

# FoodOmicsGR

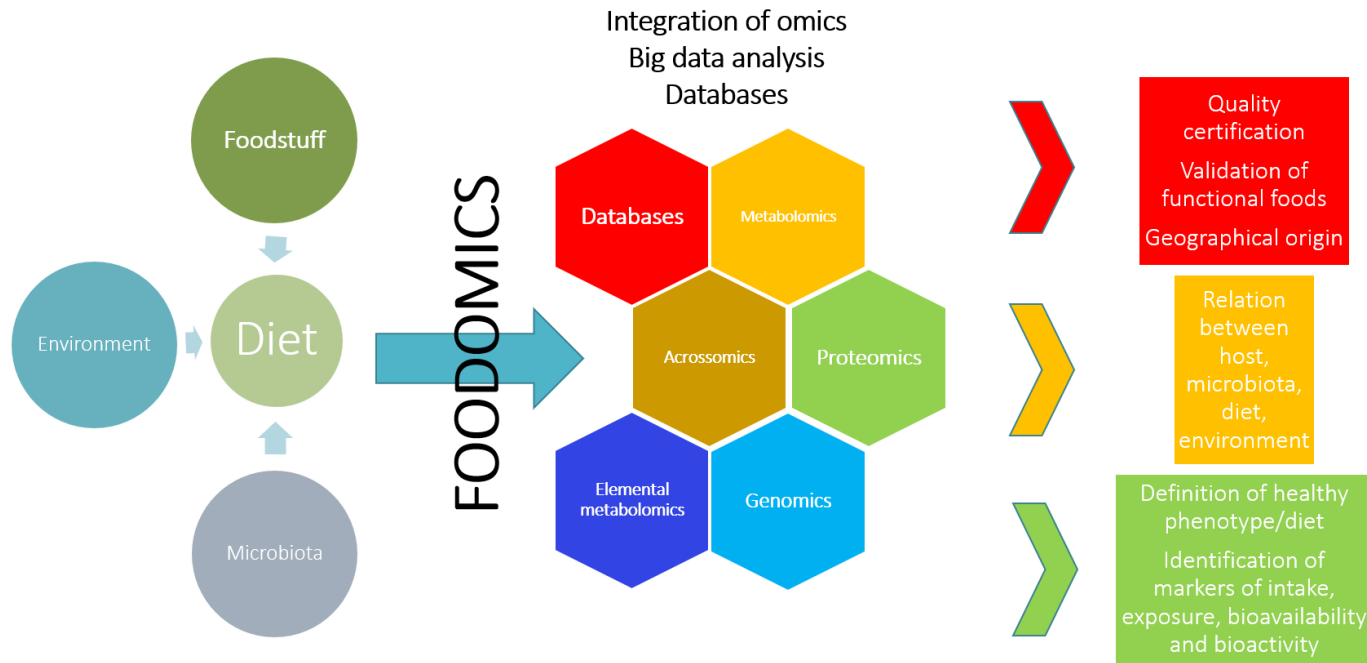
National Research Infrastructure  
for the Comprehensive  
Characterisation of Foods

Georgios Theodoridis  
Aristotle University Thessaloniki  
Dept. Chemistry

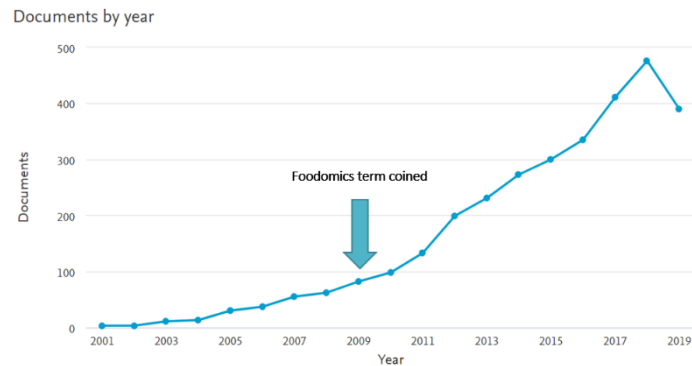
We acknowledge the support of this work by the project “FoodOmicsGR\_RI Comprehensive Characterization of Foods” (MIS 5029057) which is implemented under the Action “Reinforcement of the Research and Innovation Infrastructure”, funded by the Operational Programme Competitiveness, Entrepreneurship and Innovation (NSRF 2014–2020) and co-financed by Greece and the European Union (European Regional Development Fund).



