

**Institute of Food Research** [www.ifr.ac.uk](http://www.ifr.ac.uk)

# **Science at IFR – 2010**

**Presentation for members of the IGLO network.**

# The Norwich Science Vision

**Institute of Food Research**

**John Innes Centre**

**The Sainsbury Laboratory**

**The Genome Analysis Centre**

**University of East Anglia**

**The Norfolk & Norwich Hospital Trust**

**All these organisations are partners on the Norwich Research Park**

**[www.nrp.org.uk](http://www.nrp.org.uk)**

**Overall Research Spend - £120m [€130m]**

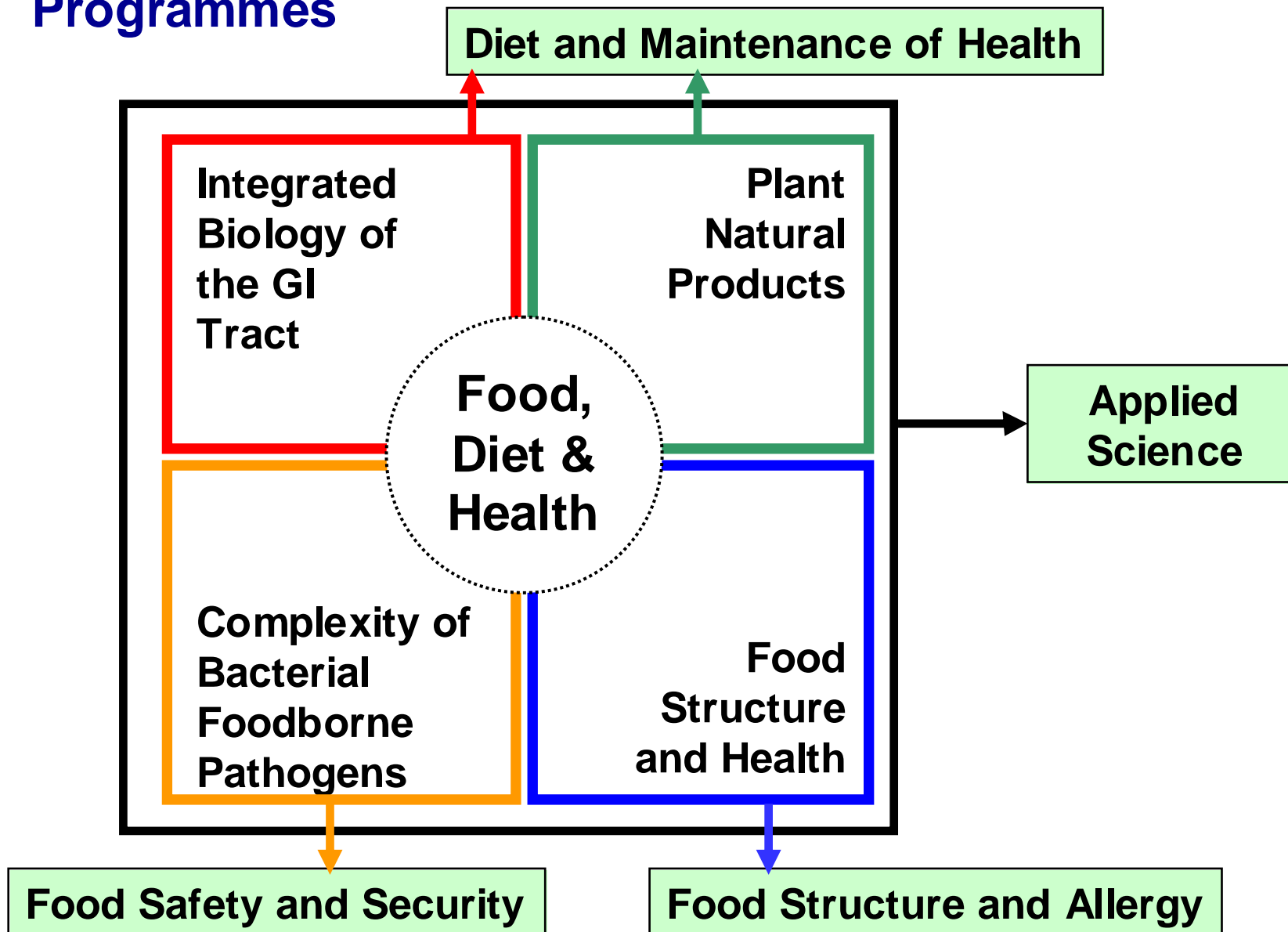


