

Food quality assessment: the role of chemists

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21 Aprile 2021 *Chemistry Wednesdays*



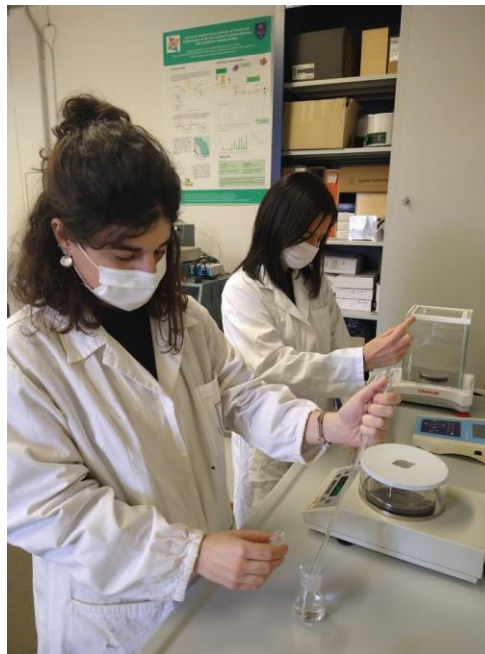
In the Lab



Out of the Lab

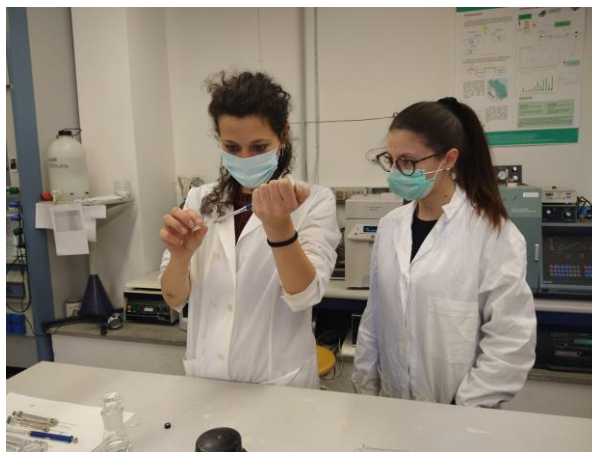


Serena,
3rd year PhD student



Lucia,
master student

Lucia,
2nd year PhD
student



Aurora,
bachelor student



Food quality assessment: the role of chemists

- Food chemists study **food composition and transformations of food constituents** during production, storage and cooking processes.
- All these stages contribute to the definition of the final quality of the food.
- The **methods for analyzing food constituents are constantly evolving** and when a method to perform an analysis should be selected, it is generally assessed whether **improvements can be made** to the identified method or whether **new methods can even be proposed**.
- And this is what we do in our group.



We develop methods for the analysis of molecules present in food and which can be important from different points of view, e.g.:

Nutritional (e.g. lipids composition)

Healthy (e.g. phenolic substances in olive oil)

Sensory (e.g. volatile substances in a wine)

To develop methods for analysing food constituents, an in-depth **knowledge of the chemical composition of foods**, of the **properties of the constituents of foods** and of their **reactivity** is necessary, issues that in fact are addressed by the food chemistry.



Examples

- Method for analysing **olive oil phenolic substances** and its application





Olive oil polyphenols: A quantitative method by high-performance liquid-chromatography-diode-array detection for their determination and the assessment of the related health claim

Massimo Ricciutelli^a, Shara Marconi^b, Maria Chiara Boarelli^b, Giovanni Caprioli^c, Gianni Sagratini^c, Roberto Ballini^b, Dennis Fiorini^{b,*}

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Micro-scaled Quantitative Method to Analyze Olive Oil Polyphenols

Giovanni Caprioli, Maria Chiara Boarelli, Massimo Ricciutelli, Gianni Sagratini & Dennis Fiorini

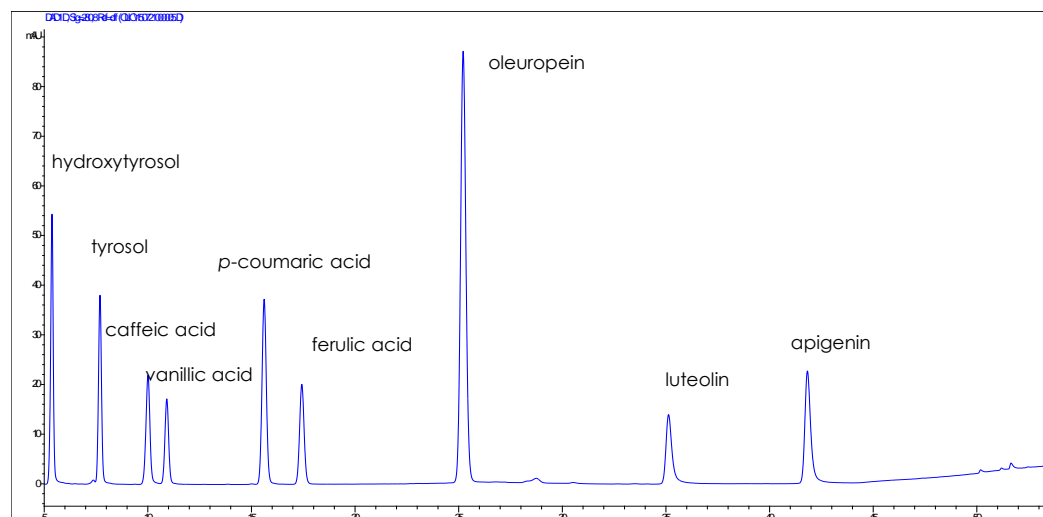
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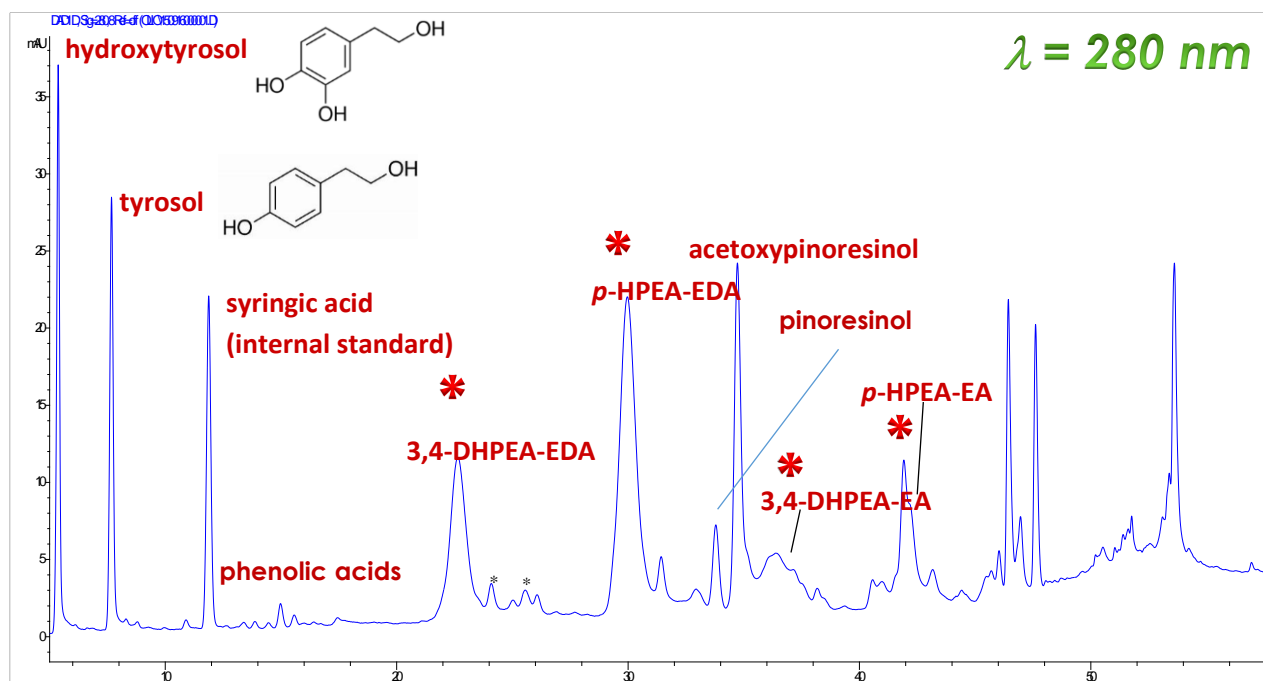


