

# FOOD AND NUTRITION

PRODUCTION, TECHNOLOGY, HEALTH  
AND BEHAVIOUR

2014



# FOOD AND NUTRITION: PRODUCTION, TECHNOLOGY, HEALTH AND BEHAVIOUR

2014

The Académie universitaire Louvain (AL) is a university consortium composed of the following three academic institutions: *Université catholique de Louvain* (UCL), *Université de Namur* (UNamur) and *Université Saint-Louis* (Saint-Louis).

In this particular case, the brochure “Food and Nutrition: Production, Technology, Health and Behaviour” has been prepared by the Research Administration Departments of the UCL and UNamur only, with the valuable help of a peer review Committee composed of:

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# Foreword

Human nutrition and food research has grown up tremendously over the past decade. Food supply is essential to the development of human societies. Meeting the human food needs requires to take into account both quantity and quality criteria. However, food can also be associated with overnutrition resulting in overweight, metabolic syndrome, diabetes or cardiovascular diseases, or, on the contrary, with undernutrition resulting in anorexia or cachexia.

The main objective of this brochure is to present the scientific skills and the research potential of the *Université catholique de Louvain* and the *Université de Namur* in the field of “Food and Nutrition”.

Since the first edition of “Food Science and Nutrition” was published, there have been major advancements, which are detailed in this second edition. A lot of research groups have been developing new models and approaches to understand how nutrition, food and lifestyles play a role in the control of non-communicable diseases. Food quality is covered by a large set of branches including microbial and chemical safety, organoleptic characteristics, technological behaviour, nutritional composition and health-promoting properties.

In this second edition major advancements in behavioural and social sciences are reported, such as a number of newly identified psychosocial factors playing a role in unhealthy food choices. Programs for the prevention of dysfunctional feeding habits and for interventions have also been validated, which are aimed at changing these in high-vulnerability groups.

Thus new fields of research have been added such as History, Law, Psychology or Sociology. These additions are now part of the interdisciplinary domain of “Food and Nutrition”.

The research teams' contributions cover three major areas:

- Food production and processing;
- Biological targets of food components;
- Behavioural, social and legal matters.

Through their collaboration on research projects, and as a result of their equipment and/or training activities sharing, the research groups mentioned in the present booklet all have close links with each other. Moreover most of them are members of the same regional, European and international networks.

This brochure is meant to be user-friendly. The several research units concerned with this publication hope that their level of expertise meets the readers' expectations and invite these to contact them for further information or in case of any interest in future collaborative projects.

The peer review Committee



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## Reading notes pivot table

The pivot table below categorises the reading notes per main research areas (“Food production and processing”, “Biological targets of food components”, “Behavioural, social and legal matters”) and per applications mainly focused on human diseases (21 rows).

	A. Food production and processing	B. Biological targets of food components	C. Behavioural, social and legal matters
Vegetal production	A6, A8, A9, A10, A13, B1	A9, B1, B3, B5, B6, B15	C3, C4, C5
Animal production	A1, A2, A3, A4, A5, A6, A12, A13	B5	A1, A2, A3, A4, C3, C5, C6
Microbiology	A2, A4, A8, A10, A11, A12		A10, A11, A12, C3
Bioactive components	A2, A3, A4, A7, A8, A9, A12, B1	A9, B1, B2, B3, B5, B6, B9, B15	B3, C3
Contaminants (mycotoxins, PCB, hormones...)	A5, A8, A10	B5	B5
Formulation	A2, A3, A5, A8		
Preservation	A8, A10, A11, A12, B3		
Physical activity		B14	C2
Diabetes / Endocrine disorders	B1	B7, B8, B9, B10, B11, B12, B13, B14, B15	C2
Obesity / Metabolic syndrome		B3, B4, B5, B7, B8, B9, B10, B11, B12, B13, B14, B15	C1, C2, C3
Under- and malnutrition (Anorexia, cachexia...)		B7, B13, B15	C1
Appetite / food intake		B7, B8, B15	C1, C3, C5
Energy intake and expenditure		B9, B10, B14, B15, B16	C3
Addiction: tabacology, alcoholology...		B7, B15, B16	B16, C3
Cancer	B1	B3, B7, B13, B15	
Neurodegenerative diseases	B1	B5	
Allergy		A12, B6	
Respiratory diseases		B6, B15	
Inflammatory Bowel Diseases / Inflammatory Bowel Syndrome		A12, B3, B4, B5, B7, B15, B16	
Osteoporosis		B3, B15	
Cardiovascular diseases	B1	B8, B10, B12, B15	



# Ovine production: research and cooperation

## SENIOR SCIENTISTS

- ▶ Nathalie KIRSCHVINK
- ▶ Marianne RAES

## Research Field and Subjects

The Integrated Veterinary Research Unit of the *Université de Namur* manages a research centre specialised in sheep production. The team has significant experience and a proven expertise in the production and reproduction of small ruminants. A flock of 400 ewes is used for research, community services and education (students from veterinary faculties, agriculture schools and sheep breeders). The flock management is based on technologies that increase productivity by preserving good agricultural and breeding practices (especially in the management of gastro-intestinal parasitism). The research team has acquired its extensive experience in applied research by working on large groups of animals, generating large databases and performing most of the analyses in its own laboratory. Nursing strategies, and in particular high quality feeding of neonate lambs, are particular research fields. Through regular collaborations with farmer associations, the research team has acquired a good knowledge of the main aspects of sheep and goat production. Actual topics of interest concern health management (for example Blue Tongue Virus and Schmallenberg virus infection in sheep) and its impact on animal performance. The Department of Veterinary Medicine has been involved in several development cooperation projects concerning sheep and goat production in Africa, including Burundi and Morocco. The research team has been involved in an academic cooperation project with the National University of Colombia since 2010, with the aim of developing a sheep research centre in Bogota. The main objectives are research (production, reproduction and health), education and community services.

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## Funding

- ▶ Conseil Interuniversitaire de la Communauté Française - Commission Universitaire pour le Développement (CIUF CUD)
- ▶ Veterinary pharmaceutical industry

## Partnership

- ▶ Fédération Interprofessionnelle Ovine et Caprine Wallonne (Belgium)

## Main Equipment

- ▶ Ovine experimental flock
- ▶ Laboratory equipment

## Products and Services

- ▶ Organization of meetings and practical trainings for sheep breeders
- ▶ Planification and realisation of field studies
- ▶ Scientific advice for ovine research projects

**Keywords**

Ovine production  
Reproduction  
Health management  
Development cooperation

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# Improvement of the nutritional quality and sustainability of dietary products of animal origin

## SENIOR SCIENTISTS

- ▶ Michel FOCANT
- ▶ Yvan LARONDELLE
- ▶ Xavier ROLLIN

## Research Field and Subjects

The research team focuses its efforts on two types of dietary products deriving from animal farming: fish flesh and cow's milk.

Regarding fish, the group aims at determining the dietary requirements of aquaculture fish, with a special interest in essential amino acids and nutritional modelling. The impact of different feeding strategies on the nutritional quality of fish flesh and particularly on its fatty acid profile is also investigated, the major aim being to evaluate how and to what extent plant-derived oils can replace dietary fish oil without excessive modification of the content in n-3 long-chain fatty acids in the flesh of carnivorous fish.

For dairy cows, optimised feeding strategies are developed to improve the nutritional quality of milk fat, *i.e.* to modulate its *trans* fatty acid profile, and to increase its content in unsaturated fatty acids, conjugated linoleic acids (CLA) and n-3 fatty acids. Particular focus is placed on the dietary modulation of the fermentation processes in the rumen since they are known to influence the ruminal biohydrogenation pathways of unsaturated fatty acids. In parallel, studies are conducted to identify ways to lower the environmental impact of dairy production (methane and nitrogen excretion). Both *in vitro* (incubations of rumen juice under controlled conditions) and *in vivo* approaches (dry and lactating cows) are used.

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## Patents

- ▶ Method to alter the isomeric profile of *trans* fatty acids in ruminant meat and milk and to increase the concentration of *cis*-9, *trans*-11 conjugated linoleic acid. PCT/EP01/15386 (21/12/2001). Published on 04/07/2002 under the number WO 02/051255.

## Funding

- ▶ Fonds de la Recherche Scientifique (F.R.S.-FNRS): Fonds de la Recherche Fondamentale Collective (FRFC)
- ▶ Service Public Fédéral (SPF) Santé Publique, Sécurité de la Chaîne alimentaire et Environnement
- ▶ Conseil Interuniversitaire de la Communauté Française - Commission Universitaire pour le Développement (CIUF CUD): Projets Interuniversitaires Ciblés (PIC), Projets Coopération Universitaire Institutionnelle (CUI)
- ▶ Service Public de Wallonie (SPW), Direction Générale de l'Agriculture, des Ressources Naturelles et de l'Environnement (DGARNE)
- ▶ European Commission: 7<sup>th</sup> Framework Programme: SME
- ▶ Private companies

## Partnership

- ▶ Centre wallon de Recherche Agronomique (CRA-W (Belgium)
- ▶ Université de Liège (ULg), Gembloux Agro-BioTech (Belgium)
- ▶ Universiteit Gent (UGent) (Belgium)
- ▶ Institut National de Recherche Agronomique (INRA), Laboratoire de génétique des poissons (France)
- ▶ Universidad Mayor de San Simon, Centro de Alimentos y Productos Naturales (Bolivia)

## Main Equipment

- ▶ Chromatography tools: 5 HPLC, 2 GC, 1 GC-MS, 1 UPC<sup>2</sup>
- ▶ Basic equipment for biochemistry tests and food analysis
- ▶ Aquaculture Laboratory
- ▶ Access to the facilities of two experimental dairy cow farms

## Products and Services

- ▶ Design of *in vivo* trials (cows, fish) evaluating the nutritional quality of feeds or feed supplements
- ▶ Design of *in vitro* trials evaluating the impact of bioactive compounds on ruminal fermentation and biohydrogenation processes

## Keywords

Ruminants  
Fish  
Amino acids  
Fatty acid metabolism  
Biohydrogenation  
Conjugated linoleic acids  
Methane  
Nutritional modelling

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# Lipid nutrition of fish and ability to synthesise highly unsaturated fatty acids in fish fed plant-based diets

SENIOR SCIENTIST

▶ Patrick KESTEMONT

## Research Field and Subjects

One of the main research topics developed in the Research Unit of Environmental and Evolutionary Biology (URBE) is the nutrition of fish species with interest in inland aquaculture diversification in Europe. Among these species, URBE focused its attention on the Eurasian perch (*Perca fluviatilis*), a carnivorous freshwater species as well as on the African catfish *Clarias gariepinus*. Indeed, contrary to most carnivorous fish species reared in aquaculture, Eurasian perch seems able to biosynthesise high amounts of highly unsaturated fatty acids (HUFA) when fed plant ingredients rich in their precursors, polyunsaturated fatty acids (PUFA). Fish are the main source of HUFA for human consumers, with important benefits for health (reduction of cardiovascular risks, etc.). Thus, this potential of HUFA biosynthesis in Eurasian perch and other percid fishes (pikeperch *Sander lucioperca*) is of prime interest in the context of marine ingredients replacement by plant sources to sustain aquaculture activity. In this respect, URBE aims to characterise in Eurasian perch the functionality of enzymes involved in desaturation and elongation of PUFA into HUFA, through various biochemical and molecular approaches. In parallel, URBE evaluates the potential of HUFA biosynthesis in fish fed plant ingredients.

Other nutritional studies focus on the influence of fish meal substitution by plant meals on the reproductive performances and growth of the African catfish, in collaboration with African universities in Rwanda and Burkina Faso.

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## Funding

- ▶ Fonds de la Recherche Scientifique (F.R.S.-FNRS)
- ▶ Fonds de la Recherche Scientifique (F.R.S.-FNRS): Fonds pour la Formation à la Recherche dans l'Industrie et l'Agriculture (FRIA) PhD grants
- ▶ Wallonie-Bruxelles International (WBI)
- ▶ Coopération Universitaire pour le Développement (CUD)

## Partnership

- ▶ Université de Namur (UNamur), Unité de Chimie Physique Théorique et Structurale, Dr E. Perpète, Dr C. Michaux (Belgium)
- ▶ Université catholique de Louvain (UCL), Laboratoire Biologie de la Nutrition et Toxicologie Environnementale, Pr Y. Larondelle, Pr C. Debier (Belgium)
- ▶ National University of Rwanda (Rwanda)
- ▶ Université Polytechnique de Bobo-Dioulasso (Burkina Faso)



### **Main Equipment**

- ▶ Equipment for molecular biology (RT-PCR, RT-qPCR, electrophoresis, gel reader, spectrophotometers)
- ▶ Lipid analysis: Extraction, separation of lipid classes and CPG analysis
- ▶ Physiology/enzymology: Spectrophotometer, microsome extractions, *in vitro* cell culture
- ▶ L2 biosecurity laboratory

### **Products and Services**

- ▶ Fish nutrition test
- ▶ Biochemical analyses

### **Keywords**

Fish nutrition and reproduction  
Aquaculture  
Vegetable diets  
*Perca fluviatilis*  
*Clarias gariepinus*  
HUFA  
Desaturase  
Elongase

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<http://www.fundp.ac.be/sciences/biologie/urbe>

# Immune and digestive responses to immunostimulants in fish

## SENIOR SCIENTISTS

- ▶ Robert S.N.M. MANDIKI
- ▶ Jessica DOUXFILS
- ▶ Frédéric SILVESTRE
- ▶ Patrick KESTEMONT

## Research Field and Subjects

The Research Unit in Environmental and Evolutionary Biology (URBE) has developed fundamental and applied research in order to contribute to the development of efficient immunotherapeutic strategies for fish. URBE team has gained a large background in the assessment of physiological and immunological responses of percid fish (namely *Perca fluviatilis*, *Sander lucioperca*) to various immunostimulants. A first attention focused on the optimization of bacteria administration and doses during the young developmental stages using an assortment of bacteria. The optimal conditions for using a *Bacillus* mixture composed of *B. subtilis*, *B. licheniformis* and *B. pumilus* have been determined, as well as the potential association of these probiotics with prebiotics such as plant extracts and polysaccharides (inulin, oligofructose, and  $\beta$ -glucan) for a better activation of autonomous digestive microflora. URBE possesses various recirculation aquaculture systems (RAS) to conduct *in vivo* experiments and L2 containment facilities when fish are challenged by virulent bacteria (*Aeromonas hydrophila* or *Edwardsiella ictaluri*).

URBE nowadays extended its expertise on further characterization of the immune pathways underlying immunomodulation by testing various bio-immunostimulants, such as lactoferrin, CpG peptides and LPS in various fish species including tropical-water fish, such as striped catfish *Pangasionodon hypophthalmus*.

The research team has tested various *in vitro* culture conditions using fish lymphoid organs (such as spleen and peripheral blood mononuclear cells, PBMC). Spectrophotometric methods, RT-PCR analyses and proteomic approach are performed to characterize the digestive enzyme activities or immune components including immune-related gene expressions.

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## Funding

- ▶ Fonds de la Recherche Scientifique (F.R.S.-FNRS): Fonds de la Recherche Fondamentale Collective (FRFC)
- ▶ Belgian Science Police Office (BELSPO) – Interuniversity Attractive Pole (IAP)

## Partnership

- ▶ Université de Namur (UNamur), Unité de Recherche en Biologie Moléculaire, Pr J.-J. Letesson (Belgium)
- ▶ Université de Namur (UNamur), Unité de Recherche en Biologie Cellulaire, Pr M. Raes (Belgium)
- ▶ INVE-Aquaculture, Dr. Geert Rombaut, Dr. O. Decamp (Belgium)
- ▶ Aquatic Science, Dr. F. Luizi (Belgium)
- ▶ Universiteit Gent (UGent), Unit Research of Bioscience Engineering, Pr. P. Sorgeloos, Pr P. Bossier (Belgium)
- ▶ Can Tho University, College of Aquaculture and Fisheries, Dr B.T.B. Hang, Dr N.T. Phuong (Vietnam)

## Main Equipment

- ▶ Spectrophotometer and various equipments (microsome extractions, *in vitro* cell culture, etc) for Physiology/enzymology
- ▶ Equipments for Molecular Biology (PCR, RT-qPCR, Proteomic platform (IPGphor, Ettan Dalt Six, gel scanner and Scaffold software), Western blot apparatus, immunohistochemistry instrument)
- ▶ RAS facilities including L2 containment facility

## Products and Services

- ▶ Fish prophylactic strategies
- ▶ Molecular (including proteomics), biochemical, and immunological analyses for aquatic organisms

## Keywords

Fish welfare  
Immunostimulants  
Immune status  
Digestive functions  
Disease resistance

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# Identification of proteins and peptides in meat and bone meal

## SENIOR SCIENTISTS

- ▶ Martine RAES
- ▶ Marc DIEU

## Research Field and Subjects

In Europe, the use of proteins derived from animal tissue has been banned in livestock feed following the BSE (Bovine Spongiform Encephalopathy) epidemic. This prohibition requires the implementation of efficient means of control.

