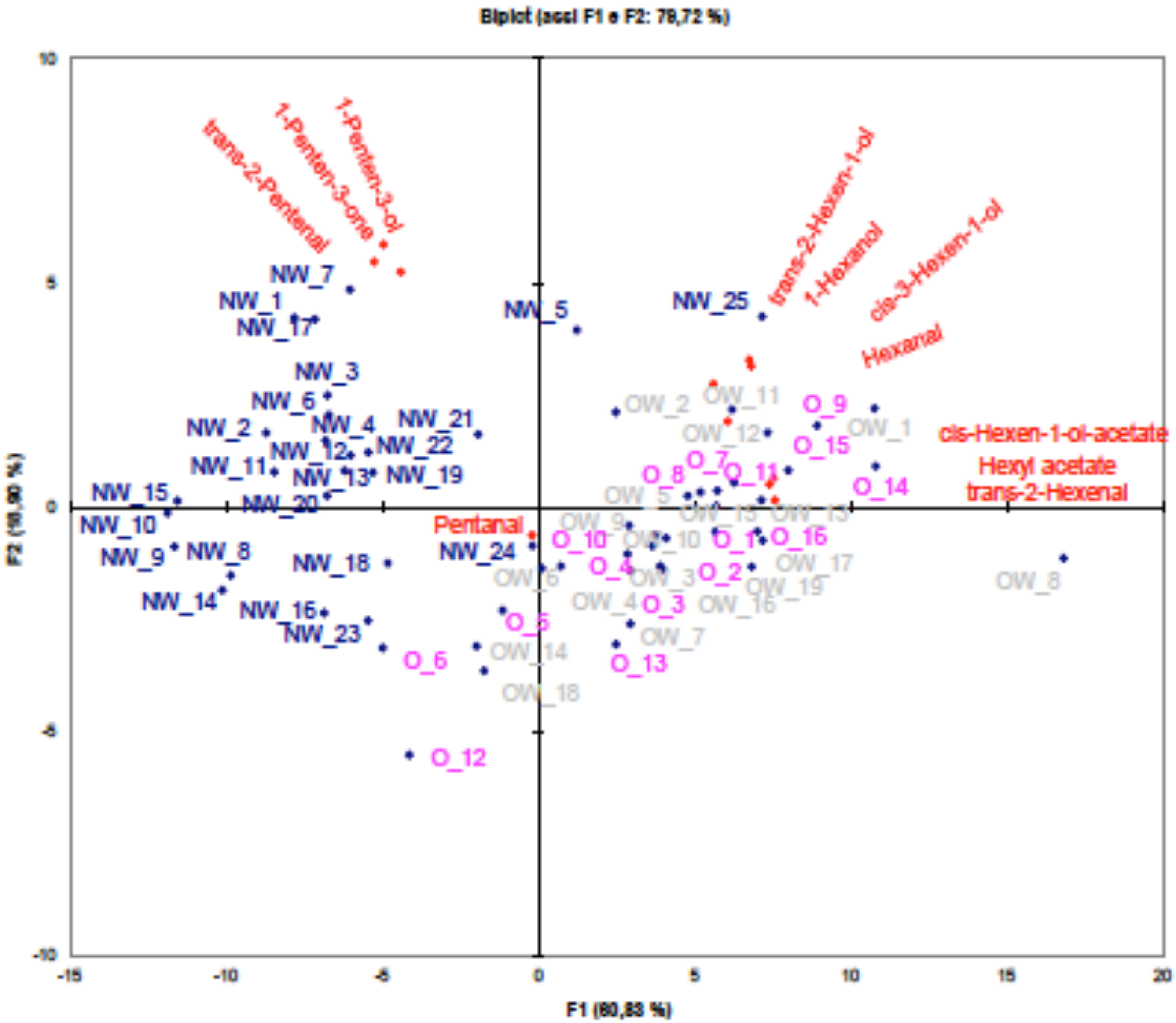


Fig.4.2 - Analisi delle componenti principali (PCA) relativa ai componenti volatili dell'EVOO rilasciati dopo interazione con la saliva di soggetti O, OW e NW.

Come percepiamo l'aroma retronasale dell'Olio?

In relazione **all'equilibrio dei componenti volatili** tra matrice lipica, fase acquosa (saliva), aria, mucosa e superficie dei recettori:

lipidic matrix $\rightleftarrows$ **aqueous matrix** $\rightleftarrows$ **air** $\rightleftarrows$ **mucosa** $\rightleftarrows$ **receptor**

Le sostanze fenoliche possono interagire con la saliva, influenzando questo equilibrio?

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Olive oil phenolic compounds affect the release of aroma compounds

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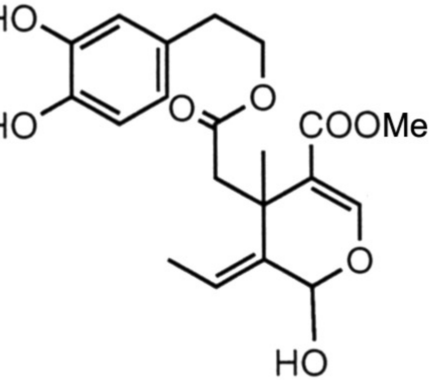
ABSTRACT

Twelve aroma compounds were monitored and quantified by dynamic headspace analysis after their addition in refined olive oil model systems with extra virgin olive oil (EVOO) biophenols to simulate EVOO aroma. The influence of polyphenols on aroma release was studied under simulated mouth conditions by using human saliva, and SPME-GC/MS analysis. While few differences were observed in orthonasal assay (without saliva), interesting results were obtained for retronasal aroma. Biophenols caused generally the lowest headspace release of almost all volatile compounds. However, only ethyl esters and linalool concentrations were significantly lower in retronasal than orthonasal assay. Saliva also caused higher concentration of hexanal, probably due to hydroperoxide lyase (HPL) action on linoleyl hydroperoxides. Epicatechin was compared to EVOO phenolics and the behaviour was dramatically different, likely to be due to salivary protein–tannin binding interactions, which influenced aroma headspace release. These results were also confirmed using two extra virgin olive oils.



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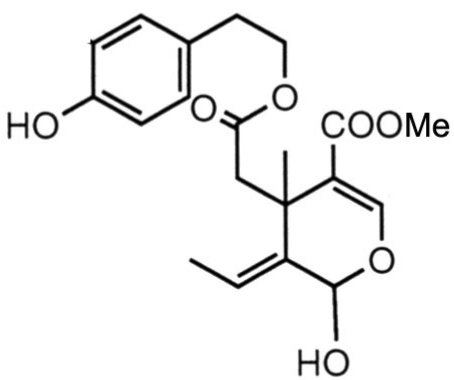

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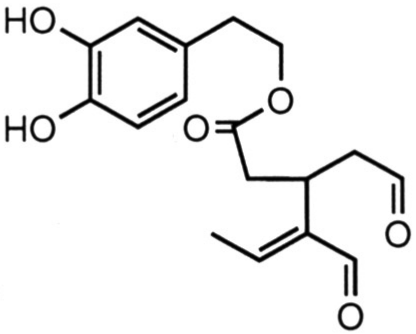

