FUTURE4PRIMA

New strategies for the valorization of agriculture productions in the Mediterranean basin

Gabriella Tamasi and Claudio Rossi

UNIVERSITÀ DI SIENA 1240

DIPARTIMENTO DI BIOTECNOLOGIE, CHIMICA E FARMACIA — DBCF

Siena, 4 novembre 2026 @ Santa Chiara Lab

SANTA CHIARA LAB

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New Challenges in the AgriFood Sector



INNOVATIVE and sustainable strategies for **VALORIZATION** of agricultural and agrifood products through innovative analytical approaches, sustainability and circular economy strategies

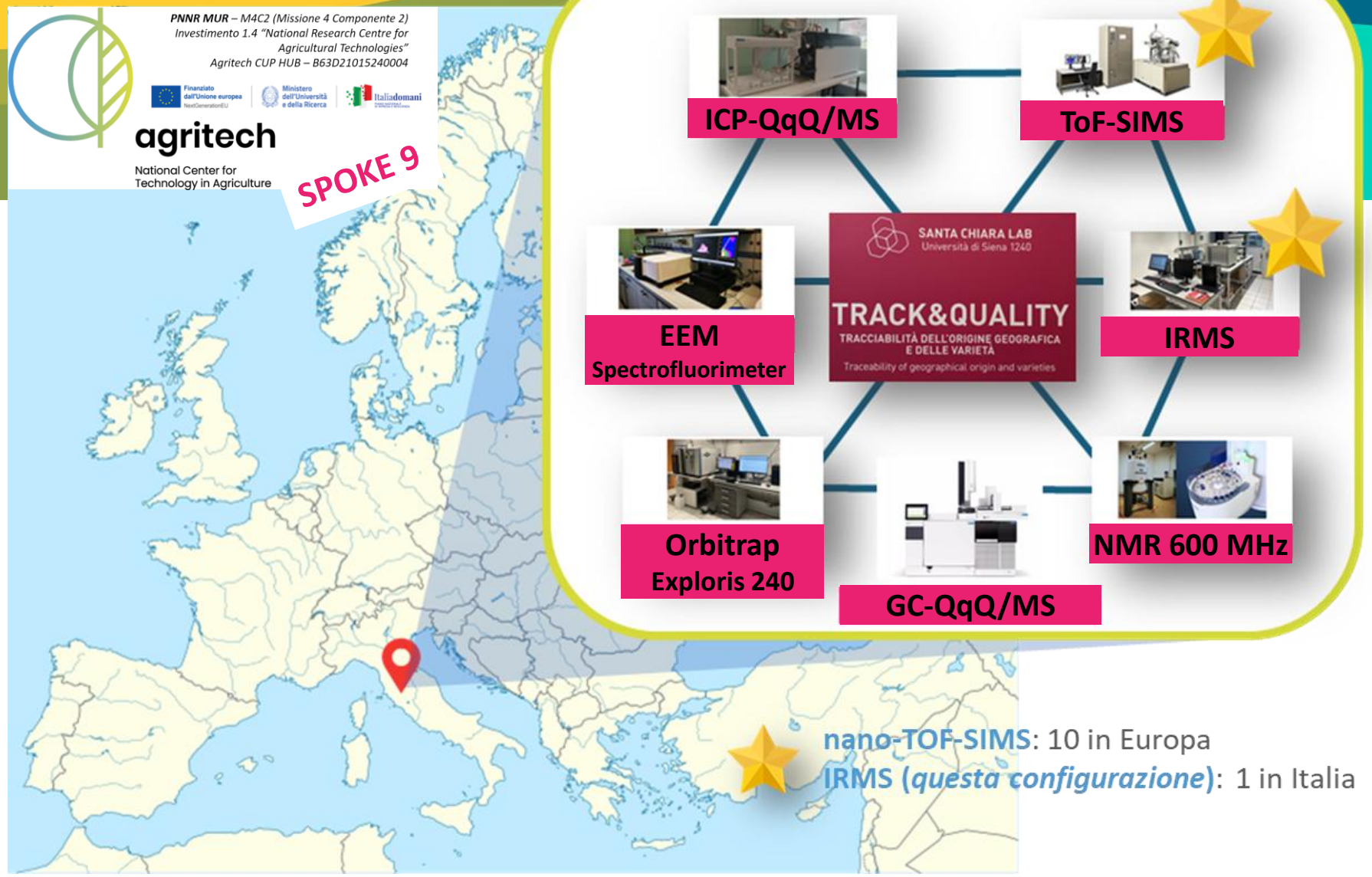
- Quality and safety of agricultural and agrifood products
- Geographical origin protection, authentication and valorization of territorial identity
- Sustainability of agricultural and agrifood production processes
- Resource recovery and by-products valorization
- Development of innovative, **HIGH-VALUE-ADDED PRODUCTS**