# The Institute of Food Research is

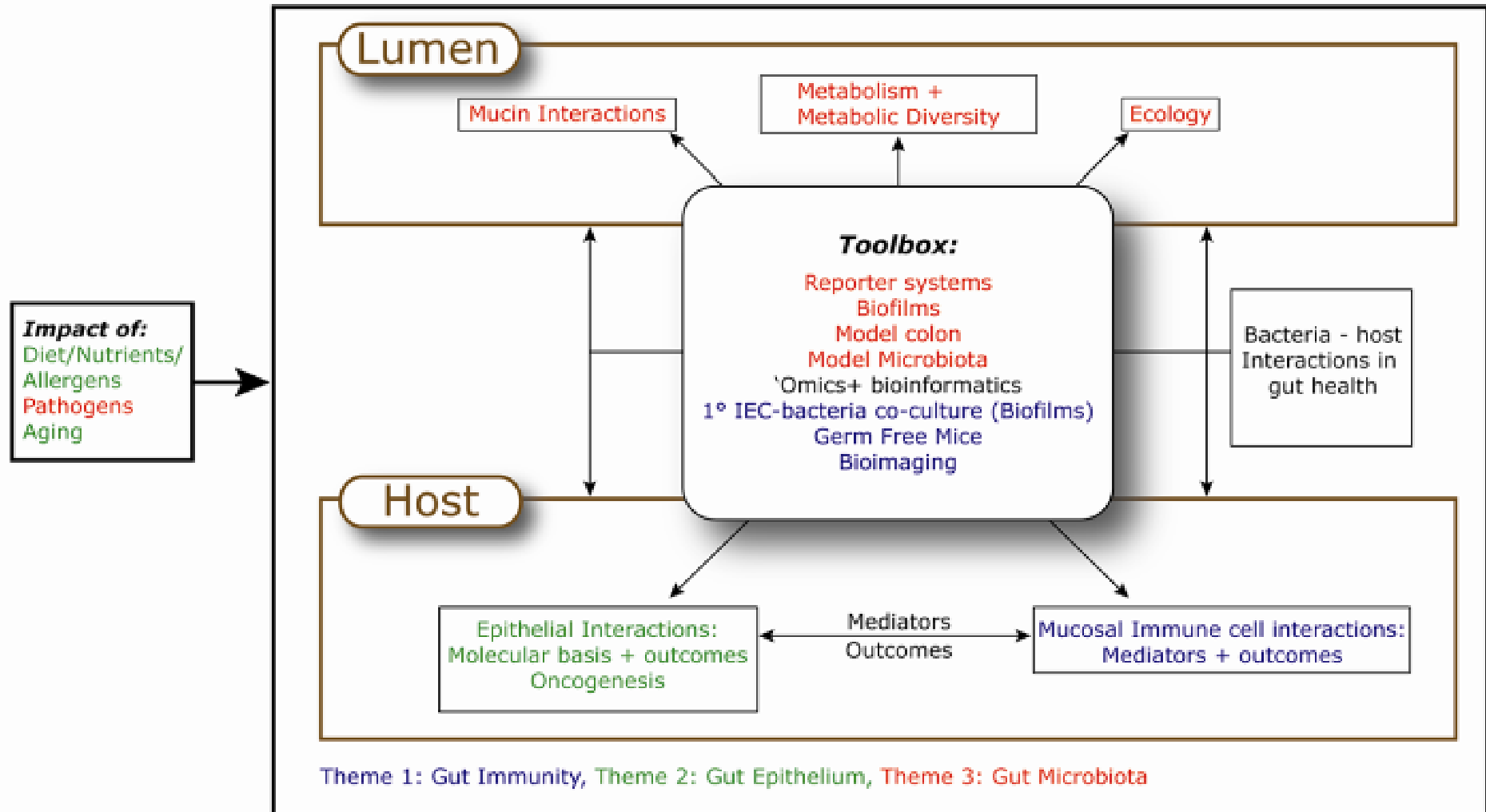
- **the only publicly-funded UK institute for food research**
- **a centre for science underpinning food and health**
- **an interface with the food industry [UK and beyond]**
- **a leader in science, training and agro-food strategy in Europe and beyond**
- **sponsored by the Biotechnology and Biological Science Research Council**
- **an active partner on the Norwich Research Park**

