

FOOD; ADDRESSING THE UK'S GRAND CHALLENGES



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The Institute of Food Research is a key player in food security and diet and health issues, particularly healthy ageing.

Alongside climate change, food is at the top of the UK's strategic agenda and central to both the Government and Biotechnology & Biological Sciences Research Council's research priorities. On Norwich Research Park an Institute of the BBSRC delivers crucial research outcomes that assist government and industry in addressing the challenges of food security, diet and health including obesity, and healthy ageing that we face as a nation. The Institute of Food Research (IFR) is the only institute in the UK wholly dedicated to the food science, diet and health agenda.

IFR has had a laboratory in Norwich for 40 years, and a January 2009 analysis confirms it is second only to Tufts University in the USA as the top institution world-wide in agricultural and food sciences, based on the scientific impact of its scientists¹.

Assessing the broader impact of such laboratories is more difficult. But in 2008, DTZ were commissioned to examine IFR's performance, and their data, for example examining some aspects of food safety research, estimate the added value of IFR work supporting UK processed chilled products to be £22.8M pa.

Extending the shelf life of products through IFR's work saves UK consumer wastage valued at £24.6M pa. And if ComBase, a predictive microbiology tool pioneered at IFR, saves the EU food sector even 1% of its R&D budget, this is worth £22M pa.

Norwich Research Park (NRP) is a unique constellation of activities that does not exist elsewhere in the UK. NRP partner organisations – the IFR and the University of East Anglia, the John Innes Centre, The Sainsbury Laboratory, and the Norfolk and Norwich University Hospital – are uniquely well-placed to respond to the great global, national and regional challenges of our times. IFR is leading and is the focal point of the NRP's initiative in food science, diet and gastrointestinal tract health. It is also undertaking joint ventures with other BBSRC institutes to enhance the impact of the Research Council's spend.

Through the development of the Norwich Science and Innovation Vision, aiming to deliver the best science in a sustainable way, NRP partners have developed a series of alliances – amongst them the Centre for Preventive Medicine and the Plant and Microbial

Natural Products Initiative. Research is leading-edge and cross-cutting, but with a science-to-clinic applicability.

Professor Richard Mithen has, through the BBSRC-supported technology transfer company PBL, extensive patent protection on broccoli lines with enhanced levels of glucosinolates. His fundamental results from a laboratory setting are also being translated into clinical trials in people, as opposed to extrapolating from animal models. In prostate cancer, the most common non-skin cancer for males in western countries, he showed that at-risk men with the GSTM1 gene (around half the population) who ate broccoli had changes in gene expression that may be associated with the reduction in cancer risk.

Professor Vic Morris has shown that a fragment released from pectin, found in all fruits and vegetables, binds to and is believed to inhibit galectin 3, a protein that plays a key role in cancer progression. This first step opens the way to a new and exciting area of research in bioactive carbohydrates. The next is to identify how pectin fragments can be taken up by the body and released so that they can exert their effect on cancer cells, which could result in functional foods with added 'bioactive pectin' as well as providing more conclusive evidence for the importance of eating at least '5-a-day'.

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Allergy is a major health issue in the UK and IFR is an international centre of expertise on both immunological and biophysical aspects of sensitisation to food allergens. Combining expertise in allergy with our interests in GI tract microbiology, in work co-funded by BBSRC and Yakult, Professor Claudio Nicoletti has found, in the first reported human study of its kind, that a probiotic drink containing *Lactobacillus casei* can modify the immune system's response to grass pollen, a common cause of seasonal hayfever. The next stage will be to perform a similar study to see if the immunological changes translate into a real reduction in clinical symptoms and to examine the mechanisms involved.

The prospect of helping people protect their health through active diet choices is on the horizon.

Food safety is a vital aspect of both food security – not only from the point of view of the food supply, but also of food safety in the context of climate change, where the behaviour of food borne pathogens may change, or new species become problematical. The Institute takes a multidisciplinary approach in studying the behaviour of *Campylobacter*, *Salmonella* and *Clostridium botulinum* to protect the health of consumers.

