



Science+ Innovation

Institute of Food Research

Issue 2:07

Institute Update

Science and Governance

The first half of 2007 has been vital for IFR as we have received not only an interim visit from BBSRC-appointed experts to examine how our 2005-10 science strategy is bedding in, but also BBSRC's recommendations on future governance.

BBSRC's report confirms our view that there is a need for a food science research institute in the UK to undertake mission-driven research focussed in the diet and health area, and that IFR should continue to fulfil that mission. The panel recognises the international value of the 'IFR brand', which would be lost were the Institute to be dissolved.

We are delighted that the review panel agrees with us that our core expertise and capability provides a critical mass of researchers, and that our future governance should be via partnerships with the university sector, which further develops the coherence of this strategically important research area.

We are also very pleased that the review panel confirms the movement of three of the major research programmes from 'High National' to 'International' standard. We are in the process of making a number of new appointments including senior positions in immunology and nutrition, as recommended in the review. Moving forward, we are undertaking useful discussions with potential

university partners. We have a clear mandate to explore the scope for working even more closely with the University of East Anglia. Clearly, this is a complex process and our proposals will be considered at the July meeting of BBSRC Council.

"The closer integration of IFR with the University of East Anglia would appear to be an obvious, though not the only, choice and helpful discussions are underway with senior university staff and our Governing Body to progress the concept" comments IFR Director, Professor David White. "We are looking forward to the challenge of the next two years and the intellectual opportunities that the recommendations will bring".

Top science and industry figures join IFR Governors



David Gregory



Mike Sternberg

Stephan Strobel, Professor of Post-Graduate Clinical Education and Director of the Peninsula Postgraduate Health Institute, Plymouth has published extensively in the field of mucosal immunoregulation (oral tolerance) and its application to children with immunodysregulatory and allergic disorders. He is a member of many national and international committees, including the Scientific Panel on Nutrition, Dietetics and Allergy of the European Food Safety Authority and is chairing its Working Group on Food Allergies.

David Gregory has worked with Marks & Spencer for 24 years and as Technical Director is responsible for ensuring Marks & Spencer's foods are technically innovative, safe and consistently meet high quality standards. He is responsible for a team of over 70 technical specialists in fields as diverse as animal welfare, pesticides, fish sourcing, nutrition and

material science. Mr Gregory is a Chartered Scientist, a Chartered Environmental Health Practitioner and a Fellow of the Institute of Food Science and Technology. David has served on a number of Government bodies including DEFRA's Research Priorities Group, The Chemistry Leadership Council and is currently Chairman of DEFRA's Quality and Innovation Link Programme.

Mike Sternberg has joined the Governing Body's Scientific sub-committee to provide expertise in bioinformatics. Professor Sternberg is Head of Imperial College London's Centre for Bioinformatics and of their Structural Bioinformatics Group.

This year also marks the departure from the GB of Professor John Mathers from the University of Newcastle and Dr David Clark, CEO of DMV International Americas; we thank them both for their very considerable service to IFR.

'Science+Innovation' is published 3 times a year and is available via e-mail, from our website ifr.ac.uk and in print format. It reflects our science discoveries, and demonstrates our economic impact. The newsletter addresses a wide stakeholder-base. If it isn't suitable for your needs, please contact us



A vital link in the food chain

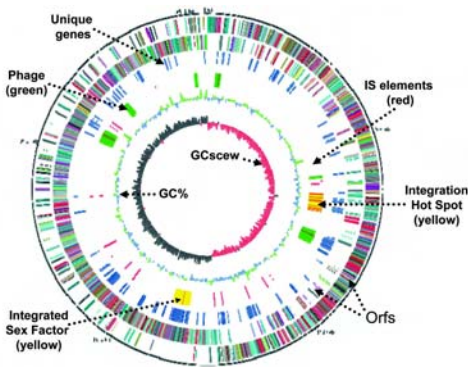
ifr.ac.uk

'Workhorse' MG1363 gives up its secrets

Lactic acid bacteria are important industrial bacteria and have been used for thousands of years in the production of cheese, butter and yoghurt.

The MG1363 strain of *Lactococcus lactis* was developed by Mike Gasson at IFR in the 1980s and is the prototype world-wide for research into the molecular genetics and biotechnology of this group of microorganisms.

Publication of its genome represents a milestone in the IFR's long-term research in this area.