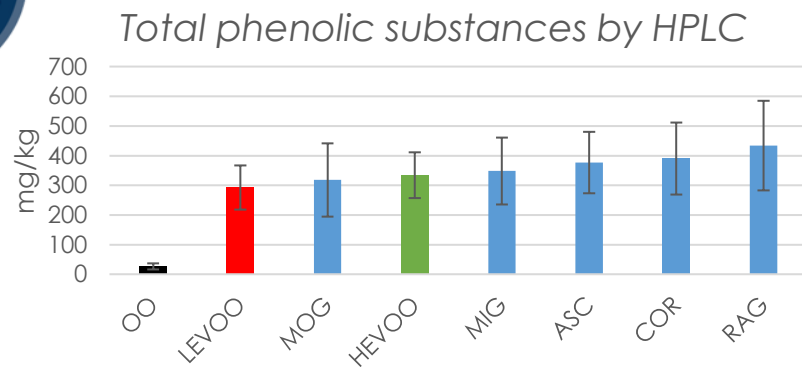
Springer



HPLC-DAD chromatogram from an HEVOO polyphenol extract

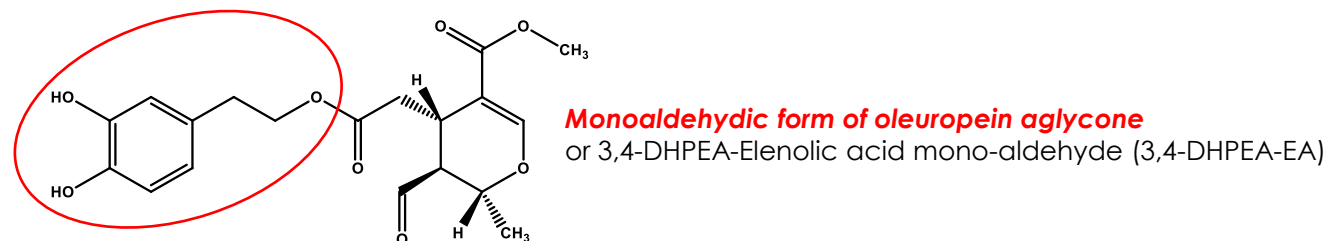
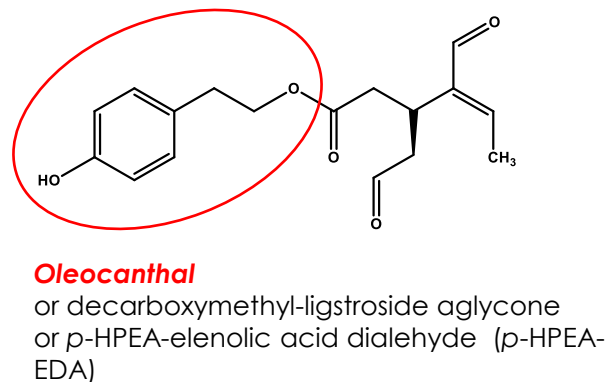
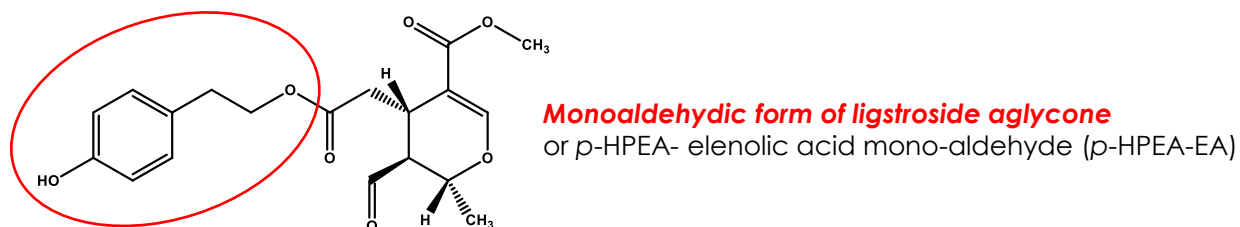
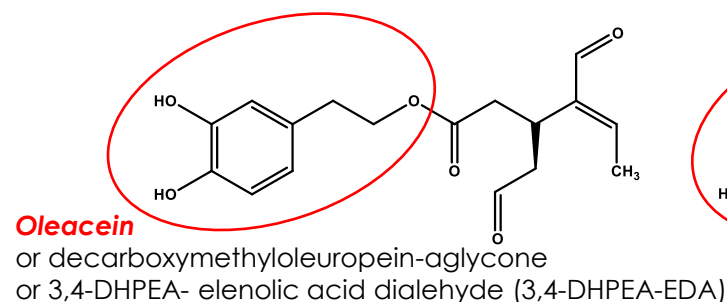
($\lambda_1 = 260 \text{ nm}$, $\lambda_2 = 280 \text{ nm}$ $\lambda_3 = 310 \text{ nm}$ $\lambda_4 = 325 \text{ nm}$ $\lambda_5 = 338 \text{ nm}$ $\lambda_6 = 350 \text{ nm}$)