Co-financed by Greece and the European Union



Foodomics: “a discipline that studies the Food and Nutrition domains through the application of advanced omics technologies to improve consumer’s well-being, health, and confidence”



Expansion of the Foodomics field

# Basic actions FoodomicsGR

FoodOmicsGR

National Research Infrastructure  
for the Comprehensive  
Characterisation of Foods

- GSRT funded 2019-2022, (MIS 5029057)
- <http://foodomics.gr/>
- Upgrading the research ecosystem in Greece, through collaborative interdisciplinary research
- Promotion of R&D in agrifood sector utilizing omics technologies
- Upgrading of research infrastructure
- Systemic review and databasing of the Greek agrifoods' content in order to highlight and promote the use of biomarkers
- Use of the data produced to promote Greek produce (PDO, PGI)
- Biomarkers/ toxicity mechanisms
- Use of new technological solutions for the control and further exploitation of industrial waste and side products
- Interaction with future users of the RI (research/public and private sector)

We acknowledge support of this work by the project “Foodomics-GR – National Research Infrastructure for the Comprehensive Characterization of Foods” (MIS 5029057) which is implemented under the Action “Reinforcement of the Research and Innovation Infrastructure”, funded by the Operational Programme “Competitiveness, Entrepreneurship and Innovation” (NSRF 2014-2020) and co-financed by Greece and the European Union (European Regional Development Fund).