Genome atlas of the chromosome of *L. lactis* MG1363

The MG1363 strain was developed to overcome problems of genetic instability that thwarted early work on the genetics of *Lactococcus*.

The strain has been used as a cell factory to produce many different proteins and peptides. It has a relatively simple metabolism that can be rerouted to make useful metabolites such as vitamins and amino acids. It has been used to develop novel antimicrobial compounds and as a GI-tract delivery vehicle for bioactive compounds. For example, MG1363 was used to pioneer the delivery of vaccine antigens and immune modulators in the gut. The biotechnological techniques and tools developed in MG1363 have been shown to be effective in other LAB as well as unrelated bacteria such as *Bacillus* and *Clostridium*, which have important industrial uses. MG1363 has also helped in the study of human pathogens such as *Listeria*. Study of the genome has given insights into its evolution and fitness. The present day genome contains elements that are essential for its growth in milk, but it also carries a number of genes that allow it to

metabolise a variety of plant-derived sugars, suggesting its ancestor was more associated with plants. Other LAB inhabit plant-based niches or derive nutrition from plants.

Comparative genomics will provide information about how the various strains of LAB have adapted to their environment, and how they use available nutrients. The genome sequence will also facilitate current and future work that aims to exploit MG1363 for a variety of medical and health maintenance applications.

Contact: Mike Gasson

Further reading: Wegmann *et al.* (2007) Complete genome sequence of the prototype lactic acid bacterium *Lactococcus lactis* subsp. *cremoris* MG1363. *Journal of Bacteriology* **189** 3256-3270

Collaboration: Alimentary Pharmabiotic Centre and Department of Microbiology, National University of Ireland; Groningen Biomolecular Sciences and Biotechnology Institute; Center for Biotechnology, Bioinformatics Resource Facility, Universität Bielefeld

Funding: BBSRC Core Strategic Grant; Higher Education Authority and Science Foundation Ireland (PRTL Cycle 3, 04/BRB0647). EMBARK postdoctoral fellowship. IOP Genomics grant IGE01018.

Allergy molecule identified

A vital molecule for resistance to food allergy has been identified and offers a potential target for therapy.

There is currently no way to treat food allergy and the only way for sufferers to manage the problem is to avoid certain foods and make sure they have injectable adrenaline at hand.

Dendritic cells secrete the molecule IL-12, which influences the immune responses of T-cells to foreign bodies. (T-cells are the white surrounding cells).

Scientists led by Claudio Nicoletti have found that a molecule called Interleukin-12 (IL-12) is absent during allergic responses. They suggest that by delivering an allergen in the presence of IL-12, allergic reactions could be brought back under control.

"A food protein can be perfectly harmless to one person and lethal to another, said Prof. Nicoletti. "We have identified the missing molecule that normally keeps immune responses under control and appropriate."

Having a food allergy means that the immune system responds to a food protein as if it was harmful. The immune system produces immunoglobulin E (IgE) antibodies, which normally help the body fight parasites. In the most severe cases individuals can suffer life-threatening reactions, including anaphylactic shock.

In previous research, his team found that special types of white blood cells called

dendritic cells are important in helping the immune system decide how to respond to foreign molecules. In the latest research, the team compared the activity of dendritic cells in the gut and in the spleen of allergic and allergy-

resistant mice, and found that in the gut of susceptible mice dendritic cells have stopped producing IL-12.

"We have identified a molecule that is very important for the regulation of immune response and for the first time clearly represents a potential target for

the therapy of allergy. This is currently under investigation", said Prof. Nicoletti.

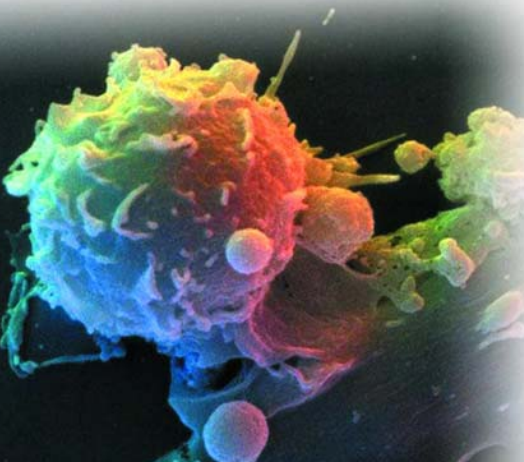
Contact: Claudio Nicoletti

Further reading: Temblay, J. N., Bertelli, E., Arques, J. L., Regoli, M. & Nicoletti, C. (2007) Production of IL-12 by Peyer's patch-dendritic cells is critical for the resistance to food allergy. *Journal of Allergy & Clinical Immunology* *in press*

