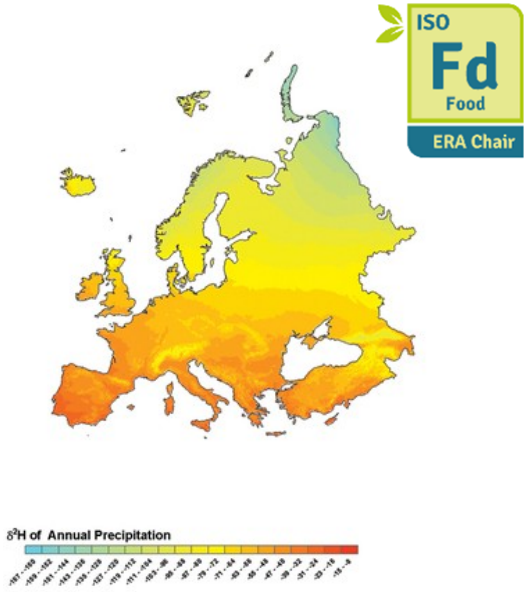
Institut "Jožef Stefan": Ljubljana, Slovenija

ERA Chair ISO-FOOD

For isotope techniques in food quality, safety and traceability

David Heath
ERA Chair holder



SEVENTH FRAMEWORK PROGRAMME

Motivation for ERA Chair ISO-FOOD?

Institut "Jožef Stefan" Ljubljana, Slovenija

ISO Fd Food ERA Chair

- Jožef Stefan Institute
  - Basic and applied research in the field of natural science and technology

- Modern food supply chain is complex / Food Fraud / Horse meat scandal 2013 / methods for determining food safety, authenticity and traceabilty

- Dept. Env. Sci. history of stable Isotopic/elemental method development for determining the authenticity of foodstuffs (wine, olive oil, juice, honey…)

ERA chair to build on our existing capacity

Vision: *becoming a recognized research and education centre for food analysis and characterisation using advanced isotopic and chemical techniques (ERA)*

- July 2014 - 2019 (FP7, 1/11)

Who is Involved?

- 4 x JSI research departments:
  - **Environmental Sciences, O2**

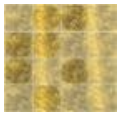
    Stable Isotopic and elemental methods for food authenticity
    Inorganic & Organic / Speciation / Transformations / Fractionation
    natural and manmade radionuclides
  - Computer Systems, E7

    Data processing and knowledge management
    dietary assessment, food composition databases
  - Condensed Matter Physics F5

    Nanoparticles in the environment/safety
  - Nanostructured Materials K7

    Nanotoxicology
  - 2 x CoE
- Jožef Stefan International Post Graduate School (IPS)







Clean laboratories and laboratories for radiochemistry
(3000m² laboratory space, 800 m² office space)

Clean laboratories and laboratories for radiochemistry
(3000 m^2 laboratory space, 800 m^2 office space)

- **Isotope ratio mass spectrometry (H, C, N, O, S, Pb, Sr...)**

  EA-IRMS, DI-IRMS, Py-IRMS, **GC-C-IRMS**, **MC-ICP-MS**

- **Mass spectrometry**

  UPLC-qTOF-MS/MS, GC(IT)MS, GC-MSD, LC-MS/MS, GC-MS/MS, ICP-MS, **ICP-MS QQQ**, LA-ICP-MS, LC-ICP-MS, GC-ICP-MS, SP-ICP-MS,