# Advantages

# Scopes

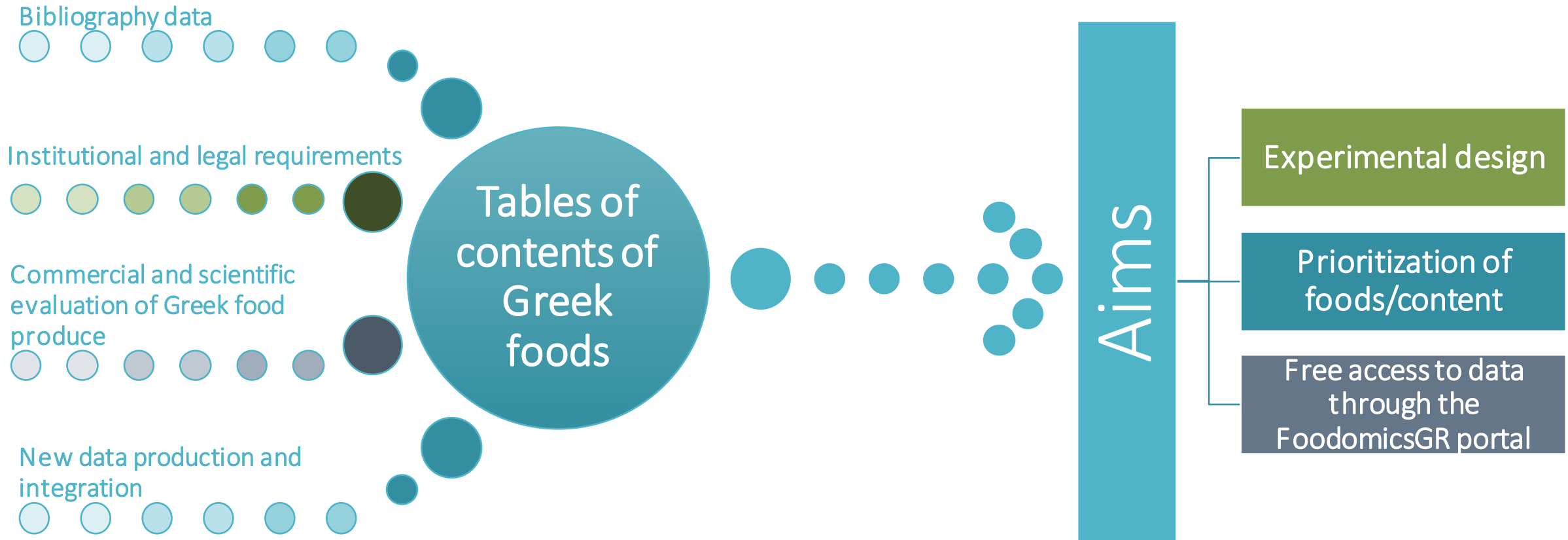
## **Complementarity:**

- Methods- protocols
- Instrumentation and expertise
- Strong Expertise in Basic Science (Analytical Chemistry, Informatics, biochemistry, Metabolomics, Proteomics, Genomics, Systems Biology, Toxicology, Molecular Pharmacology, Immunology)
- Applied Sciences (Plant Growth, Oenology, Animal Husbandry, Apiculture, Nutrition, Food Technology, Food Science, Dairy products)

## **Aims:**

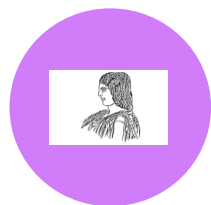
- ✓ Holistic Analysis of Food Content, emphasis on local produce: wine, olive oil, honey, dairy products
- ✓ Construction of detailed databases of food content
- ✓ Establishment of sample banks of reference agri-foodstuff from experimental/precision agriculture with detailed metadata and multiyear span
- ✓ Advanced international recognition of Greek food products
- ✓ Development of novel products utilizing bioactive compounds from the Greek flora and fauna and marine organisms.
- ✓ More than 40 protocols for metabolomic, genetic, proteomics and multi-elemental trace analysis.
- ✓ Across-omics analysis for the classification and characterization of food products.

# Tables of contents of Greek foods, target selection (analysis, foods)



# Research infrastructure upgrade

Acquirement, upgrading and installation of cutting-edge instrumentation by the partners



AUoA



UoA



AUTH



UoC

Laser Ablation (LA) installed on the already existing ICP-MS

HR-MS with IMS (ion mobility spectroscopy) capability

HR-MS with IMS (ion mobility spectroscopy) capability

NMR solid state probe

**Aim: To establish a reference center (infrastructure, SOPs, open access)**

- Cutting Edge instrumentation: 15 LC-MS (orbitrap, qTOF, IMS, QqQ), 7 GC-MS (3 MS/MS), 2 ICP-MS, NMR (600MHz, 2 x 500 MHz, 2 x 400 MHz) and more

# Metabolomics

**Aim**: Collaboration between partners through ring-trials, SOPs' and reports' harmonization.

- Examples of new methods in the pipeline:
  - α) Lipidomics analyses for biological samples (dietary studies) and food produce (fish, animal tissues).
  - β) Targeted methods' development for the simultaneous and efficient determination of nutrient in food products (vitamins, organic acid etc)

## **NKUA**

Untargeted/ targeted analytical protocols (UPLC-qTOF-MS).

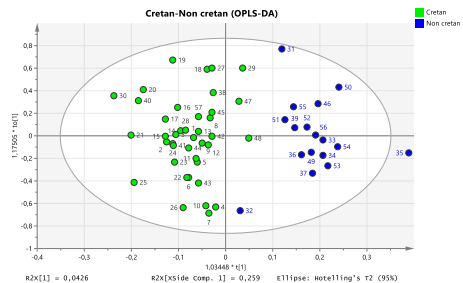
NMR spectroscopy

## **AUTH**

MS metabolomics, untargeted/targeted methods (UPLC-QqQ-MS).

