Leuven Food Science and Nutrition Research Centre

Kurt Gebruers

www.lforce.kuleuven.be
What is LFoR Ce?

- Is an interdisciplinary research centre at KU Leuven
- Brings together expertise at KU Leuven in the area of Feed-Food-Health

11 departments
26 research teams
43 professors
> 500 researchers
What is LFoRCE?
Who is involved?

**SCIENCE, ENGINEERING AND TECHNOLOGY (SET) GROUP**

**Department of Biology**
Laboratory of Molecular Plant Physiology – KU Leuven
  Prof. W. Van den Ende

**Department of Biosystems**
Division of Gene Technology – KU Leuven
  Prof. B. Goddeeris
Division of Livestock, Nutrition and Quality – KU Leuven
  Profs. J. Buyse, T. Niewold
Division of Mechatronics, Biostatistics and Sensors – KU Leuven
  Profs. A. Geeraerd, J. Lammertyn, B. Nicolai
Division of Monitoring-Modelling-Management of Bioresponses – KU Leuven
  Prof. D. Berckmans

**Department of Chemical Engineering**
Laboratory of Applied Rheology and Polymer Processing – KU Leuven
  Prof. P. Moldenaers
Laboratory of Chemical and Biochemical Process Technology and Control – KU Leuven
  Prof. J. Van Impe

**Department of Chemistry**
Laboratory of Polymer Chemistry and Materials – KU Leuven
  Prof. B. Goderis

**Centre for Science, Technology and Ethics**
Profs. J. De Tavernier, A. Geeraerd

**Department of Microbial and Molecular Systems**
Centre of Malt and Beer Science – KU Leuven
  Prof. G. Derdelinckx
Lab4Food – Campus Geel
  Profs. J. Claes, L. Van Campenhout
Laboratory of Enzyme, Fermentation and Brewing Technology – Campus Ghent
  Profs. G. Aerts, L. De Cooman
Laboratory of Food and Lipids – Campus Kortrijk
  Prof. I. Foubert
Laboratory of Food Chemistry and Biochemistry – KU Leuven
  Profs. C. Courtin, J. Delcour, I. Joye
Laboratory of Food Microbiology – KU Leuven
  Prof. C. Michiels, A. Aertsen
Laboratory of Food Technology – KU Leuven
  Profs. M. Hendrickx, A. Van Loey, T. Grauwet
Laboratory of Process Microbial Ecology and Bioinspirational Management – Campus De Nayer
  Profs. B. Lievens, K. Willems
Laboratory of Systems Biology – VIB – KU Leuven
  Prof. K. Verstrepen
Laboratory of Technology and Quality of Animal Products – Campus Ghent
  Prof. H. Paelinck, Dr. I. Fraeye
Who is involved?

**BIOMEDICAL SCIENCES (BMS) GROUP**

*Department of Clinical and Experimental Medicine*
Division of Clinical and Experimental Endocrinology – KU Leuven  
Profs. C. Mathieu, C. Matthys, B. Van Der Schueren  
Division of Translational Research in Gastrointestinal Disorders – KU Leuven  

*Department of Microbiology and Immunology*
Division of Nephrology – KU Leuven  
Prof. Pieter Evenepoel

*Department of Pharmaceutical and Pharmacological Sciences*
Division of Drug Delivery and Disposition – KU Leuven  
Profs. P. Augustijns, G. Van den Mooter

**HUMANITIES AND SOCIAL SCIENCES (HSS) GROUP**

*Faculty of Economics and Business*
Department of Managerial Economics, Strategy and innovation – KU Leuven  
Prof. K. Debackere  
Department of Marketing and Organisation Studies – KU Leuven  
Profs. S. Dewitte, L. Warlop

*Faculty of Social Sciences*
Leuven School for Mass Communication Research – KU Leuven  
Prof. J. Van den Bulck
Science, Engineering and Technology (SET) Group

**PLANT**
- Plant/fruit breeding, production & biotechnology
- Post-harvest technology
- Fruit, vegetable & cereal based food technology
- Algae based ingredients
- Malting & brewing technology
- Food microbiology
- Microbial technology
- Processing & sensor technology
- Food analytics
- ...

**ANIMAL**
- Livestock nutrition, physiology, immunology & genetics
- Quality care in animal production
- Meat based food technology
- Insect based ingredients
- ...