Funding: Biotechnology & Biological Sciences Research Council and intramural funds of the University of Siena



Professor Claudio Nicoletti



IFR scientists are key players in NovelQ, a €10.9 million FP6 Integrated Project launched in 2006, which brings together 30 partners and a 40-member Industry Advisory Platform of leading multinationals and SMEs to formulate strategic solutions for technical and basic research hurdles in order to develop and successfully demonstrate novel processing schemes for plant-based foods.

The anticipated benefits include extending shelf life responding to the demands of consumers for foods with fresh characteristics and which contribute to individual health and wellbeing and optimising eco-friendly innovative processing.

IFR researchers are contributing to a number of NovelQ targets

- Impact of novel processing on microbiological safety (Tim Brocklehurst)
- Affect of novel processing on allergens (Alan Mackie)
- Influence of novel processing on texture (Keith Waldron)
- Optimisation of the environmental efficiency of novel processing (Keith Waldron)
- Training and career development (Roger Fenwick/Siân Astley)



www.novelq.org

Novel Processing methods for the production and distribution of high quality and safe foods

Impact of novel processing on microbiological safety

We aim to understand and exploit the mechanisms occurring during inactivation of bacterial spores by combined high pressure and high temperature (HPT) technologies, and during damage and inactivation of vegetative cells by Pulsed Electric Field and Cold Gas Plasma (CGP). HPT technologies are aimed at sterilisation of foods, so will use pressures between 200 and 1000 MPa at temperatures between 20° and 80°C. PEF and CGP technologies are aimed at pasteurisation processing. Mechanisms of damage and inactivation will be supported by reference to the DNA microarray technology recently developed at IFR, enabling interrogation of the genome of *Clostridium botulinum*, *Clostridium sporogenes* and *Salmonella enterica*.

Impact of novel processing on allergy

We are investigating the effect of high pressure, heat and PEF processing on the peanut allergen ara h2 (2S albumin), and the two main allergens in apple; mal d1 the major apple allergen in Northern Europe, which is cross-reactive with birch pollen and mal d3, which is responsible for most of the apple allergy in Southern Europe. In the case of peanut allergen, gel filtration studies have shown aggregation to occur between 90-100°C and to be unaffected by application of 800 MPa pressure at room

temperature; significantly the application of pressure at 80°C does cause changes in secondary structure, which may have implications for the immunological activity of the protein.

Influence of novel processing on texture

We are involved in studies into the effect of processing on the role of exogenous enzymes to maintain or improve the texture of tomatoes. In initial studies, unripe and ripe tomatoes, in which polygalacturonase activity is absent and present, respectively, have been subjected to high pressure treatment and the effects on water distribution and cell disruption/separation examined by NMR and optical microscopy.

Optimising the environmental efficiency of novel processing

Working with SIK, Sweden, we aim to minimise and upgrade waste streams from novel tomato processing technologies and identify solutions that minimise water and energy usage. The team is also involved in assessing and comparing the environmental impacts of novel processing and conventional processing systems, and in identifying opportunities to utilise products in tomato waste.

Training and career development

38 young members of NovelQ are in a Training and Career Development Network offering wide-ranging training activities appropriate to the needs of the European Research Area; promoting the challenge and excitement of European S&T to young people through involvement with the local Teacher ScientistNetwork, www.tsn.org.uk; enhancing communication and contacts between the academic and industry sectors.

Senior members of the project are involved in the European Technology Platform Food for Life, www.ciaa.be, and their activities have contributed to the higher profile of food processing in FP7 (2007-2013) than was the case in FP6.

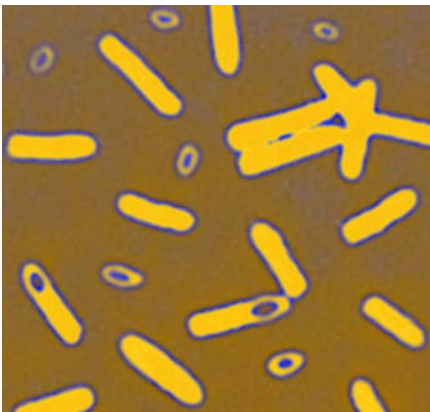
Contact: Tim Brocklehurst



Cold gas plasma processing

Botulism bug has few genome wrinkles

The genome sequence of *Clostridium botulinum* has been unravelled, revealing how the world's deadliest toxin stops nerves from working – the basis of its use in medicine to control tremors and in cosmetic treatments.



