



Safety
Quality
Traceability

Food traceability and fingerprints - Compound specific isotope analysis

Nives Ogrinc



Stable isotopes of light elements (H, C, N, O, S)

- Determination of authenticity
- Determination of geographical origin
- Tracing diet-food sources
- Tracing pollution sources in food (CSIA)

New challenge

compound specific isotope analysis to track and determine the origin of organic compounds in the environment and food products

Isotope ratio

Fractionation

Information

$^2\text{H}/^1\text{H}$
 $^{18}\text{O}/^{16}\text{O}$

evaporation
condensation
precipitation

⇒ geographical origin

$^{13}\text{C}/^{12}\text{C}$

C4, C3 plants
marine, terrestrial
nutritional status

⇒ diet
⇒ adulteration

$^{15}\text{N}/^{14}\text{N}$

nitrification/denitrification
trophic level
marine, terrestrial

⇒ agriculture practice
⇒ diet

$^{34}\text{S}/^{32}\text{S}$

bacterial

⇒ geographical origin
⇒ agricultural practice

$^{87}\text{Sr}/^{86}\text{Sr}$

underlying geology

⇒ geographical origin

These isotopic signatures are translocated through an animal to their product and can be used to trace food origin

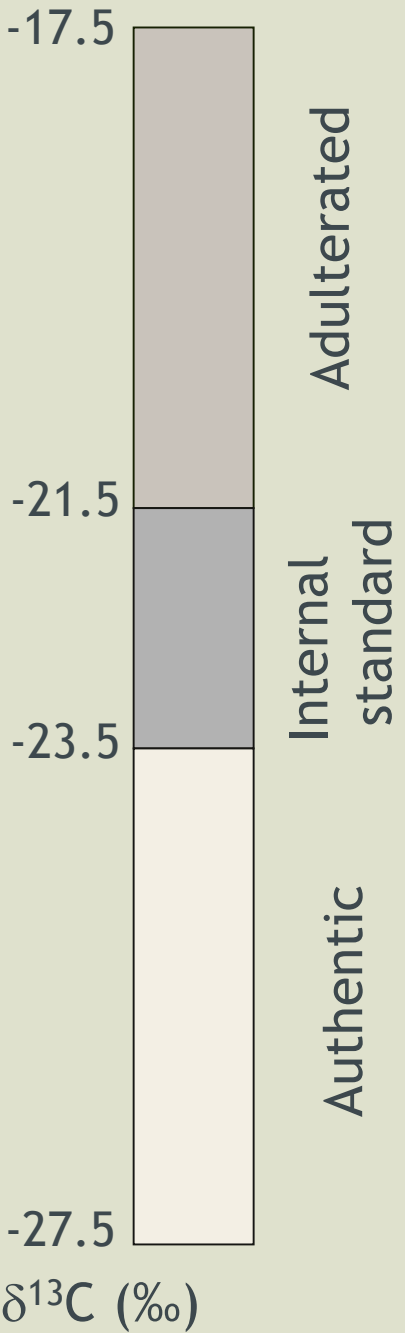
Food fraud – Who cares?