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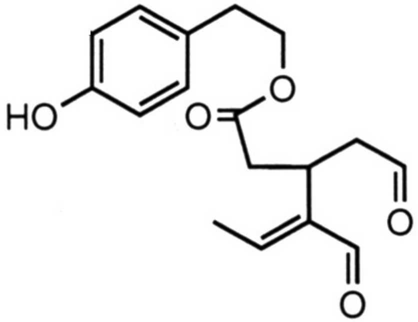
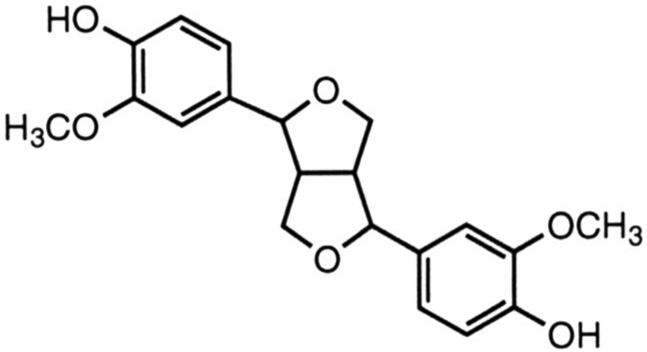


4

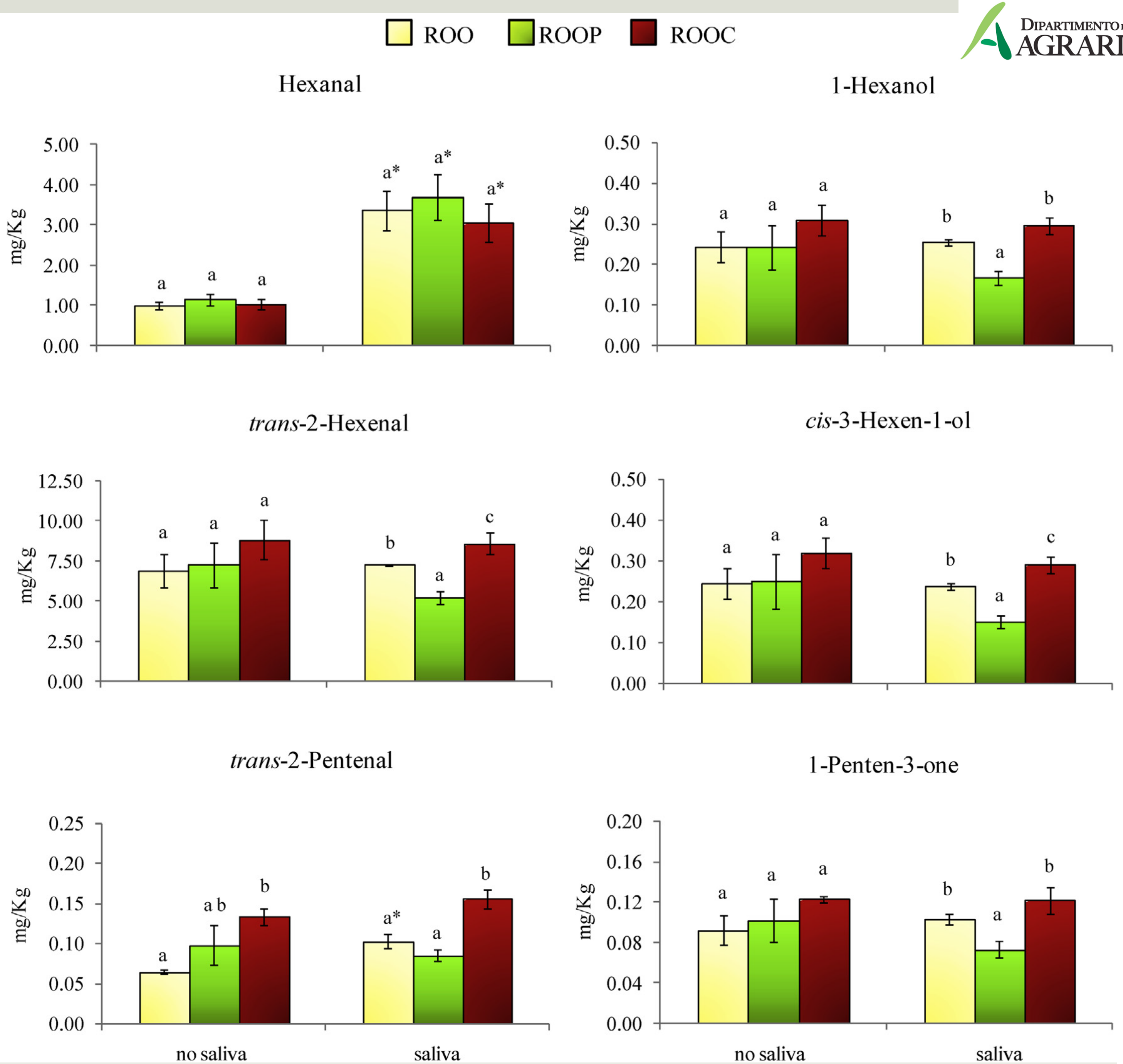
I biofenoli dell’OEVO: nutraceutici ...AMARI*