False-colour rendering of *Clostridium botulinum*. Spores are the oval-shaped bodies. Image supplied by CDC/Dr George Lombard (<http://phil.cdc.gov/>)

C. botulinum normally lives either as a dormant spore or as a scavenger of decaying material in the soil. Occasionally it grows and forms neurotoxin in food, with consumption of as little as 30ng of pre-formed neurotoxin sufficient to lead to foodborne botulism. *C. botulinum* can also cause an infection by getting into a living animal via contaminated food or an open wound. Botulism is a serious and sometimes fatal disease. There are several groups of *C. botulinum*; although described as variants of a single species, they are really very different organisms linked simply because they produce the deadly toxin. For each type, there is also a near-identical but harmless relative that lacks the toxin. *C. sporogenes* is the non-neurotoxic, near twin of the organism sequenced.

Collaborative work to sequence the genome, involving Mike Peck's team at IFR, has shown that although in the same genera as *Clostridium difficile* – the Cdiff superbug – *C. botulinum* is remarkable because its genome is so stable. Unlike Cdiff, in which many of the genes have been recently acquired from other bacteria, there is almost no footprint of this in *C. botulinum*. Mike Peck comments that "It is astonishing that 43% of the predicted genes in the *C. botulinum* genome are absent from the other five sequenced clostridia, and only 16% of the *C. botulinum* genes are common to all five clostridia. Our findings emphasise just how different

clostridia are from each other." This remarkable, stable genome demonstrates the wide range of strategies used by bacteria to enhance their chances of survival. For the clostridia, these range from the approach used by *C. difficile* – long-term interaction with hosts, which involves evading the immune system, acquiring DNA, and countering antibiotics – to the single-minded opportunistic approach of *C. botulinum*.

More than 110 of its set of almost 3700 genes are used to control spore formation and germination when the opportunity arises. The genome contains many genes that encode for enzymes to digest proteins and other material in the soil. Also found, for the first time in a sequenced clostridia, is a series of genes that allow it to digest the many insects and other small creatures that live in the soil. The 'chitinases' encoded for by these genes can degrade the casing of insects and small crustaceans.

Contact: Mike Peck

Further reading: Sebahia M *et al.* (2007) Genome sequence of a proteolytic (Group I) *Clostridium botulinum* strain Hall A and comparative analysis of the clostridial genomes. *Genome Research* **17** 1082-1092

Participating Centres: Wellcome Trust Sanger Institute, Cambridge; IFR; University of Nottingham; Heriot-Watt University, Edinburgh; Bureau of Microbial Hazards, Health Canada

Funding: Wellcome Trust, BBSRC Core Strategic Grant, CRTI-IRTC Operating Grant



Innovation grant for Coressence and IFR

DTI Innovation Grants are awarded on the basis of competitions in specific technology priority areas that are considered of critical importance to the UK economy.

Coressence is developing ingredients for the functional foods industry, which contain health giving nutrients from its own specially selected fruit varieties, and has been working with the IFR since 2004. The project will see the systematic testing and commercial development of fruit phytonutrients. Building on previous work, the project will focus on the identification of new fruit varieties containing high concentrations of polyphenols, now known to provide cardiovascular, digestive health and cognitive health benefits.

Coressence will also supply selected fruits to IFR scientist Paul Kroon, which will be used in human intervention trials in the EU-funded FLAVO project. Additionally, the company is providing industrial funding for a BBSRC CASE Studentship starting in October 2007.

Nitrogen testing to help authenticate organic crops

Organically grown crops tend to be more expensive than their conventionally grown counterparts. Higher prices obtained by producers, wholesalers, and retailers for organic commodities provide an economic incentive for the unscrupulous to mislabel and pass off conventionally grown produce as organic.



The UK's Food Standards Agency has been funding research to compare the nitrogen isotope profile of produce grown organically and conventionally. Synthetic nitrogen fertilisers can leave a characteristic 'nitrogen signature' that can be detected by mass spectrometry.

But IFR's Simon Kelly comments that the signature depends on the crop.