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Combined approach of analy**tical advanced techniques** and **chemometric data analysis** can support the transition towards more sustainable, transparent and competitive agrifood systems

INFRASTRUCTURE

Spectroscopic and **spectrometric** techniques, also hyphenated with **chromatographic** separation techniques



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PNNR MUR – M4C2 (Missione 4 Componente 2)
Investimento 1.4 "National Research Centre for Agricultural Technologies"
Agritech CUP HUB – B63D21015240004

agritech
National Center for Technology in Agriculture

SPOKE 9

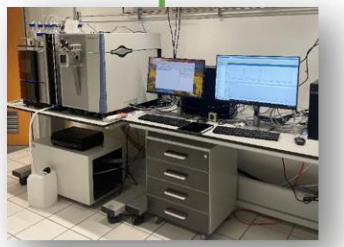
Research Area 1
Geographical Origin Traceability and Authenticity

Sample collection & Stabilization



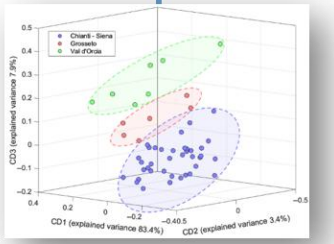
Collection/Harvesting
Cleaning
Stabilization
(freeze-drying & pulverization)
Storage
Homogenization
Extraction

Experimental Analysis



Spectroscopy
(^{1}H NMR, EEM Fluorescence, UV-Vis, XRF)
Mass Spectrometry
(ICP-MS, HPLC-DAD, HPLC-Orbitrap, IRMS, ToF-SIMS)

Development of interpretative models



Chemometric (Machine Learning)
Single Block Analysis
(Individual techniques):
PCA, LDA, SIMCA, PARAFAC
Multi Block Analysis
(Data Fusion)

Models validation & applicability



Geographical origin Authentication
Varietal characterization
Quality assessment

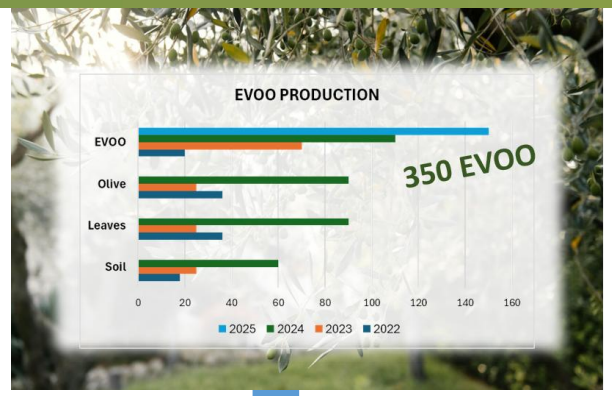
EVOO AND WIN ANALYTICAL DATASETS

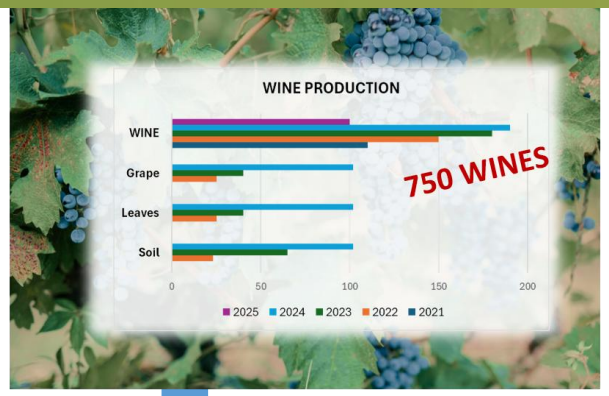
- ✓ Geographical origin identification of extra virgin olive oils and wines
- ✓ Characterization of elemental, isotopic and metabolomic profiles
- ✓ Integration of multi-analytical fingerprints (markers identification)
- ✓ Chemometric models for geographical classification
- ✓ Model validation (predictive abilities)
- ✓ Applications for **product authentication, protection and valorization**