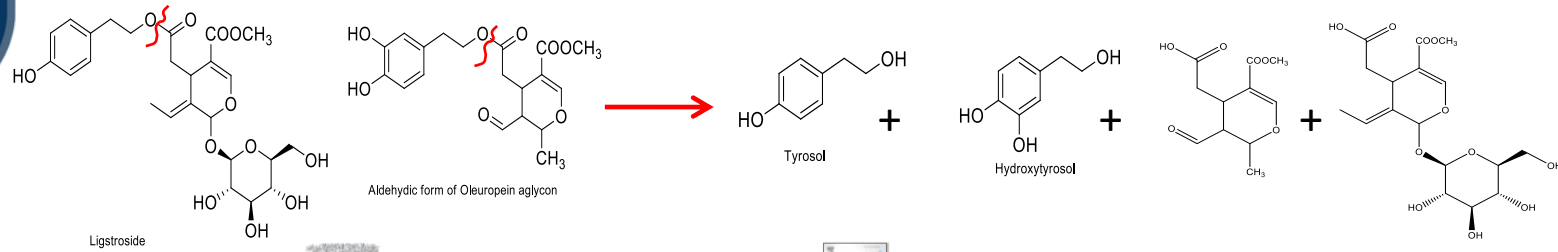




MOG: Piantone di Mogliano
 COR: Coroncina
 MIG: Mignola
 RAG: Raggia
 ASC: Ascolana tenera
 HEVOO: high price extravirgin supermarket
 LEVOO: low price extravirgin supermarket
 OO: olive oil (mixture refined and virgin)
 supermarket

Main secoiridoid derivatives



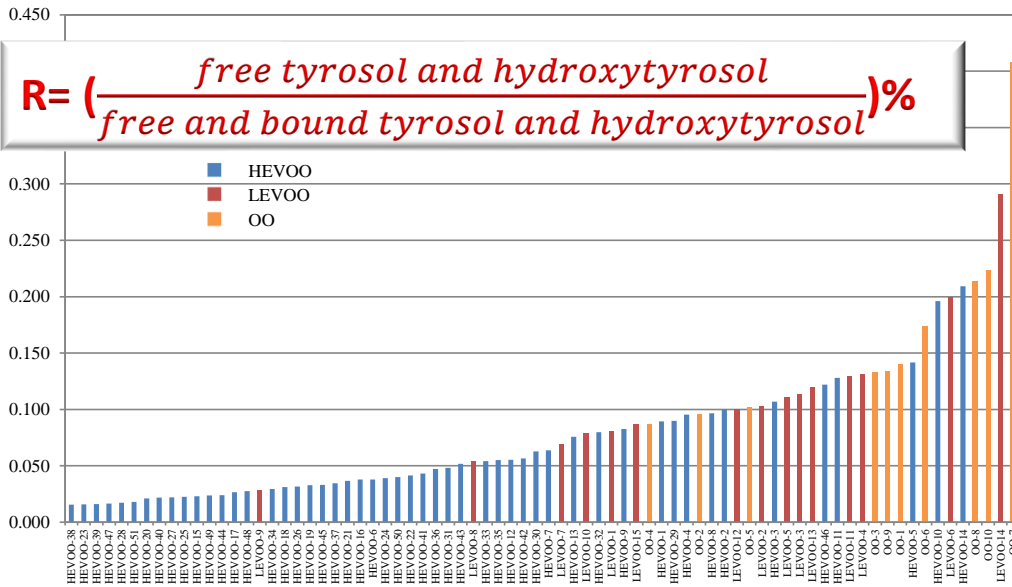
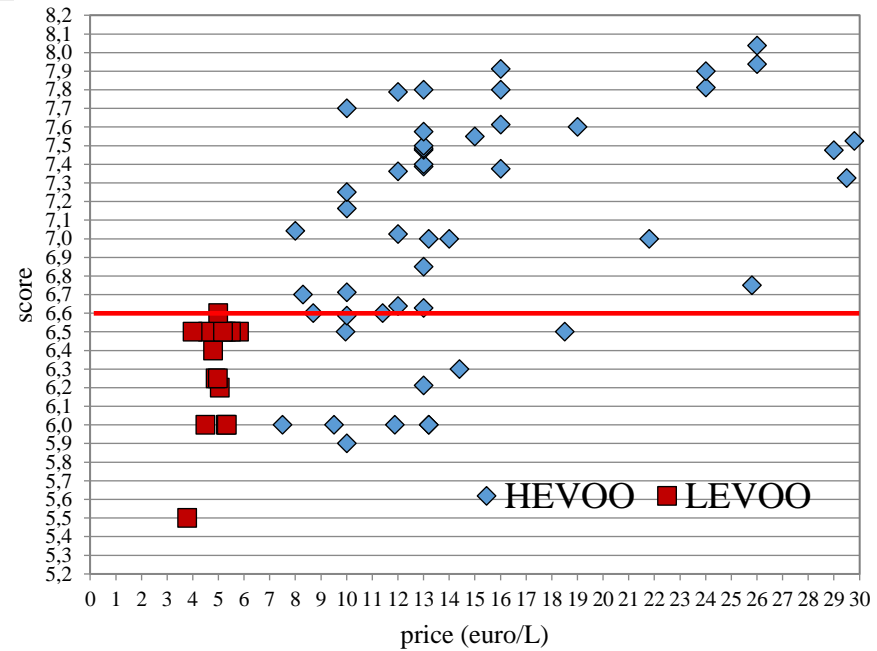


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Chemical and sensory differences between high price and low price extra virgin olive oils

Dennis Fiorini ^{a, R, B}, Maria Chiara Boarelli ^a, Paolo Conti ^a, Barbara Alfei ^b, Giovanni Caprioli ^c, Massimo Ricciutelli ^d, Gianni Sagratini ^e, Donatella Fedeli ^c, Rosita Gabbianelli ^c, Deborah Pacetti ^a



PhD student Lucia Lenti
2° year of PhD (XXXV cycle)