# ***IFR SCIENCE***

# Four IFR Programmes



# Integrated Biology of the GIT Programme



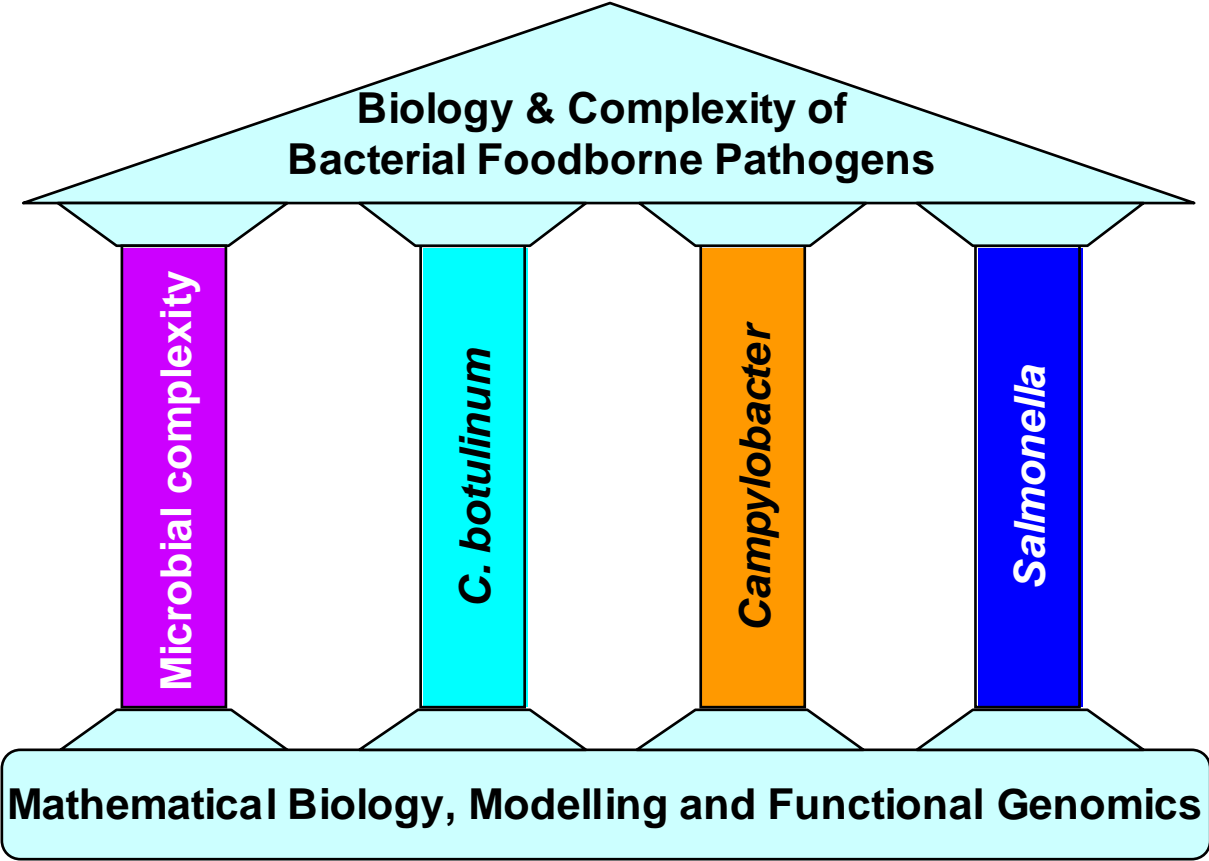
# Integrated Biology of the GIT Programme

- **Objective:** *To understand how the GIT functions as an integrated biological system*
- **Aims:**
  - ◆ What is the cellular and molecular basis of host immune responses to antigenic challenge in the GIT?
  - ◆ How is epithelial permeability and GIT barrier function regulated? What is the impact of metabolic stress, epigenetic changes and diet and microbiota on epithelial homeostasis?
  - ◆ Define the extent and function of metabolic diversity in GIT microbiota and how does it maintain the mucin-epithelial barrier?