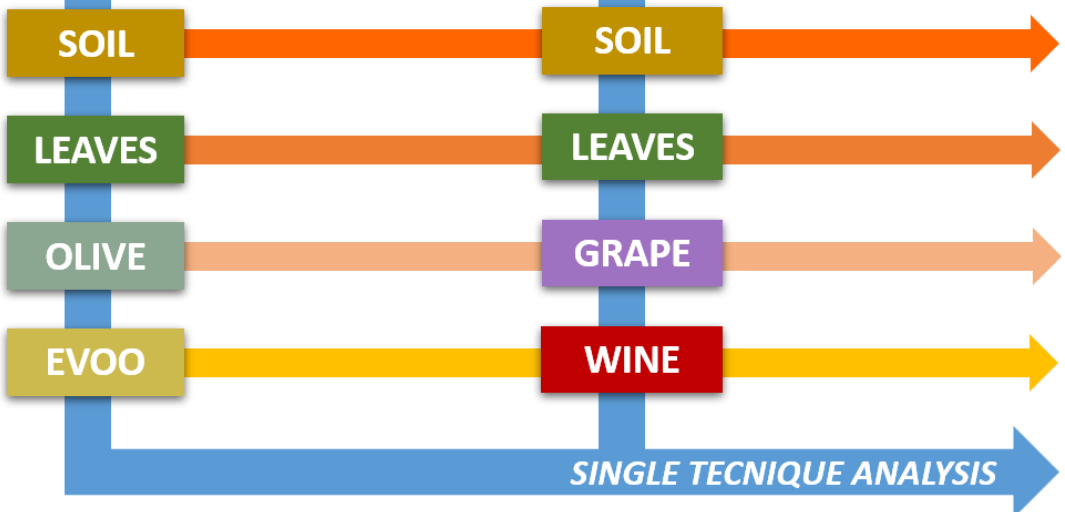
FUTURE4PRIMA

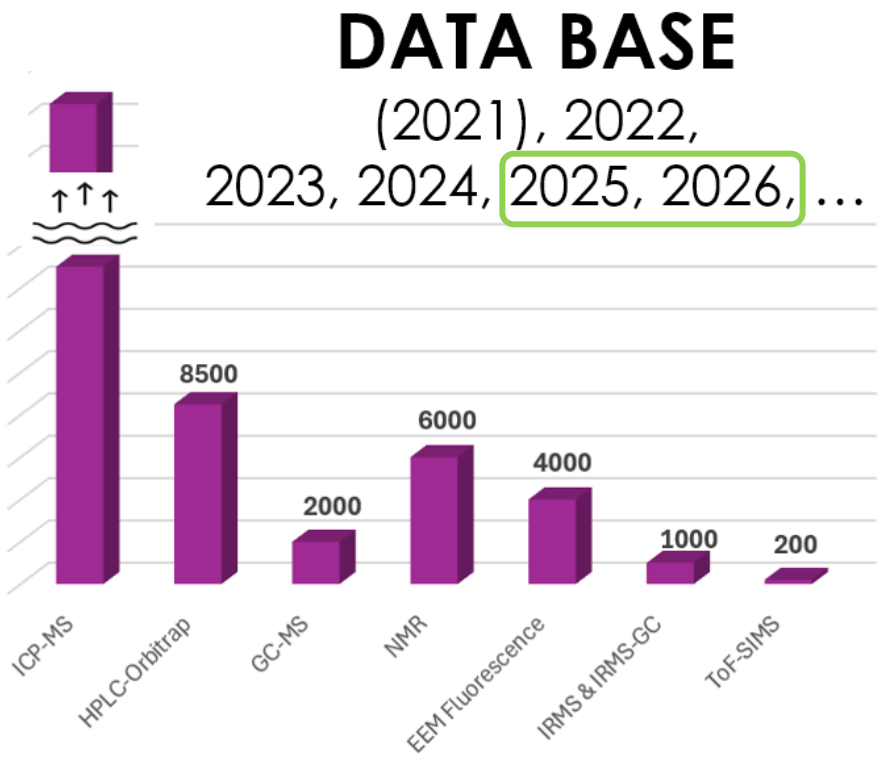
PNNR MUR – M4C2 (Missione 4 Componente 2)
Investimento 1.4 "National Research Centre for Agricultural Technologies"
Agritech CUP HUB – B63D21015240004
Finanziato dall'Unione europea NextGenerationEU | Ministero dell'Università e della Ricerca | Italiadomani
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Research Area 1
Geographical Origin Traceability and Authenticity