- **Spectrophotometry**

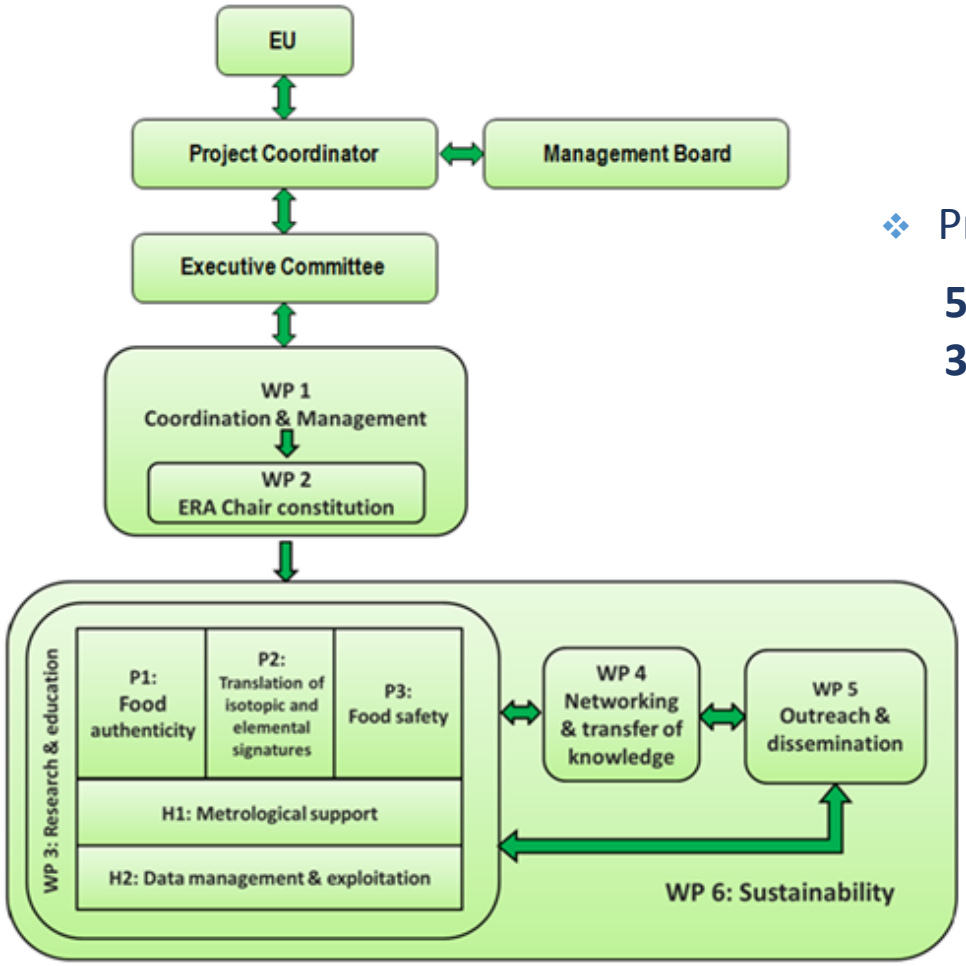
  HG-AFS, CV-AFSGF, AAS, FAAS

- **Nuclear methods**

  TRIGA MARK II nuclear reactor, alpha, beta and gamma counting, NAA

- **Access to other JSI departments & infrastructure (microscopy) and experienced researchers**

ISO-FOOD Project

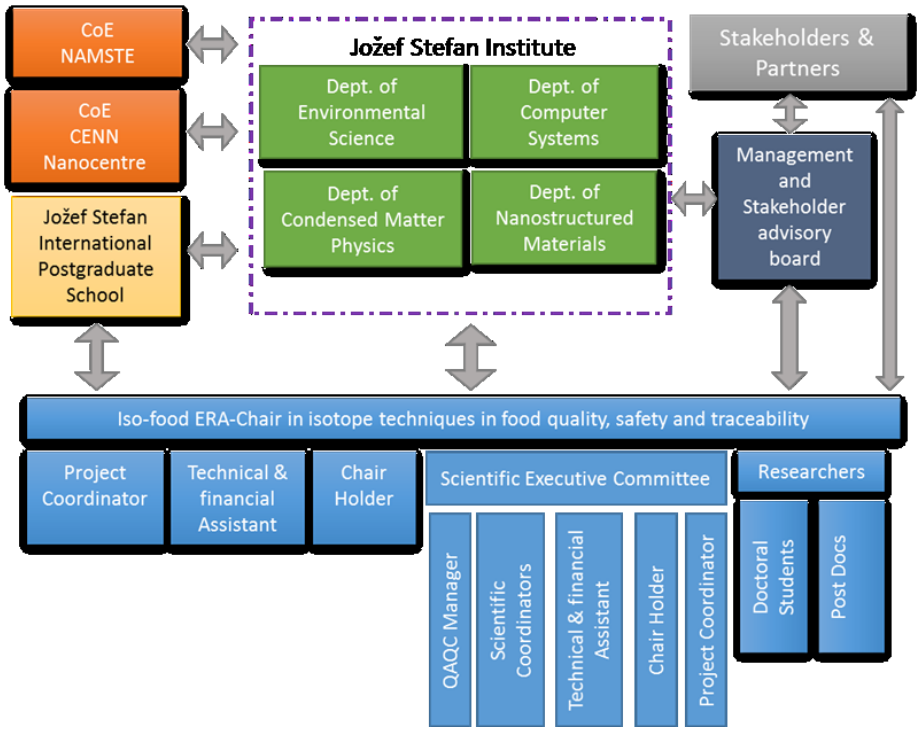


- Project:

  51 milestones
  35 project deliverables

ISO-FOOD Organizational structure

- Project Coordinator
- Chair holder
- Scientific Executive Committee
- Management Board
- Researchers