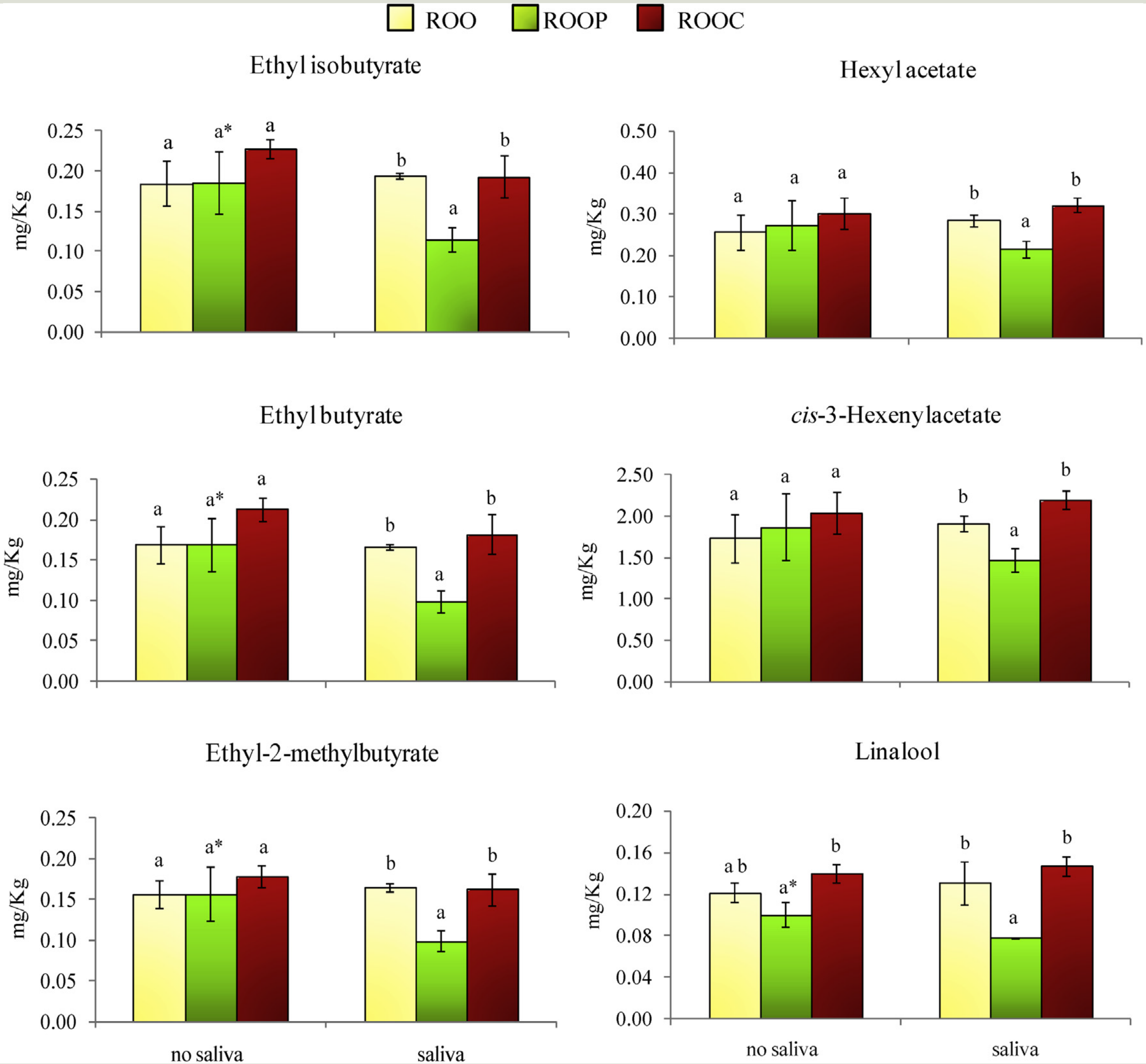


5

* **Progetto AGER 2 COMPETITIVE**

Headspace concentration of volatiles in model systems of refined olive oil (**ROO**), ROO added with VOO phenolic compounds (**ROOP**), and with added epicatechin (ROOC).





Headspace concentration of volatiles in model systems of refined olive oil (**ROO**), ROO added with VOO phenolic compounds (**ROOP**), and with added epicatechin (ROOC).

Effetto delle sostanze fenoliche sul rilascio di aroma dell'olio, studiato mediante **APCI-MS *in vitro* ed *in vivo*** .

(Genovese et al, 2018, *in press*)

Ruolo dei Composti Fenolici sul Rilascio di Aroma Dell'olio Extravergine di Oliva

Role of Phenolic Compounds on Olive Oil Aroma Release

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Accademia dei Georgofili

Regione Toscana

RESEARCH COLLABORATION

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DIPARTIMENTO DI AGRARIA

The University of Nottingham

UNITED KINGDOM · CHINA · MALAYSIA

THE ROLE OF PHENOLIC COMPOUNDS AND SALIVA ON OLIVE OIL AROMA RELEASE

2016-2017

In vitro APCI-MS dello spazio di testa dinamico

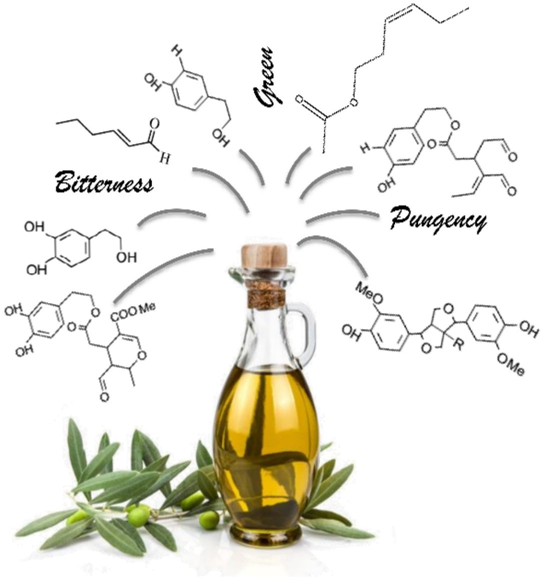
In vivo APCI/MS

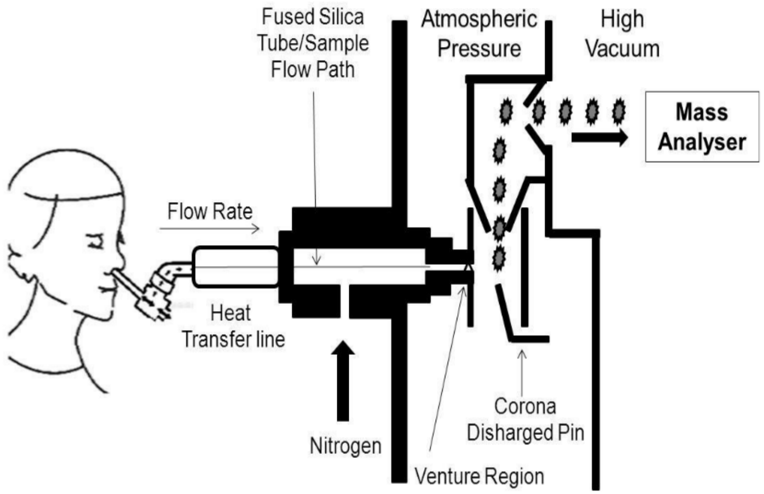
Two concentrations of phenolics and one of aroma compounds were evaluated by **APCI-MS analysis**.

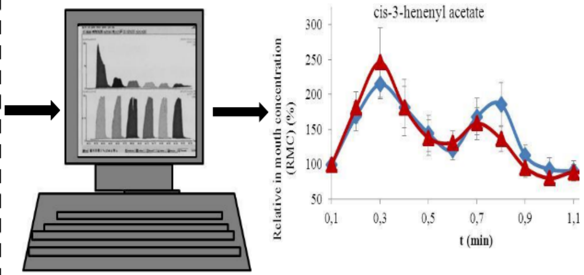
Soluzione modello in olio di oliva

APCI-MS

Curva del rilascio di aroma







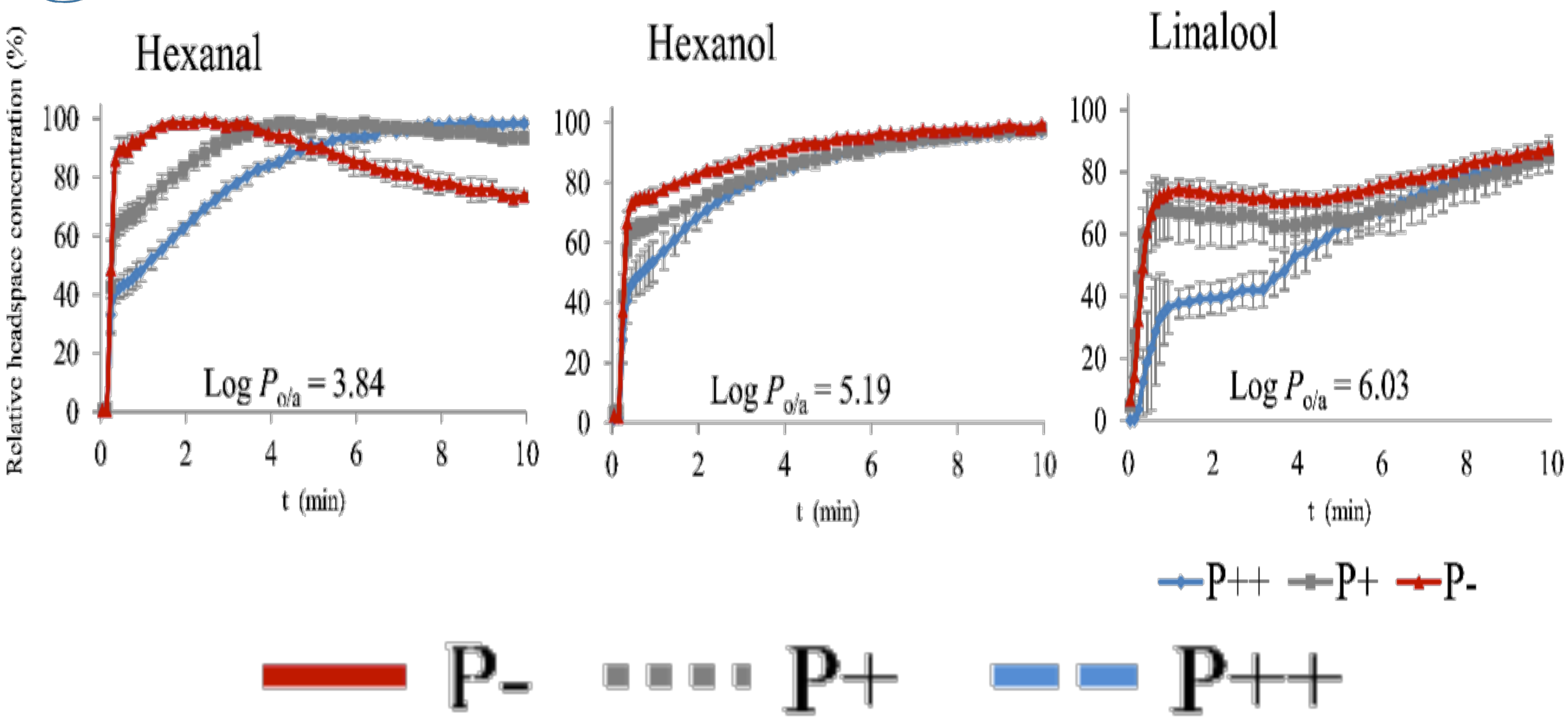
Sistemi modello in olio di oliva con diversa concentrazione di composti fenolici ed 8 componenti volatili:

P- (0 mg kg^{-1})
P+ (354 mg kg^{-1})
P++ (593 mg kg^{-1})

MS Nose interface: Micromass, Manchester, UK) fitted to a Quattro Ultima mass spectrometer (Milford, Waters)
Flow rate: 5 ml/min e (*in-vitro*) 40 ml/min (*in-vivo*)
Temperatura: Transfer line = 100 °C
sorgente ionica=75 °C
Corona discharge: 4kV
Cone voltage: 15V
Dwell time: 0,2 s (*in-vitro*) e 0,01 s (*in-vivo*)

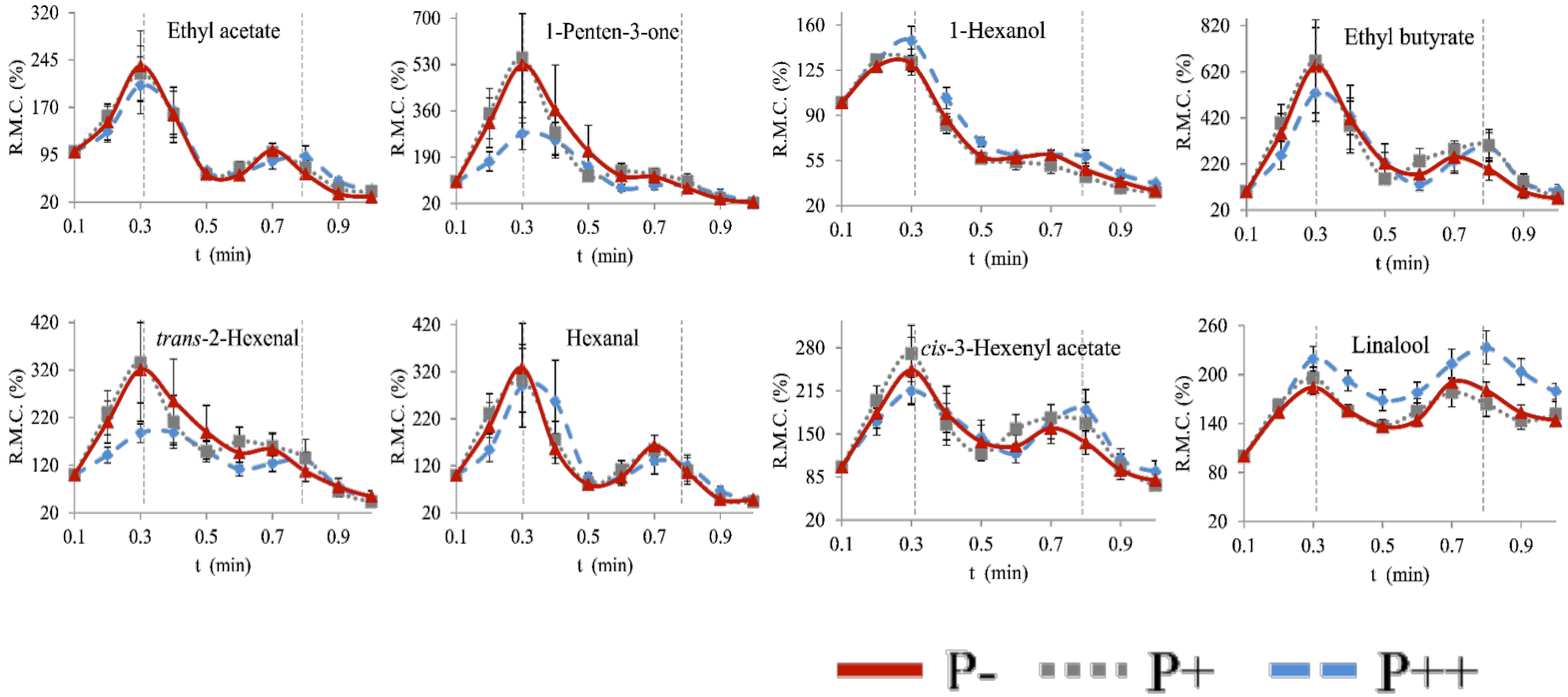
In questo studio è stato valutato **l'effetto dei composti fenolici sul rilascio di alcuni composti volatili** dell'OEVO mediante analisi APCI-MS.

Otto componenti volatili sono stati aggiunti e monitorati in condizioni dinamiche, sia *in-vitro* che *in-vivo,* in un olio di oliva rettificato, deodorato di fresco **con (P+, P++) e senza (P-) l'aggiunta dei composti fenolici estratti in precedenza da un OEVO**.



Spazio di testa dinamico di esanale (test *in-vitro*), 1-esanolo e linalolo nei sistemi modello di olio di oliva P++ (593 mg kg^{-1}), P+ (354 mg kg^{-1}) e P- (0 mg kg^{-1}). Ciascun punto è la media di 4 repliche, la barra di errore indica la deviazione standard.

I composti fenolici possono interagire con esanale, linalolo e 1-esanolo, probabilmente con legami non covalenti reversibili.



Curve del rilascio di aroma in tempo reale (test *in-vivo*) dei componenti volatili nei sistemi modello di olio di oliva P++ (593 mg kg^{-1}), P+ (354 mg kg^{-1}) e P- (0 mg kg^{-1}).
Le linee tratteggiate a 0,3 e 0,8 min indicano rispettivamente la fase di deglutizione del campione e della saliva. Ciascuna curva è la media di nove ripetizioni. La barra di errore indica la deviazione standard.

Lo studio *in-vivo* ha dimostrato che, dopo la deglutizione, in presenza di fenoli il rilascio di 1-penten-3-one, *trans*-2-esenale, *cis*-3-esenil acetato ed etil butirrato è inferiore rispetto quello determinato per il campione di olio privo di fenoli.

Al contrario, il linalolo e l'1-esanolo hanno mostrato un effetto *salting-out*.