The URBC-Narilis is involved in partnership with the CRA (Gembloux) and the CER (Marloie), in a programme intended to develop peptidomics based protocols to determine the taxonomic and tissue origin of proteins present in feed for farmed animals and in particular in meat and bone meal (MBM). The peptidomic approach focuses on the proteinic fraction of animal products or by-products by establishing their peptidic profile. A diversity of peptidic fragments will be released using preliminary physico-chemical treatments of MBM samples, combined with enzymatic digestions. The global peptide pattern as well as the identification of some peptides will provide markers for determining the origin of the detected animal(s) in the MBM. This research has two direct perspectives: on the one hand, the production of specific rabbit antibodies targeting the identified markers (CER group at Marloie) and, on the other hand, the implementation, in routine analysis, of protocols to identify species present in MBM by mass spectrometry.

The URBC-Narilis has developed gel-dependent protocols with optimisation of mechanical processing of MBM, extraction of proteins and purification of extracts. After separation on mono-dimensional electrophoresis gels and trypsin digestion of selected bands, proteins and the animal species are identified by mass spectrometry (maXis impact, Bruker) using ProteinScape and Scaffold software.

A complementary gel-independent protocol, directly on protein extracts, has also been developed, allowing the identification of robust species peptide markers.

These new approaches to identify proteins and peptides and the species in MBM would allow these by-products to be reintroduced on the market and therefore for slaughterhouse waste to be recycled, providing cheap sources of protein for livestock.

The techniques and strategies used include proteomics, peptidomics, mass spectrometry and bioinformatics. Experimental research is performed in a L2 facility.

## Representative References

- ▶ MARBAIX H., DIEU M., DELAIVE E., FUMIÈRE O., BERBEN G., SERGIO MAURO S., RAES M. Identification of proteins and peptides in meat and bone meal. 6<sup>th</sup> International Symposium on Recent Advances in Food Analysis, November 5-8 **2013**, Prague, Czech Republic.

## Funding

- ▶ Service Public Fédéral Santé Publique, Sécurité de la Chaîne alimentaire et Environnement

## Partnership

- ▶ Centre wallon de Recherches agronomiques (CRA-W) (Belgium)
- ▶ Centre d'Economie Rurale (CER Groupe) (Belgium)

## Main Equipment

- ▶ Grinder ZM 200 (Retsch)
- ▶ Equipment for peptidomics: monodimensional gel electrophoresis, "spot picker" (GE Healthcare) and Typhoon scanner (GE Healthcare)
- ▶ Mass spectrometer maXis impact (Bruker)
- ▶ ProteinScape and Scaffold Software
- ▶ Clean room
- ▶ L2 biosecurity laboratory

## Products and Services

- ▶ Mechanical grinding of meat and bone meal at 0,5 mm
- ▶ Protein extraction from meat and bone meal and purification of extracts
- ▶ 1D electrophoresis separation
- ▶ Trypsinization (in gel or in solution)
- ▶ MS analysis
- ▶ Protein identification
- ▶ Gel-dependent analysis: monodimensional electrophoresis
- ▶ Gel-independent analysis
- ▶ Digestion of extracts in cleanroom
- ▶ Mass spectrometry analysis

## Keywords

Animal feed  
Meat and bone meal  
Protein extraction and trypsinisation  
Peptidomics  
Protein identification  
Peptide biomarker  
Protein biomarker  
Mass spectrometry

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# Molecular marker-assisted breeding applied to industrial crops

## SENIOR SCIENTISTS

- ▶ Nicolas DAUCHOT
- ▶ Pierre VAN CUTSEM

## Research Field and Subjects

Our team's main field of competence concerns the development and use of molecular markers for research and breeding purposes. In the context of industrial chicory (*Cichorium intybus*) breeding, microsatellite markers (SSR) were developed from *de novo* enriched gDNA libraries as well as from bioinformatic datamining of in house generated cDNA libraries or publicly available datasets. These markers were later used to characterise the genetic diversity of a collection of industrial chicories available for breeding. SSR markers were also used in our lab for assessment of genetic diversity of wild sugar beet (*Beta vulgaris*), pigeon pea (*Cajanus cajan*) and the endangered Moroccan tree species *Argania spinosa*. Collaborations in the animal field led to the development and use of SSR markers in *Sander lucioperca*, *Oreochromis sp.*, *Pseudophoxinus sp.* and *Perca fluviatilis* species for genetic diversity analysis and kinship assessment. Another aspect of genetic variability analysis is *de novo* discovery of single nucleotide polymorphisms (SNP) and the development of genotyping tools. In this context, PCR based SNP genotyping techniques (BI-PASA, PAMSA) and EcoTILLING were implemented in our lab for systematic SNP discovery and small to middle scale SNP genotyping. EcoTILLING was used for association studies where genetic polymorphisms were compared to phenotypic variability of chicory carbohydrates content and properties. These analyses were considered as part of a candidate gene approach where polymorphisms are investigated in genes functionally related to the investigated phenotype. Alternatively, genome-wide association studies are also performed thanks to the fast evolution of next generation sequencing platforms (GBS approach – Genotyping by Sequencing).

## Representative References

▶ MUYS C., THIENPONT C.-N., DAUCHOT N., MAUDOUX O., DRAYE X., VAN CUTSEM P. Integration of AFLPs, SSRs and SNPs markers into a new genetic map of industrial chicory (*Cichorium intybus* L. var. *sativum*). *Plant Breeding. In press. 2013.*

- ▶ DAUCHOT N., MINGEOT D., PURNELLE B., MUYS C., WATILLON B., MARC BOUTRY M., VAN CUTSEM P. Construction of 12 EST libraries and characterization of a 12,226 EST dataset for chicory (*Cichorium intybus*) root, leaves and nodules in the context of carbohydrate metabolism investigation. *BMC Plant Biology* 9: 14. **2009.**
- ▶ DEGAND H., FABER A-M, DAUCHOT N., MINGEOT D., WATILLON B., VAN CUTSEM P., MORSOMME P., BOUTRY M. Proteomic analysis of chicory root identifies proteins typically involved in cold acclimation. *Proteomics* 9(10): 2903–2907. **2009.**

## Funding

- ▶ Service Public de Wallonie (SPW), Direction Générale de l'Agriculture, des Ressources naturelles et de l'Environnement (DGARNE)

## Partnership

- ▶ Université catholique de Louvain (UCL) (Belgium)
- ▶ Université de Liège (ULg), Gembloux Agro-Bio Tech (Belgium)
- ▶ Université de Namur (UNamur) (Belgium)
- ▶ Cosucra, Chicoline (Belgium)

## Main Equipment

- ▶ Capillary sequencer
- ▶ Spectrophotometer
- ▶ Fluorimager
- ▶ SSCP electrophoresis

## Products and Services

- ▶ *de novo* SNP and SSR development
- ▶ SNP and SSR Genotyping
- ▶ Bioinformatics

**Keywords**

Chicory  
Genomics  
Bioinformatics  
Marker assisted breeding  
Genotyping  
EcoTILLING  
SNP and Microsatellite  
qPCR

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# Conversion of cereal bran

## SENIOR SCIENTIST

▶ Isabelle HOUSEN

### Research Field and Subjects

The main research project concerns the conversion of cereal bran into high value carbohydrate derivatives. The goal is to extract the arabinoxylan, which is tightly associated with cellulose and linked to lignin. Hydrolysis of this arabinoxylan may result in xylo-oligosaccharides, frequently referred to as prebiotics. For this purpose, two approaches have been chosen. The first one consists of using the genetic diversity of micro-organisms and selecting specific fungi or bacteria able to grow on this substrate. These micro-organisms will produce hydrolase and oxydase enzymes able to degrade the substrate. After identification of the enzymes of interest, their genes can be isolated, modified if necessary, to improve the enzyme's physico-chemical properties and then expressed in *Pichia pastoris* to obtain recombinant enzymes. The heterologous expression could be scaled from 50 ml to 5 litre cultures.

These engineered enzymes are then used to digest cereal (e.g., wheat) bran and the products are analysed by HPSEC and GC (Gembloux).

The second approach involves using different commercial enzymes to generate specific prebiotics.

In the food industry, the enzymatic conversion of xylan to xylo-oligoaccharides is preferable to chemical technologies in terms of efficiency and environmental impact.

The techniques and strategies used are those of molecular biology, and genetic engineering.

More generally, the main application of this research is to transform agricultural waste into products with high value or to improve enzyme activity in an industrial and economic context.

### Representative References

▶ POUYEZ J., MAYARD A., VANDAMME A.M., ROUSSEL G., PERPÈTE E.A., WOUTERS J., HOUSEN I., MICHAUX C. First crystal structure of an endo-inulinase, INU2, from *Aspergillus ficuum*: discovery of an extra-pocket in the catalytic domain responsible for its endo-activity. *Biochimie* 94(11): 2423-2430. **2012.**

▶ MICHAUX C., POUYEZ J., MAYARD A., VANDURM P., HOUSEN I., WOUTERS J. Structural insights into the acidophilic pH adaptation of a novel endo-1,4- $\beta$ -xylanase from *Scytalidium acidophilum*. *Biochimie* 92(10):1407-1415. **2010.**

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### Funding

▶ Service Public de Wallonie (SPW), Direction Générale Opérationnelle de l'Économie, de l'Emploi et de la Recherche (DG06)

### Partnership

▶ Université de Namur (UNamur), Unité de chimie physique, théorique et structurale, Pr J. Wouters, (Belgium)

▶ Université de Liège (ULg), Gembloux Agro-Bio Tech, Unité de Chimie Biologique Industrielle, Pr M. Paquot (Belgium)

▶ Cosucra Groupe Warcoing, Ir J. Fockedeey

### Main Equipment

▶ Molecular biology and biochemistry equipment  
▶ Sugar analysis and dosage equipment

### Products and Services

▶ Sugar analysis and dosage  
▶ Activity-oriented molecular engineering (enzymes)



**Keywords**

Cloning  
Mutagenesis  
Protein engineering  
Protein expression  
Protein purification  
Hydrolases  
Hydrolase activity tests  
Sugar analysis

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# Brewing sciences, flavour stability and polyphenol chemistry

## SENIOR SCIENTISTS

- ▶ Sonia COLLIN
- ▶ Marc MAUDOUX

## Research Field and Subjects

The INBR/ELIM/ELI team specialises in fermented foods flavours. The main objective concerns improving aroma and polyphenol stability through ageing (impact of raw materials, manufacturing, processes, etc.).

This objective entails an understanding of all chemical and biochemical pathways leading to food flavours (beer, wine, honey, chocolate, etc.). The main but not exclusive focus of investigation is on odorant polyfunctional thiols, stale aldehydes, Madeira-like lactones and norisoprenoid-derived molecules.

A large part of our activity is concentrated on the structures and properties (*in vitro* activity, health-potential, etc.) of new antioxidants, mainly flavonoids, resveratrol analogues and melanoidins.

With the aim of developing efficient methods for extracting or analysing aroma, part of our job is also devoted to the mechanisms responsible for aroma retention in food.

Where brewing is concerned, other research topics are also investigated: mycotoxins, yeast activity, hop chemistry, and so forth.

## Representative References

- ▶ COLLIN S., NIZET S., CLAEYS BOUUAERT T., DESPATURES P. Main odorants in Jura flor-sherry wines. Relative contributions of sotolon, abhexon, and theaspirane-derived compounds. *Journal of Agricultural and Food Chemistry* 60(1): 380-387. **2012.**
- ▶ GROS J., PEETERS F., COLLIN S. Occurrence of odorant polyfunctional thiols in beers hopped with different cultivars. First evidence of an S-cysteine conjugate in hop (*Humulus lupulus* L.). *Journal of Agricultural and Food Chemistry* 60(32): 7805-7816. **2012.**
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- ▶ BROHAN M., JERKOVIC V., COLLIN S. Potentiality of red sorghum for producing stilbenoid-enriched beers with high antioxidant activity. *Journal of Agricultural and Food Chemistry* 59(8): 4088-4094. **2011.**

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▶ JERKOVIC V., BROHAN M., MONNART E., NGUYEN F., NIZET S., COLLIN S. Stilbenic profile of cocoa liquors from different origins determined by RP-HPLC-APCI (+)-MS/MS. Detection of a new resveratrol hexoside. *Journal of Agricultural and Food Chemistry* 58(11): 7067-7074. **2010.**

▶ BAILLY S., JERKOVIC V., MEUREE A., TIMMERMANS A., COLLIN S. Fate of key-odorants in Sauternes wines through aging. *Journal of Agricultural and Food Chemistry* 57(18): 8557-8563. **2009.**

## Patents

- ▶ Method to increase the antioxidant activity of chocolate. EP1894473, WO2008025684.
- ▶ Spent hop products, their content in stilbenes and their use as antioxidant for comestible production. WO2008068344.

## Awards

- ▶ GIRACT awards: 2011 C. Scholtes - 2012 M.L. Kankolongu
- ▶ Barth Haas awards: 2010 S. Chaumont, S. Nizet, J. Gros - 2012 F. Peeters, S. Nizet, J. Gros
- ▶ Interbrew Baillet Latour awards: 2002 D. Callemien - 2003 V. Jerkovic - 2007 J. Gros
- ▶ VABA awards 2002: C. Counet, D. Callemien

## Funding

- ▶ Private companies
- ▶ Service Public de Wallonie (SPW), Direction Générale Opérationnelle de l'Economie, de l'Emploi et de la Recherche (DGO6)
- ▶ Fonds de la Recherche Scientifique (F.R.S.-FNRS)

## Partnership

- ▶ Industrial partners: breweries, agro-food industries, plastic producers, wine producers
- ▶ AgroParis Tech (France)
- ▶ AgroSup Dijon (France)
- ▶ Institut National de la Recherche Agronomique (INRA), UMR Qualitrop 1270 (France)
- ▶ Institut National de la Recherche Agronomique (INRA) Rennes (France)
- ▶ Faculté d'Oenologie de Bordeaux (France)
- ▶ Université Dhar El Maraz (Marocco)

## Main Equipment

- ▶ Several GCs including on column and split/splitless, SPME, static and dynamic headspace injectors; FID, NPD, ECD, SCD, PFPD detectors
- ▶ 2 GC-MS
- ▶ GC-olfactometry
- ▶ Several HPLCs including UV, fluorescence, ELSD, refractometry and electrochemical detection
- ▶ Semi-preparative HPLC
- ▶ 2 HPLC/diode array/MS-MS (ESI and APCI)
- ▶ Micro-brewery
- ▶ Fermentation material (including 30 L and 300 L fermentation vessels)
- ▶ Usual material for malt and beer analyses
- ▶ Various volatile extraction systems
- ▶ Sensory analysis

## Products and Services

- ▶ Malt and beer analyses, consulting, new product design (Centre de référence pour la qualité des malts et de la bière)
- ▶ Extraction, identification and quantification of food flavours and food packaging volatiles
- ▶ Polyphenol analysis

## Keywords

Aroma  
Beer  
Cocoa  
Wine  
Flavour stability  
Hop  
Polyphenols  
Sulphur flavours

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# Botanochemistry: plants, fruits and vegetables as “biological reactors”

## SENIOR SCIENTISTS

- ▶ István E. MARKÓ
- ▶ Stanley LUTTS

## Research Field and Subjects

Plants, fruits and vegetables contain a large variety of enzymes that could be employed for numerous interesting purposes. Their use as “biological reactors” has been little investigated, despite the enormous diversity of the plant kingdom.