PNNR MUR – M4C2 (Missione 4 Componente 2)
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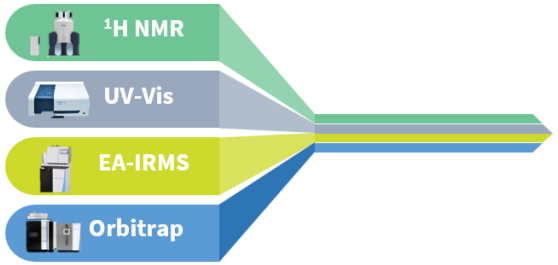
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Research Area 1
Geographical Origin Traceability and Authenticity

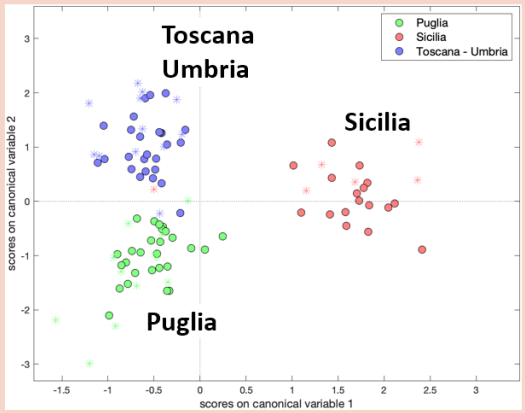
MULTI-BLOCK SPECTROSCOPIC AND ISOTOPIC SPECTROMETRIC DATA FUSION



SO-CovSel-LDA Multiblock Approach

1. **Stepwise Orthogonalization (SO)** removes redundant information across blocks
2. **Covariance Selection (CovSel)** identifies the most informative variables

Technique	Selected Variables	Chemical info
^{1}H NMR	0.53, 0.67, 2.65, 3.98, 4.4, 5.71, 6.52, 6.7 ppm	Sterols, triacylglycerols, unsaturated fatty acids, phenolic compounds
Orbitrap	Coumaric acid, Hydroxytyrosol, Luteolin	Phenolic acids, & alcohols, flavonoids
UV-Vis	Wavelength: 408, 436, 471, 666 nm	Phenolics β-carotene, pheophytin A
EA-IRMS	$\delta^{13}C$	Isotopic signature



Model Performance	SO-CovSel-LDA Accuracy
Training	93%
Cross-Validation	97%
External Test	95%

Improved Classification
Direct and **rapid** information about variable/technique **relevance**

OBJECTIVE – Design and validation of a **combined experimental-computational approach** for the **geographical origin** analysis of agricultural and agrifood products
from the olive oil and wine productions

Development of an Experimental Methodology for the traceability at ***Regional and Sub-Regional*** **geographical** level
Robustness (exportable to other agrifood products)
Accuracy more than **95%**



Finanziato dall'Unione europea NextGenerationEU
Ministero dell'Università e della Ricerca
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SANTA CHIARA LAB
Università di Siena 1240