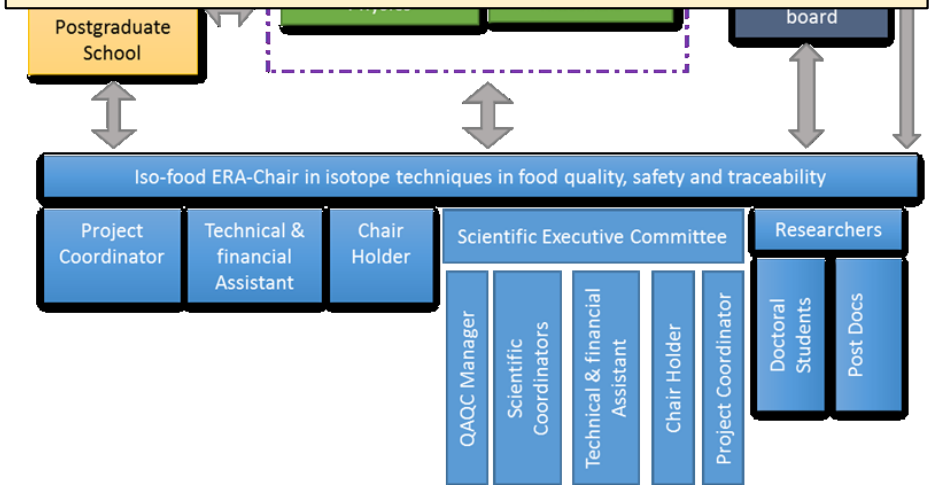


ISO-FOOD Organizational structure

- Project Coordinator
- Chair holder
- Scientific Executive Committee
- Management Board
- Researchers

Project coordinator (PC) Prof Milena Horvat

- WP 1,2 leader
- Liaises with the EC
- Responsible for administration of the project



ISO-FOOD Organizational structure

- Project Coordiator
- Chair holder
- Scientific Executive Committee
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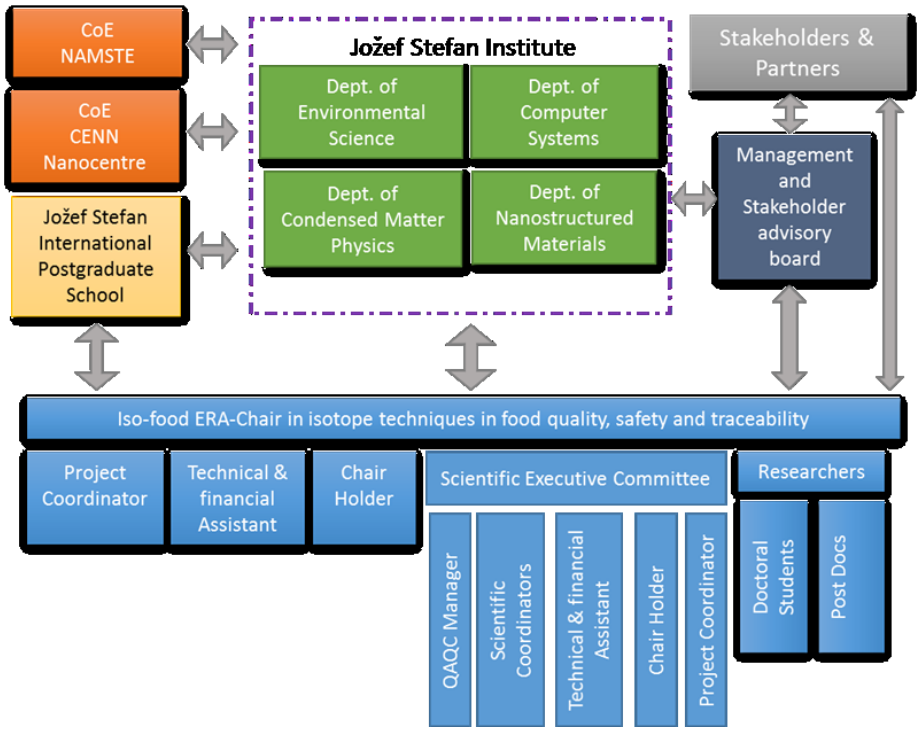
- Researchers



ISO-FOOD: Responsibilities of Chair holder

- Employed fulltime (spread over the WP1-6):
- Project: **implementation/management/development**
  - **Annex I: Description of Work (fixed)**
- Preparing deliverables / Self-evaluation reports (WP1-2)
- WP6 leader: Sustainability
  - Search for and prepare funding proposals (WP3 & WP6)
  - Prepare strategic documents (Roadmaps) (WP3 & 6)
- Quality of outputs (WP1-6)

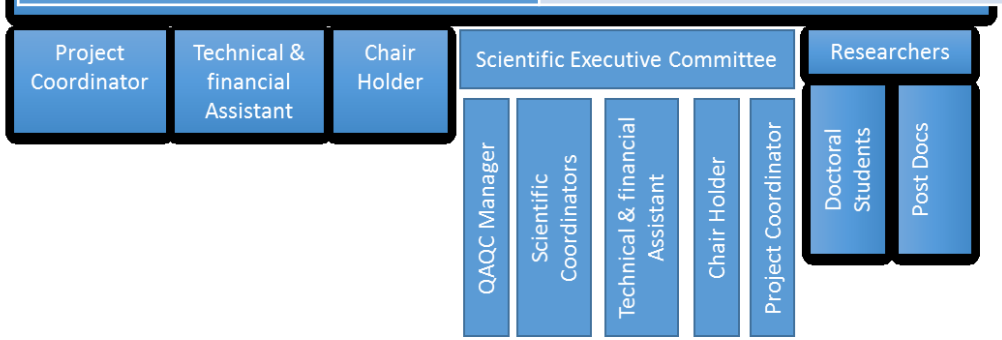
ISO-FOOD: Responsibilities of Chair holder

- Develop doctoral course at IPS (WP3)
- Organise training and stakeholder events (WP4 & 5)
- Develop the ERA Chair culture
- Research (organic analysis)
- ERA Chair Team!