Our research has centred on the use of by-products from the agri-business, such as various peels (apple, beetroot, potato, etc.) or vegetables that do not fit into the standard norm, such as deformed or oversized carrots.

The transformation of simple and inexpensive basic chemicals into high-added value products for the food, agrochemical, cosmetic, perfume and pharmaceutical industries is a key research topic in our laboratories. Whilst several methodologies are available to perform this important task, our efforts have been focused on the generation of single enantiomers – *i.e.*, non-superimposable mirror images. Indeed, such enantiomers are usually required in pure form. Typically, only one of them possesses the requisite beneficial property, the other one being either inactive or toxic.

The use of micro-organisms and isolated enzymes to perform significant chemical transformations has been extensively studied and several processes have been developed on an industrial scale. However, they suffer from several drawbacks, not the least of them being the sensitivity of the enzyme and its expense.

It was discovered that pieces of vegetables, or peels of fruits and vegetables, contain a variety of enzymes that lead to exquisite levels of asymmetric induction. Thus, treating various ketones with carrots in water generates the corresponding optically active alcohols with exceedingly high levels of enantio-purity (>99%). In addition, various lipases are present in these “bio-catalysts” and they were employed to hydrolyse a variety of, sometimes sensitive, esters at room temperature and neutral pH. Two of the most effective vegetables were identified as salsify and beets. It was possible to obtain one or the other enantiomer efficiently by treating some esters with either beetroot or apple peel. These two “bio-catalysts” proved to be complementary in this process. Notwithstanding the enormous diversity of the plant kingdom, which should offer an almost unlimited potential for finding the perfect catalyst for any given transformation, the use of by-products or nonstandard vegetables gives them a significant added value while contributing to the development of renewable reagents and ecologically benign processes.

## Representative References

- ▶ VANDENBERGHE A., MARKÓ I.E., LUCACCIONI F., LUTTS S. Enantioselective hydrolysis of racemic 1-phenylethyl acetate by an enzymatic system from fresh vegetables. *Industrial Crops and Products* 42: 380-385. **2013**.
- ▶ VANDENBERGHE A. Use of vegetable material as an original alternative for the kinetic resolution of 1-phenylethyl acetate. PhD thesis, UCL. **2012**.

## Award

- ▶ Prix Suez-Tractebel-Environnement 2006: Botanochemistry: vegetables as renewable catalysts

## Funding

- ▶ Fédération Wallonie-Bruxelles: Fond Spécial de Recherche (FSR) UCL
- ▶ Service Public de Wallonie (SPW), Direction Générale Opérationnelle de l’Economie, de l’Emploi et de la Recherche (DGO6), First Spin-off
- ▶ Prix Suez-Tractebel-Environnement
- ▶ Japan Society for the Promotion of Sciences
- ▶ Thailand Research Funds

## Partnership

- ▶ Université de Liège (ULg), Gembloux Agro-Bio Tech, Unité de Chimie générale et organique, Pr M.L. Fauconnier (Belgium)
- ▶ Centre de Recherche Public (CRP) Gabriel Lippmann, Dr J. Renaut (Luxembourg)
- ▶ Conseil de Filière Wallonne Produits Horticoles Comestibles (CFWPHC), Ir M. Schaus (Belgium)
- ▶ Omnicem-Ajinomoto, Dr J.-P. Dejonghe (Belgium)
- ▶ CMC Solutions, Dr U.P. Tilstam (Belgium)

## Main Equipment

- ▶ Modern capillary Gas Chromatography including chiral-phase
- ▶ Several HPLC systems including normal and reverse-phase HPLC, chiral phases and medium pressure equipment for large-scale purification (>100 g)
- ▶ Analytical equipment including: two 300 MHz and two 500 MHz NMR apparatus, an IR spectrophotometer, up-to-date MS and X-ray facilities
- ▶ Basic equipment for organic chemistry, synthetic organic chemistry, enzyme handling, purification equipment, inert atmosphere techniques
- ▶ Equipment for small pilot-scale reactions (3L reactors) with temperature control, stirring rate
- ▶ Circular dichroism and supercritical CO<sub>2</sub> apparatus

## Products and Services

- ▶ Detection, isolation, quantification and purification of optically active or racemic organic compounds
- ▶ Evaluation of a synthetic route towards a specific target including literature search, quantification of synthetic pathway, risk analysis
- ▶ Exploration of early synthetic route, detection of initial bottlenecks
- ▶ Process optimization including scaling-up up to 100 g scale
- ▶ Generation of small libraries of original and /or optically active compounds
- ▶ Generation of lead compounds with original structures and of novel scaffolds for pharmaceutical and agrochemical companies
- ▶ Determination of the best plant, fruit or vegetable for a specific transformation
- ▶ Advices on legal issues pertaining to organic chemistry, synthesis, methods
- ▶ Collaborative work on various other industrial topics upon discussion

## Keywords

Botanochemistry  
Biocatalysis  
Plants, fruits and vegetables  
Organic compounds  
Enantiomers  
Synthesis  
Agro, pharma and cosmetics  
Agri-business by-products

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# Food mycology

## SENIOR SCIENTISTS

- ▶ Stephan DECLERCK
- ▶ Cony DECOCK
- ▶ Heide-Marie DANIEL
- ▶ François VAN HOVE
- ▶ Sylvie CRANENBROUCK

## Research Field and Subjects

The laboratory of mycology hosts the “*Mycothèque de l’Université catholique de Louvain*” (BCCM/MUCL). This collection covers a wide array of fungal diversity and especially yeast, filamentous fungi and arbuscular mycorrhizal fungi, of interest to the food, agro-industrial and environmental sectors. The laboratory has developed a strong expertise in the fields of biodiversity assessment, species/strain isolation and identification, storage under appropriate conditions, traceability and food quality, to match industrial quality requirements. Part of the activities are certified ISO 9001:2000.

The research field includes:

- ▶ The identification and description via morphological (optical and electronic microscopy) and molecular tools (e.g., AFLP finger printing, phylogenetic studies) of filamentous fungi and yeasts from food, feed, cultivated and harvested crops, beverages and industrial processes;
- ▶ The development of molecular methods for the in-depth characterisation of fungal material, including at the strain level via fingerprinting methods;
- ▶ The strain (rather than species) characterisation, since many desirable properties are strain-specific- and not species-specific (e.g., the application of highly optimised pure cultures in industrial processes necessitates distinguishing the production strains from contaminating strains of the same species);
- ▶ The study of biodiversity of yeasts in food-related fermentations (e.g., sourdough, cocoa, lambic beer);
- ▶ The development of preservation methods for filamentous fungi and yeasts of industrial interest (e.g., beer, wine, cheese) with the aim of maintaining the properties of the biological material.

## Representative References

- ▶ CRAHAY C., DECLERCK S., COLPAERT J.V., PIGEON M., MUNAUT F. Viability of ectomycorrhizal fungi following cryopreservation. *Fungal Biology* 117(2): 103-111. **2013**.
- ▶ VAN POUCKE K., MONBALIU S., MUNAUT F., HEUNGENS K., DE SAEGER S., VAN HOVE F. Genetic diversity and mycotoxin production of *Fusarium lactis* species complex isolates from sweet pepper. *International Journal of Food Microbiology* 153(1-2): 28-37. **2012**.

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▶ PAPALEXANDRATOU Z., FALONY G., ROMANENS E., JIMENEZ J.C., AMORES F., DANIEL H.M., DE VUYST L. Species diversity, community dynamics, and metabolite kinetics of the microbiota associated with traditional Ecuadorian spontaneous cocoa bean fermentations. *Applied and Environmental Microbiology* 77(21): 7698-7714. **2011**.

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▶ VAN HOVE F., WAALWIJK C., LOGRIECO A., MUNAUT F., MORETTI A. *Gibberella musae* (*Fusarium musae*) sp. nov.: a new species from banana closely related to *F. verticillioides*. *Mycologia* 103(3): 570-585. **2011**.

## Patents

- ▶ Method and system for *in vitro* mass production of arbuscular mycorrhizal fungi. PCT patent application filed on 15/01/2009 and published under No. WO 2009/090220.

## Award

- ▶ Prix Bauchau 2013, S. Declerck

## Funding

- ▶ European Commission: 7<sup>th</sup> Framework Programme
- ▶ Belgian Science Policy Office (BELSPO)
- ▶ Service Public de Wallonie (SPW), Direction Générale de l’Agriculture, des Ressources Naturelles et de l’Environnement (D GARNE)
- ▶ Conseil Interuniversitaire de la Communauté Française - Commission Universitaire pour le Développement (CIUF CUD): Projets Interuniversitaires Ciblés (PIC)

## Partnership

- ▶ Member of BCCM (Belgian Coordinated Collections of Micro-organisms), a consortium of seven national culture collections of micro-organisms
- ▶ Private companies
- ▶ Universiteit Gent (UGent), Pr S. De Saeger, Pr Devos (Belgium)
- ▶ Vrije Universiteit Brussel (VUB), Pr L. De Vuyst (Belgium)
- ▶ University of Munich, Pr A. Schussler (Germany)
- ▶ University of Torino, Pr P. Bonfante (Italy)
- ▶ University of Western Ontario, Pr M.-A. Lachance (Canada)
- ▶ Agriculture and Agri-Food Canada, National Mycological Herbarium, Dr S.A. Redhead (Canada)
- ▶ Agriculture and Agri-food Canada, Eastern Cereal and Oilseed Research Centre, Dr Y. Dalpé (Canada)
- ▶ US Department of Agriculture, Agricultural Research Service, National Center for Agricultural Utilization Research, Dr R. Proctor (USA)
- ▶ Plant Research International, Business unit Biointeractions & Plant Health, Dr C. Waalwijk (The Netherlands)
- ▶ University of Oslo, Pr H. Kausrud (Norway)
- ▶ University of Cordoba, Dr G. Robledo (Argentina)

## Main Equipment

- ▶ A range of microbiological equipments such as light microscopes, incubators, laminar hoods, growth chambers
- ▶ Scanning Electron Microscope (SEM)
- ▶ Real time PCR machines
- ▶ Ultralow temperature (-130°C) preservation facilities
- ▶ Consolidation and management of the Belgian Collections of Microorganisms as a "Biological Resource Centre (BRC)"

## Products and Services

- ▶ Detection, isolation, enumeration and screening of filamentous fungi and yeasts in food matrices and production lines
- ▶ Targeted screening of fungal strains

- ▶ Monitoring of production chains for contaminating
- ▶ Preservation of valuable fungal and yeast strains under public, safe and patent deposits
- ▶ Distribution of fungi and yeast strains (food production or the production of specific metabolites, enzymes)
- ▶ Practical courses in (i) isolation, culture and preservation methods, (ii) morphological, physiological and molecular identification, and (iii) taxonomy
- ▶ Preparation of mycotoxin reference materials based on inoculation of cereal based matrices with accurately identified and characterized fungal strains preserved at MUCL

## Keywords

Culture collection  
Food quality  
Fungal detection in food, feed and beverages  
Molecular systematics  
Mycology  
Patent, safe and public deposit  
Quality consulting

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[http://bccm.belspo.be/db/mucl\\_search\\_form.php](http://bccm.belspo.be/db/mucl_search_form.php)

# Food bacteriology

## SENIOR SCIENTISTS

- ▶ Jacques MAHILLON
- ▶ Marleen ABDEL-MASSIH

## Research Field and Subjects

Over the years, the laboratory of Food and Environmental Microbiology has acquired a strong expertise in bacterial genetics and genomics. These approaches have led to the development of microbiological and molecular methods for the identification and discrimination of bacteria and archaea in complex matrices, including foodstuff, soil, wastewater or animal and human intestines.

Food biosafety concern has led the laboratory to apply these techniques to foodborne pathogens and opportunists, and also to food spoilage microflora. The detection and enumeration of microorganisms is enabled as well as the monitoring of the dynamics of bacterial populations over food shelf-life. Specific molecular tools have been developed for the rapid and efficient identification of microbial contaminants and/or pathogens in foodstuffs, food processing and food conservation.

The long-standing experience of the laboratory in teaching General and Food Microbiology, its active participation in the Requasud network and its frequent interactions with the agro-food industries (in particular with SME and VSE) give the laboratory a strong expertise in performing and interpreting the microbiological analyses, as well as in counselling and providing diagnostics in the fields of food processes, packaging and conservation.

The laboratory is also the coordinator, and an active actor, in the organisation of inter-laboratory (proficiency) testing, within the framework of the Requasud network. The main originalities of this activity are the use of naturally contaminated foodstuffs, the detailed feedback provided to the participants and the autonomy of the organisers.

Moreover, the laboratory is actively involved in projects dealing with the use of bacteria to control plant diseases. This work is performed in collaboration with the phytopathology unit.

Finally, genome flexibility and gene exchanges in common and extreme conditions, including high salinity, microgravity and complex food matrices, are other topics developed by the laboratory at the heart of today's concerns, faced as we are with inter-bacteria antibiotic resistance transmission.

## Representative References

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## Awards

- ▶ The “Richard C. Knudsen Publication Award” given by the American Biological Safety Association, 2010.
- ▶ BioMérieux Award: *Excellence in pathogen research* for the best Poster - 14<sup>th</sup> Conference on Food Microbiology. Liège, June 18 - 19, 2009.

## Funding

- ▶ Fonds de la Recherche scientifique (F.R.S.-FNRS)
- ▶ Service Public de Wallonie (SPW), Direction des Programmes régionaux, Recherche Collective
- ▶ Service Public Fédéral (SPF) Santé publique, Sécurité de la chaîne alimentaire et Environnement
- ▶ Fédération Wallonie-Bruxelles: Action de Recherche Concertée (ARC)
- ▶ Wallonie-Bruxelles International (WBI)

## Partnership

- ▶ Scientific Institute of Public Health (WIV-ISP)
- ▶ Service Public Fédéral (SPF) Santé publique, Sécurité de la chaîne alimentaire et Environnement (Belgium)
- ▶ Cebedeau (Belgium)
- ▶ Réseau Qualité Sud (ReQuaSud) network (Belgium)
- ▶ Wallonie-Bruxelles International (WBI) (Belgium)
- ▶ Industrial partners
- ▶ Member of the *Superior Health Council – Microbiology Committee*
- ▶ Member of the Board of Directors of the *Belgian Society for Food Microbiology* (BSFM)

## Main Equipment

- ▶ Air and surface samplers
- ▶ Pulse-Field Gel Electrophoresis (PFGE)
- ▶ Denaturing Gradient Gel Electrophoresis (DGGE)
- ▶ Real time PCR machines

- ▶ Inverse Fluorescence Microscope
- ▶ L1, L2 and L2+ biosecurity laboratories
- ▶ Collection of more than 5,000 bacterial and archaeal strains

## Products and Services

- ▶ Detection, isolation, enumeration and screening of microorganisms in food and production lines
- ▶ Identification of bacterial food contaminants and pathogens using advanced biochemical and molecular methods
- ▶ Food quality consulting for SME: decontamination techniques, hygiene and authorized disinfectants
- ▶ Advices on legal issues: criteria, norms, regulation and HACCP
- ▶ Food Microbiology reference laboratory in ReQuaSud, a network providing advices and technical support to agro-food SME industries in the Walloon Region

## Keywords

*Bacillus* spp.  
Food quality and biosafety  
Food pathogens and opportunists  
HACCP  
Quality consulting  
*Listeria* spp.  
Molecular epidemiology  
Proficiency testing

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# Modified lactic acid bacteria as novel food starters or probiotics

## SENIOR SCIENTISTS

- ▶ Laetitia FONTAINE
- ▶ Pascal HOLS

## Research Field and Subjects

Research activities are focused on a specific group of Gram-positive bacteria, generically referred to as “lactic acid bacteria” (LAB), which are of major industrial importance in food fermentation, such as yoghurt or cheese (food starters). Moreover, some LAB species are natural members of the intestinal microflora of mammals, where they play a beneficial health role (probiotics).

A multidisciplinary range of genomics/post-genomics, biochemical, and biophysical approaches are used to study the function of genes that are involved in energy metabolism, cell-wall biosynthesis, and metabolic adaptation to environmental parameters of different LAB species (*Streptococcus thermophilus*, *Lactococcus lactis*, and *Lactobacillus plantarum*).