For example, mathematicians at IFR, in collaboration with the University of Reading, have recently developed a method to measure and quantify the damage that a bacterial cell population suffers during heat treatment. The theory is important in studying the efficiency of heating, for example by microwaves, where the temperature distribution is

broad. Their new approach will enable the food industry to optimise the "Use by" dates of, for example, Ready-to-Eat products.

A variety of mechanisms are in place, both internal and BBSRC-sponsored, to foster positive economic benefit. The Institute has a particularly demanding role helping to ensure the long-term competitiveness of the UK agri-food industry – working in collaboration with companies, often funded by Government schemes designed to drive economic impact, but with advances always grounded in academic excellence.

Low fat foods are an essential part of tackling rising levels of obesity, but many lack the appeal of the full-fat product. Dr Peter Wilde's team, part-funded by the Department of the Environment, Food & Rural Affairs through the Food Quality & Innovation LINK scheme, have been working with scientists from Leatherhead Food International to investigate the concept of multiple emulsions; that is, each oil droplet in the emulsion contains many water droplets – Water in Oil in Water (WOW) emulsions. When consumed, the structures that are sensed are still oil droplets (but 40% less fat), but giving a similar sensory response to the full fat emulsion. Formulation is critical, and the next step is to research applications in specific food product areas.

IFR is an internationally-renowned centre for training the next generation of scientists working in food, diet and health. It also has in place and is enhancing innovative biomedical research training programmes for junior academic clinicians (specialist registrars, house officers) that

involve public and private health care providers.

Research by PhD student Richard Bailey into a condition called dysbacteriosis, a syndrome of growing importance to animal welfare and industry economics, has recently been recognised with a Scholarship Award by the British Poultry Council. His industry co-sponsor through the CASE Award scheme is poultry breeding company Aviagen Ltd. Complex science addressing the problem is only feasible in a research environment such as that fostered in IFR's gut health programme. The science may be fundamental, but industry recognises not only the need, but also its potential impact.

IFR scientists are encouraged to be entrepreneurial. Part of our strategy is to define a small number of activities that offer good potential for commercial development – 'Exploitation platforms'. An example is the Dynamic Gastric Model developed by Dr Martin Wickham that simulates human digestion for the first time from a true physiological perspective. The device, made from sophisticated plastics and metals, can withstand corrosive gut acids and enzymes, and can be fed real food. Interest in this model from companies worldwide is being managed, again with PBL support.

A trio of activities directly addresses industry needs: commercial subsidiary 'IFR Extra', launched in 2008 to address industry requests for short-term assistance, matches their needs with bench-expertise and leading edge equipment. Through the Food and Health Network, the Institute provides a forum for knowledge transfer and collaboration where science can make a real contribution to

industrial effectiveness and sustainability. And, via FHN Direct, a team of staff meet with a company and discuss their research or development needs in total confidence, responding with potential ideas.

The BBSRC is a major funder of organisations and projects within the Norwich Research Park and, as part of its plans to strengthen the sustainability of research in Norwich, has agreed co-funding and joint employment arrangements with the University for senior appointments at IFR. Noted immunologist Professor Simon Carding has joined to lead research on the integrated biology of the GI tract, and the most recent announcement has been that of a successor to IFR's retiring Director, Professor David White. The Vice-Principal for Research and Enterprise at the University of Dundee, Professor David Boxer, joins the campus in Spring 2009; he will have a vital role ensuring the continuing success of food, diet and health research investments in Norwich.

¹ Essential Science Indicators Database of Thomson Reuters, scientific journal articles only, period 1998-2008, rankings by citations per paper.

Front Cover Image by Caroline Weight, a BBSRC-funded PhD student at the Institute of Food Research, using the Zeiss meta 510 confocal microscope at the John Innes Centre. Purchase of this highly-specialised kit was funded by BBSRC and JIC. Caroline is investigating tight junction regulation and pathogenic invasion. Only 1 layer of cells separates the gut contents from the body; the cells are held together by tight junctions, which prevent food and pathogens from spilling out of the gut.