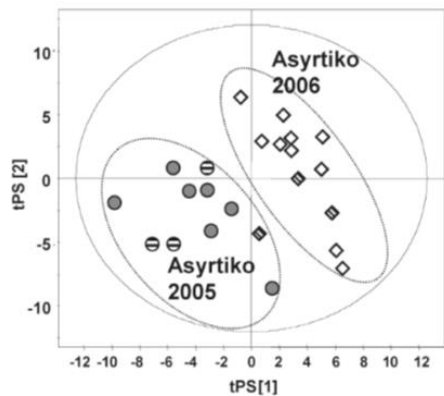
## **UOC**

NMR spectroscopy, + solid state, holistic analysis

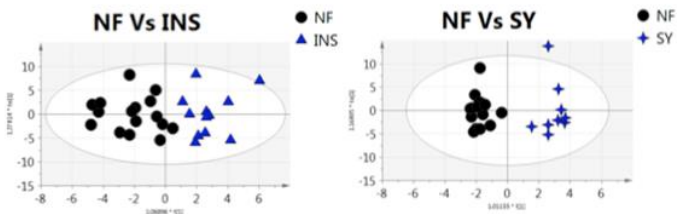


Geographical origin of Cretan gruyere cheese (graviera) P.D.O

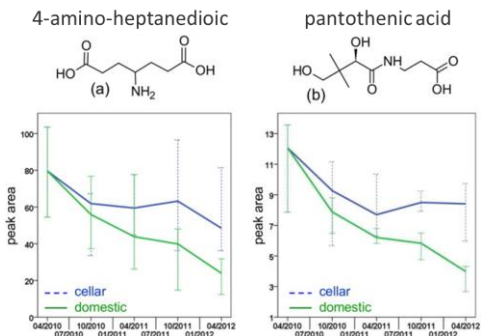
NMR, UoC



Wine classification.  
NMR, UoA



Royal jelly differentiation.  
UHPLC-MS/MS, AUTH



Effect of storage on wine  
Characteristic biomarkers  
AUTH

# Working examples



# Proteomics

- Analysis of characteristic (PDO, PGI) cheese and dairy products (feta, graviera) initially at raw material level at produce level and the geographical origin of the produce.

## **Aims**

1. The complete analysis of the proteome and the peptidome of the samples
2. Validation of the proteins and peptides that can be targeted for the authenticity of each
3. Correlation of the microbiomic and the proteomic results for the authenticity control of the aforementioned products.

## **Analysis**

- Using nano-LC- Orbitrap Elite MS/MS protocol for the complete proteome of the aforementioned products
- Proteomic analysis using nano-LC- Orbitrap Elite MS/MS for the certification of the PDO, PGI of these products.

# Elemental metabolomics

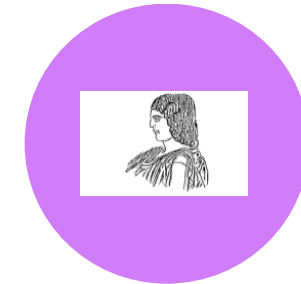
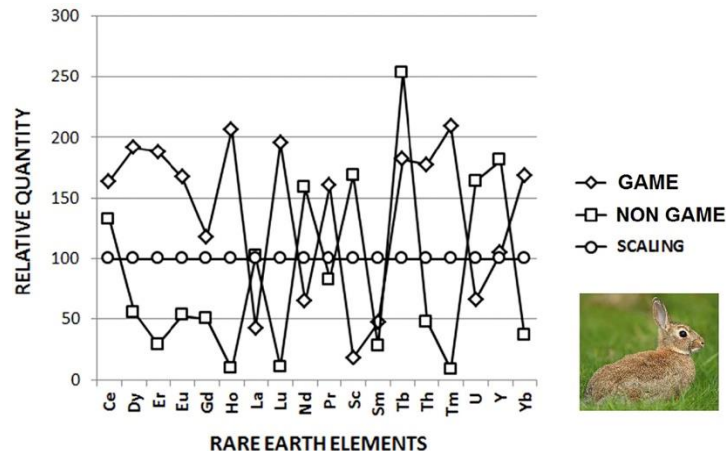
Development of elemental metabolomics methods using Inductively coupled plasma mass spectrometry (ICP-MS) for the comprehensive elemental characterization of the samples (>65 elements).