Stakeholder engagement

SIENA FOOD LAB

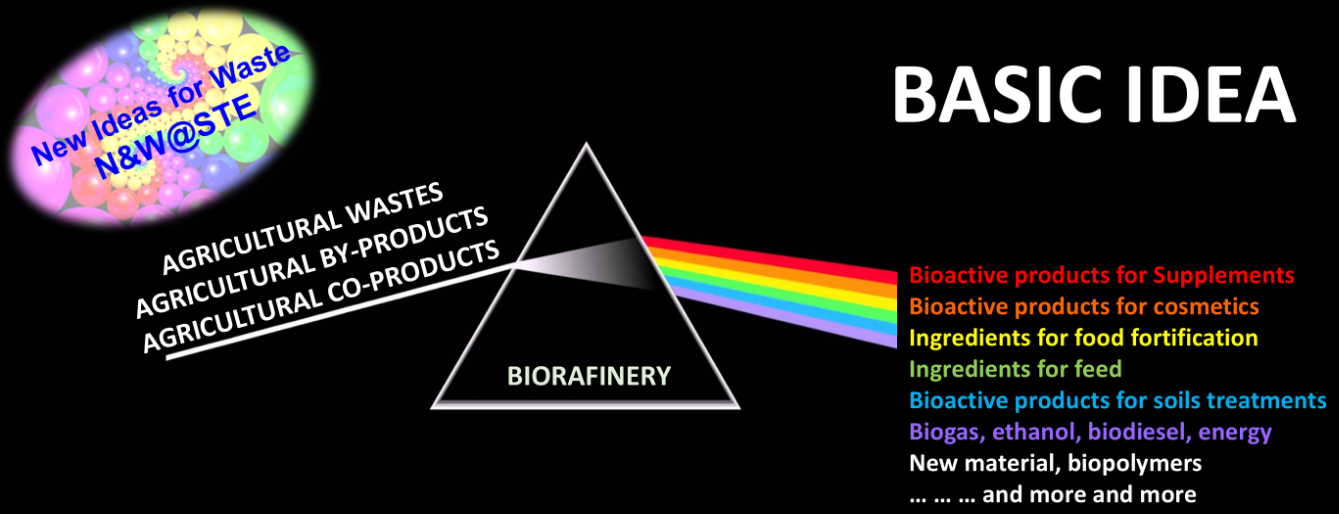
FMPS
Fondazione Monte dei Paschi di Siena

bio Distretto Biologico Maremma Toscana

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Research Area 2
Agricultural and Agrifood By-Product Valorization

BASIC IDEA



"Waste: A Resource to Recycle, Reuse and Recover Raw Materials Towards a near-zero waste society"

Importance to reduce the production of food wastes and possibly increase the value of agriculture wastes, co-products and by-products, that are currently not properly taken care of both from an environmental and economic point of view

BY-PRODUCTS REPRESENT THE STARTING MATERIAL FOR NEW PROCESSES

FROM BY-PRODUCTS TO VALUABLE RESOURCES:
circular economy and recovery of high-value compounds

- Chemical characterization of agricultural and agrifood by products
- Recovery of **bioactive** compounds and **valuable molecules**
- Assessment of chemical and **functional properties**
- Development of sustainable treatment/extraction and valorization strategies
- Potential applications in the food, agricultural and industrial sectors