# Personnel

- ◆ **Simon Carding – ISP Leader, Immunology**  
*Mucosal immunity, microbe-epithelium-immune cell interactions in health and disease (inflammatory bowel disease)*
- ◆ **Claudio Nicoletti – Immunology**  
*Mucosal dendritic cell responses to food and microbial enteric antigens*
- ◆ **Anastasia Sobolewski - Immunology**  
*Antigen uptake in the GIT, intravital imaging microbe-immune cell interactions*
- ◆ **Nigel Belshaw – Epithelium**  
*CpG methylation in epithelial homeostasis and neoplasia*
- ◆ **Mark Williams (UEA) – Epithelium**  
*Human colonic crypt, epithelial development, signaling, invasion and neoplasia*
- ◆ **Nathalie Juge - Deputy ISL Leader, Microbiota**  
*Carbohydrate metabolism in the human gut microbiota*
- ◆ **Arjan Narbad – Microbiota**  
*Molecular microbiology of gut microbiota, lantibiotics*
- ◆ **Sacha Lucchini – Microbiota**  
*Microbiota ecology and metatranscriptomics*
- ◆ **Carmen Pin – Systems biology**  
*Modeling of intestinal crypt function and microbial complexity*

# Bacterial Foodborne Pathogens Programme



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# Bacterial Foodborne Pathogens Programme

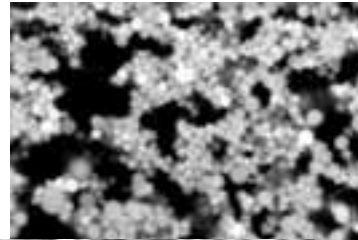
- **Objective:** *Develop fundamental insights into the biology and complexity of key bacterial foodborne pathogens that are relevant to food security and the safety of food chain*
- **Aims:**
  - ◆ How do food pathogens respond to many stresses encountered throughout the food chain, including in mammalian infection?
  - ◆ Optimise and validate network methods to extend understanding of biology of foodborne bacteria
  - ◆ Optimise mathematical approaches to quantify, model and control the risk of foodborne illness
  - ◆ Develop fundamental biological insights in order to facilitate development of new knowledge-led interventions

# Personnel

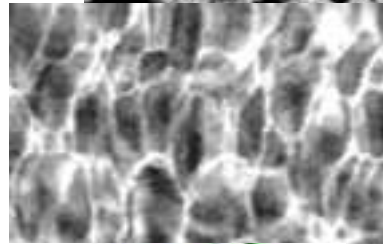
- ◆ **Mike Peck ISP Leader – Microbiology**  
*Clostridium botulinum - foodborne ecology*
- ◆ **Arnoud Van Vliet – Deputy ISP Leader, Microbiology**  
*Campylobacter - stress response*
- ◆ **Arthur Thompson - Microbiology**  
*Salmonella - stress response*
- ◆ **József Baranyi - Complexity**  
*Transcriptional networks; stochastic modelling*
- ◆ **Carmen Pin – Complexity**  
*Systems biology; Transcriptional networks*
- ◆ **Gary Barker - Complexity**  
*Quantitative microbial risk assessment*