Supervisor Prof. Dennis Fiorini
Co-supervisor Prof. Deborah Pacetti



Background

2015 • Bachelor's degree in Chemistry

2017 • Master's degree in Chemistry and advanced chemical methodologies

→ 6 months at the Instituto Superior Técnico (IST), Lisbon

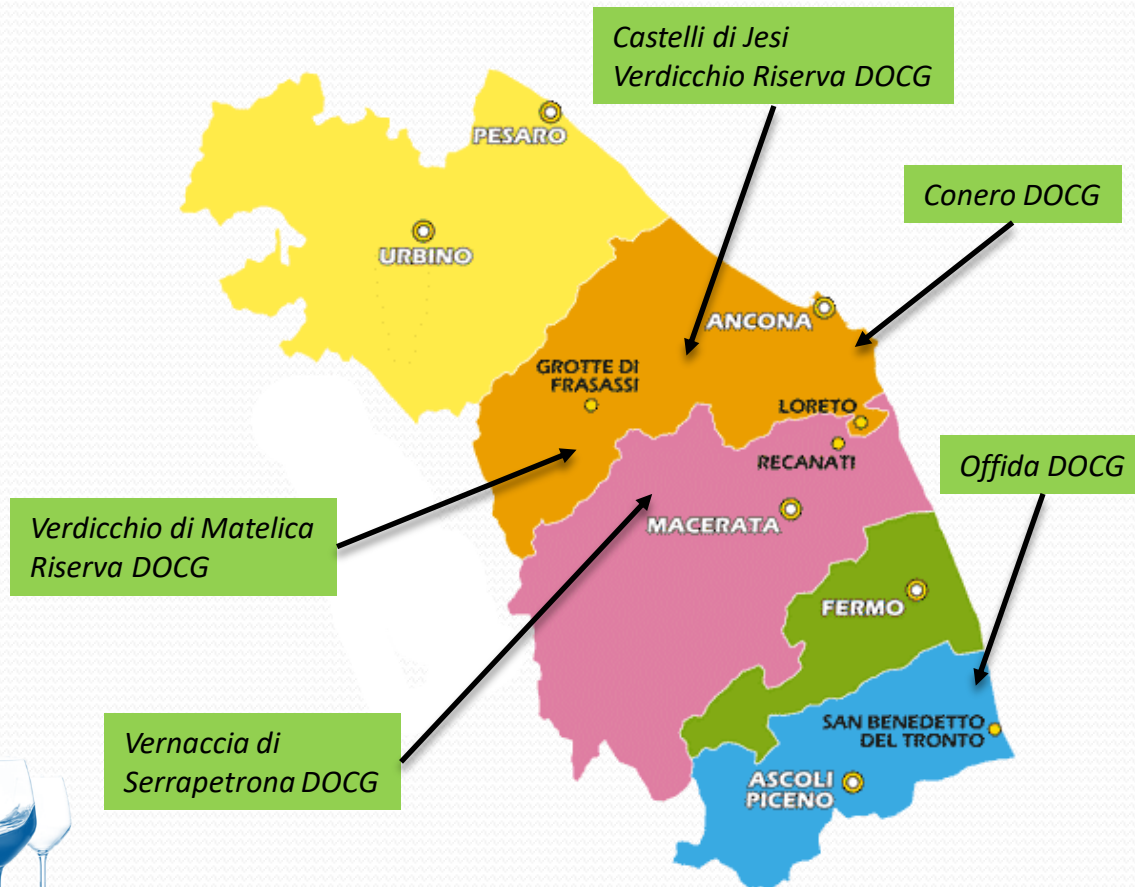
2018 • Abroad period between the UCD in Dublin and the JKU in Linz

2019 • Begin of PhD in UNICAM



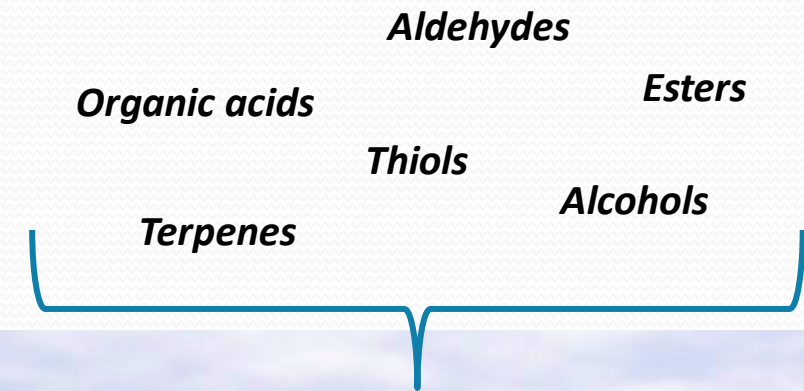
Volatile Organic Compounds in wine

PROJECT: Optimization of Volatile Organic Compounds (VOC)s extraction in wine, with final scope to characterize Marche Region's wines of excellence (D.O.C.G.).



VOCs composition has a fundamental role in wine since it is the most important parameter able to define the product quality from the sensory point of view.

In fact they are known to contribute to the wine *bouquet*.



Volatile Organic Compounds in wine

PROJECT: Optimization of Volatile Organic Compounds (VOC)s extraction in wine, with final scope to characterize Marche Region's wines of excellence (D.O.C.G.).

The extraction of VOCs is performed through SPME (**Solid Phase MicroExtraction**).

It is important to chose the best extraction conditions in terms of:

- fiber type
- extraction mode
- temperature
- sample quantity
- equilibration time
- speed of magnetic stirring