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PROJECTS

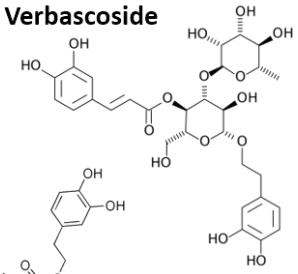
***Medicago sativa* L.**



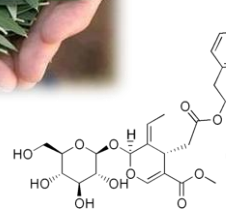
***Olea europeae* L.**



Verbascoside



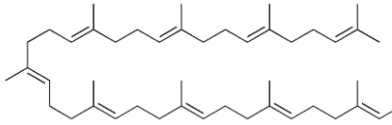
Oleuropein



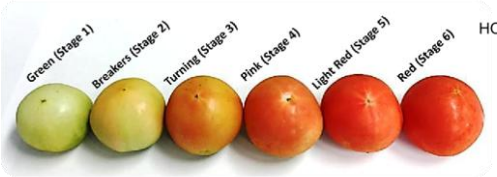
***Solanum tuberosum* L.**

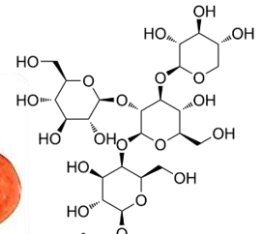


Solanesol

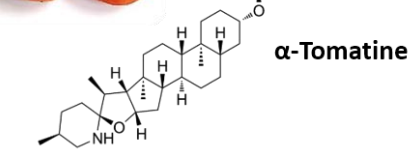


***Solanum lycopersicum* L.**





α-Tomatine

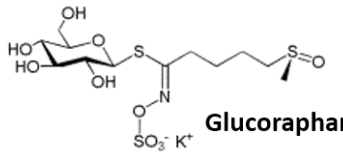


Brassica oleracea

var. *italica* **var. *botrytis***



Glucoraphanin



***Solanum melongena* L.**



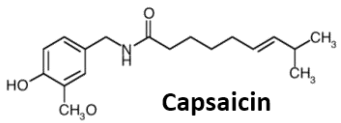
Nasunin



***Capsicum annuum* L.**



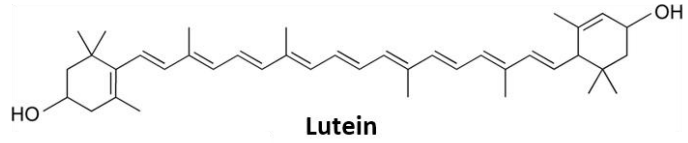
Capsaicin



Ancient grains and legumes



Lutein



- ✓ Identification of components with biological activity
- ✓ Characterization of nutritional and phytochemical profiles
- ✓ Evaluation of antioxidant properties and other relevant biological activities

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Research Area 3
Functional Products and Innovative Ingredients

FROM RESOURCE VALORIZATION TO THE DEVELOPMENT OF INNOVATIVE FUNCTIONAL PRODUCTS

- ✓ Formulation and development of innovative ingredients and products
- ✓ Assessment of stability and quality during processing and storage

Potential applications:

- ❑ Functional ingredients derived from plant by-products
- ❑ Food products enriched with bioactive compounds
- ❑ Innovative formulations with **high-added-value**

FORTIFIED PINSA



ACS FOOD SCIENCE & TECHNOLOGY 2024

pubs.acs.org/acsfoodscitech Article

Determination of Elemental Content in Vineyard Soil, Leaves, and Grapes of Sangiovese Grapes from the Chianti Region Using ICP-MS for Geographical Identification

Raffaello Nardin,* Gabriella Tamasi,* Michele Baglioni, Flavia Bisozzi, Marco Consumi, Jessica Costa, Giacomo Fattori, Cristiana Tozzi, Angelo Riccaboni, and Claudio Rossi

molecules 2024 MDPI

Article

Phenolic Profiles in Olive Leaves from Different Cultivars in Tuscany and Their Use as a Marker of Varietal and Geographical Origin on a Small Scale

Francesca Borghini [1,2,*], Gabriella Tamasi [1,3], Steven Arthur Loiselle [1,3], Michele Baglioni [1,3], Stefano Ferrari [4], Flavia Bisozzi [1,3], Sara Costantini [1,3], Cristiana Tozzi [2], Angelo Riccaboni [2,5] and Claudio Rossi [1,3]

ELSEVIER Contents lists available at ScienceDirect Food Chemistry 2021 journal homepage: www.elsevier.com/locate/foodchem

Kinetics of glucosinolate hydrolysis by myrosinase in *Brassicaceae* tissues: A high-performance liquid chromatography approach

Alessio Pardini [a,b,*], Gabriella Tamasi [a,b,*], Federica De Rocco [a], Claudia Bonechi [a,b], Marco Consumi [a,c], Gemma Leone [a,c], Agnese Magnani [a,c], Claudio Rossi [a,b]

foods 2024 MDPI

Article

Combining Metal(loid) and Secondary Metabolite Levels in *Olea europaea* L. Samples for Geographical Identification

Raffaello Nardin [1,2,*], Gabriella Tamasi [1,2,*], Michele Baglioni [1,2], Giacomo Fattori [1,2], Amedeo Boldrini [1,2], Rodolfo Esposito [1,2] and Claudio Rossi [1,2]

molecules 2025 MDPI

Article

Geographical Origin Authentication of Leaves and Drupes from *Olea europaea* via ^{1}H NMR and Excitation–Emission Fluorescence Spectroscopy: A Data Fusion Approach

Duccio Tatini [1,2,*], Flavia Bisozzi [1,2], Sara Costantini [1,2], Giacomo Fattori [1,2], Amedeo Boldrini [1,2], Michele Baglioni [1,2,*], Claudia Bonechi [1,2], Alessandro Donati [1,2], Cristiana Tozzi [3], Angelo Riccaboni [3], Gabriella Tamasi [1,2] and Claudio Rossi [1,2]

Received: 17 January 2019 | Revised: 21 June 2019 | Accepted: 25 June 2019
DOI: 10.1002/fsn3.1142

ORIGINAL RESEARCH 2019 Food Science & Nutrition WILEY

Chemical characterization and antioxidant properties of products and by-products from *Olea europaea* L.