# GI-tract Environments

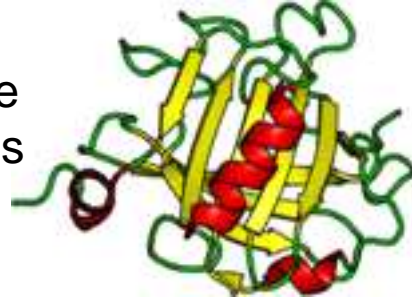
Structured Emulsions  
and Interfaces



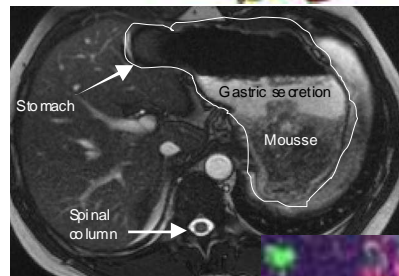
Carbohydrate  
Biopolymer  
Structure



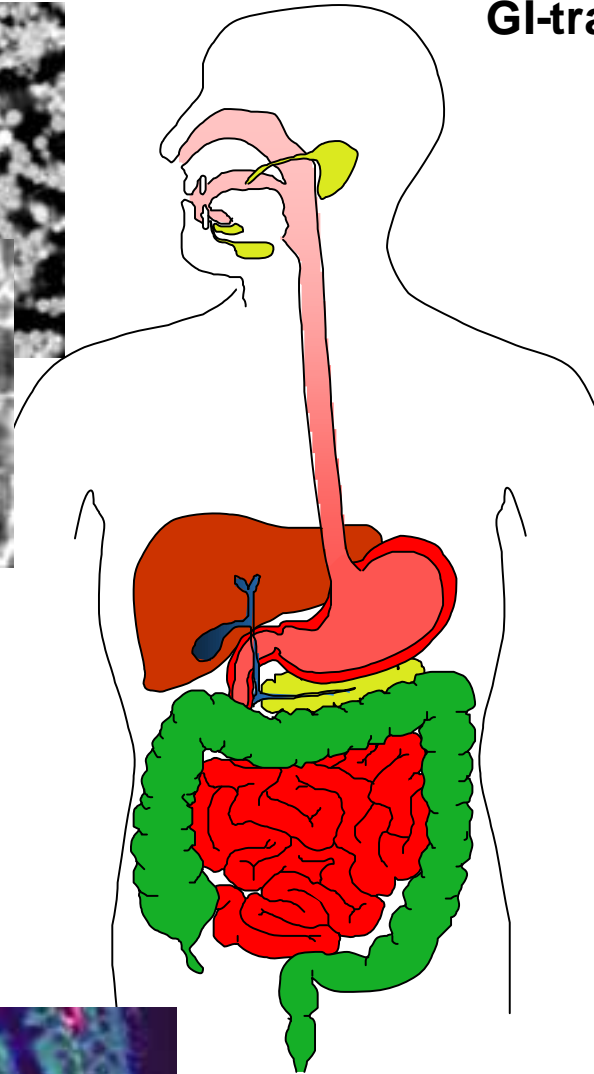
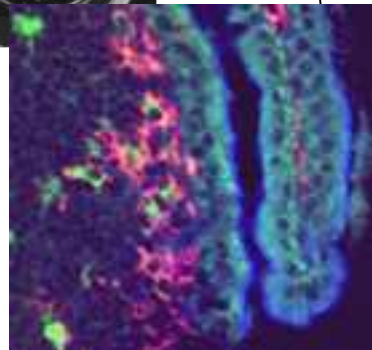
Protein Structure  
and Proteolysis



Imaging Food  
in the Gut



Transport and  
Uptake Processes



Mouth



Stomach



Small Intestine

**Food  
Structure  
and Health  
Programme**

# Food Structure and Health Programme

- **Objective:** *To develop strategies to improve the nutritional quality of ingested food, especially in relation to health and disease such as obesity, allergy and cancer.*
- **Aims:**
  - ◆ Define the physicochemical principles governing the breakdown of natural and fabricated food structures in the GI tract (emulsions, natural and fabricated carbohydrate polymer structures)
  - ◆ Show how food processing and the matrix may alter the physiological effects of foods, including their allergenic potential.
  - ◆ Investigate the role that food structure has on the uptake of biologically-active macromolecules (bioactive polysaccharides, food allergens).