ISO-FOOD Management structure

- Project Coordinator
- Chair holder
- Scientific Executive Committee
- Management Board
- Researchers

Scientific Executive Committee (ERA Team)	
Prof Milena Horvat	Project coordinator, Head of O2, Dean of IPS, WP1&2
Dr David Heath	ERA Chair holder, WP6
Vanja Usenik/Lucija Korbar	Financial and technical officer
Prof Nives Ogrinc	Scientific advisor, WP3, O2
Prof Barbara Koroušić Seljak	Scientific advisor, WP4, E7,
Prof Sonja Lojen	Scientific advisor, WP5, O2
Dr Polona Vreča	Scientific advisor, QC control
Dr Saša Novak	Scientific advisor, K7
Prof Maja Remškar	Scientific advisor, F5



ISO-FOOD Management structure

- Project Coordinator
- Chair holder
- Scientific Executive committee
- Management Board
- Researchers

Management & Stakeholder Advisory Board	
Representatives of the ERA Chair	
Prof Dr Milena Horvat	Project coordinator, Dean of IPS
Dr David Heath	ERA Chair holder
Lucija Korbar	Financial and technical officer
Representatives of the JSI	
Prof Dr Igor Muševič	Head of F5 department
Assist Prof Dr Gregor Papa	Head of E7 department
Dr Peter Vrtačnik	Representative of Jožef Stefan Institute's Board of Governors
Prof Dr Spomenka Kobe	Head of K7 department, Jožef Stefan Institute's Scientific Council
Government Bodies	
Dr Urška Blaznik	National Institute for Public Health
Dr Blaža Nahtigal	Ministry of Agriculture, Forestry and Food, EFSA
Dr Tatjana Zagorc	Chamber of Commerce and Industry
Representative from academia	
Prof Dr Nataša Poklar Ulrih	Biotechnical faculty, University of Ljubljana
Representative from Industry	
Dr Matjaž Červek	Emona RCP d.o.o. Jata Emona

ISO-FOOD Management structure

- Project Coordinator
- Chair holder
- Scientific Executive cor
- Management Board
- Researchers

6 X Post doctoral researchers

Dr Kelly Peeters O2
Element speciation in food

Dr Martina Lorenzetti K7
Nanoparticles in food

Dr Miha Trdin O2
Radionuclides in food

4) Organic contaminants in food
5) Compound specific stable isotopes in food
6) Metrology support in food analysis

3 X Doctoral Students

Anja Mahne Opatić O2
Isotopic and elemental characterisation of food

Eva Kranjc F5
Plant-nanoparticle interactions

Tome Eftimov Computer Systems E7
Developing tools for data management, exploration and exploitation

Master's Student

Anja Drame (K7)
Nanoparticles in food

QAQC Man
Scientifi Coordinat
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Chair Hold
Project Coord
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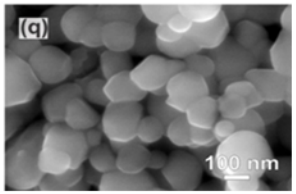
ISO-FOOD Student Study Group
15 Students

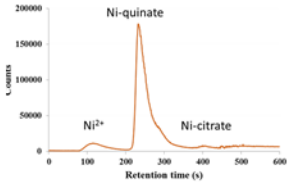
ISO-FOOD: Research focus

Isotope and elemental fingerprinting

Nanoparticles



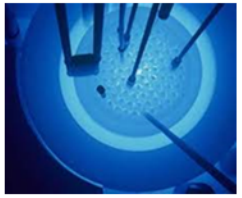
Element speciation and fractionation



Data processing / Knowledge management / Food composition databases

Organic contaminants

Radionuclides (natural & artificial)



Metrology Support

ISO-FOOD Education: doctoral course

- Integrated into the ECO-Technology Programme IPS
- Five new ISO-FOOD topics:

Course Title	Credits
Traceability and Authenticity of Food	10
Chemical safety – Inorganic, organic contaminants, nanoparticles	10
Foodomics	5
Chemical and food toxicology	5
Sensor systems	5

- In collaboration with UL-BF's Interdisciplinary Doctoral Programme BIOSCIENCES – Food Sciences

First students enrolled 2016/2017

ISO-FOOD Education

- Exploratory Workshops, Training Events, Summer Schools

1. International stakeholder workshop ✓
2. Metrology workshop ✓
3. Mercury in food workshop ✓
4. Radionuclides in food Summer School ✓
5. Isotopic techniques in food characterization ✓
6. Food authenticity and traceability, Spring School ✓
7. Nanoparticles in food
8. Element speciation in food analysis

- eLearning modules
- Conference (2019)

Dissemination & Outreach

- Scientific papers /conferences
- Webpage,
  Facebook, Twitter
- Public presentations
- Invited speakers
- Promotional material