Gabriella Tamasi[1,2] | Maria Camilla Baratto[1] | Claudia Bonechi[1,2] | Anastasiya Byelyakova[1] | Alessio Pardini[1,2] | Alessandro Donati[1,2] | Gemma Leone[1,3] | Marco Consumi[1,3] | Stefania Lamponi[1,3] | Agnese Magnani[1,3] | Claudio Rossi[1,2,4]

ELSEVIER Contents lists available at ScienceDirect Microchemical Journal 2026 journal homepage: www.elsevier.com/locate/microc

Elemental and spectrophotometric profiling of Italian extra virgin olive oils: geographical classification, data fusion and soil-oil relationships

Raffaello Nardin [a,b], Duccio Tatini [a,b,*], Giacomo Fattori [a,b], Michele Baglioni [a,b], Claudio Rossi [a,b], Gabriella Tamasi [a,b]

molecules 2025 MDPI

Article

Hydrogel Beads Loaded with Glucosinolate-Rich *Brassicaceae* Extract as a Controlled-Release Alternative to Biofumigation

Michele Baglioni [1,2,*], Ilaria Clemente [1,2], Raffaello Nardin [1,2], Flavia Bisozzi [1,2], Sara Costantini [1,2], Giacomo Fattori [1,2], Gabriella Tamasi [1,2] and Claudio Rossi [1,2]

ELSEVIER Contents lists available at ScienceDirect Journal of Food Composition and Analysis 2021 journal homepage: www.elsevier.com/locate/jfca

Original Research Article

Effect of different post-harvest storage conditions and heat treatment on tomatine content in commercial varieties of green tomatoes

Alessio Pardini [a,b], Marco Consumi [a,c,*], Gemma Leone [a,c], Claudia Bonechi [a,b], Gabriella Tamasi [a,b,*], Paola Sangiorgio [d], Alessandra Verardi [d], Claudio Rossi [a,b], Agnese Magnani [a,c]

RSC Advances 2026 ROYAL SOCIETY OF CHEMISTRY

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Cite this: DOI: 10.1039/d6ra01563h

Mangiferin and oleocanthal in the modulation of oxidative stress in monocytes and macrophages

Richa Sharma, [a] Naga Venkata Anusha Anthikapalli, [a] Renu Kushwaha, [a] Alina Ovsii, [a] Marek Rác, [a] Pavel Pospíšil, [a] Gabriella Tamasi, [b] Agnese Magnani, [b] Claudio Rossi [*b] and Ankush Prasad [*a]

polymers 2023 MDPI

Article

Green Hydrogels Loaded with Extracts from *Solanaceae* for the Controlled Disinfection of Agricultural Soils

Ilaria Clemente [1,2,*], Michele Baglioni [1,2], Claudia Bonechi [1,2], Flavia Bisozzi [1,2], Claudio Rossi [1,2] and Gabriella Tamasi [1,2]

molecules 2021 MDPI

Article

Combined Experimental and Multivariate Model Approaches for Glycoalkaloid Quantification in Tomatoes

Gabriella Tamasi [1,2,*], Alessio Pardini [1,2], Riccardo Croce [1], Marco Consumi [1,3,*], Gemma Leone [1,3], Claudia Bonechi [1,2], Claudio Rossi [1,2] and Agnese Magnani [1,3]

foods 2022 MDPI

Article

Characterization of Extracts of Coffee Leaves (*Coffea arabica* L.) by Spectroscopic and Chromatographic/Spectrometric Techniques

Lorenzo Cangeloni [1,2], Claudia Bonechi [1,2], Gemma Leone [1,3], Marco Consumi [1,3], Marco Andreassi [1,2], Agnese Magnani [1,3], Claudio Rossi [1,2] and Gabriella Tamasi [1,2,*]

Patents

A Flexible and Modular Multi-Technique Data Fusion Approach for the Geographical Authentication of Agri-Food Products, with a Focus on Wine and Extra Virgin Olive Oil

Carbon, Oxygen and Hydrogen Isotope Ratios as Specific Markers for the Geographical Origin Authentication of Aqueous and Hydroalcoholic Beverages and Products

Spin off…

Stat up…

Exploring opportunities

FUTURE4PRIMA

Research Area 4
Perspective … New Challenges in AgriFood Sector

SOIL DATA LAB - A Territorial System for Monitoring Soil Health on Agricultural Farms

Soil health is currently one of the major challenges facing European agriculture. The increasing frequency of extreme weather events, the loss of organic matter, soil erosion, declining biodiversity, and the need to produce high-quality food with a lower environmental impact call for new tools to improve soil knowledge and management.