# Personnel

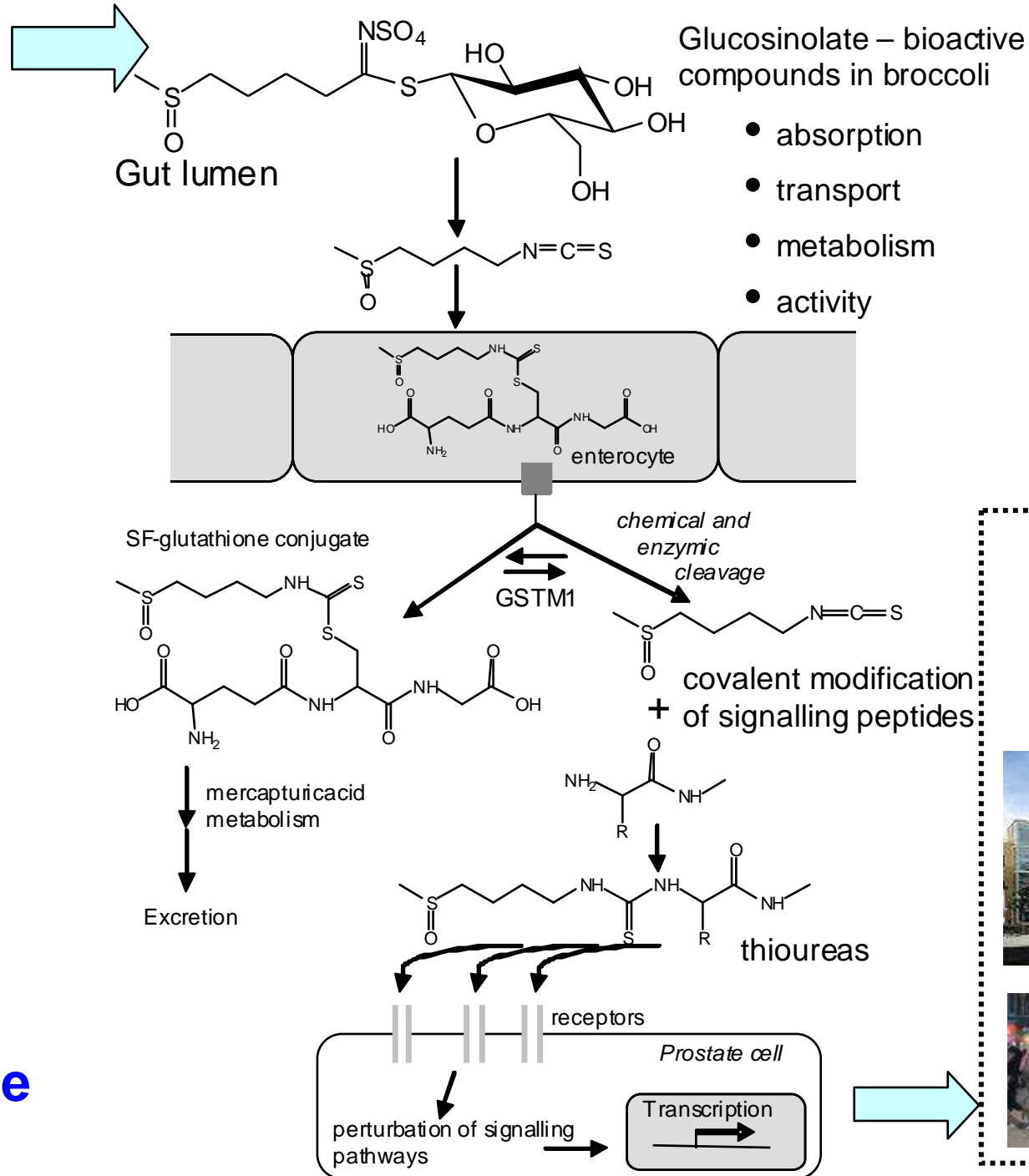
- ◆ **Clare Mills – ISP Leader Biochemistry**  
*Proteolysis in GI tract: fragmentation of allergens*
- ◆ **Vic Morris – Biochemistry/Biophysics**  
*Carbohydrate polymer structure: imaging*
- ◆ **Pete Wilde - Biophysics**  
*Interfaces and emulsions: salivary mucus*
- ◆ **Brian Hills - Physics**  
*Magnetic resonance imaging of the gut*
- ◆ **Alan Mackie**  
*Rheology of GI-tract mucin-protein interactions*



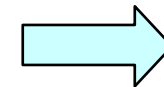
## Plant and Crop Science

## Plant Natural Products Programme

15



## Individual Nutrition and Public Health



# Plant Natural Products Programme

- **Objective:** *To understand how bioactive plant natural products exert their biological effect.*
- **Aims:**
  - ◆ What is the basis for the health benefits in glucosinolates from cruciferous plants?
  - ◆ What factors influence the bioavailability of dietary polyphenols?
  - ◆ What are the biological consequences of folate and folic acid in the diet?

# Personnel

- ◆ **Richard Mithen – ISP Leader: Plant Natural Products**  
*Glucosinolates and health benefits*
- ◆ **Paul Kroon - Nutrition**  
*Polyphenols*
- ◆ **Paul Finglas - Nutrition**  
*Folates, folic acid and health*
- ◆ **Paul O' Maille – Molecular Biology**  
*Plant secondary metabolism and evolution*
- ◆ **Thomas Wilhelm – Mathematics**  
*Mathematical modelling: natural products*

# Strategic Relevance of IFR Research

- *Food security*
- *Allergy*
- *Obesity*
- *Ageing population*
- *Diet and disease*
- *Bio-terrorism*
- *Microbial safety of the food chain*
- *Emerging pathogens*
- *Waste sustainability*
- *Quality in the food chain*
- *“Dry Biology” Predictive-Systems Biology*

# ***IFR INNOVATION***

# IFR Innovation

Head: Dr Reg Wilson

- **Food and Health Network**
- **IFR Extra**
- **Intellectual Property**
- **Exploitation Platforms [Translational Science]**
- **Spin-outs and subsidiaries**
- **Partnerships**

# Food and Health Network

## Head: Professor Tim Brocklehurst

### Translation and Knowledge Exchange

- **Membership-based** [currently >200 industry members]
- **Cluster concept**
- **FHN conferences** [London, Leeds, Norwich]
- **FHN-SIK UK-Swedish Workshop** [similar activities planned]
- **FHN presence at conferences and trade exhibitions**
- **FHN Direct** [1-to-1 confidential engagement with industry]
- **FHN International**
- **Involvement in FP7 Food-Pharma Regions of Knowledge proposal**

To further enhance impact and value-for-money, IFR's FHN and International activities will be merged in 2010.



