INCDTIM

National Institute for Research and Development of Isotopic and Molecular Technologies

History

Prof. Aurel Ionescu

1950
Born as the Physics Department of the Romanian Academy

1956
Department of Physics Academy of Cluj become a subsidiary of IFA Bucharest

Prof. Victor Mercea

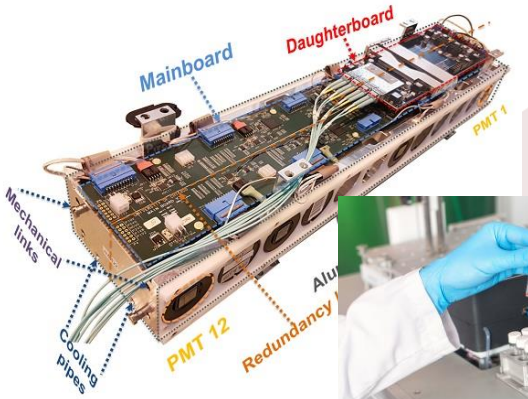
1970
Institute of Stable Isotopes

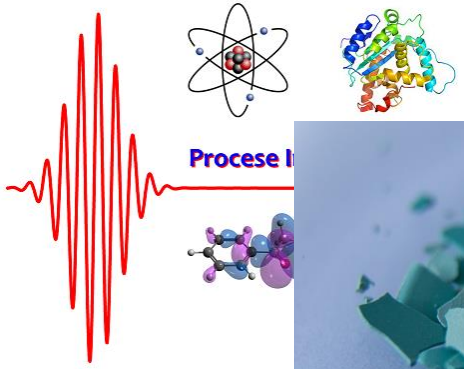
1977
Institute of Isotopic and Molecular Technologies ITIM Cluj-Napoca

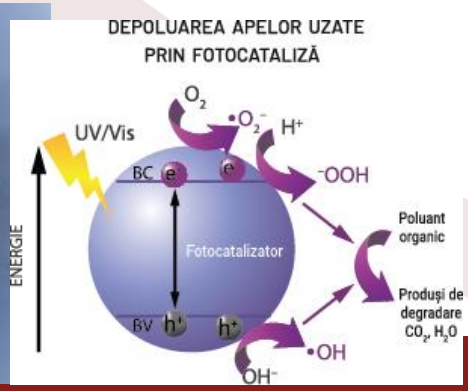
1999
National Institute for Research and Development of Isotopic and Molecular Technologies INCDTIM Cluj-Napoca (HG 408/1999)

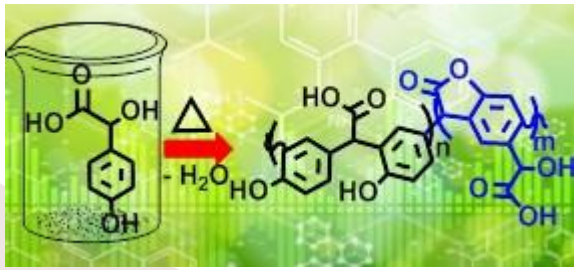
Research Departments

- Mass Spectrometry, Chromatography and Applied Physics
- Physics of Nanostructured Systems
- Molecular and Biomolecular Physics
- Physics and Technology of Isotopes
- Center for Advanced Research and Technologies for Alternative Energy – CETATEA









Research directions

Food and beverages
Food quality and safety

Cosmetic industry

Agriculture and Environment

Areas of expertise

I. Mass spectrometry

1. Isotopic Ratio Mass Spectrometry (IRMS)
2. Inductively Coupled Plasma Mass Spectrometry (ICP-MS)
3. Chromatography and Mass Spectrometry (GC-FID, GC-ECD, GC-MS and HPLC)

Product authentication for brand protection

- **authentication** in relation to the geographical and botanical origin, and production year (**PDO** - *Protected Designation of Origin*, **PGI** - *Protected Geographical Indication,* **STG** - Guaranteed Traditional Specialty)

Identification of adulteration or ‘mislabeling’

i) water in wines or fruit juices - $^{18}O/^{16}O$ of water
ii) exogenous ethanol/sugar in wines or spirits - $^{13}C/^{12}C$ of ethanol
iii) corn sweeteners in fruit juices, honey.