Metabolic engineering and heterologous gene expression technologies are used to engineer LAB strains to serve as starters in dairy fermentation, as cell factories for the production of lactate isomers, aromas, low calorie sugars, or as host systems for the production and the delivery of specific compounds of food and pharmaceutical interest. This includes the development of second generation probiotics (e.g., immunomodulation, ammonia removal).

In order to select modified LAB strains with a non-GMO status, competence for natural transformation is studied in various LAB species of major industrial interest. This natural gene transfer technology has been successfully applied to combine novel properties (e.g. acidification, amino acid prototrophy, phage resistance) in starter strains of *Streptococcus thermophilus*, a species of major interest in yoghurt and cheese making.

To improve our knowledge of the control of LAB metabolism, DNA microarrays are currently exploited for transcriptomic analyses in order to study regulatory networks responding to modifications of environmental parameters (e.g., growth conditions, thermal stress, osmotic stress, etc.).

## Representative References

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## Patents

- ▶ A method for transforming a bacterium belonging to the *streptococcus* genus by natural competence. US and EU patents #WO2010149721, 2010.
- ▶ Method for producing succinic acid. JP patent #JP2008187934, 2008.
- ▶ Cell wall mutants for delivery of biologically active compounds. EU patent #EP02447119.5, 2003.
- ▶ Process for the production of alanine by recombinant microorganisms. EU patent # EP19990900710, 1999.

## Awards

- ▶ LAB Industrial Platform (LABIP) and ASM awards for the best posters of the 10<sup>th</sup> Symposium on Lactic acid Bacteria, Egmond aan Zee, The Netherlands, September 2011.
- ▶ Food Ingredients Research Award (UCL/NIZO food research, Paris, 1999).

## Funding

- ▶ Fonds de la Recherche Scientifique (F.R.S.-FNRS)
- ▶ Belgian Science Policy Office (BELSPO), Inter-university Attraction Poles (IAP)
- ▶ Fédération Wallonie Bruxelles: Action de Recherche Concertée (ARC)
- ▶ Wallonie et Fonds Européen de Développement Régional : subvention RETECH
- ▶ Service Public de Wallonie (SPW), Direction Générale Opérationnelle de l'Economie, de l'Emploi et de la Recherche (DGO6)

## Partnership

- ▶ Contractual research with private companies
- ▶ Participant in national biotech projects supported by private companies
- ▶ Université catholique de Louvain (UCL), Life Sciences Institute (ISV) research group
- ▶ European collaborations with:
  - NIZO Food Research (The Netherlands)
  - TI Food and Nutrition, ITFN (The Netherlands)
  - University of Wageningen (The Netherlands)
  - Institut National de la Recherche Agronomique (INRA) Jouy en Josas, France
  - Institut Pasteur de Lille (IPL) (France)

## Main Equipment

- ▶ DNA microarray scanner and bioinformatics servers
- ▶ Nanodrop spectrophotometer
- ▶ Capillary electrophoresis system (Bionalyser)
- ▶ Small scale fermentors (2 L and 10 L)
- ▶ High performance liquid chromatography (2) with UV, IR, ELSD detectors

## Products and Services

- ▶ Construction of Non-GMO and GMO LAB strains
- ▶ Heterologous gene expression in LAB
- ▶ Gene knockout in LAB
- ▶ Transcriptomic analyses using DNA microarrays (Agilent platform)
- ▶ Small-scale fermentation facilities
- ▶ Analysis of fermentation products (sugars, organic acids, lactate isomers, aa.).

## Keywords

Bacterial genetics  
Genomics  
Lactic acid bacteria  
Dairy products  
Yoghurt  
Cheese  
Probiotics  
Metabolic engineering

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# Process modelling, monitoring, control and real-time optimisation

## SENIOR SCIENTIST

▶ Denis DOCHAIN

### Research Field and Subjects

Well-accepted trends in food process industries require factories to be flexible in order to adapt in real-time to market driven demand and to comply with safety and environmental requirements. This translates into the need for integrated tools for factory-wide operational support that are able to predict future scenarios and factory malfunctions using reliable models that result from full access to factory conditions.

The main area of expertise concerns the mathematical modelling of the dynamics of chemical, biochemical and other industrial food processes, the analysis of the model properties and the design and application of model-based monitoring and control algorithms.

The developed approaches are largely based on mass and energy balance models. One of the underlying ideas is to incorporate information about the process dynamics (e.g., primarily metabolic network and material balances) in monitoring and control algorithms; moreover, the latter are able to deal with process uncertainties (in particular of the reaction kinetics) by introducing an adaptation scheme.

The monitoring and control strategies are applied to stirred tank reactors (dynamics described by ordinary differential equations) as well as to processes, the dynamics of which are described by partial differential equations, such as plug flow reactors, fixed or fluidised bed reactors as well as population-balance based models (for processes with size-distributed particles or age-distributed cells). Monitoring is pertinent to the design of software sensors, which are based on available knowledge of the process dynamics and on on-line measurements of a limited number of process variables. The values of the unmeasured key process variables can thus be reconstructed on-line. Particular consideration is also given to the design and implementation of real-time optimisation methods via adaptive extremum-seeking control techniques that allow the process to reach a priori unknown optimal operating points, trajectories or profiles.

Several research projects have been carried out in cooperation with industrial partners. This includes an EC FP7 project "Computer-aided food processes for control engineering" (CAFÉ).

### Representative References

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### Funding

- ▶ European Commission: 7<sup>th</sup> Framework Programme
- ▶ European Space Agency (ESA)
- ▶ Fonds de la Recherche Scientifique (F.R.S.-FNRS)

## Partnership

- ▶ Institut National de la Recherche Agronomique (INRA) Montpellier, Laboratoire de Biométrie, Dr A. Rapaport (France)
- ▶ Université de Technologie de Compiègne, Département de Génie Chimique, Pr A. Pauss, Dr O. Schoefs (France)
- ▶ Université de Lyon I, Laboratoire d'Automatique et de Génie des Procédés (LAGEP), Pr B. Maschke (France)
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## Keywords

Modelling  
Monitoring  
Estimation  
Software sensor  
Control  
Real-time optimisation  
Population balance

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## Main Equipment

- ▶ Computers

## Products and Services

- ▶ Dynamical models
- ▶ Software sensors
- ▶ Control algorithms
- ▶ Real-time optimisation algorithms

# Biologically active components of plants and vegetables

## SENIOR SCIENTIST

▶ István E. MARKÓ

## Research Field and Subjects

The extraction of readily available natural products, present in large amounts in various plants and by-products of the agriculture industry, can provide interesting starting materials for the generation of high added value compounds that are useful for diverse industrial purposes.

One of the major goals of this research is to produce high added value compounds for the food, fragrance, pharmaceutical, agrochemical, and cosmetic industries from cheap, readily available and renewable agro-resources.

The process involves a unique combination of enzyme-catalysed transformations combined with various chemical steps. These synthetic operations embody catalytic processes that either employ environmentally friendly metal-based reagents or use ecologically benign non-metal-containing catalysts.

The substrates are cheap and easily obtained from plant material typically produced in Belgium for non-food applications.

New methodologies, developed in our laboratories, are employed to obtain, from natural sources, known building blocks (synthons) used in pharmaceutical industries for various medicinal applications.

Commonly prescribed anti-diabetic drugs can easily be obtained from our building blocks in only a few simple steps.

Because of their natural origin and thus their specific stereochemical structures, our building blocks can also be transformed into various other important drugs, for example, those that have shown promising results in the treatment of Gaucher's disease. Gaucher's disease is an orphan disease caused by a dysfunctional metabolism of sphingolipids.

Some of the most promising molecules for the treatment of this disease are difficult to assemble by a traditional chemical synthesis approach due to the configuration of the various chiral centres present on the backbone of the molecule. As a result, a less effective drug is currently the only approved treatment available on the market.

This research may lead to the efficient generation of some of these drugs, thus making them available for treating this disease. Applications to other fields (agrochemical, cosmetics and fragrances) and diseases are also being investigated.

## Representative References

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## Award

- ▶ Prix Suez-Tractebel-Environnement 2006: Botanochemistry: vegetables as renewable catalysts

## Funding

- ▶ Fonds de la Recherche Scientifique (F.R.S.-FNRS)
- ▶ Fédération Wallonie-Bruxelles: Fond Spécial de Recherche (FSR) UCL et ULg
- ▶ Service Public de Wallonie (SPW), Direction Générale Opérationnelle de l'Economie, de l'Emploi et de la Recherche (DGO6), First Spin-off
- ▶ Prix Suez-Tractebel-Environnement
- ▶ Japan Society for the Promotion of Sciences
- ▶ Thailand Research Funds

## Partnership

- ▶ Université de Liège (ULg), Gembloux Agro-Bio Tech, Unité de Chimie générale et organique, Pr M.L. Fauconnier (Belgium)
- ▶ Kansas State University, Lipidomic Research Center, Pr Ruth Welti (USA)
- ▶ Goettingen University, Plant Science Department, Pr Ivo Feussner (Germany)
- ▶ Omnicem-Ajinomoto, Dr Jean-Paul Dejonghe (Belgium)
- ▶ CMC Solutions, Dr Ulf Peter Tilstam (Belgium)

## Main Equipment

- ▶ Modern Capillary Gas Chromatography including chiral-phase
- ▶ Several low-pressure purification systems (protein purification)
- ▶ Gas chromatographs coupled to a mass detector (GC-MS) including automated multimode injection system (liquid injection, thermodesorption, SPME injection, head-space injection)
- ▶ Gas chromatograph coupled to a Fourier transform infrared spectrometer
- ▶ Semi-preparative fractionated distillation unit (controlled by a micro-processor)
- ▶ Supercritical CO<sub>2</sub> Extraction / synthesis pilot system and Circular Dichroism
- ▶ Electrophoresis equipment
- ▶ Several HPLC systems including HPLC-MS, normal and reverse-phase HPLC, chiral phases and medium pressure equipment for large-scale purification (>100 g)
- ▶ Analytical equipment including: two 300 MHz and two 500 MHz NMR apparatus, an IR spectrophotometer, up-to-date MS and X-ray facilities
- ▶ Basic equipment for Organic Chemistry, Synthetic Organic Chemistry, Enzyme handling, purification equipment, inert atmosphere techniques
- ▶ Equipment for small pilot-scale reactions (3L reactors) with temperature control, stirring rate
- ▶ Circular dichroism and supercritical CO<sub>2</sub> apparatus

## Products and Services

- ▶ Extraction, purification and characterization of natural products
- ▶ Enzymatic synthesis and enzyme catalysis
- ▶ Detection, isolation, quantification and purification of optically active or racemic organic compounds
- ▶ Evaluation of a synthetic route towards a specific target including literature search, quantification of synthetic pathway, risk analysis
- ▶ Exploration of early synthetic route, detection of initial bottlenecks
- ▶ Process optimization including scaling-up up to 100 g scale
- ▶ Generation of small libraries of original and /or optically active compounds
- ▶ Generation of lead compounds with original structures and of novel scaffolds for pharmaceutical and agrochemical companies
- ▶ Determination of the best plant, fruit or vegetable for a specific transformation
- ▶ Advices on legal issues pertaining to organic chemistry, synthesis, methods
- ▶ Collaborative work on various other industrial topics upon discussion

## Keywords

Anti-diabetic drugs  
Gaucher's disease  
Renewable agro-resources  
Building blocks  
Enzyme catalysis  
Chemical synthesis  
Natural products extraction

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# Isolation, identification and quantification of biologically active molecules from crude extracts

## SENIOR SCIENTISTS

- ▶ Joëlle QUETIN-LECLERCQ
- ▶ Marie-France HÉRENT
- ▶ Joanne BERO

## Research Field and Subjects

The pharmacognosy (GNOS) laboratory of *Université catholique de Louvain* has expertises in extraction, isolation, identification (NMR and LC-HRMS<sup>n</sup>) and quantification of biologically active molecules from plant material, including food items: preparation of crude extracts, optimisation of extraction by different processes, including micro-wave assisted extraction, fractionation and purification by different preparative methods (bio-guided or not), including prep-HPLC, chemical identification of isolated compounds or known compounds in mixtures (including essential oils) and development of quantification methods in extracts, plants or biological fluids. Our expertise allows us to validate certain activities of plants, extracts or compounds and to identify active molecules from plants used in traditional medicine or that have interesting health or nutritional values. The laboratory is certified by the Belgian Federal Agency for Medicines and Health Products for analysis of natural and synthetic compounds. LC-HRMS analyses are performed in collaboration with the Massmet platform of UCL-LDRI for the structural and quantitative analysis of natural products by chromatography coupled to high resolution mass spectrometry.

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## Patents

- ▶ Novel phenazine derivatives and their use. Deposited on 28/6/2012 - N°WO2012/085222 A1

## Funding

- ▶ Fonds de la Recherche Scientifique (F.R.S.-FNRS)
- ▶ Brussels Institute for Research and Innovation (INNOVIRIS)
- ▶ Belgian Science Policy Office (BELSPO)
- ▶ Conseil Interuniversitaire de la Communauté Française - Commission Universitaire pour le Développement (CIUF CUD)



## Partnership

- ▶ Université catholique de Louvain (UCL), Pr O. Feron, Pr O. Riant (Belgium)
- ▶ Université catholique de Louvain (UCL), Institute of Life Sciences (ISV) (Belgium)
- ▶ Université de Liège (ULg), Pr M. Frederich (Belgium)
- ▶ Service Public Fédéral (SPF) Santé Publique - Agence Fédérale des Médicaments et Produits de Santé (AFMPS) (Belgium)

## Main Equipment

- ▶ Preparative and analytical chromatographies
  - Over Pressure Laminar Chromatography (OPLC)
  - Centrifugal Partition Chromatography (CPC)
  - Column chromatography, preparative-HPLC
  - HPLC-DAD, U-HPLC-DAD-HRMS
  - GC-FID, GC-MS
  - HPTLC-densitometry-HRMS
- ▶ Lyophilisator
- ▶ Ion trap or orbitrap mass spectrometer with GC and LC coupling
- ▶ Micro-waves assisted extractor (MAE)

## Products and Services

- ▶ Isolation of bioactive molecules from plants or crude extracts – Evaluation of their biological activities
- ▶ Molecule structure identification
- ▶ Quantification of natural compounds in plants or crude extracts
- ▶ Analysis according to European Pharmacopea
- ▶ Quality control
- ▶ Qualitative and quantitative analysis by mass spectrometry coupled to chromatography

## Keywords

Active natural products  
Plants  
Quantitative analysis  
Secondary metabolites  
Nutraceuticals

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# Biochemical interactions between bioactive compounds of dietary origin and animal or human cells in culture

## SENIOR SCIENTISTS

- ▶ Yvan LARONDELLE
- ▶ Yves-Jacques SCHNEIDER

## Research Field and Subjects

Different cell culture systems mimicking the intestinal barrier are used to study the biochemical interactions that may occur with dietary bioactive compounds (specific nutrients, phenolic compounds, conjugated fatty acids, triterpenes, glucosinolates, nanoparticles). The main focus is on intestinal absorption and transport mechanisms, first-pass metabolic processing of the absorbed compounds, and their impact on the cellular metabolic behaviour.

The bioactivity of different plant-derived compounds and extracts is evaluated on Caco-2 cells at different stages of differentiation. These cells are cultivated in different culture systems, including bicameral devices allowing a separate access to the apical and basolateral poles of the cells. Defined culture media have been designed without serum and help to clarify the specific interactions of the bioactive compounds with biological mediators, such as growth factors and cytokines. Systems based on co-cultures, including Caco-2 cells and M-like cells, goblet, mucin-secreting, cells and/or macrophages, have been set up and characterised.

A special focus is placed on the anti-inflammatory properties of natural compounds. In this case, the cells are stimulated with pro-inflammatory factors, either alone or as a mixture, and counteracting effects are monitored after addition of the products of interest.

The metabolic processing of different kinds of dietary fatty acids (n-3 and n-6 polyunsaturated fatty acids, CLAs, CLnAs) is studied in different cell lines mimicking the intestinal epithelium. Inversely, the impact of modifications of the cellular fatty acid profile on the cell properties is investigated in terms of barrier function and response to inflammatory stimulants.