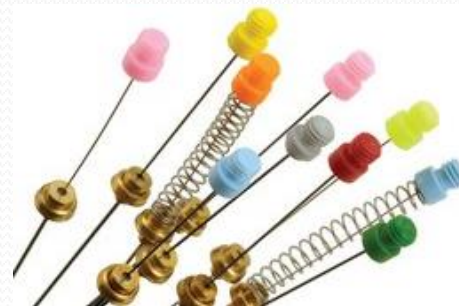


head space

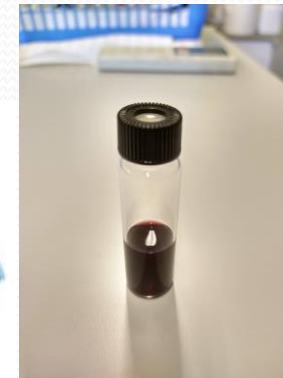


direct immersion

OC-fiber
PDMS/CAR/DVB-PDMS



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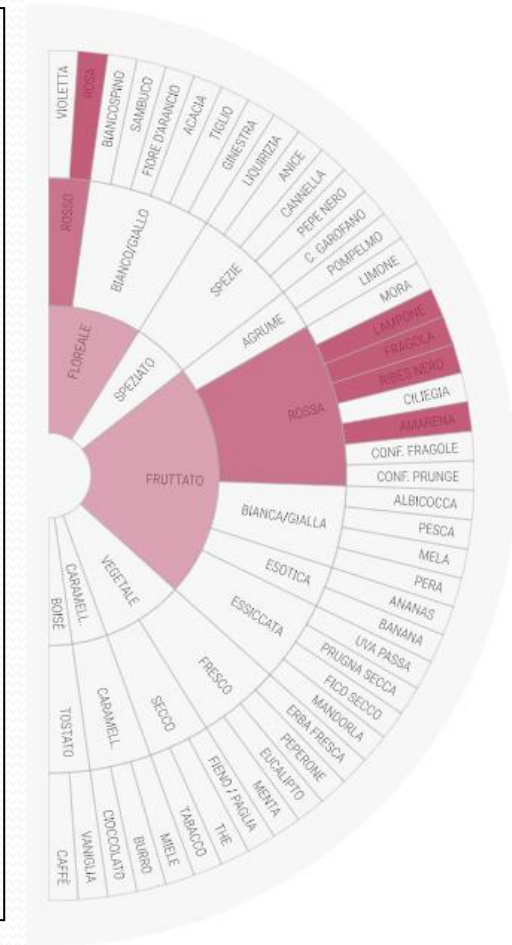
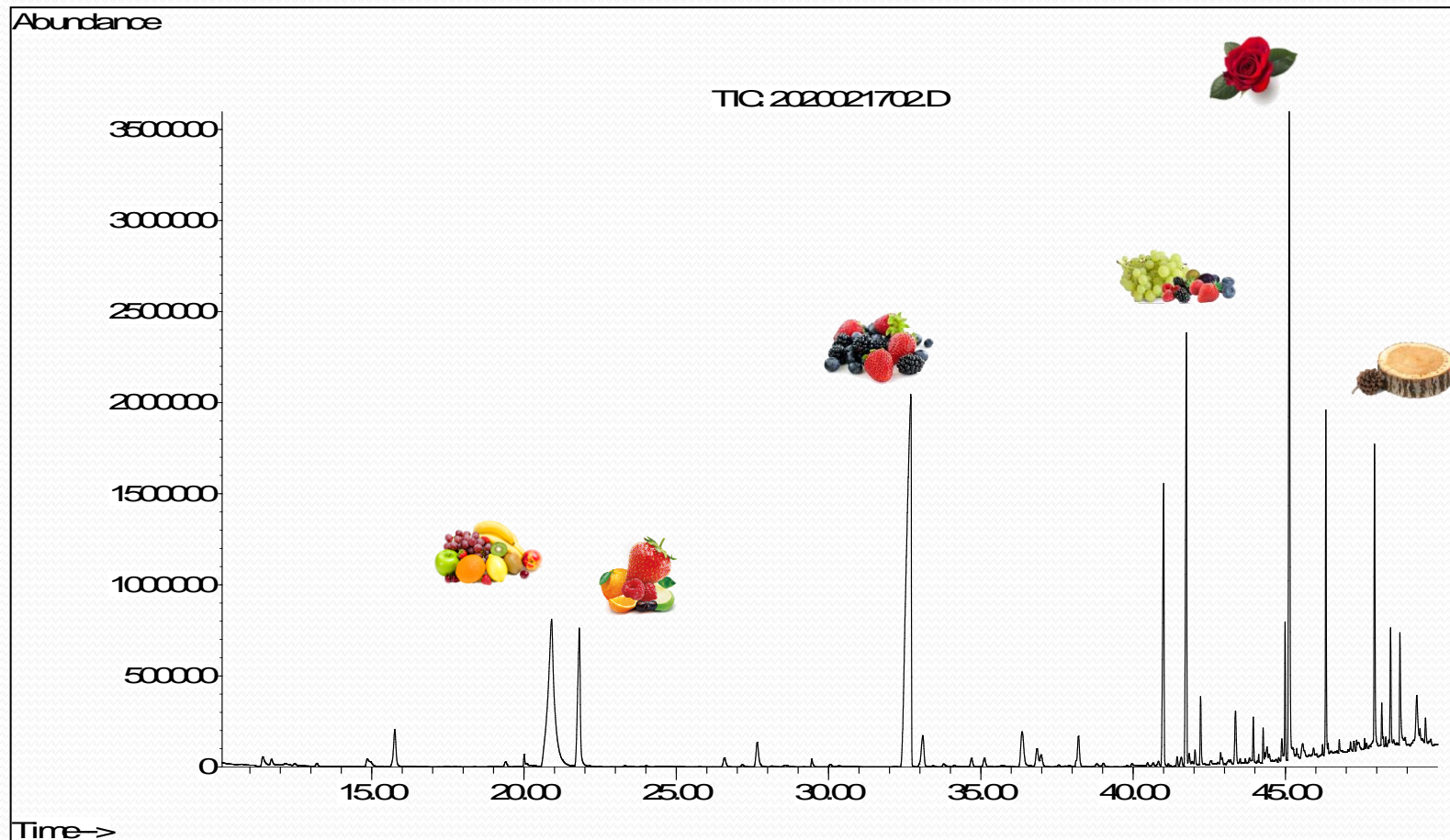


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Volatile Organic Compounds in wine

The SPME extraction of VOCs is followed by the gas-chromatographic-mass spectrometry analysis (GC-MS). Only VOCs present above their olfactory threshold will contribute to the final bouquet.



Vino Lacrima
di Morro d'Alba



Short and medium chain fatty acids in wine

PROJECT: Optimization and validation of a GC-FID method for the extraction and quantification of short and medium chain fatty acids (C2-C10).

S/MCFAs is a very important class of organic compounds. They contribute to the *flavor* and are related to the production process and product quality.