I composti fenolici dell'OEVO causano una maggiore persistenza in bocca dei composti idrofobi come linalolo e *cis*-3-esenil acetato.

Questo potrebbe portare ad una **maggiore intensità odorosa, percepita durante l'assaggio di un OEVO ricco di biofenoli, dei composti idrofobi rispetto a quelli idrofili**.

E' possibile ipotizzare una **diversa percezione del flavour e degli *off-flavour* in presenza di un diverso livello di biofenoli**.

UNIVERSITA' DEGLI STUDI DI NAPOI FEDERICO II

MASTER'S DEGREE IN FOOD SCIENCE AND TECHNOLOGY

DEPARTMENT OF AGRICULTURE

ROLE OF PHENOLIC COMPOUNDS ON POSITIVE AND NEGATIVE EXTRA VIRGIN OLIVE OIL OLFACTORY ATTRIBUTES

Supervisor
Ch.mo Prof.
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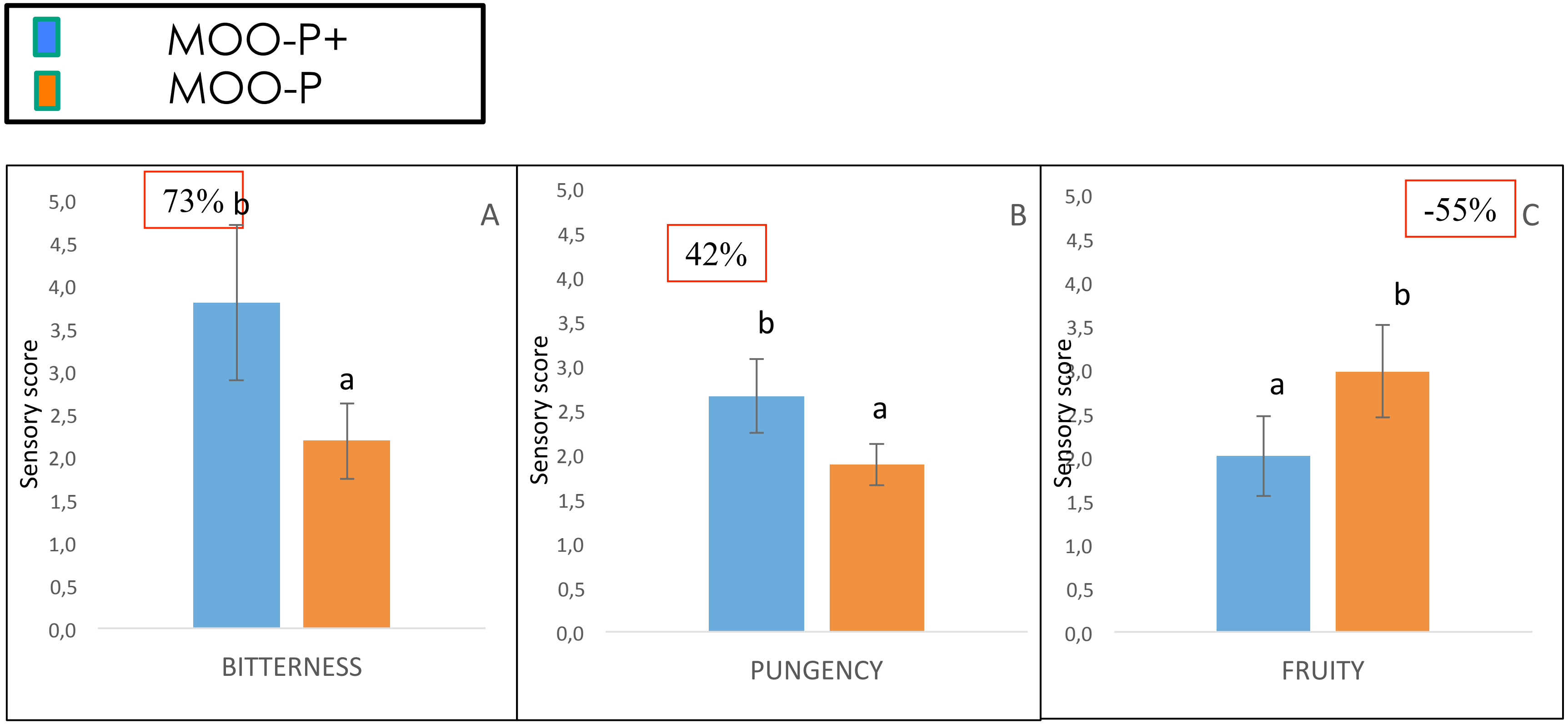
Candidate:
Ferdinando Mondola
N06/617

PORTICI, 23 ottobre 2017

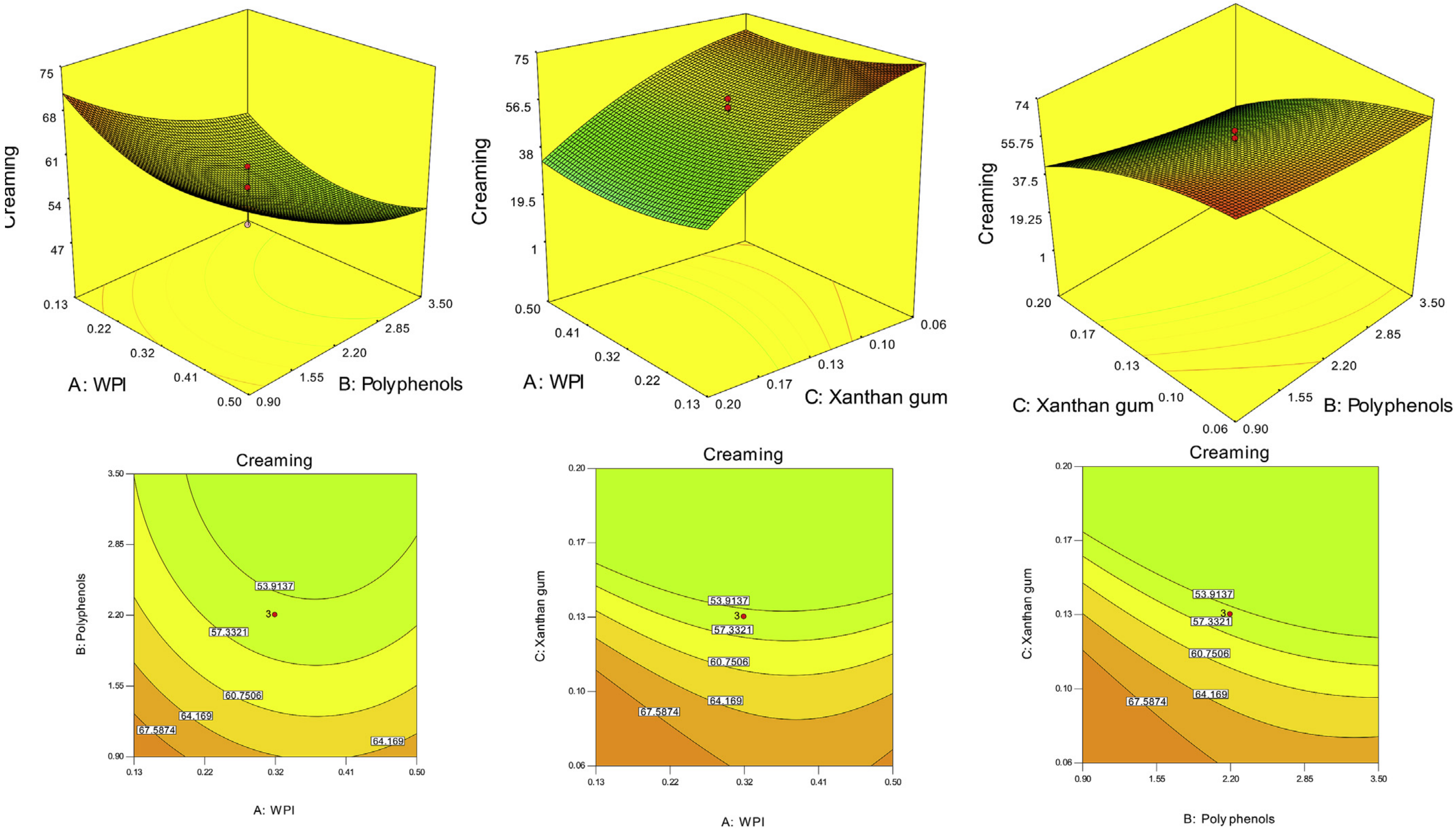
Interazioni biofenoli-proteine della saliva: effetto di mascheramento delle note aromatiche.