Authentication of vegetables and fruits (fresh or frozen)

- **differentiation with respect to:**
  - *Geographical and botanical origin (isotopic and elemental composition)*
  - *Growing system (content of pesticides, fertilizers, metals):*
    - ***organic*** *vs.* ***conventional***
    - ***greenhouse*** *vs.* ***open air***
    - ***wild*** *vs.* ***cultivated***

Alcoholic (distillates, wine, beer, cider) and non-alcoholic (mineral waters, fruit juices) beverages

- **Identification of significant parameters for the differentiation of distillates**
  - ***Geographical origin***
  - ***Production year (wines)***
  - ***Manufacturer fingerprint***
  - ***Fruit type***

- **Alcoholic beverages quality evaluation**
  - ***Acetaldehyde, methanol, ethanol and higher alcohols content***

Agri-food products (honey, meat, eggs and dairy products) fingerprinting

➢ ***Identification of specific parameters in accordance with:***

- ***Geographical and botanical origin*** (isotopic and elemental composition)

- ***Type of tissue***: chop, tenderloin, leg, neck (pork); breast, leg, wing (chicken); rib, loin (beef)
- ***Rearing system***:
  - Yard *vs.* Conventional farms (fatty acid profile, isotopic and elemental composition)

  - Chicken growing system (egg white, yolk and eggshell)

- Evaluation of the ***particularities*** of the investigated areas (soil, water, vegetation/fodder)
- Isotopic and elemental fingerprinting of ***milk*** and ***cheese***

- Evaluation of the content of persistent pesticides on the chain soil-fodder-milk-dairy products

Evaluation of the quality of agri-food products

- ❑ Nutritional indices based on fatty acid profile
- ❑ Minerals (Ca, Mg, K, Fe, Cu, Zn, etc.)
- ❑ Vitamins (Vitamin A, D3, and E)
- ❑ Phenolic acids (caffeic, chlorogenic, rosmarinic)
- ❑ Flavonoids (rutin, quercetin, naringenin, etc.)

Nutritional Indices

- ✓ Atherogenicity Index (AI)
- ✓ Thrombogenicity Index (TI)
- ✓ Hypocholesterolemiclindex (HI)
- ✓ Hypocholesterolemic/Hypercholesterolemic Ratio (h/H)
- ✓ Health-promoting Index (HPI)
- ✓ Nutritional value Index (NVI)
- ✓ Saturation Index (SI)
- ✓ Unsaturation index (UI)
- ✓ Linoleic acid/α-Linolenic acid ratio (LA/ALA)
- ✓ n-6/n-3 Polyunsaturated fatty acid families Ratio (n-6/n-3 PUFA)
- ✓ Polyunsaturated/Saturated fatty acid Ratio (PUFA/SFA)
- ✓ Monounsaturated/Saturated fatty acid Ratio (MUFA/SFA)

Quality and safety assessment

- **Risk assessment of heavy metals**
  - ❑ Provisional Tolerable Daily Intake (**PTDI**)
  - ❑ Target Hazard Quotient (**THQ**)
  - ❑ Total Target Hazard Coefficient (**TTHQ**)
  - ❑ Cancer Risk Coefficient (**CR**)

- **Migration of Metals from packaging and enamel vessels**
- **Pesticide Residues**
- ***trans* - Fatty Acids**

Cosmetic and pharmaceutical industry

- **Evaluation of the content of potentially toxic metals and organic compounds**
  - ✓ Along the production chain:

Raw materials (natural/synthetic ingredients) → Intermediate product → *Final product*

- **Quality assessment of essential oils and medicinal plants**

- **Formaldehyde customized method**
  - ✓ product export to Japan (quantification limits 10 times lower than those in Europe)

Environment

Isotopic composition

Metals

- **WATER**
- **SOIL**
- **SEDIMENTS**
- **VEGETATION**

Organic contaminants

- ❑ Pesticides
- ❑ Pharmaceutical products
- ❑ Endocrine Disrupting Compounds (EDCs)
- ❑ Synthetic dyes