ISO-FOOD: Sustainability

MASSTWIN – Spreading excellence and widening participation in support of mass spectrometry and related techniques in Health, the Environment, and **Food**. (Coordinator: M. Horvat)

Slovenian Smart Specialization program: sustainable food production, Coordinator Žito d.o.o., Authenticity of raw materials - Frutarom Etol (IJS: N. Ogrinc)

ARIMNet-REALMed

Pursuing authenticity and valorization of traditional Mediterranean products - High premium products e.g., Slovenian truffles, (JSI: N. Ogrinc)

European Strategy Forum for Research Infrastructures (ESFRI) – infrastructure for promoting metrology in food and nutrition (JSI: M. Horvat, N. Ogrinc)

The Use of Stable Isotopes and Elemental Composition for Determination of Authenticity and Geographical Origin of Milk and Dairy Products (Coordinator: N. Ogrinc)

National = 2 *International = 4* *Pipeline !*

Summary

- Progress of ERA Chair ISO-FOOD is good achieving all of its major Milestones and Deliverables.
- Having stakeholders & partners directly involved
- Importance of having a strong team
- Main task remains sustainability of the Chair

Thank you for your attention

www.isofood.eu

Thank you for your attention

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Thank you for your attention

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Thank you for your attention

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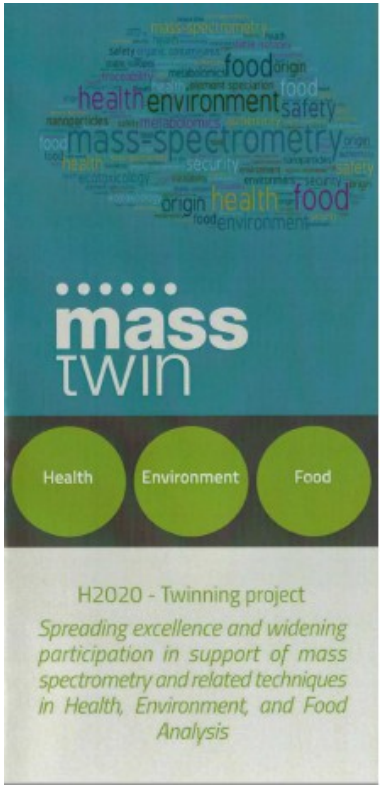
MASSTWIN

*Spreading Excellence and widening participation in support of mass spectrometry and related techniques in **Health**, the **Environment**, and **Food Analysis***

Milena Horvat (Coordinator), Radmila Milačič, Janez Ščančar, Nives Ogrinc, Ester Heath, Sonja Lojen, Dušan Žigon, Vanja Usenik, David Heath

- Five partners form five different countries
- 3 year project (Kick off meeting 29/3/2016)
- Establish a Community of Practice in MS
- Improve the mass-spectrometry based analytical skills of researchers and to adopt best practices comparable to the world's leading laboratories.
- Exploratory workshops / group trainings / collaborative research / staff exchange / Outreach
- The scientific content of the project is complementary to the activities of the ISO-FOOD ERA Chair.
- Joint Projects



https://www.masstwin.eu/

mass twin

HELMHOLTZ CENTRE FOR ENVIRONMENTAL RESEARCH – UFZ

Helmholtz-Zentrum fuer Umweltforschung GmbH – UFZ

http://www.ufz.de

Contact: Kay Knöller

FONDAZIONE EDMUND MACH

Fondazione Edmund Mach di San Michele all'Adige (FEM)

http://www.fmach.it

Contact: Federica Camin

Universiteit Antwerpen

The National Institute for Agricultural and Food Research and Technology (INIA) and the University of Antwerp (UA)

https://www.uantwerpen.be/en

Contact: Adrian Covaci

UNIVERSITÉ DE PAU ET DES PAYS DE L'ADOUR

Institut des Sciences Analytiques et de Physico-chimie pour l'Environnement et les Matériaux and the Unversite de Pau et Pays de L'Adour (IPREM/UPPA)

http://www.univ-pau.fr

Contact: Olivier Donard

INIA
Instituto Nacional de Investigación y Tecnología Agraria y Alimentaria

The National Institute for Agricultural and Food Research and Technology (INIA) and agrifood research in Spain.

http://www.inia.es

Contact: María Dolores

Jožef Stefan Institute
Ljubljana, Slovenija

The Jožef Stefan Institute is the leading Slovenian scientific research institute, covering a broad spectrum of basic and applied research.

http://www.environment.si

Contact: Milena Horvat

ISO-FOOD: Other activities

- Accreditation of analytical methods (ISO/IEC 17025: 2005)

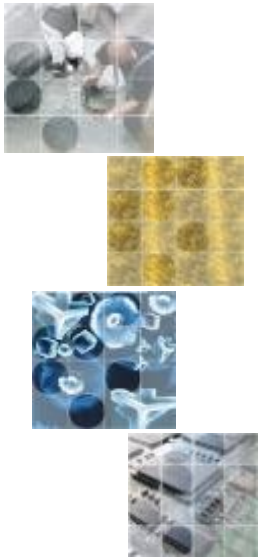
  1) Carbon isotope ratio 13C/12C in ethanol by mass spectrometry
  2) Oxygen isotope ratio 18O/16O in wine by mass spectrometry

- Two Interlaboratory comparison exercises

  1) Speciation of selected metals in foodstuffs
  2) Stable isotope composition of foodstuffs

Who is involved?