# IFR Extra

**This is a 100%-owned  
IFR subsidiary which  
markets the Institute's**

**Expertise**

**Training**

**Research**

**Analysis**

**[www.ifrextra.co.uk](http://www.ifrextra.co.uk)**



# IFR Extra: Examples of activities

## Small research projects for industry

- Food safety and shelf life
- Phytochemical analyses
- Spectroscopy
- Human Nutrition Unit [managed by IFR Extra]
- Consumer sciences [external consultants]
- Materials sciences
- Microscopy
- Consultancies
- Model Gut

# Exploitation Platforms

## Application and translation

- **Technology Platform:**

**Dynamic Gastric Model**  
**MRI**

- **Applied Science Platform**

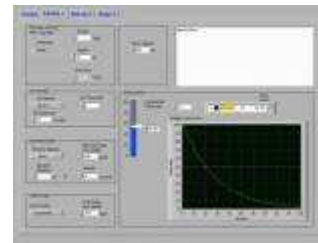
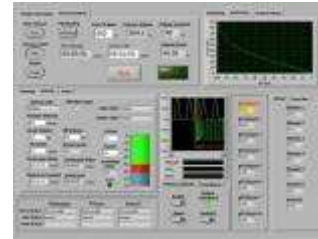
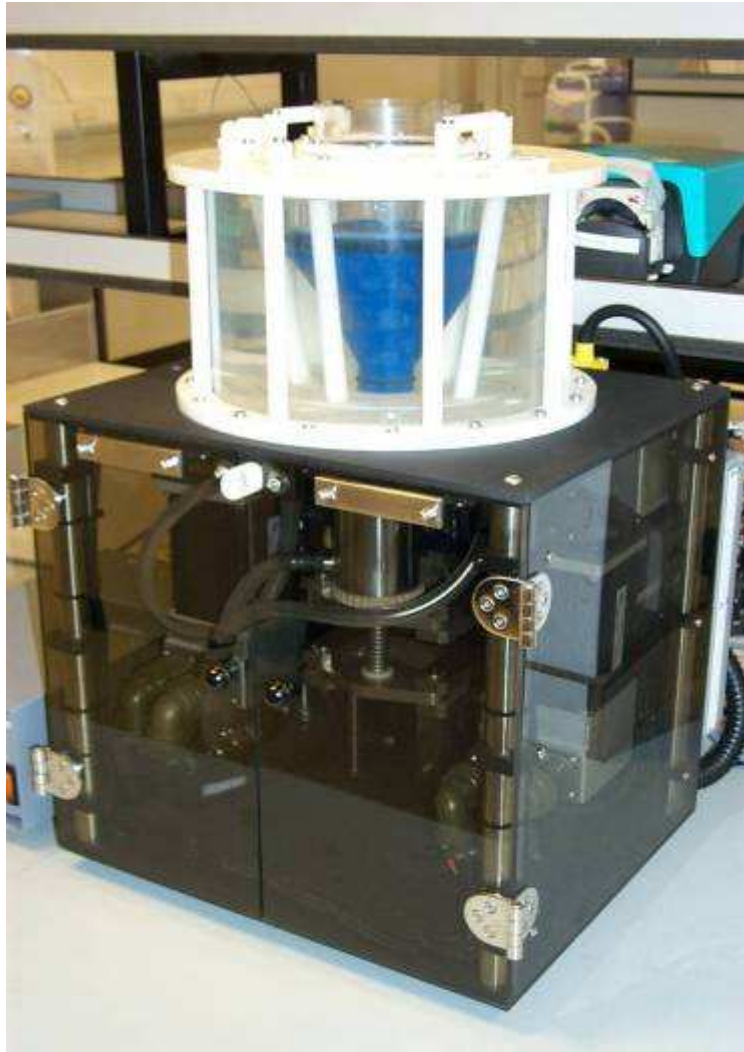
**Food Chain Sustainability**  
**Microbial Ecology**