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- ▶ LAI N.H.; HÉRENT M.F., QUETIN-LECLERCQ J., NGUYEN B.T., ROGEZ H., LARONDELLE Y., ANDRE C. Piceatannol, a potent bioactive stilbene, as major phenolic component in *Rhodomyrtus tomentosa*. *Food Chemistry* 138(2-3): 1421-1430. **2013**.
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## Funding

- ▶ Fonds de la Recherche Scientifique (F.R.S.-FNRS): Fonds de la Recherche Fondamentale Collective (FRFC), Fonds pour la Formation à la Recherche dans l'Industrie et l'Agriculture (FRIA)
- ▶ Fédération Wallonie-Bruxelles: Fonds Spécial de Recherche (FSR) UCL
- ▶ Service Public Fédéral (SPF) Santé Publique, Sécurité de la Chaîne alimentaire et Environnement
- ▶ Service Public de Wallonie (SPW), Direction Générale Opérationnelle de l'Économie, de l'Emploi et de la Recherche (DG06)
- ▶ Conseil Interuniversitaire de la Communauté Française - Commission Universitaire pour le Développement (CIUF CUD): Projets Interuniversitaires Ciblés (PIC), Coopération Universitaire Institutionnelle (CUI).

## Partnership

- ▶ Private companies
- ▶ Centre wallon de Recherche agronomique (CRA-w) (Belgium)
- ▶ Haute Ecole Léonard de Vinci, Institut Paul Lambin (Belgium)
- ▶ Université de Liège (ULg) (Belgium)
- ▶ Université Libre de Bruxelles (ULB) (Belgium)
- ▶ International network of universities from Southern countries:
  - Federal University of Para (Brazil)
  - Agricultural University of La Molina (Peru)
  - Hanoi Agricultural University (Vietnam)
  - Technological Institute of Cambodia (Cambodia)
- ▶ Gabriel Lippmann Research Centre (Luxembourg)

## Main Equipment

- ▶ Chromatography tools: 5 HPLC, 2 GC, 1 GC-MS, 1 UPC<sup>2</sup>
- ▶ Complete cell culture facility
- ▶ Basic equipment for biochemistry, as well as cell and molecular biology
- ▶ Confocal microscope

## Keywords

Cell culture  
Defined culture media  
Bioavailability  
Phenolic compounds  
Triterpene  
Fatty acid  
Conjugated fatty acid  
Silver nanoparticles

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# Transcriptomic analyses of food components in *in vitro* cellular models and in human volunteers at different ages

## SENIOR SCIENTISTS

- ▶ Olivier TOUSSAINT
- ▶ Florence DEBACQ-CHAINIAUX

## Research Field and Subjects

The identification of transcriptomic biomarkers has uses for many areas, including the field of nutrition. Transcriptomic biomarkers were shown to be associated with metabolic syndrome, intestinal function and intestinal inflammation, which may occur during the exposure of intestinal cells to substances of interest. Transcriptomic biomarkers were also found in diet-induced obese mice and rats. The identification of these biomarkers is useful to better understand the changes related to eating disorders.

In terms of ageing, it has been shown that transcriptomic markers were associated with frailty and with age. First, transcriptomic studies were performed on hospitalised elderly patients (with heart disease, hip fracture or infection) and several genes were found to be associated with frailty. Second, in healthy volunteers aged between 35 and 75 years several genes were also found to be associated with age or with various diseases associated with ageing. These analyses were performed from RNA extracted from Peripheral Blood Mononuclear Cells (PBMC) from blood samples.

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## Funding

- ▶ Service public de Wallonie (SPW), Direction Générale Opérationnelle de l'Economie, de l'Emploi et de la Recherche (DGO6)
- ▶ European Commission: 7<sup>th</sup> Framework Programme

## Partnership

- ▶ Université catholique de Louvain (UCL), Louvain Drug Research Institute, Metabolism and Nutrition Research Group, Pr N. Delzenne (Belgium)
- ▶ Université catholique de Louvain (UCL), Life Science Institute (ISV), Pr Y.-J. Schneider, Pr Y. Larondelle (Belgium)
- ▶ Université catholique de Louvain (UCL), Centre Hospitalier Universitaire Mont-Godinne, Department of Geriatrics, Pr C. Swine, Dr M. de Saint Hubert (Belgium)
- ▶ Université de Liège, Center of Immunology, Laboratory of Immunoendocrinology (CIL), Pr V. Geenen, Dr H. Martens (Belgium)
- ▶ University of Konstanz, Pr Alexander Burkle (Germany)
- ▶ University of Bologna, Pr Claudio Franceschi (Italy)
- ▶ Nestlé and other private companies

## Main Equipment

- ▶ Cell culture facilities (hoods, incubators, low oxygen pressure facility (WOW company))
- ▶ Analysis of the mRNA expression (Bioanalyzer (Agilent), 7900 HT Real Time PCR (Applied Biosystems))
- ▶ Microscopy and imaging (confocal fluorescence (Leica), BD Pathway bioimaging systems (BD))
- ▶ Analysis and identification of proteins (LC-MS-MS (Bruker))

## Keywords

Transcriptomics  
Low oxygen platform  
Cellular models  
Ageing  
Human volunteers  
Food components

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# Impact of dietary contaminants (heavy metals, persistent organic pollutants, mycotoxins) on animal and human metabolism

## SENIOR SCIENTISTS

- ▶ Cathy DEBIER
- ▶ Yvan LARONDELLE
- ▶ Jean-François REES

## Research Field and Subjects

The research team aims at studying the physiological and toxicological consequences of the ingestion of dietary contaminants, especially in terms of interactions with other food-borne compounds. A major focus is placed on heavy metals such as mercury and cadmium, persistent organic pollutants such as PolyChlorinated Biphenyls (PCBs), Polybrominated Diphenyl Ethers (PBDEs), organochlorine pesticides and mycotoxins.

Mechanistic studies are based on *in vitro* experimental models including animal or human cells in culture (primary cultures of rat and seal adipocytes at different stages of differentiation, adipose tissue-related cell lines, human intestinal cell lines, fish primary hepatocytes and related cell lines), as well as precision-cut liver and brain slices. Different *in vivo* models (caught fish, cold- and warm-water farmed fish at different stages of growth, rats, laying hens, rabbit does, different free-ranging seal populations) allow toxicokinetic and toxicodynamic studies, as well as evaluations of the impact of the contaminants on animal growth and performance. Both the *in vitro* and *in vivo* models are used to evaluate by which mechanisms and to which extent the effects of the dietary contaminants are influenced by nutrients (fatty acids, vitamins, minerals) and other food-borne bioactive compounds (phenolic compounds, terpenoids, glucosinolates), and *vice versa*.

In a more oriented way, the research group develops ways to lower the negative impacts of dietary contaminants, through the use of plant-derived adsorbents and biological compounds, that have antagonistic effects on the toxicological target sites.

## Representative References

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- ▶ LEMAIRE B., BECK M., JASPART M., DEBIER C., CALDERON P.B., THOMÉ J.-P., REES J.-F. Precision-cut liver slices of *Salmo salar* as a tool to investigate the oxidative impact of CYP1A-mediated PCB 126 and 3-methylcholanthrene metabolism. *Toxicology in vitro* 25(1): 335-342. **2011**.
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## Patents

- ▶ Utilisation de fibres végétales micronisées pour la préparation d'une composition alimentaire destinée à diminuer la biodisponibilité des mycotoxines. FR0400090 INPI Paris (07/01/2004).
- ▶ Procédé biologique de détoxification d'un milieu liquide alimentaire et milieu liquide alimentaire détoxifié obtenu selon ce procédé. FR0308689/75 INPI Paris (16/07/2003).

## Funding

- ▶ Belgian Science Policy Office (BELSPO): Interuniversity Attraction Poles
- ▶ Fonds de la Recherche Scientifique (F.R.S.-FNRS): Fonds de la Recherche Fondamentale Collective (FRFC), Fonds pour la Formation à la Recherche dans l'Industrie et l'Agriculture (FRIA)
- ▶ Fédération Wallonie-Bruxelles: Fonds Spécial de Recherche (FSR) UCL
- ▶ Service Public Fédéral (SPF) Santé Publique, Sécurité de la Chaîne alimentaire et Environnement
- ▶ European Commission: 7<sup>th</sup> Framework Programme: SME

## Partnership

- ▶ Veterinary and Agrochemical Research Centre (Belgium)
- ▶ Université de Liège (ULg) (Belgium)
- ▶ Universiteit Gent (UGent) (Belgium)
- ▶ University of Antwerp (UA) (Belgium)
- ▶ Katholieke Universiteit Leuven (KU Leuven) (Belgium)
- ▶ Université de Namur (UNamur) (Belgium)
- ▶ University of St Andrews, Sea Mammal Research Unit (Scotland)
- ▶ University of California at Santa Cruz (USA)
- ▶ Sonoma State University (USA)

## Main Equipment

- ▶ Chromatography tools: 5 HPLC, 2 GC, 1 GC-MS, 1 UPC<sup>2</sup>
- ▶ Toxicology-dedicated cell culture facility
- ▶ Precision-cut tissue slice equipment
- ▶ Basic equipment for biochemistry tests and food analysis
- ▶ Aquaculture facility
- ▶ Rodent housing facility

## Products and Services

- ▶ Mycotoxin quantification in food matrices
- ▶ Design of *in vivo* trials evaluating toxicity antagonists

## Keywords

Heavy metals  
Persistent organic pollutants  
Mycotoxins  
Fatty acids  
Eel  
Salmonids  
Seals  
Toxicokinetics

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# Profile of allergic sensitisation in patients with allergic airway disease to pollens and related food allergies

## SENIOR SCIENTISTS

- ▶ Charles PILETTE
- ▶ Françoise PIRSON
- ▶ Cloé HUPIN
- ▶ Carine SOHY

## Research Field and Subjects

The research topic currently explored in the *Centre de l'Allergie Saint-Luc* and in the *Centre de l'Allergie Mont-Godinne* is the characterisation of the profile of allergic sensitisation (*i.e.* allergenic proteins recognised by their IgE antibodies) in patients living in Belgium with rhinitis, conjunctivitis and or asthma due to pollen allergy with or without pollen-related food allergy.

The aims of this study are:

- ▶ to define their profile of sensitisation to pollen allergenic components
- ▶ to observe the cross mechanisms of sensitisation between birch and/or grass pollens and foods
- ▶ to look at an eventual link between the length and/or severity of the allergic respiratory disease and the risk of food allergy.

Three clinical entities are considered:

- ▶ patients with respiratory allergy to birch pollen (symptoms typically from March to April and positive skin tests to birch pollen);
- ▶ patients with allergy to grass pollen (symptoms in May and June with positive skin tests to grass pollen)
- ▶ patients with allergic symptoms and skin reactivity to both pollens.

The first step of the research is to compare the sensitisation profile (IgE antibodies) of these patients to similar populations studied in other European countries. The second step is to consider mechanisms of "cross sensitisation" to food (*e.g.* containing pollen-related proteins, such as Bet v1 analogues) and to identify whether a relationship exists between the length and/or the severity of the respiratory allergy and the risk of development of food allergy. The third step is to explore the link between the allergen sensitisation profile within a same family of pollen and the development of food allergy. Two biological techniques are used: a quantitative immunoassay of IgE to pollens and food extracts and allergenic components (CAP®, ThermoScientific/Phadia) and a semi-quantitative microarray to multiple allergens (ImmunoCAP® ISAC, ThermoScientific/Phadia) with comparison of their performances.

Following this baseline characterisation, we plan to follow up this cohort to get insights into the natural history of these forms of allergy to pollens and related food.

## Representative References

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- ▶ DAHLQVIST C., PIRSON F. Anaphylaxie induite par l'exercice physique / Exercise-induced anaphylaxis. *Revue Française d'Allergologie* 51(4): 414-418. **2011**.
- ▶ PIRSON F., DETRY B., PILETTE C. Occupational rhinoconjunctivitis and asthma caused by chicory and oral allergy syndrome associated with bet v 1-related protein. *Journal of Investigational Allergology and Clinical Immunology* 19(4): 306-10. **2009**.

## Award

- ▶ FNRS / Scientific Award Foundation AstraZeneca - Asthma & COPD, 2009, C. Pilette

## Funding

- ▶ Fondation Saint-Luc

## Partnership

- ▶ Université catholique de Louvain (UCL), Cliniques Universitaires Saint-Luc, C. Fillée (Belgium)
- ▶ Université catholique de Louvain (UCL), CTMA, Pr J.-L. Gala (Belgium)

## Main Equipment

- ▶ ImmunoCAP100 & 250
- ▶ ImmunoCAP ISAC (112) microarray
- ▶ Cellular/immunological bench-lab assays (IREC-PNEU)



### **Products and Services**

- ▶ Allergic skin-prick tests to pollens and native foods available in our outpatient clinics (ENT, pneumology) Cliniques Universitaires de Mont-Godinne, Yvoir, Belgium and Cliniques Universitaires Saint-Luc, Brussels
- ▶ CAP® tests (ThermoScientific/Phadia) in the clinical laboratory of the Cliniques Universitaires Saint-Luc and Cliniques Universitaires de Mont-Godinne  
Birch pollen allergy, grass pollen allergy, food allergy, profile of allergic sensitization, Belgian population
- ▶ ImmunoCAP® ISAC112, ThermoScientific/Phadia, CTMA, UCL Brussels
- ▶ *In vitro* T-cell & IgA responses to allergens, IREC-PNEU, UCL, Brussels

### **Keywords**

Birch pollen allergy  
Grass pollen allergy  
Food allergy  
Profile of allergic sensitisation  
Belgian population

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# Evaluation of functional food components and phytochemicals in the control of gut-microbiota-related metabolic diseases

## SENIOR SCIENTISTS

- ▶ Nathalie M. DELZENNE
- ▶ Patrice D. CANI
- ▶ Audrey M. NEYRINCK

## Research Field and Subjects

The development of functional food promises to be an interesting way of modulating key metabolic functions in the body, in order to improve health and well-being. Our research group has focused its scientific activities on demonstrating how nutrients that interact with the gut microbiota (commensal bacteria present in the gastro-intestinal tract) can be helpful in the control of metabolic disorders associated with ageing, obesity, cancer development and malnutrition (including alcohol consumption, nutritional deficiencies, cachexia). Experimental models, and appropriate biomarkers/procedures, have been developed *in vitro* and in animals. They allow us to study the action of nutrients or bioactive molecules on gut microbiota composition/activity and key gut functions (endocrine, immune, and barrier functions). We are particularly interested in understanding the systemic effects of components targeting the gut microbiota, namely how they modulate appetite, behaviour, lipid and glucose homeostasis and innate and systemic immunity. The studies are mostly performed *in vitro* or in animal models (genetic, pharmacologic or nutritional models of metabolic diseases) but intervention studies are also performed on humans in collaboration with clinicians.

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## Patents

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- ▶ Médicament à base de laminarine ou d'oligomarinines pour le traitement des hépatites virales. N° PCT/FR2006/001128, 2006.
- ▶ Médicament à base de laminarine ou d'oligomarinines pour le traitement de la septicémie et du choc septique. N° PCT/FR2006/00113, 2006.
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- ▶ Composition for prevention, inhibition and treatment of obesity and related diseases. N° PCT/EP2004/010907W0 - 2005/036990, 2005.
- ▶ Composition for suppressing ghrelin and method for same. N° EP 03022007.3, 2003.
- ▶ Prevention of mammary carcinogenesis and breast cancer treatment N° US 5,721,345 ref PRAFF 15/US, 1998.