- 4 x JSI research departments:
  - **Environmental Sciences (O2)**
  - Condensed Matter Physics (F5)
  - Nanostructured Materials (K7)
  - Computer Systems (E7)
- 2 x COE
- Jožef Stefan International Postgraduate School (IPS)



NAMASTE
CENTRE OF EXCELLENCE

Nanocenter

Jožef Stefan Institute

$$j = \sigma T^4$$

Jožef Stefan 1835 – 1893

19th century physicist,
Stefan-Boltzmann law of black-body radiation

1949 – Institute of Physics
1959 – Jožef Stefan Nuclear Institute
1966 – Triga Mark II research reactor
1969 – Jožef Stefan Institute

960 staff (app. 400 Ph.D)
28 Research Departments
12 Research Centres
4 Centres of Excellence
900 Projects

Basic & Applied Research

Physics, Reactor Technologies, Energetics Chemistry, Biochemistry, Environmental Sciences, Materials, Electronics and Information technologies

Infrastructure and equipment

- **Isotope ratio mass spectrometry (H, C, N, O, S, Pb, Sr...)**

  EA-IRMS, DI-IRMS, Py-IRMS, **GC-C-IRMS**, **MC-ICP-MS**

- **Mass spectrometry**

  UPLC-qTOF-MS/MS, GC(IT)MS, GC-MSD, LC-MS/MS, GC-MS/MS, ICP-MS, **ICP-MS QQQ**, LA-ICP-MS, LC-ICP-MS, GC-ICP-MS, SP-ICP-MS,

- **Spectrophotometry**

  HG-AFS, CV-AFSGF, AAS, FAAS

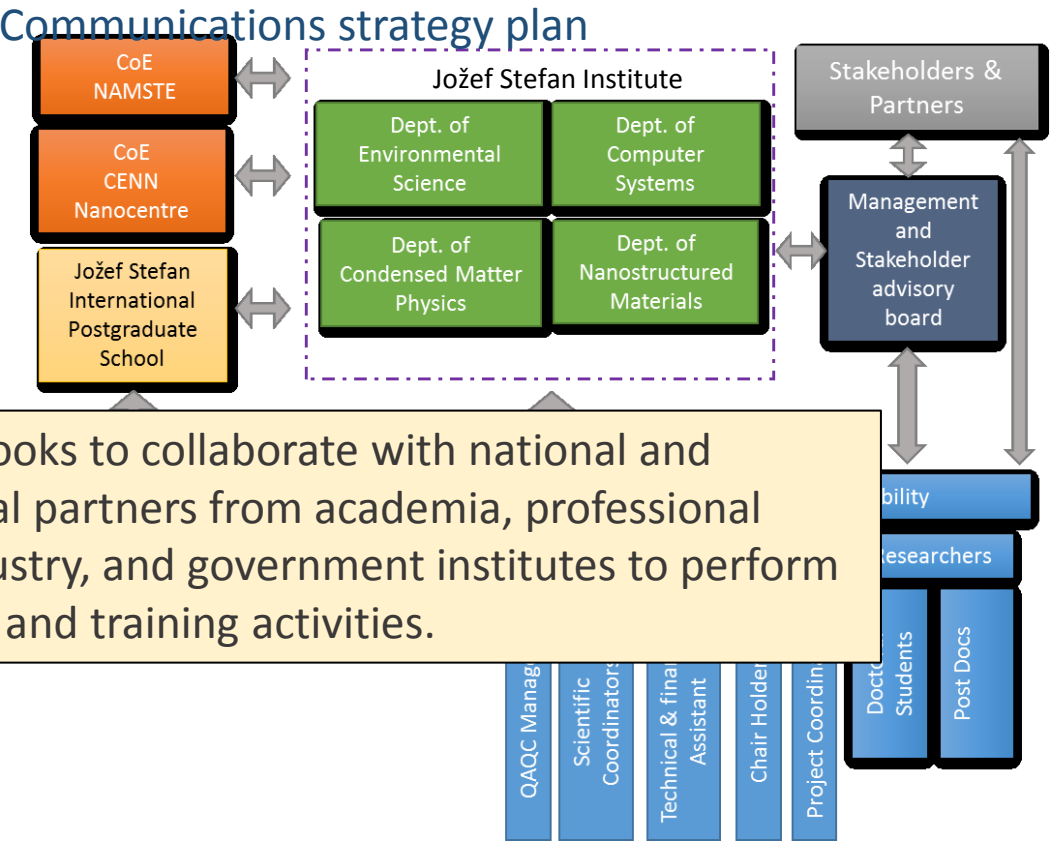
- **Nuclear methods**

  TRIGA MARK II nuclear reactor, alpha, beta and gamma counting, NAA

- **Access to other JSI departments & infrastructure (microscopy) and experienced researchers**