We expect the detection of new markers like rare earth elements and precious metals that are present in very small quantities in every sample (ultra trace elements).

## Aim

- Authenticity, geographical and genetic origin along with the method used for the production of traditional Greek products.
- Contribution in the estimation of the nutritional value and safety by analysing nutritional as well as potentially toxic elements.

## Example



AUoA

Fluctuation of REE in different meat type (game/non-game)  
Multielemental ICP-MS

# Genomics

- ✓ Validation of the DNA Barcoding method, used as a golden standard for the identification of fish.
  - Sensitivity in a variety of species/sample substrates
  - Reproducibility
  - Repeatability

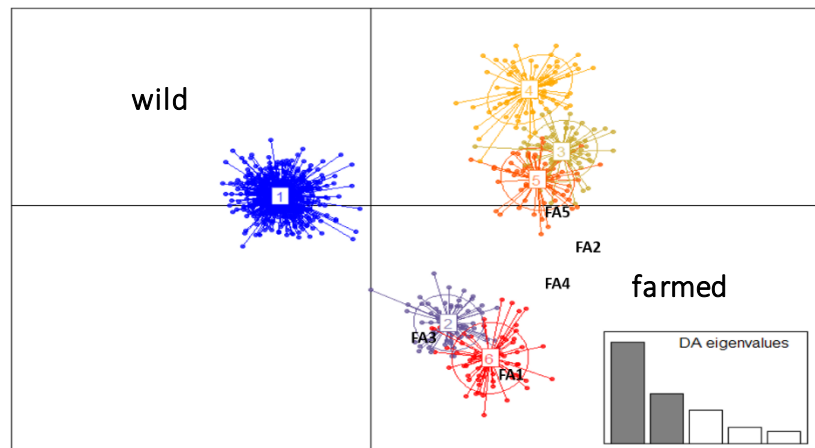
## Aims

- ✓ Using the protocols in accordance with international standards (ISO 17025)
- ✓ Next generation sequencing (NGS).



AUTH

## Example



Sea Bream classification (N=878):  
Wild/farmed.  
PCR

# Control / Secondary use of Industrial Waste

Registration of agri-food processing industries, database on generated quantities of liquid and solid waste by industry, geographical breakdown of these categories of waste.

Sampling and chemical characterization of waste produced by selected agri-food industries, such as mills, dairies, juices, tomato pulp and fruit canning industries.

## Aims:

- Production of high-quality antioxidant distillates from agro-industrial waste that can be used in the food and cosmetics industry
  - olive oil waste for the production of phenol-rich distillates with strong antioxidant capacity
  - waste products from the citrus fruit industry for the production of essential oils rich in limonene
- Investigation of the potential of utilizing agri-food waste for high protein and starch biomass production. For this reason, the aquatic plant *Lemna minor* will be grown in dairy waste to produce biomass that can be used as feed in poultry farms and fish farms.



UotA

# Quality control/ food safety assessment

## Use of advances techniques for the quality control of agri-food produce

- LC-MS/MS, GC-MS, LC-LTQ-Orbitrap-MS instrumentation
- Advanced extraction methods for the determination of pesticide residues in ppt levels
  - SPE,
  - matrix solid-phase dispersion extraction (MSPDE Quechers)



# Services

To the researcher and entrepreneur :

- Access to the infrastructure. Research services.
- Validated analysis SOPs
- One stop shop: Experimental design, analysis, statistics/bioinformatics, biomarker discovery and validation
- Interdisciplinarity, expertise in more than 18 scientific disciplines
- Experience in national and international research funding (R&D)
- Experience/compliance to GLP, LIMS, Laboratory accreditation ISO 17025