Biomedical Sciences (BMS) Group

**GASTROINTESTINAL TRACT**
- Inflammatory bowel diseases
- Gastrointestinal peptides & their receptors
- Nutrient sensing
- Gastrointestinal motility & sensitivity
- Regulation of food intake
- Colonic bacterial metabolism
- Gut microbiomics
- ...

**ENDOCRINE SYSTEM**
- Type I diabetes
- Obesity, Type II diabetes and Metabolism
- ...

**NUTRITION**
- Diabetes, obesity, cachexia, gastrointestinal disorders, ...

Humanities and Social Sciences (HSS) Group

**CONSUMER SCIENCE**
- Consumer behaviour
- Consumer competence
- Behavioural change
- Measurement technologies
- Impact of media
- ...

Food and health research @ KU Leuven
## Food and health research @ KU Leuven

### Science, Engineering and Technology (SET) Group

**PLANT**
- Plant/fruit breeding, production & biotechnology
- Post-harvest technology
- Fruit, vegetable & cereal based food technology
- Algae based ingredients
- Malting & brewing technology
- Food microbiology
- Microbial technology
- Processing & sensor technology
- Food analytics
- ...

**ANIMAL**
- Livestock nutrition, physiology, immunology & genetics
- Quality care in animal production
- Meat based food technology
- Insect based ingredients
- ...

### Biomedical Sciences (BMS) Group

**GASTROINTESTINAL TRACT**
- Inflammatory bowel diseases
- Gastrointestinal peptides & their receptors
- Nutrient sensing
- Gastrointestinal motility & sensitivity
- Regulation of food intake
- Colonic bacterial metabolism
- Gut microbiomics
- ...

**ENDOCRINE SYSTEM**
- Type I diabetes
- Obesity, Type II diabetes and Metabolism
- ...

**NUTRITION**
- Diabetes, obesity, cachexia, gastrointestinal disorders, ...

### Humanities and Social Sciences (HSS) Group

**CONSUMER SCIENCE**
- Consumer behaviour
- Consumer competence
- Behavioural change
- Measurement technologies
- Impact of media
- ...

### Food and health research @ KU Leuven

#### Science, Engineering and Technology (SET) Group

**PLANT**
- Plant/fruit breeding, production & biotechnology
- Post-harvest technology
- Fruit, vegetable & cereal based food technology
- Algae based ingredients
- Malting & brewing technology
- Food microbiology
- Microbial technology
- Processing & sensor technology
- Food analytics
- ...

**ANIMAL**
- Livestock nutrition, physiology, immunology & genetics
- Quality care in animal production
- Meat based food technology
- Insect based ingredients
- ...

---
Post-harvest technology

• Quality measurement, control and preservation of fresh produce, wrt ripening, ageing, nutritional properties, texture, color, flavor, defects, …
• Underlying mechanisms at different length and time scales
• Reduction of food waste and energy consumption in the (cold) food chain

[Division Mechatronics, Biostatistics and Sensors (MeBioS), B. Nicolai, A. Geeraerd]
Food technology

- Structure and function of food and changes and interactions of food constituents during different unit operations in the entire food life cycle

- Heat, moisture and gas transport during processing and storage

- Ingredients/constituents with health impact and ingredients from alternative sources (e.g. insects and algae)

- Process impact on nutritional and organoleptic quality and risk factors (microbial and chemical)

- Kinetic and mechanistic models of food system phenomena allowing to (re-)evaluate and (re-)design (existing) processes for improved
  - Chemical (process induced risk components, …) and microbial (pathogenic, spoilage) safety and quality
  - Organoleptic quality (structure engineering, classical/instrumental analysis, …)
  - Nutritional quality (nutrients, bioaccessibility, fiber, prebiotics, *in vitro*/*in vivo* assessment, …)
  - Shelf-life (physical, chemical and microbial stability)
  - Sustainability (reduction of food waste and energy consumption)
Food technology