Average values of bitterness (A), pungency (B) and fruity (C) attributes as evaluated by 3 IOOC panels in a model EVOO (MOO-P) and in the same sample furtherly added of phenols (MOO-P+).

L’aroma ‘mandorlato’ della *Coratina*, ’erbaceo’ della *Tonda Iblea*, di ‘carciofo’ e la ‘foglia’ del Frantoio, di ‘Pomodoro verde’ della *Ravece* etc., non dipende solo dalla **composizione delle sostanze volatili**, ma anche dal particolare **equilibrio con i biofenoli** che – oltre a determinare il gusto amaro/piccante dell’OEVO – possono mascherare o modificare l’impatto sensoriale di alcuni aromi influendo sul loro rilascio nel cavo orale.

Alla base di ciò ci sono le interazioni dei biofenoli con le proteine della saliva, con le molecole volatili, ma anche quelle con le **matrici alimentari** con cui l’olio è combinato (es: proteine del siero di latte, WPI).



Response surface plots for emulsions creaming rate (%) showing the interaction effects between (a) WPI, (b) OMW phenolic compounds and (c) xanthan (Caporaso et al, 2016 (*Food Hydrocolloids*).

vii) qualità nutrizionale dell'OEVO ed effetto saziante di alcune molecole aromatiche.

Cite this: *Food Funct.*, 2015, **6**, 204

Oleic acid content of a meal promotes oleoylethanolamide response and reduces subsequent energy intake in humans

Ilario Mennella, Maria Savarese, Rosalia Ferracane, Raffaele Sacchi and Paola Vitaglione*

Received 4th August 2014,
Accepted 30th September 2014

DOI: 10.1039/c4fo00697f

www.rsc.org/foodfunction

Animal data suggest that dietary fat composition may influence endocannabinoid (EC) response and dietary behavior. This study tested the hypothesis that fatty acid composition of a meal can influence the short-term response of ECs and subsequent energy intake in humans. Fifteen volunteers on three occasions were randomly offered a meal containing 30 g of bread and 30 mL of one of three selected oils: sunflower oil (SO), high oleic sunflower oil (HOSO) and virgin olive oil (VOO). Plasma EC concentrations and appetite ratings over 2 h and energy intake over 24 h following the experimental meal were measured. Results showed that after HOSO and VOO consumption the circulating oleoylethanolamide (OEA) was significantly higher than after SO consumption; a concomitantly significant reduction of energy intake was found. For the first time the oleic acid content of a meal was demonstrated to increase the post-prandial response of circulating OEA and to reduce energy intake at subsequent meals in humans.

(L'olio extravergine fa aumentare gli endocannabinoidi … e riduce la fame!)

Estratto aromatico dell'olio extravergine aggiunto allo yogurt (aroma non percepito in bocca)

yogurt magro

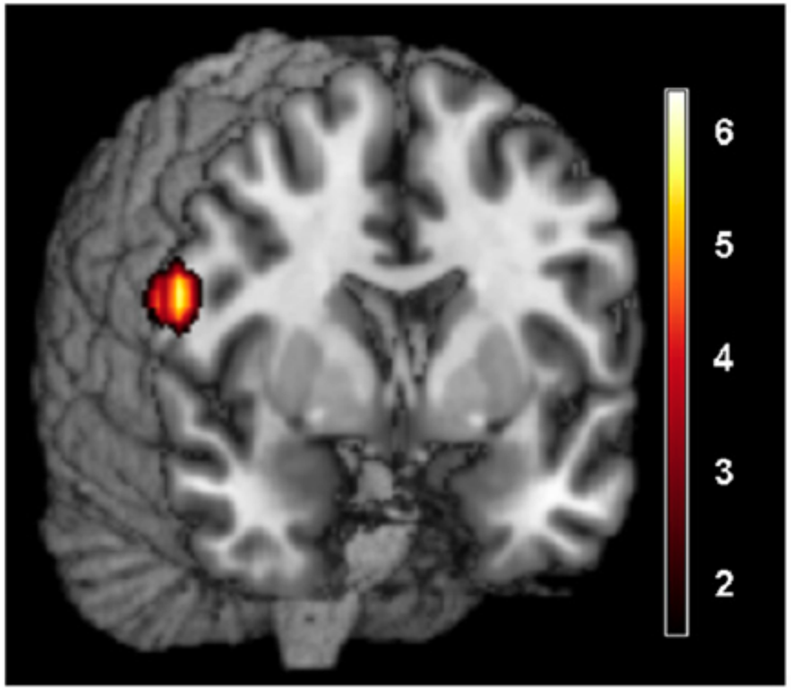
+

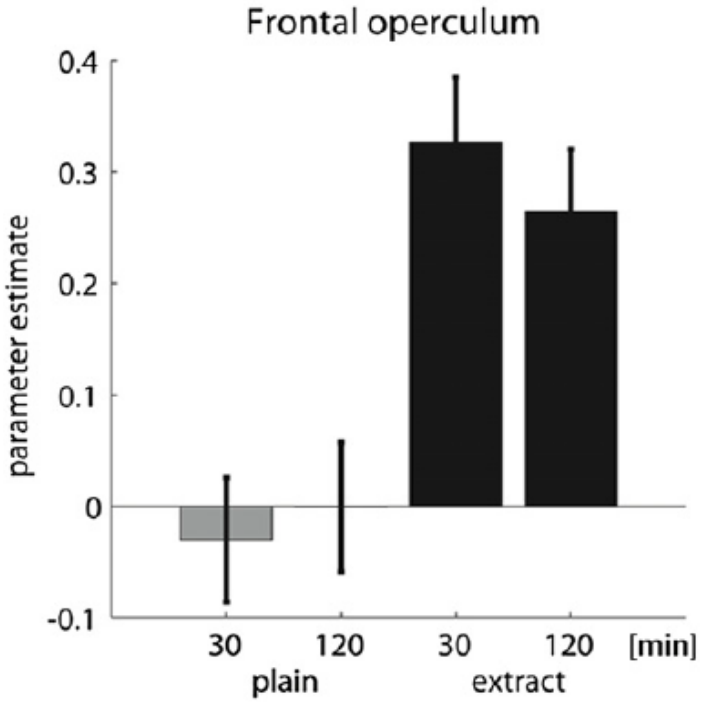
Estratto aromi di un olio extravergine italiano(volatile compounds 0.025%, wt:w)

yogurt

(Età 28.82 ±1.04; BMI 24.6 ± 0.56)

Frank et al., 2013 – Am. J. Clin. Nutr., 98, 1360–1366.