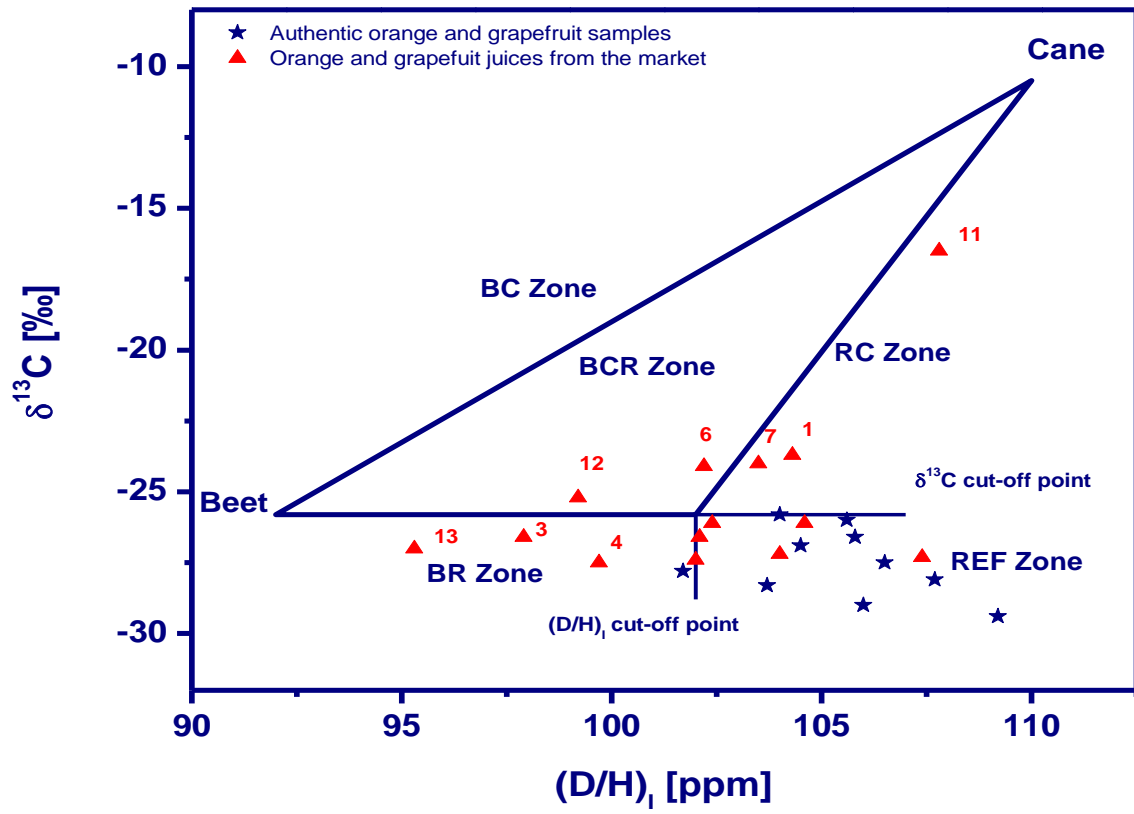
Types of analyses

- “Traditional” - authenticity check
is a given compound a natural product from a food material or has it been added ?
- Natural or not natural
e.g. vanillin from beans or synthesized from lignin
- “New”
Compliance with declaration
e.g. conventional or “organic” production
- Geographical origin of (premium) products
e.g. PDO (Emmentaler) cheese or ham (Parma)

Data evaluation methodology



“cutoff-values”



Geographical origin

Multi-element stable isotope pattern

e.g. hydrogen, carbon, nitrogen, sulphur isotope data combined with sophisticated data evaluation methods (Chemometry)