• Food systems
  • Cereal based food systems (incl malt) [Lab Food Chemistry and Biochemistry (LFCB), J. Delcour, C. Courtin, I. Joye]
  • Fruit/vegetable based food/beverage systems [Lab Food Technology (LFT), M. Hendrickx, A. Van Loey, T. Grauwet]
  • Animal based food systems (Lab Technology and Quality of Animal Products (LTQAP), I. Fraeye, H. Paelinck, Campus Ghent)
  • Oil/fats and oil/fat rich food systems [Lab Food and Lipids (LFL), I. Foubert, Campus Kortrijk]

• Alternative sources
  • Algae and compounds derived thereof (e.g. proteins, lipids and bio-actives) (LFL, Campus Kortrijk)
  • Insect and compounds derived thereof (e.g. proteins and lipids) (Lab4Food, J. Claes, L. Van Campenhout, Campus Geel)
Brewing technology

• Brewing technology (from malt milling to bottling)
• Sustainability brewing (e.g. reduction of brewing time)
• Advanced hopping technology
• Flavour production and stabilization
• Bioinformatics and biostatistics [e.g. next generation sequencing, microbial community analysis, (comparative) genomics, modeling (molecular, kinetic, metabolic)]
• Applied genetics and bioengineering of industrial yeasts towards improved functionality in beer production (e.g. flavour, flocculation, fermentation efficiency)
• Microbial communities in malting and brewing environments and their impact on technological parameters and beer quality
• (Bio)chemical analysis (e.g. high-throughput flavour analysis, standard malt, wort, hop and beer analysis, sensory analysis)

[Leuven Institute for beer research (LIBR), K. Verstrepen (KU Leuven), G. Aerts, L. De Cooman (KU Leuven Campus Ghent), B. Lievens, K. Willems (KU Leuven Campus De Nayer)]
Food microbiology

• Behaviour of microorganisms throughout the food chain
  • Pathogens and spoilage organisms
  • Factors affecting growth survival, inactivation, competition
  • Stress adaptation of microorganisms
• New or improved methods for control of safety, shelf-life and quality

[Laboratory of Food Microbiology (LFM), A. Aertsen, C. Michiels]
Microbial technology

- Microbial ecology
- Functional molecular biology
- Industrial microbiology and biotechnology
- Microbial geno- and fenotyping
- Bioinformatics and biostatistics
- Metagenomics for the exploitation of micro-organisms and genes
- Applied genetics and bioengineering of industrial yeasts and bacteria towards improved technological properties
- DNA- and RNA-based tools for rapid detection and identification of microorganisms (incl. pathogenic and spoilage)
- Enzyme and fermentation technology
- Fermented food systems (*e.g.* beer, wine, cider, chocolate, bread, meat)

[LIBR, (TLQAP)]
Analytics and processing technology

• Analytical techniques
  • Fully equipped lab infrastructures
  • Fast analysis and sensor technologies
  • Advanced high-through compound analysis [e.g. GS-MS: flavour, process induced compounds; SPR: e.g. allergens]
  • Core facilities ['omics’, crystallography, material analysis (e.g. tomography), …]

• Pilot-scale unit operations
  • Post-harvest preservation (e.g. climate chambers) (MeBioS)
  • Milling (e.g. Chopin, Bühler, ball mill, Satake) and baking (e.g. bread, croissants, cookies, cakes, waffles, …) (LFCB)
  • Extrusion and pasta making (LFCB)
  • Malting and brewing (fully equipped facility) (LFCB, LIBR)
  • Fruit/vegetable processing (e.g. thermal, high-pressure processing/homogenization, high-voltage, low-temperature, …) (LFT)
  • Meat processing (e.g. cutting, homogenization, tumbling, pickling, smoking, fermentation, drying, cooking, steaming, packaging, …) (LTQAP)
  • …
Fast analysis and sensor technologies

• Based on different technologies (MeBioS, B. De Ketelaere, J. Lammertyn, W. Saeys)
  • Spectrophotometry
  • VIS/NIR spectroscopy (different setups)
  • ATR FTIR spectroscopy
  • Laser scattering
  • Surface plasmon resonance
  • Hyperspectral imaging
  • Ultrasonic waves
  • Lab-on-chip
  • X-ray tomography (3D-imaging)
  • Electronic nose
  • Nanoparticles, aptamers
  • Acoustics
  • Puff device
  • …

In-line and off-line monitoring of:
1) Safety aspects
2) Color
3) Composition
4) Structure, texture and rheology
5) Flavour

Application in:
1) Process design
2) Product design
3) Process automation
4) Quality and safety evaluation
5) Product sorting
6) Precision agriculture
7) Production/supply chain monitoring

(MeBioS, B. De Ketelaere, J. Lammertyn, W. Saeys)
High-throughput compound analysis

- Headspace fingerprinting (e.g. SPME GC MS/Fast GC MS)
  - Impact of conventional and novel processing technologies immediately after processing or as a function of shelf-life (LFT)
  - High-throughput flavour analysis (LFT, MeBioS, LIBR)
- Surface Plasmon Resonance (e.g. allergen detection)
- ...