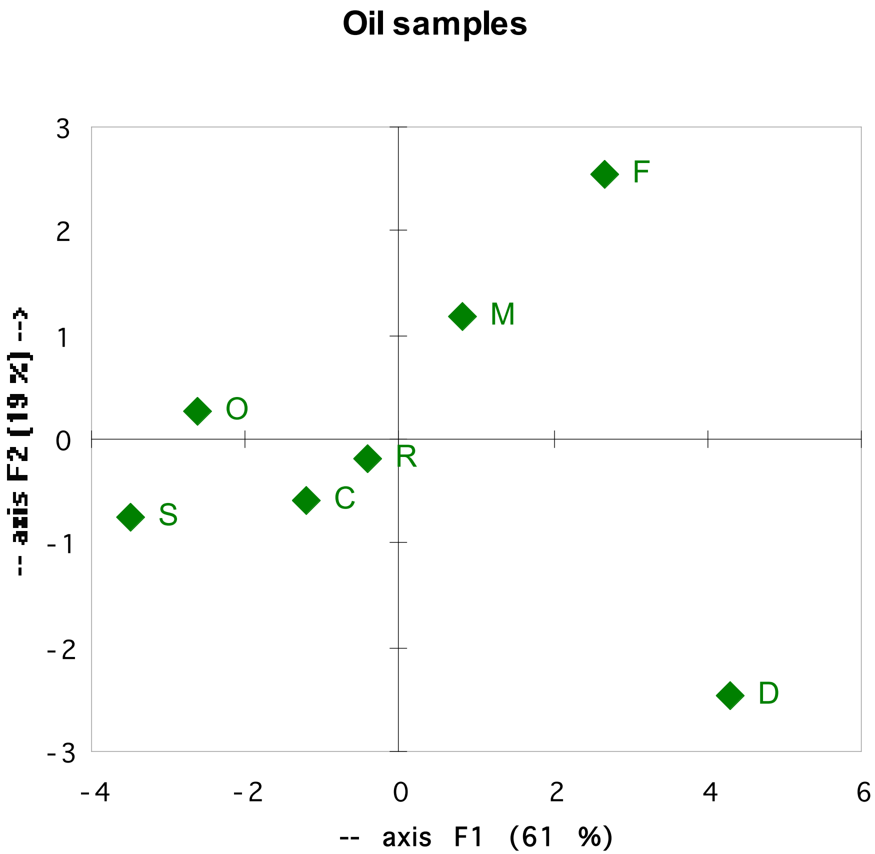
L'estratto aromatico dell'Olio Extravergine influenza il flusso sanguino **nell'area gustativa** del cervello umano!

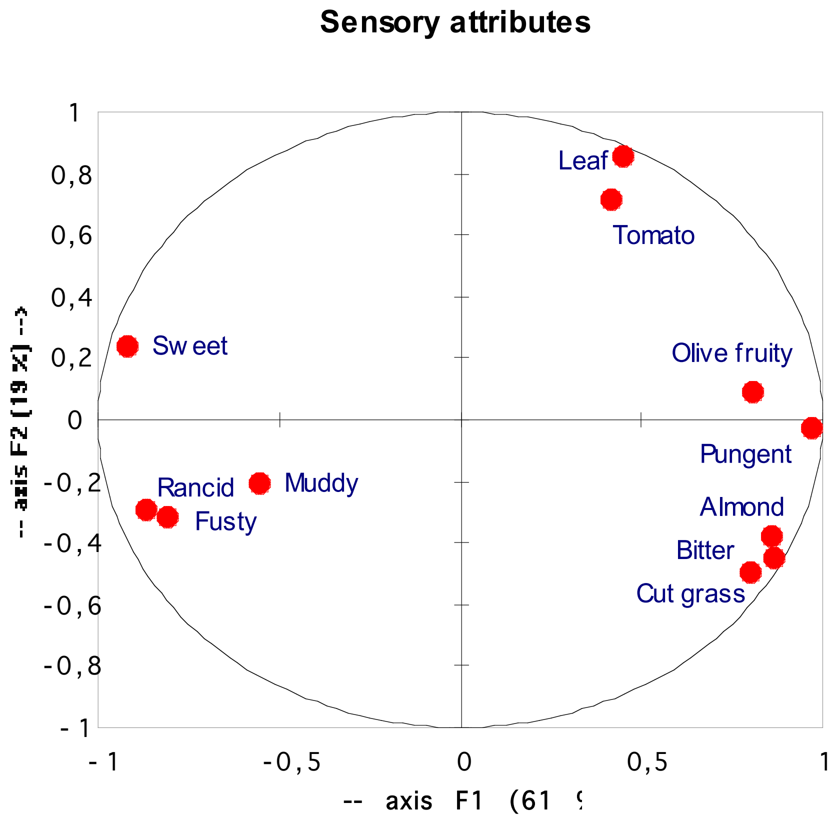
Frank et al (2013). Olive oil aroma extract modulates cerebral blood flow in gustatory brain areas in humans. *The American Journal of Clinical Nutrition*, 98, 1360–1366.

From … the EC-FLAIR Program on "Sensory and nutritional quality of virgin olive oil" (1993-1997) up today…

How to educate consumers that 'bitter is good for you"?

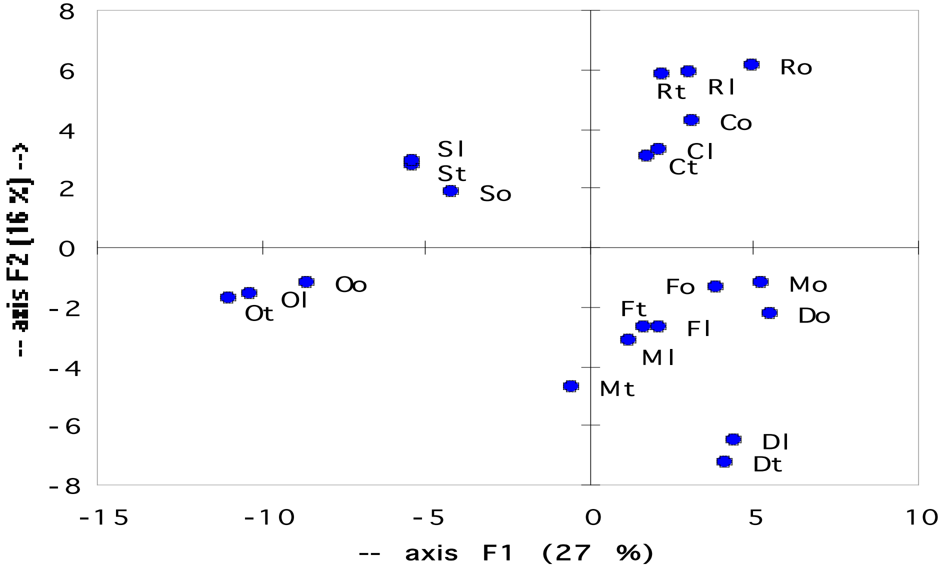
Selected olive oils used for a consumer test (Naples, 2005).