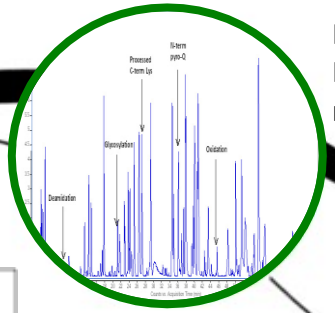
ISO-FOOD Organizational structure Structure

- Project Coordinator
- Chair holder
- Scientific Executive committee
- Management Board
- Stakeholders

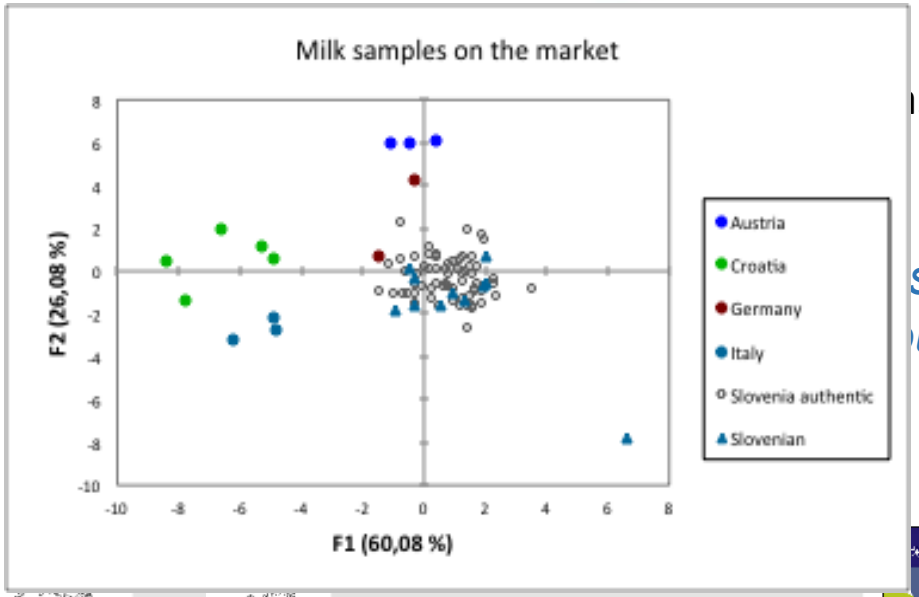


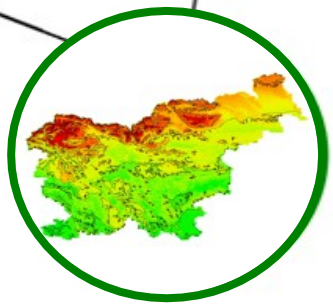
ISO-FOOD looks to collaborate with national and international partners from academia, professional bodies, industry, and government institutes to perform its research and training activities.

Food authenticity and traceability



Fingerprint
Isotopic/elemental/Biomarker





Authentic?

Adulterated?

Natural?

Organic?

ELSEVIER

journal homepage: www.elsevier.com/locate/jfca

Original research article

Isotopic and eleme
according to geogr

Karmen Bizjak Bat [a], Kle
Nives Ogrinc [c,*]

Discrimination between Slovenian cow, goat and sheep milk and cheese according to geographical origin using a combination of elemental content and stable isotope data

Marijan Nečemer[a,*], Doris Potočnik[b,c], Nives Ogrinc[b,c]

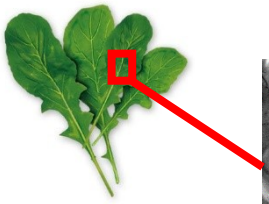
[a] Department of Low and Medium Energy Physics, Jožef Stefan Institute, Jamova 39, 1000 Ljubljana, Slovenia
[b] Department of Environmental Science, Jožef Stefan Institute, Jamova 39, 1000 Ljubljana, Slovenia
[c] Jožef Stefan International Postgraduate School, Jamova 39, 1000 Ljubljana, Slovenia

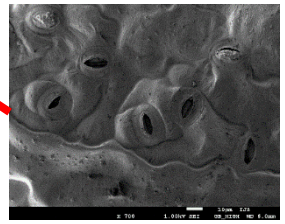
[a] Fructal d.d., Tovarniška cesta 7, SI-5270
[b] Department of Agronomy, Biotechnical Faculty, University of Ljubljana, Jamnikarjeva 101, SI-1000 Ljubljana, Slovenia
[c] Department of Environmental Sciences, Jožef Stefan Institute, Jamova 39, SI-1000 Ljubljana, Slovenia
[d] Wine Research Centre, University of Nova Gorica, Vipavska 11c, SI-5270 Ajdovščina, Slovenia
[e] Department of Low and Intermediate Energy Physics, Jožef Stefan Institute, Jamova 39, SI-1000 Ljubljana, Slovenia