## Awards

- ▶ Prize Eugène de Somer, N.M. Delzenne, 2012
- ▶ Société Francophone du Diabète (SFD) prize, Foreigner Researcher, P.D. Cani, 2012
- ▶ Danone Institute Human Nutrition Research program, P.D. Cani, 2010
- ▶ Kraft Foods Europe Award for Cereal Research, A.M. Neyrinck, 2011
- ▶ First Prize poster award in the session "Managing bacteria-host interactions", First international symposium on microbial resource management in biotechnology: Concepts & applications, A. Everard, 2011
- ▶ Prize Alpro Soja, C. Druart, 2010
- ▶ Société Francophone du Diabète (SFD), Special Research Allocation, P.D. Cani, 2009

## Partnership

- ▶ Université catholique de Louvain (UCL), Pr G. Bommer, Pr S. Brichard, Pr J.B. Demoulin, Pr M. Francaux, Pr Y. Guiot, Pr D. Lambert, Pr I. Leclercq, Pr G. Muccioli, Pr J.-P. Thissen, Pr Y. Larondelle, Pr P. de Timary, Pr R. Vanbever (Belgium)
- ▶ Institut National de la Santé et de la Recherche Médicale (INSERM): Toulouse, Pr P. Valet, Dr C. Knauf; Paris, Pr P. Ferré, Dr. F. Foufelle (France)
- ▶ University of Reading, Pr G. Gibson, Dr. S Claus (United Kingdom)
- ▶ University of Wageningen, Pr W. de Vos (The Netherlands)
- ▶ Sahlgrenska Institute, Gothenburg, Pr F. Backhed (Sweden)
- ▶ Equipe HERGE, Pr C. Magnan, Pr S. Luquet (France)
- ▶ Imperial College, Pr J. Nicholson, Pr E. Holmes (United Kingdom)
- ▶ Institut Pasteur, Pr B. Pot, Dr C. Grangette (France)
- ▶ Université de Genève, Pr J. Schrenzel, Pr P. François, Pr V. Lazarevic (Switzerland)
- ▶ University of Aberdeen, Pr K. Scott (United Kingdom)

## Main Equipment

- ▶ Molecular biology techniques, including q-RT PCR and western blotting
- ▶ Luminex® Technology (multiple immunoquantification of peptides or RNA)
- ▶ Immunohistochemistry
- ▶ Krumbiek slicer and adequate incubation of precision-cut organ slices
- ▶ Tissue and cell cultures (2 rooms)
- ▶ Spectrophoto/fluori-meter, gas and high performance liquid chromatography (5)
- ▶ Nuclear Magnetic Resonance for mice (body composition)
- ▶ Animal care facilities with required authorizations

## Products and Services

- ▶ Testing *in vivo* for potential effect of new ingredients (*i.e.* phytochemicals, prebiotics, probiotics, dietary fibers on gut microbiota, composition/function related to improvement of host health)
- ▶ Testing *in vitro* on explants or cultured cells (liver, adipose tissue) for interaction of any bioactives on metabolic pathways, inflammation, gene expression or and/or cell proliferation/differentiation (cancer cells)
- ▶ Portfolio of biomarkers related to gut microbiota activity and function, measurable in small biological human or animal samples (LPS, pro- and anti-inflammatory cytokines, gut peptides, microbial metabolites...)
- ▶ Assessment of gut fermentation, gastro-intestinal tolerance, food intake behavior, fiber and prebiotic intake (food questionnaire) in human volunteers

## Keywords

Prebiotics  
Gut microbiota  
Obesity  
Satiety  
Dietary fibers  
Inflammation  
Metabolic diseases  
Malnutrition

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# Regulation of cardiac metabolism by nutrients and hormones under physiological and patho-physiological conditions

## SENIOR SCIENTISTS

- ▶ Luc BERTRAND
- ▶ Christophe BEAULOYE
- ▶ Sandrine HORMAN
- ▶ Jean-Louis VANOVERSCHELDE

## Research Field and Subjects

The heart has to constantly adapt its function and, therefore, its energy consumption to changes in the supply of circulating nutrients, hormones, and oxygen. A healthy human heart produces and immediately consumes 3,5 to 5 kg of energy (ATP) each day to sustain its function. This ATP is mainly generated by mitochondrial oxidation of fatty acids and glucose but the proportion of each can vary upon substrate availability and hormonal status. For example, when insulin concentration rises in response to an elevation in glucose plasma level, glucose becomes the favoured oxidised substrate of the heart. There is compelling evidence showing that this metabolic flexibility is crucial to maintain an appropriate cardiac function. By contrast, a metabolic inflexibility is induced by the nutrient disequilibrium found in diabetes. This inflexibility is clearly linked to the development of a cardiac dysfunction called diabetic cardiomyopathy that can cause heart failure.

The research team is studying the implication of intracellular signalling in the control of cardiovascular metabolism. Its programme is focused on the interplay between hormones like insulin, metabolites such as glucose, lipids and amino acids and the protein kinase called AMP-activated protein kinase (AMPK). AMPK is considered to be a cellular sensor that plays a key role in the overall regulation of metabolism. Previous work by the team suggests that AMPK activation could protect the heart against several patho-physiological processes, including ischemic injury, heart failure and diabetic cardiomyopathy. The main research currently under investigation studies whether modulation of the AMPK signalling pathway by hormones, pharmacological compounds and nutrients could exert potential therapeutic effects. The team has developed a set of (*in vivo* and *in vitro*) cardiovascular assay evaluating cardiac metabolism and function in small and big animals as well as in humans.

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## Awards

- ▶ Prix Léopold et Marthe Delsaux-Champy 2009, S. Horman
- ▶ Prix Camille et Germaine Damman 2007, L. Bertrand
- ▶ Prix Léopold et Marthe Delsaux-Champy 2006, L. Bertrand
- ▶ Young Investigator Award of Belgian Society of Cardiology 2001, C. Beauloye
- ▶ Lecture Bischof 2001, J.-L. Vanoverschelde
- ▶ Chaire Astra Foundation 1997-1999, J.-L. Vanoverschelde
- ▶ Prix Bekales 1996, J.-L. Vanoverschelde
- ▶ Prix Van Vaerenbergh - de Visccher 1996, J.-L. Vanoverschelde
- ▶ Prix Therabel 1995, J.-L. Vanoverschelde

## Funding

- ▶ Fonds de la Recherche Scientifique (F.R.S.-FNRS)
- ▶ Fédération Wallonie-Bruxelles: Action de Recherche Concertée (ARC), Fonds Spécial de recherche (FSR) UCL
- ▶ Service Public de Wallonie (SPW), Direction des Programmes Régionaux

## Partnership

- ▶ Université de Montréal, Montreal Heart Institute, Pr C. Des Rosiers (Canada)
- ▶ Nestlé Institute of Health Sciences, Dr K. Sakamoto (Switzerland)
- ▶ Université Paris Descartes, Cochin Institute, Sorbonne Paris Cité, Dr B. Viollet (France)

## Main Equipment

- ▶ Human and animal cardiac imaging (standard and high resolution echocardiography, SPECT and  $\mu$ SPECT, PET and  $\mu$ PET, MRI, CT)
- ▶ *Ex vivo* system of heart perfusion (for small and big animals)
- ▶ Metabolic measurement platform
- ▶ Standard biochemical and cellular biology equipment (1D and 2D electrophoresis, cell culture, immunohistochemistry)
- ▶ Liquid scintillation analyzers, multimodal imaging system (chemiluminescence and fluorescence) and spectrophotometer
- ▶ Lumi-Aggregrometer (Chrono-Log)

## Products and Services

- ▶ Cardiac metabolic and functional measurements in human and animals (mouse, rat, rabbit, pig).
- ▶ Clinical tests
- ▶ *In vitro* and *in vivo* protein kinase assay
- ▶ Evaluation of platelet activation and aggregation

## Keywords

Heart metabolism  
Signal transduction  
Diabetes  
Nutrient  
Insulin resistance  
Cardiac imaging  
Heart perfusion  
Cell therapy

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# Food components on adipocytes: role of mitochondria

## SENIOR SCIENTISTS

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- ▶ Patricia RENARD

## Research Field and Subjects

Current sets of data suggest that different classes of bioactive food components, including vitamin B3, retinoids, fatty acids and polyphenols, may have the potential to modulate mitochondrial function and consequently prevent adipose dysfunction in obesity. Understanding how nutrients affect mitochondrial function is thus necessary.

The main research topics currently under investigation in the laboratory involve the analysis of various stressing conditions on mitochondrial function, dynamics (fusion-fission), morphology, biogenesis, degradation and organelle crosstalk.

The first model is composed of 3T3-L1 adipocytes in which we developed tools to analyse and characterize the various aspects of mitochondrial biology in response to mitochondrial uncoupling. Cell signalling involved in the control of gene expression related to adipocyte “dedifferentiation” and mechanisms responsible for triglyceride content (lipogenesis and lipolysis) and adipokine synthesis (monitored at the secretome level) are analysed at several levels including the role of miRNA and epigenetics. A second model of human adipocytes will be used soon to address questions about mitochondrial dysfunction and metabolism. Altogether, this metabolic platform can be used to assess the effects of bioactive components as well as additives on the biology of adipocytes and especially on the powerhouse of the cell.

The techniques and strategies are those used in biochemistry, cell and molecular biology, including imagery and proteomic approaches. The research group was a partner laboratory in *MITOFOOD (COST Action)*, a EU network working on understanding how food bioactive components affect mitochondria and the laboratory has maintained several active collaborations in the field.

Through collaborations with CER (Marloie), a research project has been initiated that is devoted to the development of proteomic approaches allowing the detection of multiple allergens in food matrices (milk, soya, wine and eggs). This project should lead to the identification of new markers resistant to food processing and to the analysis of still poorly studied allergens.

## Representative References

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- ▶ DE PAUW A., TEJERINA S., RAES M., KEIJER J., ARNOULD T. Mitochondrial (dys)function in adipocyte (de)differentiation and systemic metabolic alterations. *The American Journal of Pathology* 175(3): 927-939. **2009**.

## Patents

- ▶ Method and kit for the determination of cellular activation profiles, US patent 7892818 (2011) - US patent 7407748 (2008)
- ▶ Method and kit for the screening, the detection and/or the quantification of transcriptional factors. WO Patent WO/2001/073,115 (2001) - EP Patent 1,136,567 (2001) - US Patent 7,396,643 (2008)

## Funding

- ▶ Fonds de la Recherche Scientifique (F.R.S.-FNRS)
- ▶ Fédération Wallonie-Bruxelles: Action de Recherche Concertée (ARC)
- ▶ Université de Namur (UNamur), Centre d'Etudes et de Recherches Universitaires de NAMur (CERUNA)
- ▶ Service Public de Wallonie (SPW): First DoCA
- ▶ Wallonie et Fonds Européen de Développement Régional: subvention RETECH (Promethera)
- ▶ Association Belge contre les Maladies Musculaires (ABMM)
- ▶ European Union: COST Action FA0602

## Partnership

- ▶ Centre d'Economie Rurale (CER Groupe), Ph. Delahaut (Belgium)
- ▶ Wageningen University, Human and Animal physiology, Animal Sciences, Pr J. Keijer (The Netherlands)
- ▶ Academy of Sciences of the Czech Republic, Dr J. Kopecky (Czech Republic)
- ▶ University of Debrecen, Dr Ralph Ruhl (Hungary)
- ▶ Justus Liebig University Giessen, Molecular Nutrition Research Institute, Pr U. Wenzel (Germany)

## Main Equipment

- ▶ Proteomic platform: combines a mass spectrometer (MaXis Impact Bruker coupled to a Dionex Ultimate 3000 2D-LC system). The facility has been mainly dedicated to identifying proteins separated by 2D-DIGE gels, based on the sequence of the peptides obtained after trypsinisation. Recently, gel-independent proteomics only relying on the MassSpec facility has been developed.
- ▶ Imagery platform: confocal microscopy, BD Pathway 855, transmission electron microscopy, scanning electron microscopy and digital holographic microscopy
- ▶ Basic equipment for molecular and cell biology (RT-qPCR, electrophoresis, gel reader, spectrophotometers, electroporator, incubators, laminar flows, light-microscopes, etc.)
- ▶ L2 and L2+ biosecurity laboratories (access to L3)

## Products and Services

- ▶ Detection and screening of allergens in food in various matrices
- ▶ Analyses of the effects of nutrients and food additives on the biology of adipocytes. Assess of metabolic impact of bioactive food components

## Keywords

Adipocytes  
Cell differentiation-dedifferentiation  
Mitochondrial uncoupling  
Antioxidants  
Allergens  
Metabolism  
Fatty acids  
Adipokines

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# Obesity-related kidney disease: *in vivo* and *in vitro* models

## SENIOR SCIENTIST

▶ Nathalie CARON

## Research Field and Subjects

The main research interest of our laboratory concerns the pathophysiological mechanisms underlying acute and chronic renal injury, using *in vitro* and *in vivo* models, with emphasis on regulation of kidney blood supply.

One of our ongoing projects aims to study obesity-induced kidney disease (KD), which is a leading cause of end-stage renal disease in Western countries. Central obesity is related to caloric excess promoting deleterious responses in targeted organs, leading to a highest susceptibility to developing metabolic syndrome, a multi-factorial chronic disease with high morbidity and mortality rates. Endothelial dysfunction, impaired vasodilatation, and insulin resistance are considered as key features of obesity and diabetes in experimental models and humans. A recent study, conducted in collaboration with our team, highlighted the appearance of these features in a high-fat diet (HFD)-induced obesity-related KD mouse model, and demonstrated a beneficial effect of the specific central energy sensor AMPK activation in regulating the renal response induced by the inflammatory environment. Based on this model, our strategic approaches aim to provide a high-level biochemical, bioenergetic and hemodynamic analysis of the endothelial challenge associated with obesity-induced KD. Of note, a comprehensive metabolomic study will help to identify metabolic changes in urine and kidney extracts and better characterize the pathogenic pathways, as well as providing prognostic and diagnostic tools.

Moreover, in an attempt to limit obesity-induced KD progression, paracrine factors of interest may be considered as potential targets. In particular, nitric oxide (NO) bioavailability will be investigated since NO deficiency has been shown to contribute to impairment of renal function and structure, as well as to reduce the insulin-stimulated glucose intake in skeletal muscle, suggesting its potential role in metabolic disease.

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- ▶ SANCHEZ A.P., ZHAO J., YOU Y., DECLÈVES A.E., DIAMOND-STANIC M., SHARMA K. Role of the USF1 transcription factor in diabetic kidney disease. *American Journal of Physiology. Renal Physiology*. 301(2): F271-279. **2011**.
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## Funding

- ▶ Fédération Wallonie-Bruxelles: Fonds Spécial de Recherche (FSR) UNamur
- ▶ European Union: Actions Marie Curie - COFUND

## Partnership

- ▶ Université Libre de Bruxelles (ULB) Erasme, Unit of Experimental Nephrology, Dr J. Nortier (Belgium)
- ▶ Université de Mons (UMONS), Service de Biologie Humaine et Toxicologie, Dr J.M. Colet (Belgium)
- ▶ University of California San Diego (UCSD), Center for Renal Translational Medicine, Dr K. Sharma (USA)



### **Main Equipment**

- ▶ Integrated platform for *in vivo* experiments in rodent models
- ▶ Real-time blood pressure and flow measurements (electromagnetic/ultrasound Doppler probes)
- ▶ Basic equipment for analysis of biological samples (plasma, serum, urine, tissue): ELISA, RT-qPCR, Western blots, IHC, ...

### **Products and Services**

- ▶ Animal models (AKI, CKD, diabetes, hypertension)
- ▶ Production and analysis of various biological samples
- ▶ Real-time measurement of renal hemodynamics

### **Keywords**

Acute kidney injury (AKI)  
Chronic kidney disease (CKD)  
Renal hemodynamics  
Obesity  
Diabetes  
Metabolic syndrome  
Hypertension

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# Nutrient regulation of insulin and glucagon secretion and their alteration in obesity and diabetes

## SENIOR SCIENTISTS

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- ▶ Patrick GILON

## Research Field and Subjects

The main research objective of the lab is to better understand the pathophysiology of the endocrine pancreas in obesity and diabetes.

Current projects are dealing with regulation, by nutrients, of glucagon secretion in alpha-cells and of insulin secretion by beta-cells, with the alterations of beta-cell survival and function by chronic changes in nutrient supply (mainly glucotoxicity but also lipotoxicity). Studies evaluating the effects of new drugs (antioxidants and others) on beta-cell dysfunction and apoptosis in diabetes are also ongoing. These studies are carried out in cultures of islets isolated from normal rodents as well as from various rodent models of obesity and diabetes.