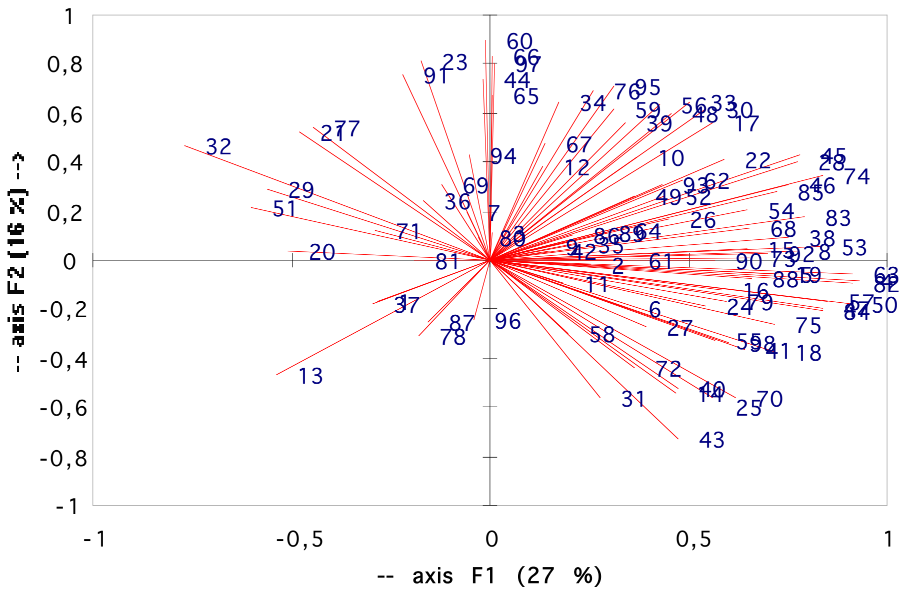


Consumer preferences measured **before** a nutritional information

Oil samples



98 consumers

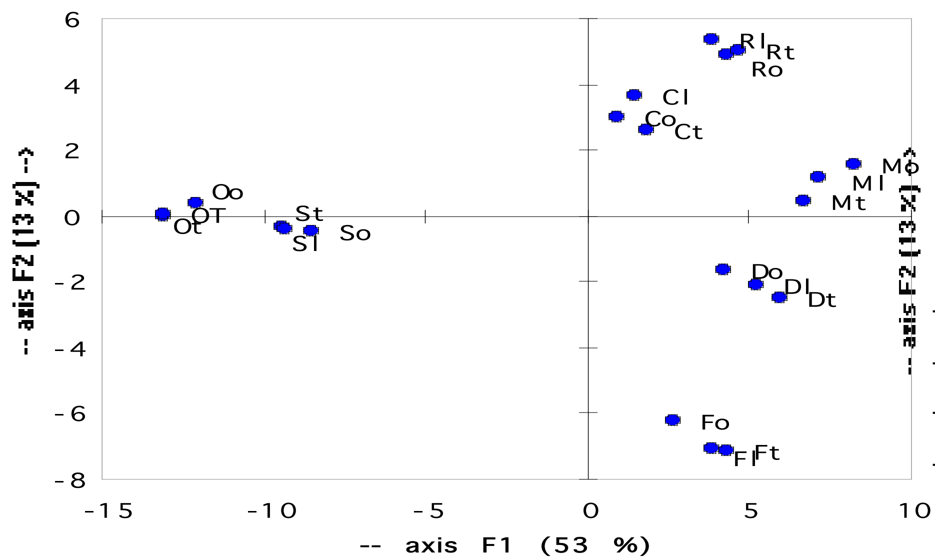


More than 50% consumers prefer low-quality virgin olive oil

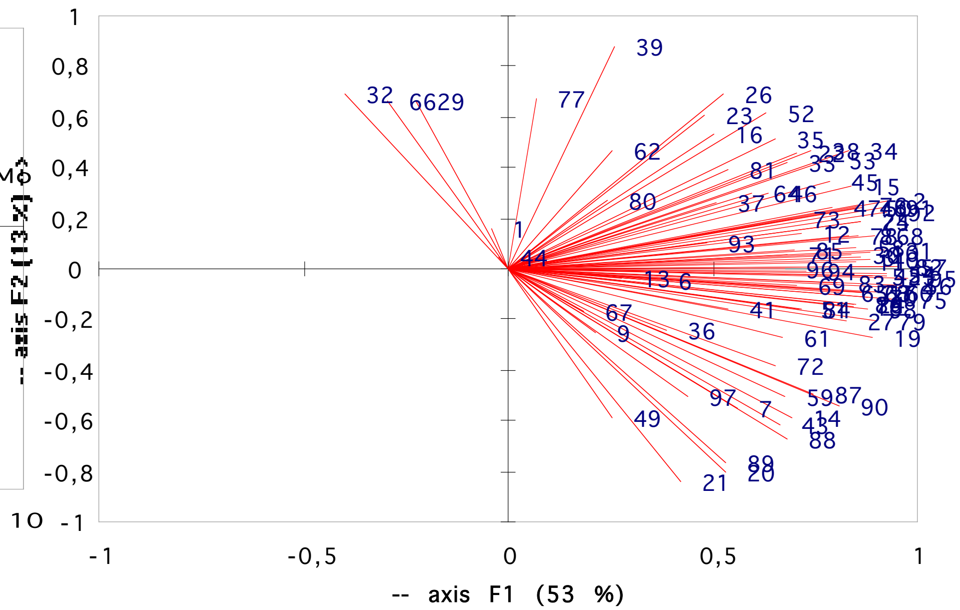
R.SACCHI, *EU Olive sector: driving innovation and sustainability*, Brussels, March 7th, 2018

After the nutritional information (without any sensory training)

Oil Samples



98 consumers



The majority (70%) of the consumers changes the preference after a simple information on the positive effect of bitter compounds of olive oil!

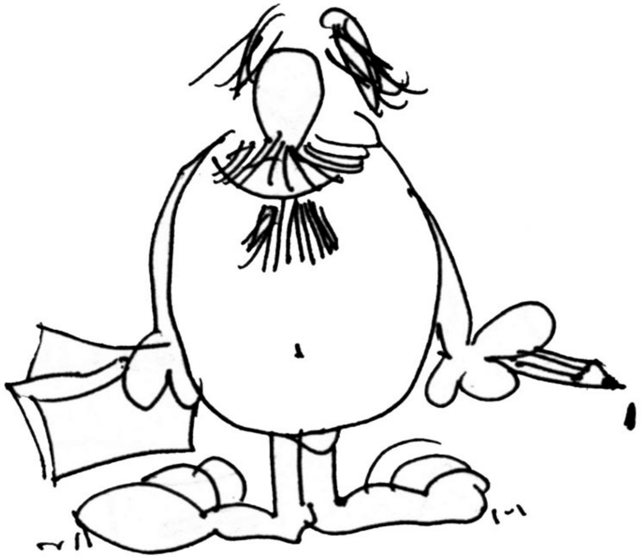
Progetto AGER 2 “COMPETiTiVE”

Claims of Olive oil to iMProvE The markeT ValuE

COMPETiTiVE

Claims for Olive oil to iMProvE The markeT ValuE of the product

GRAZIE PER L'ATTENZIONE!



PROGETTO Ager AGROALIMENTARE E RICERCA

FONDAZIONI IN RETE PER LA RICERCA AGROALIMENTARE

COMPETiTiVE Claims for Olive oil to iMProvE The markeT ValuE of the products

sacchi@unina.it

PROGETTO Ager AGROALIMENTARE E RICERCA

FONDAZIONI IN RETE PER LA RICERCA AGROALIMENTARE

COMPETiTiVE
Claims for Olive oil to iMProvE The markeT ValuE of the products