C2-C10

acetic acid

propionic acid

iso-butyric acid

butyric acid

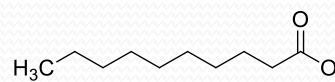
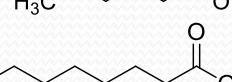
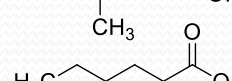
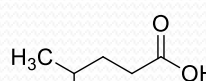
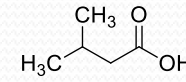
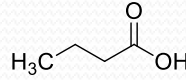
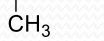
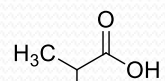
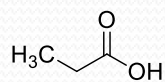
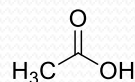
iso-pentanoic acid

iso-hexanoic acid

hexanoic acid

octanoic acid

decanoic acid



diethyl ether

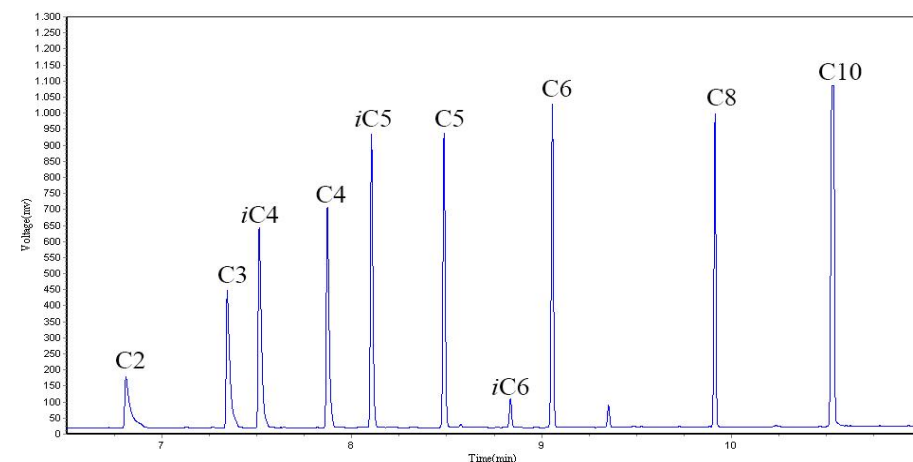
wine



The extraction has been optimized through LLE (**Liquid-Liquid Extraction**)

The use of salts greatly contribute to the extraction of these analytes of interest.

- NaCl
- $(\text{NH}_4)_2\text{SO}_4$
- NaH_2PO_4
- $(\text{NH}_4)_2\text{SO}_4 / \text{NaH}_2\text{PO}_4$



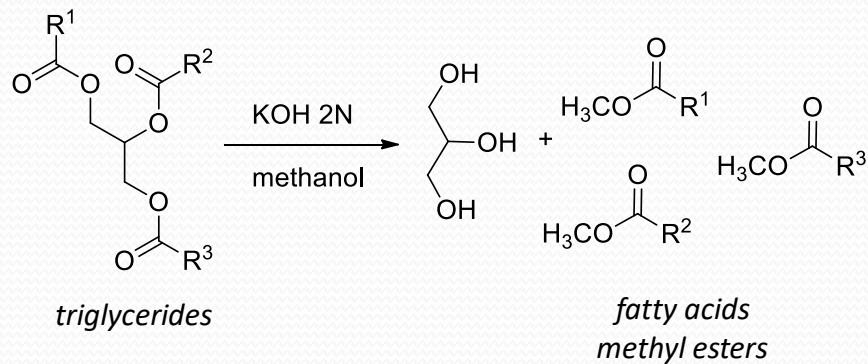
GC-FID chromatogram of a mix standard, from C2 to C10



Linalool and Eugenol from basil powder

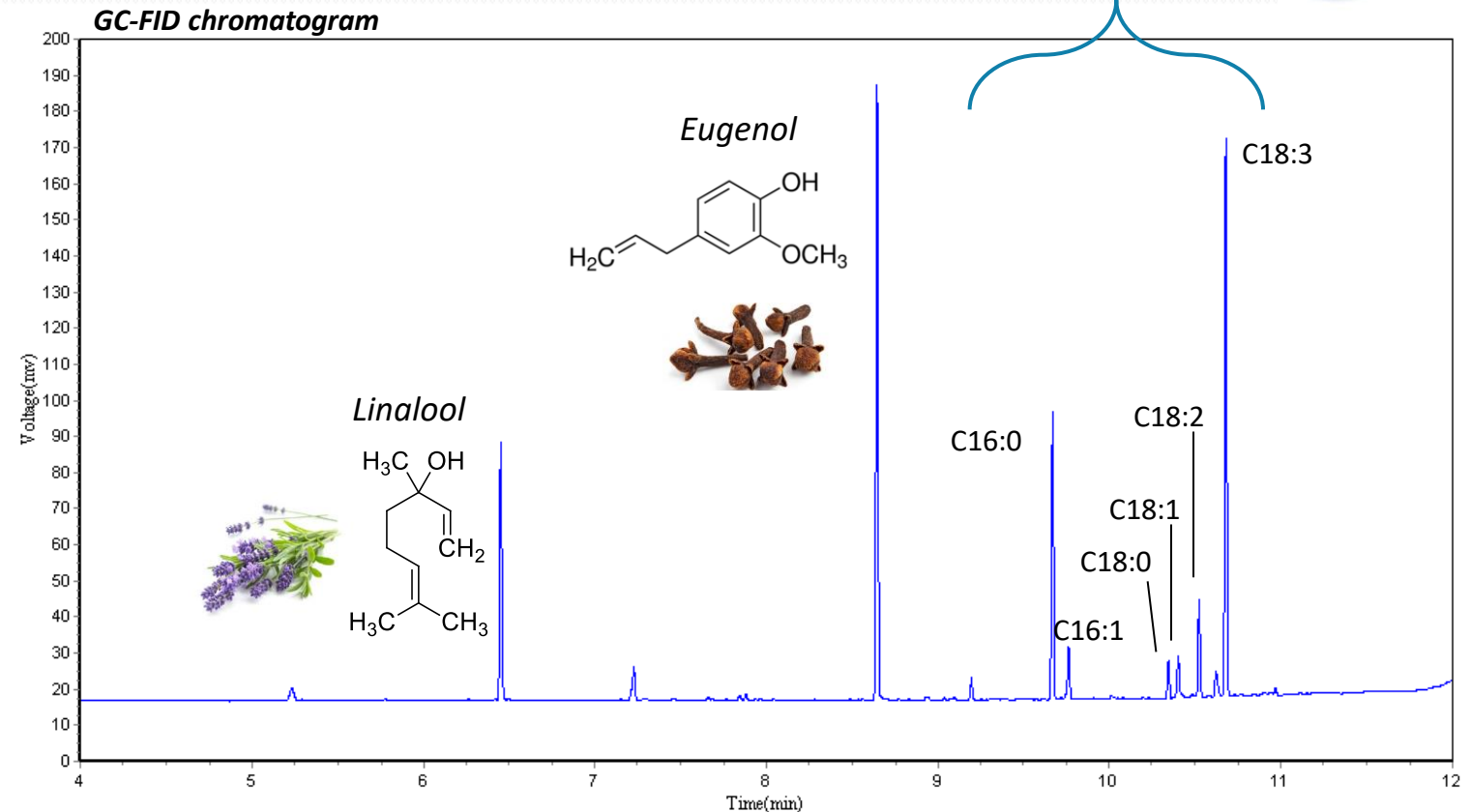
PROJECT: Extraction optimization and validation of a GC-FID method for the quantification of:

- **Linalool and Eugenol**, through liquid-liquid extraction in organic solvent.
- **Fatty acids**, through triglycerides trans-methylation.