"The nitrogen isotope profiles of carrots grown organically are similar to those of carrots grown conventionally. This may be because carrots have a lower nitrogen requirement. Field growth, rather than

growth in a protected environment, also exposes the carrots to many other variables, such as climate and soil type."

Conventionally grown tomatoes are often grown hydroponically, and receive a constant stream of synthetic nitrogen fertiliser. They are protected from the influences of other nitrogen sources and

have a very different nitrogen isotope profile to organically grown tomatoes.

Additional funding is required to develop the test to improve the reliability across a range of crops including the addition of other elements, which are indicative of conventional and organic agriculture. When the test has been made more reliable, we may get to the stage where it can be used routinely in addition to the organic certification system. The researchers have pointed out that fertilisers were only one small aspect of organic farming and a nitrogen signature cannot unequivocally rule on 'organic' or 'non-organic'.

Contact: Simon Kelly

Further reading: Bateman, A. S., Kelly, S. D. & Woolfe, M. (2007) Nitrogen isotope composition of organically and conventionally grown crops. *Journal of Agricultural & Food Chemistry* **55** 2664-2670

Bateman, A. S., Kelly, S. D. & Jickells, T. D. (2005) Nitrogen isotope relationships between crops and fertilizer: implications for using Nitrogen isotope analysis as an indicator of agricultural regime. *Journal of Agricultural & Food Chemistry* **53** 5760-5765

Collaboration: University of East Anglia and Food Standards Agency

Food Health
& Network

Clusters

An Allergy Cluster Meeting on **Standardisation of allergen analysis and approaches to allergen management**

will be held on Tuesday 24 July at MRC Headquarters, London.

NEW for 2007 - Conferences

Come and join us in London or Leeds to hear from IFR scientists on: **101 Reasons why Salmonella & Campylobacter genomics are important for the food industry**

9 October **Keyworth Centre, London**

6 November **Royal Armouries, Leeds**

Conferences are open to FHN Members (£50 + VAT)
Non-Members alike (£150 + VAT)
and will take place from 2-5pm.

To reserve your place at an FHN event, please visit the FHN website and complete the electronic registration form or contact **Lesley Swift**.

British Bioalcohols Group launched

BBG aims to exploit agri-food-chain biomass such as wheat or oilseed rape straw for the production of second generation bioalcohols. Using waste or co-product materials maximises bioalcohol production whilst minimising competition with the food industry.

It provides research in support of the new low carbon fuel industry and seeks to help make the UK a leader in low-carbon transport. The BBG is a multidisciplinary collaboration between scientists from the University of East Anglia, IFR and John Innes Centre. The group works closely with the Norwich Research Park-based company, Renewables East, which fosters commercial development of low-carbon technologies.

The group has experts in enzyme and microbial technologies, biochemistry, fermentation, bio-materials, plant genomics and breeding, biofuel technologies and life cycle analysis required for second generation biofuel development.

www.britishbioalcoholsgroup.nrp.org.uk



Enzymes in Grain Processing

esEGP, launched in 1996, provides a forum for researchers and technologists across academia and industry to facilitate the exchange of ideas and shape future directions for the use of enzymes in grain processing. The 2008 Symposium (31 March - 2 April <http://www.ifr.ac.uk/esEGP5/>) is being organised by IFR, in Norwich, with a focus on the use of enzymes in traditional (baking, brewing) and emerging (functional foods, biofuels) grain technologies, the use of "-omics" technologies, and the development and regulation of novel enzymatic biotoolsto process grains. Sponsorship opportunities are available – to find out more contact Craig Faulds and Nathalie Juge or the conference secretariat at e-mail esegp5@bbsrc.ac.uk.

Preventive Medicine Taste of Science

At Spring Fling in Norfolk, an annual schools event, over 3000 children had the chance to explore the theme of "taste". IFR scientists explained the difference between taste and flavour and how smell



Dave Hart – facepaint
by Gerry Toole

was related to taste, and volunteers from the John Innes Centre tested people's sense of smell by asking them to recognise ten everyday aromas and match them to the plant they came from.

Sense about Science

IFR recently co-sponsored the 2nd annual 'Sense about Science' lecture given in London by Raymond Tallis FMedSci, Emeritus Professor of Geriatric Medicine at University of Manchester on 'Longer, healthier, happier? Human needs, human values and science'.



sense about science

Intra-European Fellowships

Antonio Dumont has joined IFR for two years to research the development of recombinant lactic acid bacteria for the treatment of food allergy, targeting intestinal dendritic cells.