The lab is one among few in the Benelux and France to master methods to isolate whole islets, alpha-cells and beta-cells from the pancreas of normal, obese and diabetic mice or rats. Physiological studies on human islets are also carried out depending on their availability. Over the years, the lab has acquired the equipment and know-how to study (patho) physiological events in minute amounts of tissue, with a particular focus on dynamic live-cell imaging techniques applied to the study of the free calcium concentration, glutathione oxidation and other indicators of oxidative stress in the cytosol, the mitochondrial matrix, the endoplasmic reticulum and the submembrane compartment (see references for examples). The lab also masters molecular biology and morphological analysis of pancreatic islet cells, including immunohistochemistry and confocal imaging.

## Representative References

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## Awards

- ▶ Prix Y. et J. François-de Meurs 2005, Fondation Roi Baudoin, J.-C. Jonas
- ▶ Amylin/Paul Langerhans Research Award 2003, European Association for the Study of Diabetes, J.-C. Jonas
- ▶ Belgian Endocrine Society Lecture 2003, J.-C. Jonas
- ▶ Belgian Endocrine Society Lecture 2000, P. Gilon

## Funding

- ▶ Fonds de la Recherche Scientifique (F.R.S.-FNRS)
- ▶ Fédération Wallonie-Bruxelles: Action de Recherche Concertée (ARC), Fonds Spécial de Recherche (FSR) UCL
- ▶ European Association for the Study of Diabetes (EFSD)
- ▶ Société Francophone du Diabète (SFD)

## Partnership

- ▶ Katholieke Universiteit Leuven (KU Leuven), Gene expression Unit, Division of Biochemistry, F. Schuit (Belgium)
- ▶ Université de Bordeaux, European Institute of Chemistry and Biology, J. Lang (France)
- ▶ Université de Montpellier, Institut de Génomique Fonctionnelle, S. Dalle (France)
- ▶ Université de Genève, Département de Morphologie, P. Herrera (Switzerland)

## Main Equipment

- ▶ Equipment for hormone RIA
- ▶ Perfusion systems for dynamic measurements of islet hormone secretion
- ▶ Live-cell imaging equipment allowing low intensity fluorescence measurement (excitation and/or emission ratio, FRET, TIRF, spinning disk confocal microscope)
- ▶ Patch-clamp setup
- ▶ Basic equipment for cell culture and molecular biology, including an incubator with variable pO<sub>2</sub> (5 to 90%), several real-time PCR machines, and a L2 biosecurity laboratory for adenovirus production

## Products and Services

- ▶ Advice on testing drug and nutrient effects on the endocrine pancreas (hormone secretion, cell survival)
- ▶ Measurement of intracellular calcium and of glutathione oxidation in subcellular compartments
- ▶ Possibility to use the lab's specialised equipment with other cell types

## Keywords

Glucagon  
Insulin  
Endocrine pancreas  
Diabetes  
Oxidative stress  
ER stress  
Dynamic live-cell imaging  
Electrophysiology

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[http://rch2011.adre.ucl.ac.be/browse/list\\_alpha/EDIN/en](http://rch2011.adre.ucl.ac.be/browse/list_alpha/EDIN/en)  
<http://www.uclouvain.be/398890.html>

# Adipokines and myokines: role in metabolic syndrome and other disorders

## SENIOR SCIENTIST

► Sonia BRICHARD

### Research Field and Subjects

Adipose tissue (the major fuel storage organ) and skeletal muscle (the main organ that utilises fuel) play key roles in the pathogenesis of obesity-related complications (so-called metabolic syndrome, which includes type 2 diabetes and cardiovascular disease).

The aim of our work is to get a better insight into the pathogenesis of this syndrome.

To this end, our team searches for new regulatory peptides secreted by adipose tissue (adipokines), which are involved in the pathogenesis of this syndrome. Related microRNAs (small non-coding RNAs that regulate gene expression) are also under investigation. This research is of importance to open new therapeutic perspectives for overweight or obese patients.

Our team is also involved in studying the role and regulation of peptides secreted by skeletal muscle (myokines), which may contribute to the pathogenesis of metabolic syndrome as well. Adipokines and myokines may also positively or negatively modulate the course of other disorders. Of particular significance is the study of the anti-inflammatory properties of adiponectin, an adipokine that may have crucial repercussions not only for metabolic syndrome, but also for other inflammatory diseases.

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### Awards

- Sanofi awards of the metabolic syndrome 2006
- Sanofi awards in diabetology 2005

### Funding

- Fonds de la Recherche Scientifique (F.R.S.-FNRS)
- Fédération Wallonie-Bruxelles: Fonds Spécial de Recherche (FSR) UCL, Action de Recherche Concertée (ARC)

### Partnership

- University of Osaka (Japan)
- University of Geneva (Switzerland)
- Saint-Luc University Hospital, Abdominal surgery unit for obtaining human fat tissue (Belgium)

### Main Equipment

- Culture
- RTQ-PCR
- Immunoassays

### **Products and Services**

- ▶ Testing the effects of different molecules (pharmacological or metabolic agents, such as hormones) on human or murine adipose tissue or skeletal muscle cell function and metabolism *in vitro*
- ▶ Studying the effects of the same agents *in vivo* on different mouse models of obesity or diabetes
- ▶ Transgenic mouse for adiponectin available
- ▶ Clinical expertise in obesity and type 2 diabetes
- ▶ Studies on human tissue (fat, muscle cells)

### **Keywords**

Obesity  
Adipose tissue  
Skeletal muscle  
Transgenic mice  
Adipokines  
Myokines  
Hormones

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# Interactions between nutrients and growth factors in the regulation of skeletal muscle mass

## SENIOR SCIENTIST

► Jean-Paul THISSEN

### Research Field and Subjects

Our research is concerned with gaining better insights into the role and mechanisms of action of growth factors involved in skeletal muscle mass regulation, with a special emphasis on Insulin-like Growth Factors and Myostatin.

These two growth factors control the development of skeletal muscle in opposite ways and their manipulation, therefore, offers opportunities to mitigate muscle atrophy and its deleterious consequences. Since amino acids availability controls the production and action of these growth factors, we are currently investigating the molecular mechanisms involved in these interactions.

Our research also focuses on characterising the role of these hormones in the development of human cancer cachexia. Cachexia is a complex metabolic syndrome associated with underlying illness and characterised by loss of skeletal muscle. In contrast to simple malnutrition, cachexia cannot be reversed simply by increasing nutritional intake. The mechanisms of cancer cachexia remain, therefore, poorly characterised. We hypothesise that alterations in the production of these growth factors may play a role in cancer cachexia and constitute future therapeutic targets.

Our research work will help to guide therapeutic strategies targeting these growth factors in a wide variety of conditions where muscle atrophy impairs survival or life quality.

### Representative References

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### Partnership

- Université de Liège (ULg), L. Grobet (Belgium)
- Hôpital Saint-Antoine, Y. Le Bouc (France)
- Institut National de la recherche Agronomique (INRA) Clermond-Ferrand, D. Attaix (France)
- Institut de Myologie, Pierre Carlier (France)
- Olli Ritvos Research Group (Finland)

### **Main Equipment**

- ▶ Animal facility and manipulation
- ▶ Cell culture (primary and cell lines)
- ▶ RTQ-PCR
- ▶ Western blot
- ▶ Immunoassays

### **Products and Services**

- ▶ We test the effects of different molecules (pharmacological agents or nutrients) on skeletal muscle development both *in vitro* and *in vivo* (morphology and function)
- ▶ We develop a collection of blood, muscle and tumour samples of patients with cancer cachexia to characterise new biomarkers of (or predictors of) skeletal mass loss

### **Keywords**

Skeletal muscle  
Growth factors  
Muscle atrophy  
Cachexia  
Anabolic agents  
Cancer

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# Improvement of sports performance and muscle health by nutritional interventions

## SENIOR SCIENTIST

▶ Marc FRANCAUX

### Research Field and Subjects

Skeletal muscles are responsible for locomotion, posture and breathing. Substantial loss of muscle mass is associated with impaired ability to carry out daily activities, a subsequent decline in autonomy and poor quality of life. Because skeletal muscle also plays an important role in whole body metabolism, loss of muscle mass is associated with metabolic disturbances such as glucose intolerance and type 2 diabetes. Physical exercise combined with an appropriate diet is probably the most effective, and the cheapest, strategy for maintaining a healthy muscle function. The Francaux's group studies the molecular mechanisms by which exercise and nutrition act cooperatively to regulate protein synthesis and breakdown in skeletal muscle. During the last decade, it contributed to highlighting the mechanisms by which creatine and amino acids are able to increase protein synthesis in cultured cells, in mice but also in healthy and sick people. Currently, the group's work is focused on the mechanisms triggering protein breakdown in skeletal muscle and on the potential protective effects of various polyphenols. It is able to study the influence of dietary compounds on growth and differentiation of myogenic cells in culture. It has animal models and is able to induce muscle atrophy by preventing muscle activity or by inducing a general inflammatory state. Moreover, it is one of the few groups directly implicated in human protocols, including long-term exercise training and a controlled diet. Due to its involvement in the training and nutritional programme of top Belgian athletes, the members of this group have developed an outstanding expertise for assessing the (legal-) enhancement of sports performance by appropriate nutritional strategies. In summary, the Francaux's group is able to monitor the effects of dietary compounds on muscle health and sports performance, from the molecular level of cell mechanism implications for daily human life.

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### Funding

- ▶ Service Public de Wallonie (SPW)
- ▶ Fonds de la Recherche Scientifique (F.S.R.-FNRS)
- ▶ Fédération Wallonie-Bruxelles: Fonds Spécial de Recherche (FSR) UCL
- ▶ Louvain Foundation
- ▶ Delhaize Chair
- ▶ Private companies



### **Partnership**

- ▶ University of Padova, Pr M. Sandri (Italy)
- ▶ Ohio State University, Pr T. Hai (USA)
- ▶ University California Davis, Pr A. Gomes (USA)
- ▶ Université Jean Monnet Saint-Etienne, Pr L. Féasson and Pr G. Millet (France)
- ▶ Katholieke Universiteit Leuven (KU Leuven), Pr P. Hespel, Pr L. Deldicque (Belgium)

### **Main Equipment**

- ▶ Exercise physiology laboratory (various ergometers, indirect calorimetry, lactate, osmometer, ...)
- ▶ Hypoxic climatized chamber
- ▶ Dual X-Ray Absorptiometry (DXA)
- ▶ Equipment for blood analyses (spectrophotometry, ELISA, fluorometry)
- ▶ Equipement for muscle analyses (Western-blot, G-box, RT-qPCR)
- ▶ Molecular biology equipment (Nucleofector, bacteria amplification)

### **Products and Services**

- ▶ Exercise testing in animals and humans
- ▶ Physical fitness assessment
- ▶ Human protocols including muscle biopsies

### **Keywords**

Autophagy  
Ubiquitin-proteasome  
Protein synthesis  
Endoplasmic reticulum stress  
Polyphenols  
Amino acids  
High-fat diet  
Inflammation

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# Nutritional status and oxidative stress in specific populations, particularly among smokers

## SENIOR SCIENTISTS

- ▶ Laurence GALANTI
- ▶ Marie GODET
- ▶ Jacques JAMART
- ▶ Dominique LACROSSE

## Research Field and Subjects

Lifestyle features, particularly tobacco smoking, consumption habits and some chronic diseases may affect the nutritional and oxidative stress status with harmful effects to health. The main research field of our laboratory is the evaluation of biomarkers of the exposure to tobacco smoke (thiocyanates, nicotine, cotinine, OHcotinine) and the assessment of nutritional and oxidative stress markers in specific populations. In addition to technical tools allowing quantification of standard biological parameters, we developed and validated specific assays to quantify oxidative stress and anti-oxidants (GPx, SOD,  $\beta$ carotene, Coenzyme Q10, Vitamins A, E and C, oxLDL, etc.) in biological fluids. Methods include HPLC, UPLC, ELISA, photometry, capillary and agarose gel electrophoresis, and nephelometry. Among other applications, we used the concentration of nicotine major metabolites (cotinine, OH-cotinine) in several biological samples to quantify the exposure to tobacco smoke in active or passive smokers, including children and new-borns of smoking parents. We confirmed the lower concentration of some anti-oxidants among smokers in relation to the nicotine absorption. A research project recently conducted in our laboratory evaluates the evolution of these parameters at the early stages of smoking cessation and the influence of nicotine on these changes. Studies were also conducted in geriatric populations to assess the evolution of several biological markers of nutritional status after hospital admission and the reversibility of this status after hospital discharge. These parameters are going to be followed in a population of patients undergoing bariatric surgery to evaluate the modification in supply and absorption of nutrients. Among other patients' populations liable to suffer from some specific nutritional deficits, we studied diabetic patients and demonstrated a significant vitamin D and B12 deficit in this population.

## Representative References

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## Awards

- ▶ Third Prize Poster Award European Association of Hospital Pharmacists, 2009
- ▶ Prix de la Belgian Society of Clinical Biology, 2008

## Partnership

- ▶ Hôpital de la Salpêtrière, Service de Biochimie médicale (France)
- ▶ Hôpital de la Salpêtrière, Service de Pharmacologie clinique (France)
- ▶ Centre Hospitalier Universitaire Mont-Godinne, Unité transversale de nutrition (Belgium)
- ▶ Centre Hospitalier Universitaire Mont-Godinne, Unité de Pharmacie Clinique (Belgium)

## Main Equipement

- ▶ UPLC, Waters
- ▶ Alliance, Waters
- ▶ Chaîne HPLC modulaire, Waters
- ▶ Fusion 5.1, Ortho-Diagnostics
- ▶ Architect i4000, Abbott
- ▶ BNII, Siemens
- ▶ Capillarys, Analis
- ▶ Hydrasys, Sebia

## Products and Services

- ▶ Set up of biological markers measurement by HPLC/UPLC
- ▶ Quantification of tobacco smoking components absorption
- ▶ Measurement of clinical biological parameters
- ▶ Evaluation of biological markers of oxidative stress

## Keywords

Smokers  
Nutritional status  
Oxidative stress  
Cotinine

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# Nutritional aspects of psychiatric disorders

## SENIOR SCIENTISTS

- ▶ Philippe DE TIMARY
- ▶ Peter STARKEL

## Research Field and Subjects

The main research topic currently under investigation by the group is the various nutritional aspects of alcohol-dependence:

- ▶ We developed a metabolic and endocrine approach to start with: in particular, we focused on the possibility of a metabolic dysregulation in alcohol-dependence that might explain why very excessive energy intake in at least a subpopulation of alcohol-dependent subjects is related to a decrease in fat mass and in leptin plasma levels. This observation raises the possibility that besides the significant effects of ethanol at the level of brain neurotransmitters, the scale of the addiction is also related to metabolic dysregulation;
- ▶ We are currently studying the possibility that alcohol-dependence might also be related to changes in the composition of the gut microbiota, in intestinal permeability and in inflammation, that could drive the tendency to drink. This type of relationship could also be tested in other pathological patient populations and in relation to emotion-related personality factors in normal subjects.