Fatty acids

- Palmitic acid C16:0
- Stearic acid C18:0
- Oleic acid C18:1
- Linoleic acids C18:2
- Linolenic acid C18:3



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VOLATILE ORGANIC
COMPOUNDS FROM
COOKING PROCESSES

STUDY OF SHELF-LIFE
OF CHICKEN BREAST

SHORT CHAIN
FATTY ACIDS
IN FECES



UNIVERSITÀ
di CAMERINO

Serena Scortichini

PhD Student, School of Science and Technologies
Chemistry Division
Supervisor: Dennis Fiorini





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?

What happens when
we cook food?



COLLABORATION
WITH ELICA SpA



Analytical Method

PROGETTO EUREKA



Study of the development of VOCs from different food matrices and different cooking methods and of the efficiency of different filters used in kitchen hoods

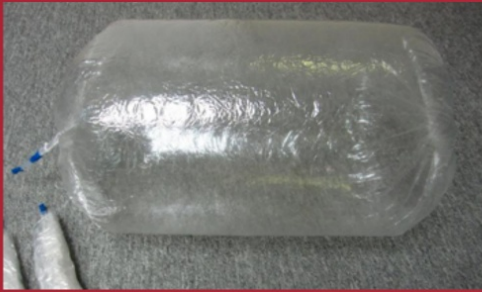
Received: 30 January 2020 | Revised: 28 March 2020 | Accepted: 14 April 2020
DOI: 10.1002/jms.4534

SPECIAL ISSUE - RESEARCH ARTICLE

MASS SPECTROMETRY WILEY

Development and application of a solid-phase microextraction gas chromatography mass spectrometry method for analysing volatile organic compounds produced during cooking

Serena Scortichini¹ | Maria Chiara Boarelli² | Mauro Castello² |
Francesco Chiavarini² | Serena Gabrielli¹ | Enrico Marcantoni¹ | Dennis Fiorini¹



OLFACTOMETRIC BAGS



GC-MS ANALYSIS



SPME EXTRACTION

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FATTY ACIDS
IN FECES



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di CAMERINO

Serena Scortichini

PhD Student, School of Science and Technologies
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Supervisor: Dennis Fiorini





Shelf-life of chicken breast
meat stored in MATER-BI and
conventional packagings



CONVENTIONAL

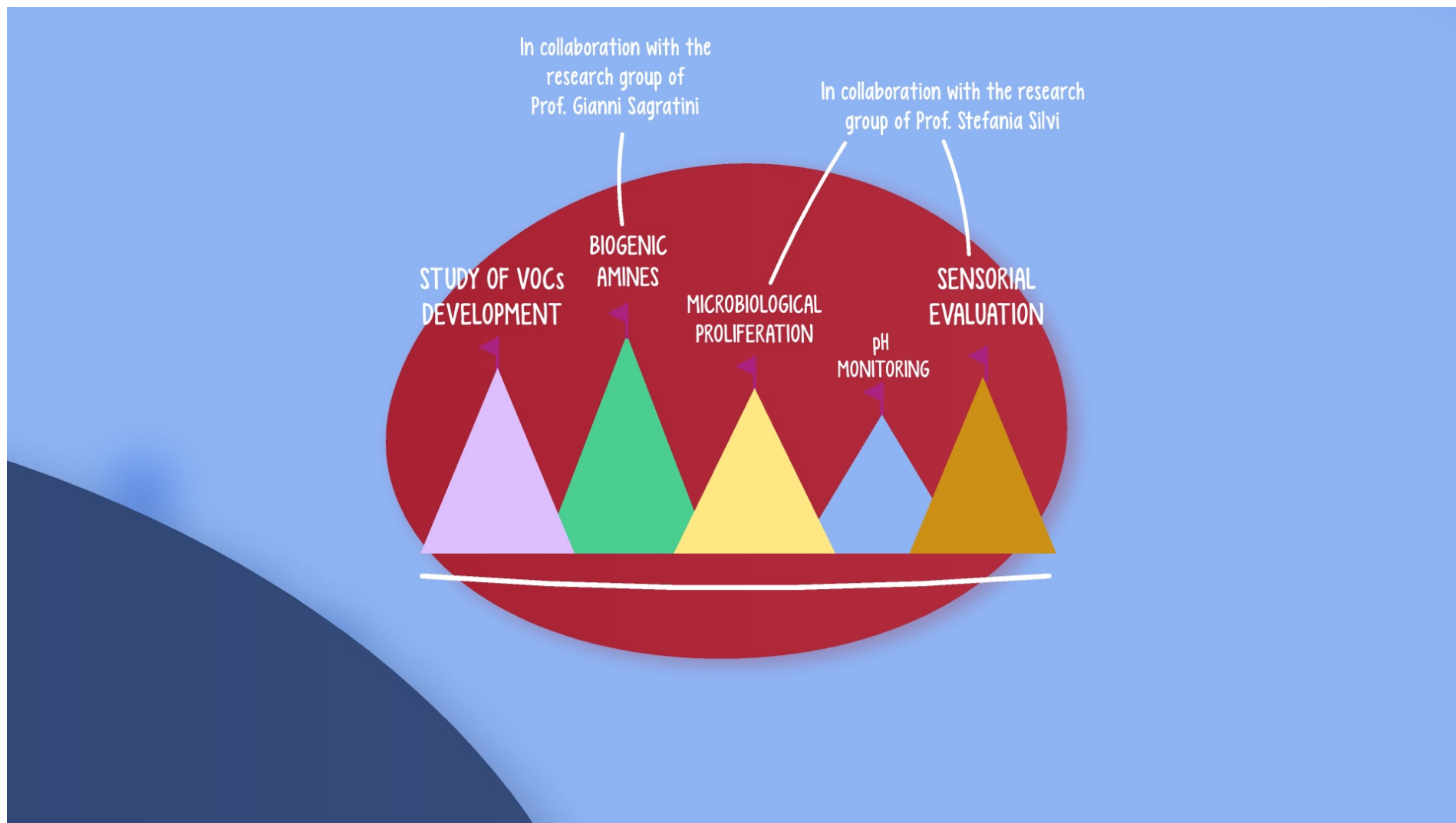


MATER-BI
(compostable)