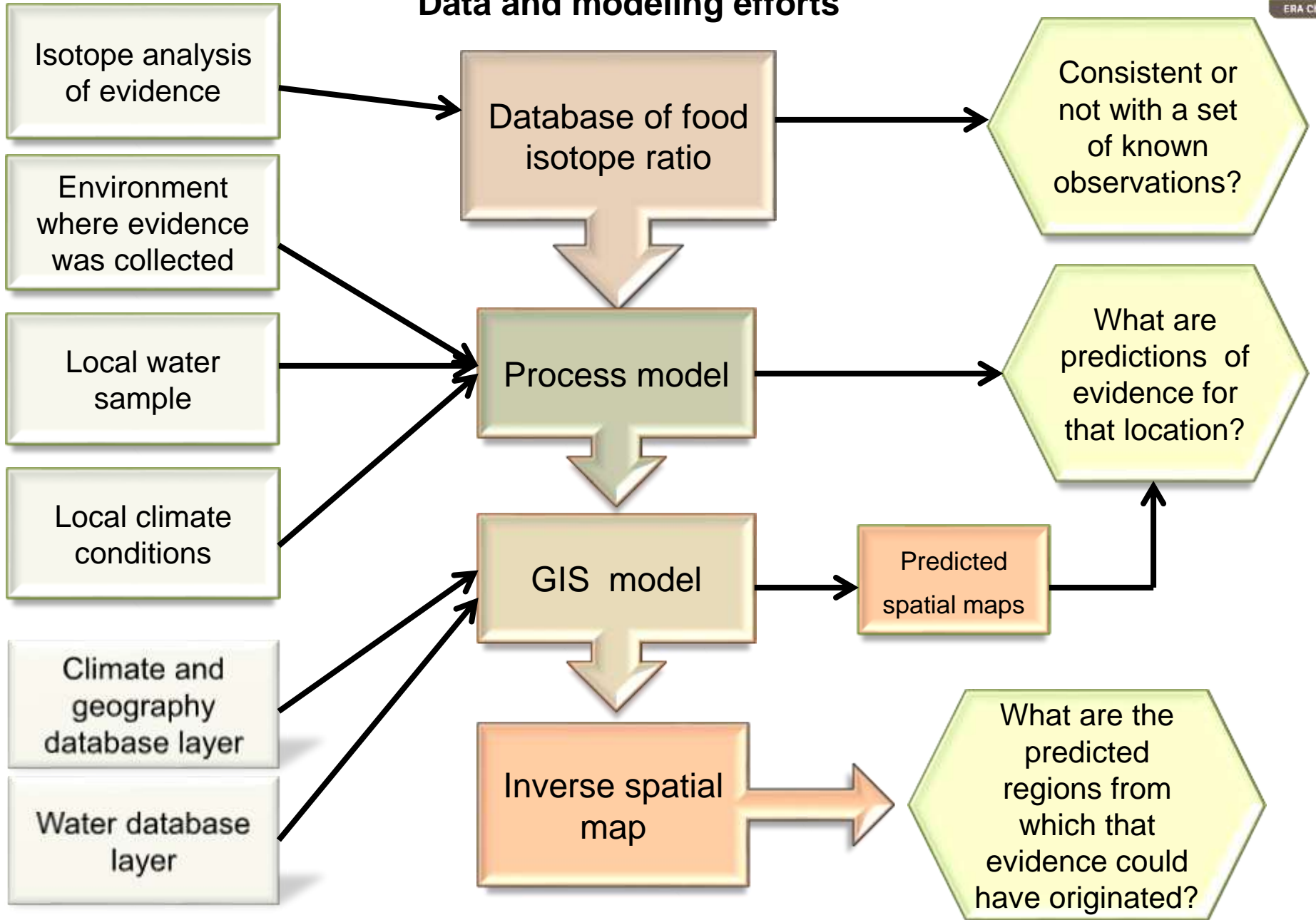
A database of authentic samples is required until now

Databases in Slovenia: wine, honey, olive oil, apple juice, milk, sheep and goat cheese