## Representative References

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- ▶ LECLERCQ S., CANI P., NEYRINCK A.M., STARKEL P., JAMAR F., MIKOLAJCZAK M., DELZENNE N., DE TIMARY P. Role of intestinal permeability and inflammation in the biological and behavioural control of alcohol dependent subjects. *Brain, Behaviour and Immunity* 26(6): 911-918. **2012**.
- ▶ DE TIMARY P., CANI P., DUCHEMIN J., NEYRINCK A.M., GIHOUSSE D., LATERRE P.F., BADAoui A., LECLERCQ S., DELZENNE N., STARKEL P. The loss of metabolic control on alcohol drinking in heavy drinking, alcohol-dependent subjects. *PLoS One* 7(7): e38682. **2012**.
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## Awards

- ▶ Research Grant Saint-Luc Foundation 2007
- ▶ Research Grant Saint-Luc Foundation 2005
- ▶ Best clinical Fellow Pfizer Foundation 2003
- ▶ Psychiatry Award Pfizer Foundation 2003

## Funding

- ▶ Fonds de la Recherche Scientifique (F.R.S.-FNRS): Fonds pour la Formation à la Recherche dans l'Industrie et l'Agriculture (FRIA)
- ▶ Fédération Wallonie-Bruxelles: Fond Spécial de Recherche (FSR) UCL
- ▶ Fonds de Recherche Clinique Saint-Luc

## Partnership

- ▶ Université catholique de Louvain (UCL) (Belgium)
  - Metabolism and Nutrition Research Group, Louvain Drug Research Institute, N. Delzenne, P. Cani, A. Neyrinck
  - Centre de Recherche en Santé et Développement Psychologique, M. Mikolajczak, O. Luminet
  - Laboratory of Experimental Psychopathology, P. Maurage
- ▶ Several psychiatric hospitals :
  - Université catholique de Louvain (UCL), Cliniques Saint-Luc (Belgium)
  - Centre Hospitalier Psychiatrique Le Chêne aux Haies (Belgium)
  - Centre Hospitalier Universitaire Ambroise Paré (Belgium)
  - Groupe Hospitalier La Ramée Fond’Roy (Belgium)
  - Hôpital psychiatrique du Beauvallon (Belgium)
  - Hôpitaux universitaires de Genève (Switzerland)

## Keywords

Alcohol-dependence  
Psychiatry  
Psychology  
Emotion regulation  
Neuroendocrinology  
Metabolism  
Translational studies

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## Web site

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## Main Equipment

- ▶ Magnetic Resonance Imagery, EEG, ERPs, access to collaboration with laboratories dedicated to biological measurements

## Products and Services

- ▶ Studies on human populations with an expertise in the field of psychology, emotion regulation, metabolism, diet regulation, nutrition, gut microbiota and neuroendocrinology. Access to various normal or psychiatric populations

# Problematic eating and food related behaviour

## SENIOR SCIENTISTS

- ▶ Olivier LUMINET
- ▶ Renata CSERJESI
- ▶ Nicolas VERMEULEN
- ▶ Moira MIKOLAJCZAK
- ▶ Philippe DE TIMARY

## Research Field and Subjects

The different research projects carried out by this group focus on three main areas:

- ▶ Identification and assessment of those cognitive processes and their related specific brain areas that can be associated with poorly regulated eating behaviours leading either to over or under-nutrition. Standardised psychological self-reported questionnaires and carefully selected neuropsychological battery have been used;
- ▶ Identification of those psychosocial factors that may play a role in unhealthy food selections, the development and the maintenance of unhealthy eating. Taking into account social desirability biases, both controlled and automatic processes have been evaluated by using implicit and explicit tests. The results showed that individuals with problematic eating have discrepancies between their self-reported controlled and unconscious automatic behaviours in terms of emotion processes, food preference and attitudes toward physical appearance. Identification of these factors can be helpful to design tools for early detection of individual at risk of developing problematic eating. Furthermore, the discrepancies between automatic and controlled behaviour have been associated with unsuccessful behaviour change and poor weight management outcome. Thus, this technique allows a better insight of individual's internal motivation in order to predict and/or induce future behavioural change;
- ▶ Based on all these findings the current aim of the lab is to develop such innovative, non-invasive, low-cost interventions that can help people with problematic eating and individuals at risk.

The target groups are obese patients and those with eating disorders (anorexia-bulimia).

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## Funding

- ▶ Fonds de la Recherche Scientifique (F.R.S.-FNRS)
- ▶ Brussels Institute for Research and Innovation (INNOVIRIS): Prospective Research for Brussels (PRFB)
- ▶ Fédération Wallonie-Bruxelles: Fonds Spécial de Recherche (FSR) UCL

## Partnership

- ▶ Université catholique de Louvain (UCL), Cliniques universitaires Saint-Luc (Belgium)
- ▶ Université Libre de Bruxelles (ULB), Clinique le Domaine (Belgium)
- ▶ Vrije Universiteit Brussel (VUB), Universitair Ziekenhuis Brussel (Belgium)
- ▶ University of Pecs, Physiology Institute (Hungary)

### **Main Equipment**

- ▶ Computer based behavioural tasks
- ▶ Standardized (neuro)psychological battery
- ▶ Electrophysiology

### **Products and Services**

- ▶ Multidisciplinary evaluations
- ▶ Clinical trials
- ▶ Intervention development

### **Keywords**

Obesity  
Anorexia  
Bulimia  
Diet and health  
Food perception and preferences  
Intervention development

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# Promoting healthy eating

## SENIOR SCIENTIST

▶ Stephan VAN DEN BROUCKE

### Research Field and Subjects

The research projects carried out by this group focus on three main areas:

- ▶ Identification of the cognitive, emotional and social determinants of healthy eating habits by applying and testing socio-cognitive and socio-ecological models of preventive health behaviour change;
- ▶ Evaluation of campaigns to promote healthy eating habits, using process, outcome and impact evaluation models and methods to evaluate the quality of planning and implementation as well as the outcomes and broader societal impact;
- ▶ Enhancing the capacity of public health and health promotion professionals to develop and implement effective interventions to promote healthy eating patterns in the population.

The above-mentioned research is carried out in natural settings at group, community or (sub)population level, using standardised and validated self-report questionnaires based on well-tested theoretical models of preventive behaviour, evaluation, and public health capacity building. Nutrition education, social marketing and environmental approaches are used to promote healthy eating habits. Specific target groups include school children, elderly persons and socio-economically deprived communities.

The results indicate that the choice of individuals to adopt and maintain healthy eating habits can be explained and predicted by socio-cognitive and socio-ecological models of health behaviour and that systematic, targeted, well-planned and carefully implemented interventions combining different methods and impacting on different determinants of healthy eating (attitudes, social norms, perceived control, environmental constraints and barriers, incentives, rewards) in an “integrated approach” are most effective. Target audiences distinguish between commercial advertisements and health promotion campaigns and the behavioural determinants of adopting a healthy diet differ from those of purchasing advertised food products. Campaigns to promote healthy eating should therefore not imitate marketing strategies blindly.

Future research of the team will focus on the role of compensatory health beliefs and of incentives or “nudges” for developing healthy eating habits and on developing targeted approaches to encouraging healthy eating among people with low health literacy.

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### Partnership

- ▶ International Union for Health Promotion and Education (IUHPE)
- ▶ Katholieke Universiteit Leuven (KU Leuven), Research Group for Health Psychology & Youth Health Care (Belgium)



**Keywords**

Obesity  
Anorexia  
Bulimia  
Diet and health  
Food perception and preferences  
Intervention development

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# Health and nutrition claims

## SENIOR SCIENTIST

► Paul NIHOUL

### Research Field and Subjects

The *Centre de droit de la consommation* has developed a special expertise in food law. That expertise covers various aspects of activities performed in the food chain from the production of food to its use by consumers.

A first issue traditionally considered in that context is the obligation for food suppliers and distributors to avoid providing food likely to endanger the health of consumers. In the EU, there is a tradition of strict regulation for products commercialised on the market to ensure that the use of such products does not result in claims for compensation. The EU is special in that regard, in that it regulates production activities *ex ante* (safety) and *ex post facto* (liability). Our project, in that field, is to analyse the rules applicable in the US and the EU – and to monitor their effect on undertakings.

A second issue generating much discussion on food in a legal context is the extent to which genetically modified organisms (GMOs) can be researched, cultivated or commercialised. GMOs have been introduced massively in the US, where the regulation is lax. By contrast, activities around these products are heavily regulated in Europe – research, development and commercialization. In our studies, we try to assess the procedures established in the EU and the US in order to appraise the risks associated with such products and the level of requirements imposed to obtain an authorisation to carry out activities in that field on the two continents.

A third issue generated by food related activities is to what extent the communication used by firms to sell their products should be regulated. “Claims” made by firms in the food sector have been regulated in the first instance in the USA, where businesses developed sophisticated marketing strategies early on to induce consumers to purchase their products. As these strategies were crossing the ocean, the European Union took drastic measures to curb the liberty of firms to say what they want about their products. Strict conditions and procedures are imposed before claims can be made. In the laboratory, particular focus has been placed on the analysis of such regulations, and on the adequacy of such regulation in the face of behaviours generally adopted by consumers confronted with such practices.

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- NIHOUL P., MAHIEU S. *La sécurité alimentaire et la réglementation des OGM. Perspectives nationale, européenne et internationale*. Ed. Larcier, Bruxelles, 348 pp. **2005**.

### Funding

- Fonds de la Recherche Scientifique (F.R.S-FNRS)

### Partnership

- Université catholique de Louvain, Institut de recherche en sciences psychologiques, Pr O. Corneille (Belgium)

### Products and Services

- One scientific journal devoted to food related issues in addition to other issues concerning the protection of consumers in general
- Consultancy: analysis of EU and US regulation on food and nutrition claims

**Keywords**

Health  
Claims  
Nutrition  
Consumers  
Marketing  
Safety  
GMOs Genetically Modified Organisms

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# Intellectual property rights, seed law and agriculture

## SENIOR SCIENTIST

▶ Séverine DUSOLLIER

### Research Field and Subjects

The Intellectual Property Research Unit of the CRIDS (Research Center for Information, Law and Society) of the *Université de Namur* researches intellectual property rights for technologies. Given the important role of science and biotechnologies in agricultural plant research, the Research Unit studies and analyses the application of intellectual property rights, such as the Breeders Right and the Patent Right, to food and agriculture. The research also deals with seed laws (official seed catalogues). Beyond the study of the application of intellectual property rights to agriculture, the Research Unit questions the role of these regulations in shaping agriculture, biodiversity and the food we eat. In fact, these regulations, as a result of the conditions they set for the protection of plant varieties - by means of intellectual property rights and marketing standards (seed law) - determine important characteristics of agricultural plant innovation. These regulations are modelled on the productivist agricultural regime. Other agricultural models (e.g., the agroecological model) therefore face legal obstacles that hamper their development. The Convention on Biological Diversity and the International Treaty on Plant Genetic Resources for Food and Agriculture (FAO) are also studied in a broader research on seed regulation and governance.

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### Funding

- ▶ Fédération Wallonie-Bruxelles: Fond Spécial de Recherche (FSR) (UNamur)

### Partnership

- ▶ Namur Research Group in Sustainable Development (NaGRIDD) (Belgium)

### Products and Services

- ▶ Information and legal advice on Intellectual Property, Seed Law and, more broadly, on Plant Genetic Resources regulation and governance, to researchers, to farmers associations, to the civil society and lawmakers

**Keywords**

Intellectual Property Rights  
Biotechnologies  
Agriculture  
Seed Law  
Agroecology

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# Terroir products: history and sociology

## SENIOR SCIENTIST

▶ Isabelle PARMENTIER

### Research Field and Subjects

The Appellation d'Origine Protégée (AOP) and the Indication Géographique Protégée (IGP) provide information about the origin and quality of a product, and the Spécialité Traditionnelle Garantie (STG) gives information about the recipe. These labels help to promote the products and are incorporated in Walloon regional policy (2009-2014).

A Cellule d'Appui aux Indications Géographiques (CAIG) was created in 2011 to support applications for an AOP, IGP or STG written by producers (craftsmen or industrial). The CAIG is composed of historians (*Université de Namur*) and agricultural engineers (University of Liège, Gembloux AgroBio Tech) working in collaboration with the DGARNE and producers who want to obtain an AOP, IGP or STG.

In order to meet European standards, scope statements must be drawn up according to rigorous scientific methodology. These files must include information about the specificity of the product (scientific characteristics and organoleptic properties), but also some cultural, historical and sociological data needed to demonstrate the seniority and the reputation of the product: how long has it been produced, what were/are the production areas and where was/is the product known and consumed. All this information has to be linked to the "terroir", including natural and human specifications (soil types, topography, vegetation, climate, but also know-how, traditions, etc.).

The Department of History at the UNamur is in charge of the historico-sociological part of this research and can help the producers to find information in these fields. The services offered by the UNamur's team are: oral surveys and data collection in documentation centres in Belgium and abroad (the State Archives, the Royal Library of Belgium in Brussels, the Centre for the History of Science and Technology in Liege, the Museum of Gastronomy in Hermalle-sous-Huy, the Museum of Walloon Life in Liege,...). On this basis, we realise studies to ensure that European specifications are met and we write the scope statement for or with the producers.

This particular research – known as Public History – is also the topic of methodological and epistemological works.

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### Funding

- ▶ Service Public de Wallonie (SPW), Direction Générale de l'Agriculture, des Ressources Naturelles et de l'Environnement (DGARNE), Département du Développement, Direction de la Qualité (Belgium)

### Partnership

- ▶ Université de Liège – Gembloux Agro-Bio Tech, Unité Analyses, Qualité, Risques, Laboratoire Qualité et Sécurité des Produits Agroalimentaires

### Products and Services

- ▶ Publications
- ▶ Advices to apply for AOP/IGP/STG

**Keywords**

Terroir  
History  
Sociology  
Labels  
Local products  
AOP  
IGP  
STG

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# Improving animal welfare makes profitable animals

## SENIOR SCIENTIST

► Claire DIEDERICH

### Research Field and Subjects

In 2009, the status of “sentient beings” was accorded to all animals by the Treaty of Lisbon (governing document of the European Union). For animals intended for human nutrition, this included not only their raising, transport and professional slaughtering processes but also implied assistance regarding training and education, best practices, information and consumer / owner communication about animal welfare, welfare assessment, the establishment of welfare standards and the impact of environmental modifications on welfare, provided that those topics are based on scientific findings.

In direct line with the Treaty of Lisbon and European Policy, the Integrated Veterinary Research Unit (IVRU-NARILIS) of the *Université de Namur* intends to collect and provide information about animal needs and appropriate ways of dealing with animal welfare in order to make the animals profitable and/or adapted to live in close proximity with humans (on farms – food animals - and/or in human homes – companion animals). To attain these objectives, the IVRU-NARILIS is studying the canine species as a mammalian model, both as a working and companion animal. This allows bachelor veterinary students, master students, PhDs and post-doctoral researchers to decipher human-dog relationships and dog welfare in different situations, such as breeding practices, basic and specialised training, game activities, animal-assisted activities, ontogeny of behaviour, canine personality, stress identification and so forth. Furthermore, this expertise allows direct application of the results as the authorities, society and animal protection movements pay particular attention to the way we treat animals (C. Diederich is Vice-President of the Belgian Federal Animal Welfare Council; Member of the Federal Deontological Committee for Laboratory Animals and Expert of Federal General Direction for Contractual Research).

The skills in animal behaviour research that are developed at the IVRU-NARILIS include observations of spontaneous and/or induced behaviours (animal testing), precise and meticulous analyses of human and animal behavioural sequences and interactions (with the help of video recordings and a specialised software – The Observer®, Noldus – for data collection), physiological analyses (for example, stress indicators such as blood and salivary cortisol, heart rate frequency and variability) and DNA sequences analyses (via internal and external collaborations).

This animal behaviour expertise of the IVRU-NARILIS can easily be transposed from one species to another (including large animals and laboratory animals). Indeed, with the help of The Observer, behavioural data are collected according to their frequency of occurrence and their duration. This scrutiny can then be deeply analysed and compared to physiological responses of the same animal, in order to collect a ‘whole body response’ to one particular environmental and/or human treatment. This integrated analysis is of the utmost interest as it makes a science-based statement about animal welfare.



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## Funding

- ▶ Fédération Wallonie-Bruxelles: Fonds Spécial de la Recherche (FSR) UNamur
- ▶ Service Public Fédéral (SPF) Santé Publique, Sécurité de la Chaîne alimentaire et Environnement, Recherche contractuelle
- ▶ Défense Nationale Belge

## Partnership

- ▶ Universiteit Gent (UGent), Dr C. Moons (Belgium)
- ▶ Université Paris 13, Pr P. Gouat (France)
- ▶ University of Davis CA, Dr. L. Lit (USA)
- ▶ International Pet Food Manufacturer
- ▶ Union Royal Cynologique Saint-Hubert (URCSH) (Belgium)
- ▶ University of Prague, Pr E. Baranyiova (Czech Republic)

## Main Equipment

- ▶ The Observer (Noldus) software for behaviour analyses
- ▶ Laboratory equipment for cortisol analyses

## Products and Services

- ▶ Expertise in animal behaviour, human animal relationship and animal welfare
- ▶ Conferences to (un)specialised audiences

## Keywords

Human-animal relationship  
Animal welfare  
Stress  
Cortisol  
DNA tandem repeat

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- ▶ Human-animal relationships, animal welfare:  
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- ▶ Condog project:  
[www.tempdog.be](http://www.tempdog.be)
- ▶ Horse Behavioural Conference (yearly event):  
<http://www.ethologie-cheval.be/index.php?Link=7>

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