GOAL ACHIEVEMENT

SAMPLES

STUDY OF VOCs





TIME 0



AFTER 3
DAYS



AFTER 6
DAYS



AFTER 9
DAYS

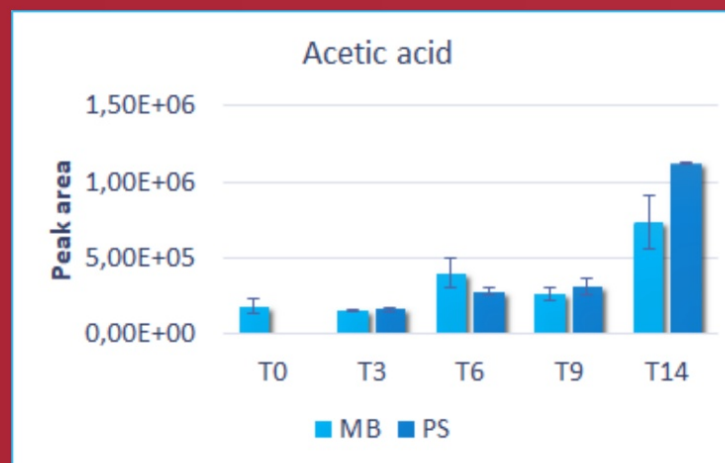


AFTER 14
DAYS

STUDY OF VOCs



STUDY OF VOCs



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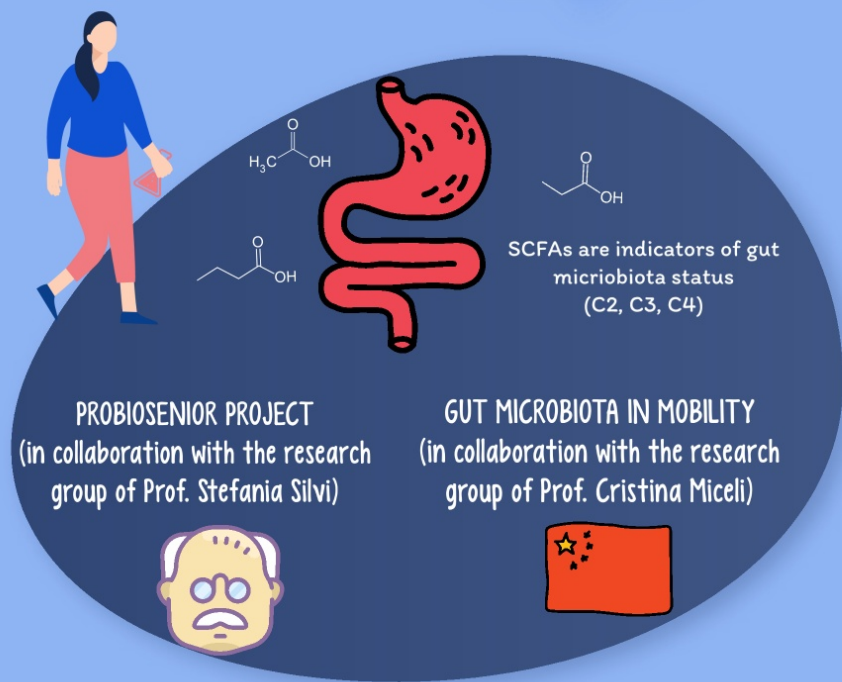


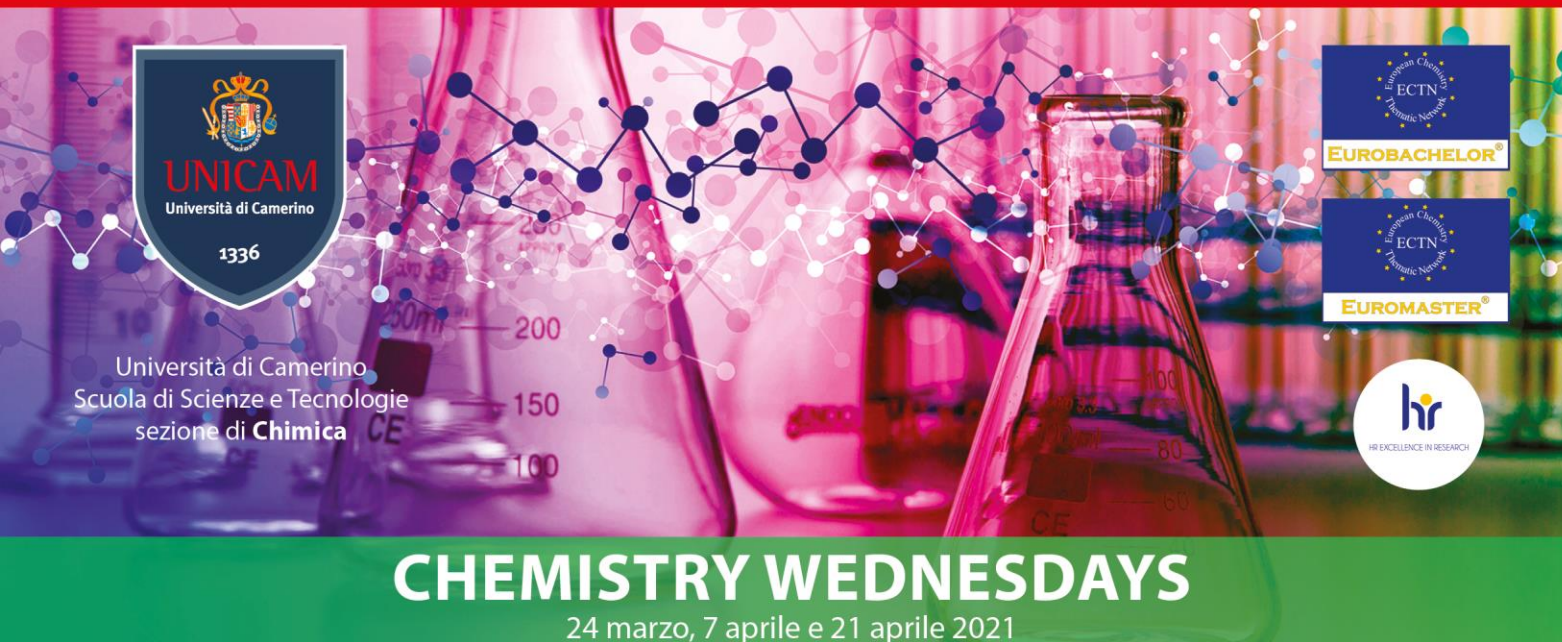
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Serena Scortichini

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Chemistry Division
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Thanks

PhD students Serena and Lucia

All the co-working colleagues from UNICAM
and from other universities and institutions

All of you for the kind attention!