Selection and identification of fingerprint marker

Surface Plasmon Resonance

Fast flavour analysis
Pilot-scale unit operations

- Mill and bakery
- Pasta making
- Extrusion
- Malting and brewing
- Post harvest preservation
- Processing (fruits, vegetables, ...)
- Meat processing
- Algae cultivation
Food and health research @ KU Leuven

**Biomedical Sciences (BMS) Group**

**Gastrointestinal Tract**
- Inflammatory bowel diseases
- Gastrointestinal peptides & their receptors
- Nutrient sensing
- Gastrointestinal motility & sensitivity
- Regulation of food intake
- Colonic bacterial metabolism
- Gut microbiomics
- ...

**Endocrine System**
- Type I diabetes
- Obesity, Type II diabetes and Metabolism
- ...

**Nutrition**
- Diabetes, obesity, cachexia, gastrointestinal disorders, ...

---

Science, Engineering and Technology (SET) Group

Consumer PAN profiles
Gastrointestinal tract and health

Pathophysiology of GI disorders and (adjuvant) therapies

Colonic bacterial metabolism and gut health

Intestinal microbiomics in health and disease

Nutrient sensing, sensorimotor function and hormonal peptides in GI the tract and the gut-brain axis in regulating food intake

[Translational Research Centre for Gastrointestinal Disorders (TARGID), I. Depoortere, J. Tack, K. Verbeke, S. Vermeire]
Endocrine system and health

Type 1 diabetes

Beta-cell

Immune system

Active role of the beta-cell  Antigen specific tolerance induction  Vitamin D analogues

Proteomics  In vitro immune assays  Microarray  ChIP-Seq

Preclinical mouse models: natural models, transgenic models, KO models

Artificial pancreas  Novel agents  Prevention trials  Intervention trials  Transplantation

National and international networks EU-FP6, EU-FP7, JDRF, DVN, FWO, BDR...

(Division of Clinical and Experimental Endocrinology, C. Mathieu, C. Matthys, A. Meulemans, B. Van Der Schueren)
Endocrine system and health

Obesity, type 2 diabetes and metabolism

Type 2 diabetes  Obesity  Bariatric surgery

Beta-cell  Insulin resistance  Drug absorption

Proteomics  Food toxins  Pharmacology

Preclinical mouse models: natural models, transgenic models, KO models

Novel agents  Intervention trials  Iron absorption  Drug resorption in bariatric patients

National and international programs on gestational diabetes and on obesity

(Division of Clinical and Experimental Endocrinology, C. Mathieu, C. Matthys, A. Meulemans, B. Van Der Schueren)
LFoRCe and industry collaboration

- **Bilateral** (*e.g.* co-funded by IWT)
- **Framework agreements**
- Industrial PhD
- Collective research (*e.g.* Flanders’ Food)
- Strategic basic research (funded by IWT)
- EU-projects [*e.g.* EC, FP, Marie Curie, JPI, EIT, ERANETs (*e.g.* SusFood, Cornet)]
- **Endowed chairs** (*e.g.* WK Kellogg chair in cereal science and nutrition)
- **Consultancy/analytical services**

Call for the KIC Food4Future of the EIT…
Industry collaboration
W.K. Kellogg Chair

... in Cereal Science and Nutrition

- **Time frame:** November 2010 - October 2015
- **Chair holders:** Jan Delcour and Kristin Verbeke
- **Purpose:** to stimulate innovative research in cereal science and nutrition
- **Funds:** to help cover teaching/research expenses of Chair holders
- **Research:** quantification of short chain fatty acid (SCFA) production from different wheat fractions (and combinations) in healthy subjects
The Kellogg Company opens research facility in Leuven

Leuven (Belgium) and Battle Creek (MI, USA), September 2, 2013. The Kellogg Company, the world’s leading cereal company, today officially opened a new food science research & development facility in the Leuven Bio-Incubator. A team of 20 Kellogg researchers will focus on developing innovative food concepts and products with the goal of meeting the needs of Kellogg consumers. Kellogg is one of several life sciences companies that have set up operations in the Leuven region. These companies interact closely with KU Leuven, University Hospitals Leuven, VIB and imec, and together form a dynamic science cluster that stimulates knowledge-driven entrepreneurship and innovation.