II. Spectroscopic methods

1. **Vibrational spectroscopy (IR, Raman, SERS)**
2. **NMR spectroscopy (^{1}H-NMR, ^{13}C-NMR)**
3. **Fluorescence spectroscopy**

Statistical methods

Artificial Intelligence

i) Food and beverage classification models

Botanical origin

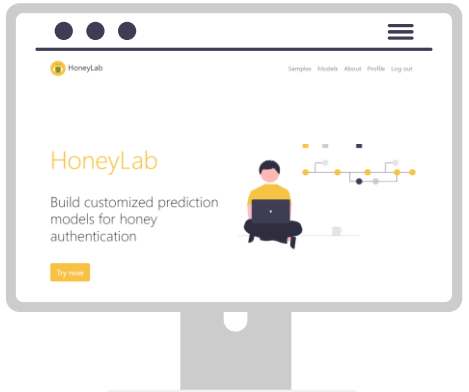
Geographical origin

Production year

ii) Models for detecting subtle adulterations

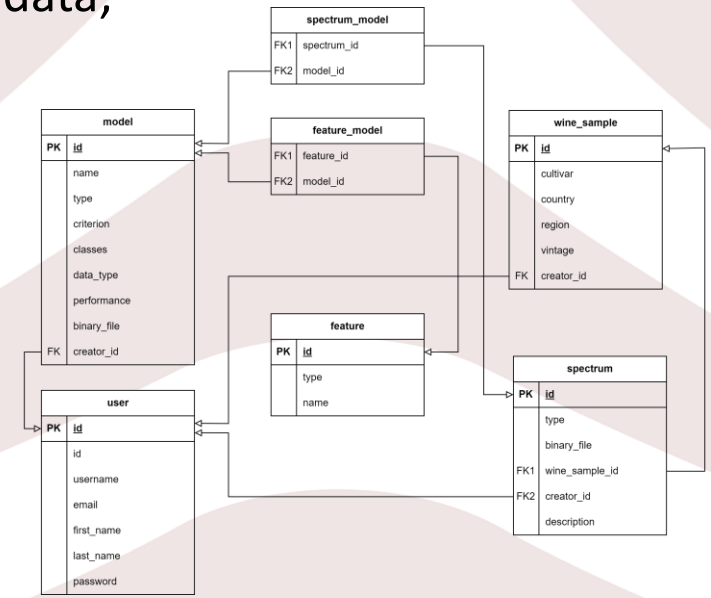
- partial replacement of an expensive food product with a cheaper variety

III. Computer applications

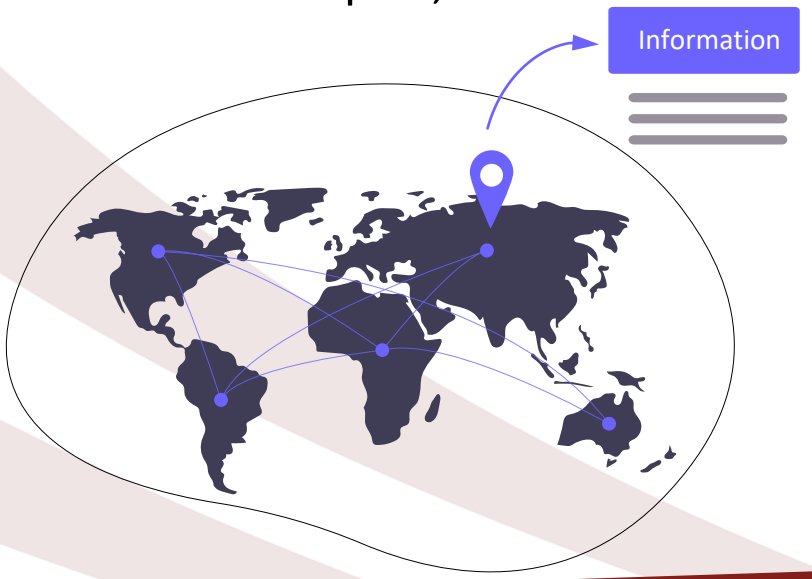


- **web applications** for facilitating the development and application of *machine learning* models for food and beverage authentication purposes;

- **databases** for efficient management of experimental data;



- **interactive maps** to visualize the geographical distribution of samples;



Thank you for your attention!