- **National Resources Platforms**

**Food Databanks**  
**National Collection of Yeast**  
**Cultures**



# Dynamic Gastric Model [Model Gut]



## **A step-change technology advance**

- Can accept real food and drugs
- Simulates physical and biochemical processing in real time
- Intelligent software
- Patent coverage
- Developed using EP-MRI
- Validated against human volunteers

**Goal – to become the industry standard model for human digestion studies**

# Food Chain Sustainability Exploitation Platform

- **Novel method for producing peat replacement compost from food waste [patent; 2009 spin-out]**
- **Novel application for brewer's spent grain [patent]**
- **Pilot waste plant [under discussion]**
- **British Bioalcohols Group**
- **Waste utilisation [spin-out]**

**Bioethanol Research**



Provision of industrial wastes

Pre treatment

Industrial enzymes

vireol. Industrial Bio-alcohol

optimising combustion



**Research programme: Environment for invention and innovation**

Selection and categorisation

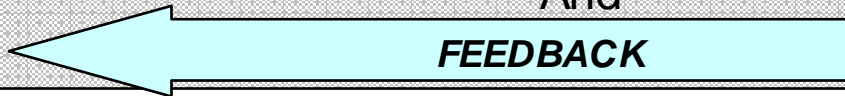
Digestion and Release of sugars And

Fermentation & separation

LIGNO-CELLULOSE

BIO-ALCOHOL

FEEDBACK



**Task 4:**  
Evaluation of Combustion

**Task 1:** Supply and characterise Lignocellulosic co-products

**Task 2:** Cell wall disassembly depolymerisation and saccharification

**Task 3:** Further saccharification and Fermentation



HOOCH



**Academic partners**  
*(Environment for invention)*



# Spin-outs and subsidiaries

contact: [reg.wilson@bbsrc.ac.uk](mailto:reg.wilson@bbsrc.ac.uk)

- Dynamic Gastric Model

- Ovatus Ltd

Delivery platforms for pharmaceuticals

- IFR Extra

[www.ifrextra.co.uk](http://www.ifrextra.co.uk)

- NCYC

[www.ncyc.co.uk](http://www.ncyc.co.uk)

- Waste Utilisation

- Food Databanks Aisbl [based in Belgium]

Originated from EU FP6 project  
EuroFIR



# Partnerships

## Cross-cutting support

- **Proteomics**
- **Metabolomics**
- **Bioinformatics and statistics**
- **Theoretical systems biology**
- **Human Nutrition Unit**
- **Imaging**
- **Advanced animal house facilities**

# International Cooperation

[roger.fenwick@bbsrc.ac.uk](mailto:roger.fenwick@bbsrc.ac.uk)

## Optimising the success and reputation of IFR's science and scientists

- **\*Supporting FP7 and other transnational proposals in research, training and career development, and knowledge transfer** [influencing call topics, early sight of calls, facilitating consortia development, assisting proposal writing, identifying key partners]
- **Encouraging and supporting younger scientists in trans-national ventures**
- **Networking and establishing contacts across Europe and beyond**
- **\*\*Information hub and seeker of advice**
- **Securing national funding** [for visits, proposal preparation, bilateral workshops etc.]
- **Supporting FOODforce** [network of directors of key European food and nutrition research centres]
- **Supporting the European Technology Platform Food for Life**, [www.etp.ciaa.eu](http://www.etp.ciaa.eu)

\* **Complementary administrative, financial support and advice is provided by experienced staff within TOC, The Operational Centre.**

\*\* **Underpinned by the UK Research Office, UKRO, in Brussels, and EC staff.**

# Our hope for 2010

The strategic programme of the Institute of Food Research in Norwich has undergone significant changes under Professor David Boxer.

Professional excellence, effective communication, timely knowledge transfer and global collaboration remain at the heart of our delivery in food and health.

**We would very much welcome opportunities to cooperate with colleagues having similar or complementary interests.**



# Contacts

## Director

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## Programme Leaders

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Professor Mike Peck [mike.peck@bbsrc.ac.uk](mailto:mike.peck@bbsrc.ac.uk)

Professor Clare Mills [clare.mills@bbsrc.ac.uk](mailto:clare.mills@bbsrc.ac.uk)

Professor Richard Mithen [richard.mithen@bbsrc.ac.uk](mailto:richard.mithen@bbsrc.ac.uk)

## Innovation

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## International Coordinator

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**Please contact us if you would like additional information.**