At the official opening, Ms. Margaret Bath, Senior Vice President Research, Quality, and Technology of The Kellogg Company said: “We are very excited to open this new Kellogg Research and Development facility in Flanders, and more in particular, at the Leuven Bio-Incubator. This new partnership we are creating with KU Leuven is a great example of industry-university cooperation and will help to drive the future of food innovation. Our presence here in Leuven will provide Kellogg with access to incredible talent, strong infrastructure and the right environment to nurture creative thinking and problem solving. We are confident that the facility will help us meet our business goals and provide our consumers with foods that delight.”

Mr. Kris Peeters, Minister-President of the Government of Flanders, added: “Flanders ranks among the top five knowledge-intensive regions in Europe. By deploying our Flanders in Action project, the Government of Flanders aims to progress Flanders further towards a competitive and multi-faceted knowledge economy. In order to meet this goal, it is crucial to invest in research & development and further deploy our New Industrial Policy to attract knowledge-intensive companies – such as The Kellogg Company – to Flanders. Flanders is driven by innovation. Companies such as The Kellogg Company, knowledge institutes and governments share a clear will to stay one step ahead of the competition and to create added value in promising new fields. I want to thank The Kellogg Company for their firm belief in Flanders.”

“We are delighted to be able to welcome such an important player in the food industry to Leuven,” said Mr. Michael De Blauwe, Executive Director of the Leuven Bio-Incubator. “Leuven is situated in the heart of Belgium, only a 15-minute drive from Brussels International Airport. The region has an innovative business climate with many high-tech companies and state-of-the-art incubators and science parks. In short, it is the ideal environment for Kellogg’s new facility. The Leuven Bio-Incubator offers excellent facilities for R&D-intensive companies. Its lab and office space is fully customizable, allowing Kellogg to modify it to meet their needs. We also provide support throughout the installation.”
Scientific and valorisation output

- Peer reviewed publications per annum
  $\geq 350$ peer reviewed papers

- 30-40 PhD degrees per annum

- Patents (2002-2012)
  $\sim 50$ patent families, of which $\sim 19$ with $\geq 1$ granted patent

- Spin-offs

Yeast technology…
The arabinoxylan case: past, present and future

Isolation and characterization of arabinoxylan (AX) in cereal grains

Research on the functionality of AX and AX degrading enzymes in cereal processing

Research on the health-related properties of (bran-derived) AX in model systems and humans

Nutritional upgrading of wheat bran for food applications (dry processing)

1991

1995

1997

2001

Negotiation for project with large multinational

Strategic research projects with industrial advisory boards co-funded by the Flemish Government

Present

Patenting

Patenting

Licensing

Puratos

FUGEIA

BRANDING

XYLAFUN

IMPAXOS

Cargill

DANISCO

KU LEUVEN
Contact

**Daily Management: Dr. Kurt Gebruers**

Katholieke Universiteit Leuven  
Science, Engineering and Technology Group  
Leuven Food Science and Nutrition Research Centre (LFoRCe)  
Kasteelpark Arenberg 20 box 2463  
BE-3001 Leuven  
Belgium

Phone +32 16 321919  
Secretary +32 16 321634  
Fax +32 16 321997  
E-mail kurt.gebruers@biw.kuleuven.be

**Chair: Prof. Jan Delcour**

Katholieke Universiteit Leuven  
Department of Microbial and Molecular Systems  
Centre for Food and Microbial Technology  
Laboratory of Food Chemistry and Biochemistry  
Kasteelpark Arenberg 20 box 2463  
BE-3001 Leuven  
Belgium

Phone +32 16 321581  
Secretary +32 16 321634  
Fax +32 16 321997  
E-mail jan.delcour@biw.kuleuven.be