WATER DATA LAB - An Integrated System for Water Quality Monitoring and Sustainable Management

Water is a key resource for agricultural productivity, ecosystem health and food quality. WATER DATA LAB aims to develop innovative analytical tools and monitoring strategies to assess water quality, understand water–soil interactions and support the sustainable management of water resources in agricultural and agro-food systems.

FUTURE4PRIMA

Research Group



SANTA CHIARA LAB

UNIVERSITÀ DI SIENA 1240

DIPARTIMENTO DI BIOTECNOLOGIE, CHIMICA E FARMACIA — DBCF

Prof. Claudio Rossi
Prof. Gabriella Tamasi
Prof . Agnese Magnani
Prof. Michele Baglioni
Prof. Marco Consumi
Prof. Alessandro Donati
Prof. Claudia Bonechi
Dr. Duccio Tatini

Dr. Amedeo Boldrini
Dr. Simone Pepi
Dr. Ginevra Vigni
Dr. Camilla Baldanzi
Dr. Serena Morrocchesi



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CHIMICA PER LE SCIENZE AGROALIMENTARI

Dipartimento di Biotecnologie, chimica e farmacia

UNIVERSITÀ DI SIENA 1240

IL CORSO **ISCRIVERSI** **STUDIARE** **OPPORTUNITÀ**



Il corso di laurea magistrale in **Chimica per le Scienze Agroalimentari** si propone di formare chimici qualificati con competenze specialistiche nel settore agroalimentare, offrendo un percorso accademico che integra conoscenze approfondite in chimica con una comprensione dettagliata delle dinamiche e delle esigenze specifiche di tale ambito applicativo. Attraverso un approccio interdisciplinare, il corso mira a preparare professionisti in grado di affrontare le complesse sfide del settore, nell'ottica di garantire la qualità dei prodotti agroalimentari, la tracciabilità geografica, la sostenibilità e di promuovere l'innovazione tecnologica.

Durata: 2 anni, **Crediti formativi:** 120

Classe LM-54 - Scienze chimiche

Prime lauree in Chimica per le scienze agroalimentari

Venerdì, 30 Ottobre, 2026 - 11:15

SI TRATTA DI UN IMPORTANTE TRAGUARDO PER IL CORSO DI STUDIO ATTIVATO AL DIPARTIMENTO DI BIOTECNOLOGIE, CHIMICA E FARMACIA

Una giornata significativa per l'Università di Siena che il **29 ottobre 2026** ha celebrato le **prime lauree del Corso di laurea magistrale in Chimica per le scienze agroalimentari** (Classe delle lauree in Scienze chimiche, LM-54), attivato presso il **dipartimento di Biotecnologie, chimica e farmacia**.



Quattro laureati, Alice Barnabà, Matteo Centofanti, Amel Ibricic e Edoardo Sacchini, hanno concluso il percorso di studi conseguendo il titolo con il massimo dei voti, coronando un percorso di formazione e ricerca che ha affrontato tematiche di grande attualità e interesse per il settore agroalimentare.

La varietà degli argomenti affrontati – dagli antifungini potenzialmente ecocompatibili, a materiali innovativi ottenuti dal recupero e valorizzazione di sottoprodotti agricoli e agroalimentari – ha confermato la natura interdisciplinare del corso di studio, orientato a formare figure professionali in grado di applicare e integrare le competenze chimiche avanzate alle sfide emergenti in un settore trainante e strategico per l'economia toscana e Italiana.

Le prime lauree rappresentano un importante traguardo per il corso di studio e testimoniano il valore di un percorso formativo.

Alla neolaureata e ai neolaureati vanno le congratulazioni della commissione di laurea e i migliori auguri per un futuro professionale ricco di soddisfazioni professionali e nuove opportunità di crescita e ricerca.

- Il sito web del Corso di laurea magistrale in Chimica per le scienze agroalimentari