An allergic reaction occurs when the body's immune system overreacts to a particular allergen. Cytokine IL-12



Antonio Dumont

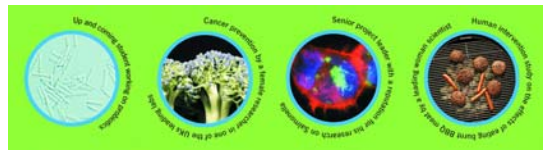
has the potential to beneficially modulate the immune response but, although it can be administered systemically, this route has toxic effects in human and animals. If we can express and deliver bioactive cytokine IL-12 to the gut mucosa, we hope to produce smart probiotics that can be given orally without the toxic side effects.

Federica Lodi returns to IFR this summer, funded initially by a British Council grant, then for a further two years via Marie Curie funding. She will be working with David Hughes assessing the role of quercetin metabolites in improving vascular health.

New funding

Pete Wilde has received a grant from EPSRC 'Controlling the rheology and flow of food emulsions'.

Science Funding – You Decide



As part of IFR's Outreach programme, a public audience was recently invited to vote for the science they would fund. At a venue in Norwich called 'The Garage', and hosted by BBC Radio 4 presenter Anna Hill, four Institute of Food Research scientists ran the gauntlet after a presentation by Dr Mary Anderson (Head of Contracts) explaining how science funding works in the UK. Prof. Jay Hinton, Caroline Furniss, Jeff Temblay and Dr Liz Lund each had 10 minutes to convince the audience to vote for their research proposal. Jay spoke about a previously unsuccessful grant proposal on *Salmonella*, supported by Edwina Currie. Caroline, supported by Dr Ian Gibson MP, talked about a funded research project investigating the anti-cancer properties of broccoli. Jeff (a third year PhD student) also presented a previously funded proposal looking at the effect of probiotics on the incidence of asthma, supported by Norfolk & Norwich University Hospital Consultant, Andrew Wilson. Finally, Dr Liz Lund invented a proposal on the effects of eating undercooked or overcooked meat, endorsed by Norfolk celebrity chef, Galton Blackiston.



Jeff Temblay

The voiceover endorsements were pre-recorded, and then played as part of the presentations.

Jeff Temblay won, securing 51% of the votes cast.

IFR scientists Jack Dainty and Dr Gene Rowe are currently analysing the results of the questionnaires, which asked the audience why they voted the way they did.

Recognition



Clare Mills has been promoted to Band 3 (Personal Merit Promotion) with effect from 1 July 2007. Promotions to Band 3 are as a result of application to BBSRC and have a rigorous process involving exclusively external assessors of international standing. The letter from BBSRC paid tribute to the outstanding work and leadership that Clare has shown in the Institute and beyond.

Ian Johnson has received the JK Puri Memorial Lifetime Achievement Award for his work on glucosinolates and isothiocyanates, at the 12th International Rapeseed Congress in Wuhan, China. During the 1980s, Ian Johnson and Roger Fenwick launched a substantial programme of research on phytochemicals at IFR. In 2004, Ian's team published work that showed that allyl isothiocyanate, the compound responsible for giving mustard and horseradish its bitter taste, could kill cancerous cells in a way similar to some anti-cancer drugs.



Colin Hanfrey recently chaired a US Gordon Research Conference Graduate Research Seminar on Polyamines.

David White recently chaired 'Nutrients in our Food' at the University of Cambridge's 'Horizon' conference on 'Foodomics'.



Our Mission is

- To undertake international quality scientific research relevant to food and human health
- To work in partnership with others to provide underpinning science for consumers, policy makers, the food industry and academia

Updating our Contacts

- Please let us know if your address is incorrect, or if you would like to receive Science+Innovation by e-mail in future (contact details right)

Data Protection

- Copyright & Data Protection www.ifr.ac.uk/copyright.html

Contact Us

- Communications Team, Norwich BioSciences Institutes Colney, Norwich NR4 7UA
Tel: +44 (0)1603 255328
Fax: +44 (0)1603 255168

- Media Enquiries: Zoe Dunford (Media Manager)
Tel +44 (0) 1603 255111
Andrew Chapple (Assistant Press Officer)
Tel +44 (0) 1603 251490
- General Enquiries to the Communications Team
email ifr.communications@bbsrc.ac.uk
- E-mail addresses
forename.surname@bbsrc.ac.uk