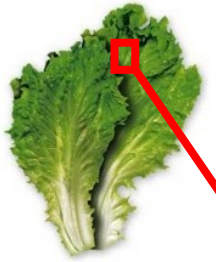
Nanoparticle Monitoring of Food Production and Processing Areas and Food

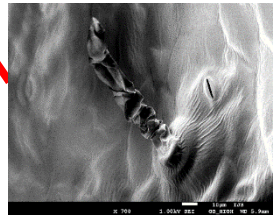
Eva Kranjc Mentor: Maja Remškar

- Aim: Developing analytical methodologies for investigating nanoparticle foliar uptake in plants
- Uptake of Pt nanoparticles using two morphologically different salad greens using ICP-MS and microscopy techniques



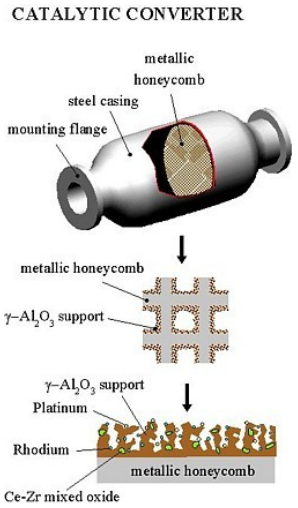






MOTIVATION:

- Human and public health implications from nanoparticle ingestion



- Pt nanoparticles are taken up and translocate as NP to non exposed sites

Ni speciation in cocoa (HPLC-ICP-MS)

Dr Kelly Peeters, Prof Radmila Milačič, Prof Janez Ščančar

- Normally low, but sensitive individuals may develop allergic reactions to Ni.
- Food represents an important source of exposure to Ni.

"**10-12** % of the female **population** and **6%** of the male **population** are believed to experience an **allergy** to **nickel and its increasing**"

- Cocoa products contain elevated Ni concentrations

Cocoa
Cocoa infusions were prepared by adding cocoa in boiling Milli-Q water for 5 min. After cooling the samples were filtered

Separation of Ni-complexes
by HPLC-ICP-MS

Qualification: (1) Synthesis of all Ni-complexes and (2) Determination of complexes with HR-MS and MS-MS

- Ni species were quantified by the post-column isotope dilution ICP-MS
- Cocoa infusions as Ni2+ and Ni-gluconate and Ni-citrate complexes.

Food Chemistry
Volume 230, 1 September 2017, Pages 327–335

Nickel speciation in cocoa infusions using monolithic chromatography – Post-column ID-ICP-MS and Q-TOF-MS

Kelly Peeters, Tea Zuliani, Dušan Žigon, Radmila Milačič, Janez Ščančar

ISO-FOOD Education

MEDNARODNA PODIPLOMSKA ŠOLA JOŽEFA STEFANA

JOŽEF STEFAN INTERNATIONAL POSTGRADUATE SCHOOL

- Independent higher education institution (2004)
- link between pure (research) and applied (industry) science
- Opportunities for joint R&D projects in industry
- ISO-FOOD students are enrolled at IPS

ISO-FOOD Vision and Mission

Our vision is…

To become a recognized research and education centre in isotopic and chemical techniques in food (feed) analysis (ERA)

Our mission is…

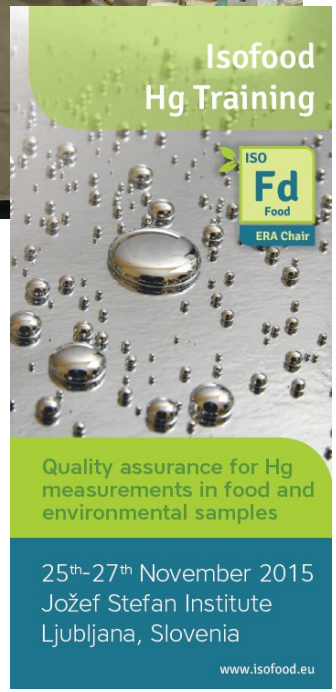
Contribute to knowledge through research

- Food analysis and characterization using advanced analytical methods
- Develop/exploit food composition databases

Transfer knowledge through education

- Workshops and training events / Doctoral course /outreach

"Destination of choice for excellent researchers"



ISO-FOOD Sponsored Researchers

6 X Post doctoral researchers

Dr Kelly Peeters O2
Element speciation in food

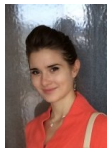
Dr Martina Lorenzetti K7
Nanoparticles in food

Dr Miha Trdin O2
Radionuclides in food

4) Organic contaminants in food
5) Compound specific stable isotopes in food
6) Metrology support in food analysis

3 X Doctoral Students

Anja Mahne Opatić O2
Isotopic and elemental characterisation of food



Eva Kranjc F5
Plant-nanoparticle interactions

Tome Eftimov Computer Systems E7
Developing tools for data management, exploration and exploitation

Master's Student

Anja Drame (K7)
Nanoparticles in food

ISO-FOOD Student Study Group
15 Students