Inputs

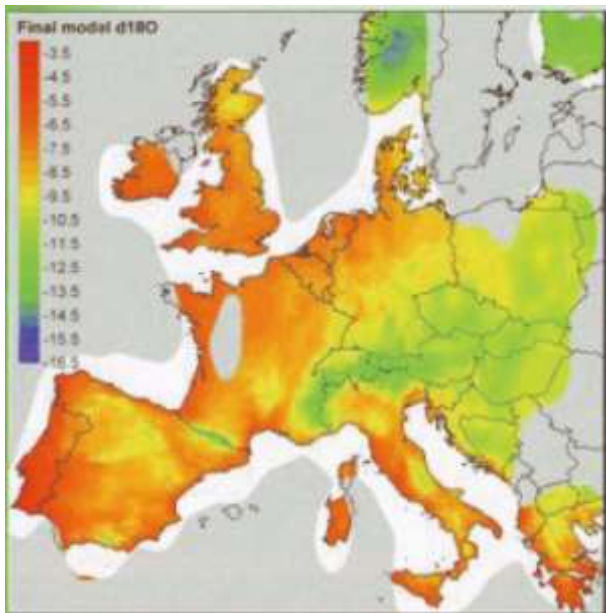
Data and modeling efforts

Outputs



GIS modeling based on isotope, altitude and latitude

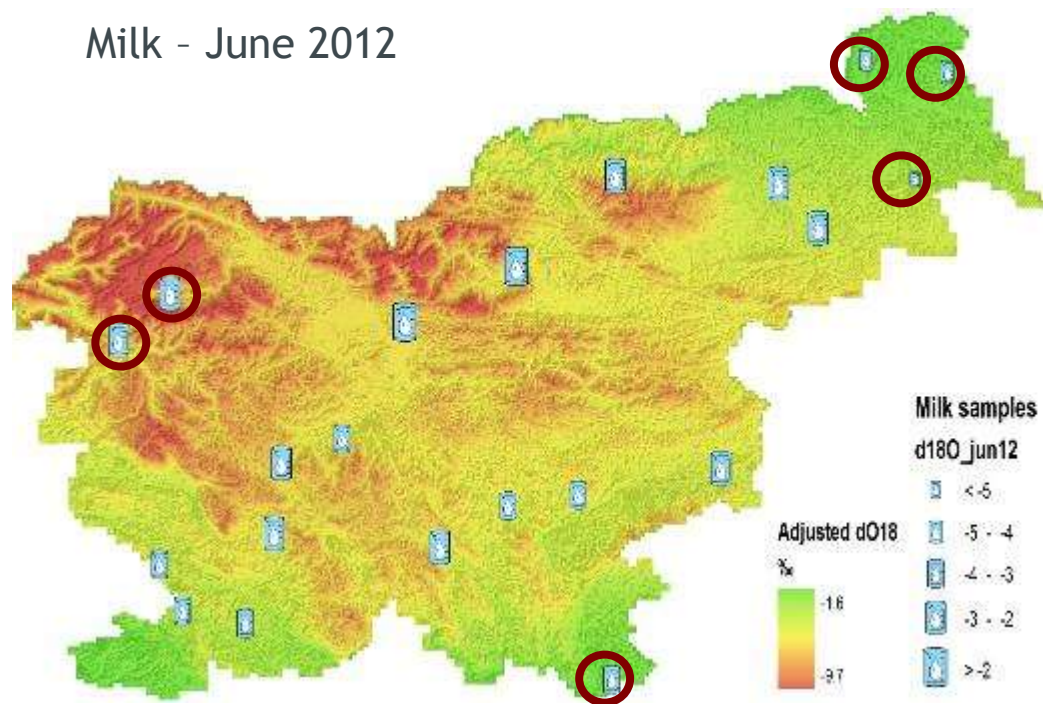
Europe



Graz

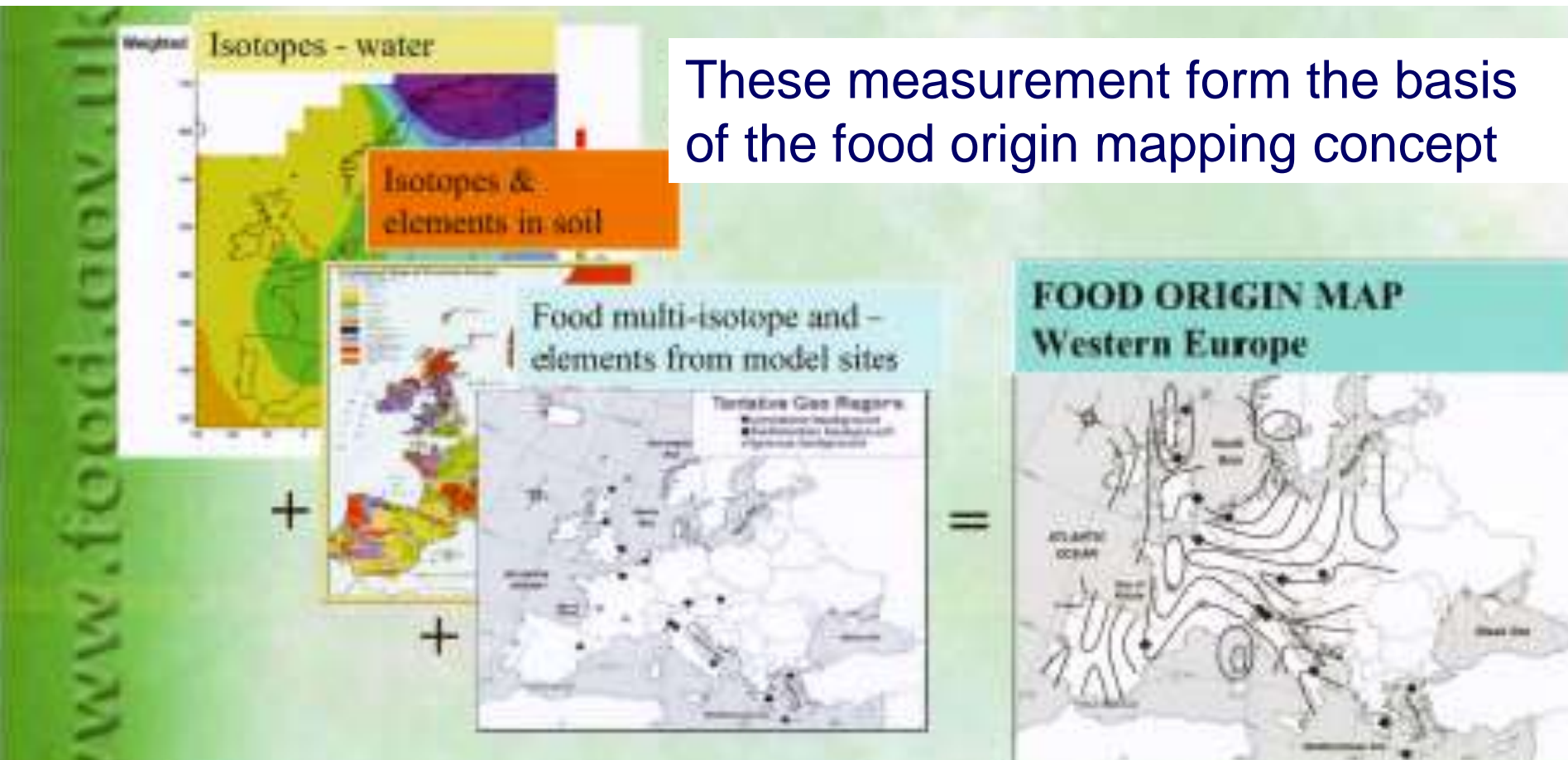
Zagreb

Milk - June 2012



The concept of food origin mapping

www.governmentchemist.org.uk/dm_documents/LGC_talk_BtufO.pdf



Link the isotopic and TE composition of the commodity to the composition of soil and climate parameters in the production region

Predict the multi-isotopic and ME specification for same food from different origin by extrapolation

Compound specific isotope analysis

- Diet - sources identification and geographical origin – lipid biomarkers
- Tracing contamination sources – PAHs, hormones

Steroid hormones: make an isotope distinction between endogenous (produced naturally) and exogenous (administrated) or synthetic forms of hormones

Sophisticated methods for both sample preparation and instrumental analysis

Metrological - issues

- No certified reference material available - also for solid $\delta^2\text{H}$
- Reference material does not match the matrix
- Occurrence of isotope fractionation during sample preparation
- Linearity
- Possible transformation processes and isotope fractionation

Activities within ISO-FOOD

- Research throughout training:
 - PhD study on milk and dairy products (D. Potočnik)
 - Master degree study – database on milk and dairy products
 - New research performed on vegetables available at Slovenian market – PhD study within ISO-FOOD
 - Postdoctoral position – within ISO-FOOD
- Workshops:
 - Food traceability methodologies (2nd yr)
 - Isotopic techniques in food characterization (4th yr)
- Summer school:
 - Authentication of food products by isotope and elemental fingerprinting (2nd yr)
- Interlaboratory exercises:
 - Stable isotope analyses of light elements in foodstuffs (5th yr)
- Accreditation

Activities already performed

- ISO-FOOD project presentation at conferences, symposiums:
 - TEF (Copenhagen)
 - 1st IMEKOFOODS: Conference Metrology Promoting Objective and Measurable Food Quality and Safety (Rome)
 - Workshop organized by IJS and UNILJ-BF in Ljubljana (50 participants including stakeholders)
- Preparation of national and international project (1 national, 3 international – 2 EU, 1 IAEA)
- Associated partners in EU project FoodIntegrity (P. Brerenton, UK)