



Queen's University
Belfast

Institute for Global
Food Security

We are exceptional

WELCOME

As the Institute continues to grow and develop we have a number of key events taking place between now and the end of the year. The official launch of the 'Food Fortress' initiative will take place at Queen's University. This is an industry led initiative, heavily supported by the Institute to develop the world's best system to manage risks associated with contamination of the agri-food supply chain. Institute staff are also organising two important conferences. The first is on the important role of antibiotics in agriculture and the impact this has on microbial resistance. The second is on the topic of climate change and the impact this has already had and will have in the future in relation to food safety on the Island of Ireland - Professor Chris Elliott



IGFS secures Grand Challenges Explorations (GCE) funds



Dr Johnathan Dalzell (left) and Dr Paul McVeigh named as Grand Challenges Explorations winners, an initiative founded by the Bill & Melinda Gates Foundation

IGFS has been awarded grants to pursue two Innovative global health and development research projects aimed at tackling tropical diseases.

Dr Paul McVeigh's project aims to develop new ways to diagnose Lymphatic Filariasis, a tropical disease affecting more than 120 million people in 73 developing countries. The condition is caused by a parasitic worm and is usually transmitted through the bite of an infected mosquito. The worms live in the body's lymphatic system, leading to severe disfigurement of the limbs,

chronic pain and disability. Very little research has been carried out into the condition and current diagnostic tests are limited and often involve a painful method of collecting samples from patients. Dr McVeigh's team will use the \$100,000 awarded by the Bill & Melinda Gates Foundation to investigate the usefulness of MicroRNAs – molecules found in blood, saliva, urine and breastmilk – as indicators of the presence of the infection. This has the potential to lead to the development of faster, more reliable, non-invasive diagnostic tests.

Dr Johnathan Dalzell will lead a \$100,000 project to develop food crops containing drugs to treat neglected tropical diseases such as elephantiasis and trypanosomiasis. When humans eat the crop, the drug will circulate in their blood and be passed to blood-borne parasites and blood-feeding insects like mosquitoes, killing them and helping control the diseases that they spread, such as malaria and the many tick-borne diseases that can have a devastating impact on people and livestock. As well as generating an entirely new way of simultaneously treating tropical diseases and the insects that carry them, this approach would also lead to huge financial savings in terms of drug discovery costs, and the storage and delivery of medicines on a global scale.

Commenting on the award, Professor Chris Elliott said "The food borne and tropical diseases that our Grand Challenges Explorations winners are researching affect millions of people across the developing world. By tackling these diseases, and the scourge of parasites, we can have a real impact on the lives of some of the world's poorest and most vulnerable people."

Professor John Dalton joins the Institute for Global Food Security

Professor John P. Dalton will be joining the Institute for Global Food Security this summer.

John is Professor of Infectious Diseases at the Institute and recently joined from McGill University, Canada where he is a Tier 1 Canada Research Chair in Infectious Diseases.

Before McGill, Dalton was Director of the Institute for the Biotechnology of Infectious Diseases (IBID), University of Technology Sydney (UTS), Australia. He was awarded the New South Wales Government BioFirst Award in Biotechnology between 2003-2008 for his work on molecular vaccines.

His interests include the development of vaccines against parasites that can cause serious disease in agricultural animals (cattle and sheep), for example, liver fluke disease. He has exploited techniques in genomics, gene transcription and proteomics to elucidate the interaction between the parasite and its animal host immune system to identify targets at which protective vaccines can be directed.

Professor Dalton is specialist editor for



Professor John Dalton pictured with his Ph.D. postgraduate student, Rency Mathew

the International Journal of Parasitology, International Editor for Parasite Immunology and an Associate Editor for PlosNTD.

John's Ph.D. postgraduate student, Rency Mathew, who works on the biochemistry of proteolytic enzymes of malaria (plasmodium species) with a view to understanding their function in the

parasite's cell, will soon follow him.

Rency and John have a major programme on the discovery of compounds that inhibit these enzymes and have anti-malarial activity. This program will be expanded at Queen's University Belfast to include protozoan parasites of cattle e.g. babesia.

IGFS postgraduate students selected to attend IPARAF course in Nantes

Postgraduate students Ruth Kinead and Daniel McDowell had the opportunity recently to attend the Intensive Programme for Advanced Residue Analysis in Food (IPARAF) based in LABERCA (ONIRIS), Nantes, France. LABERCA is part of the National College of veterinary Medicine, Food Science

and Engineering with over 50 members of staff carrying out research in chemical food safety, and is a leading EU national reference laboratory testing for dioxins PCBs, PAH, melamine as well as growth promoters in cattle. The main aim of the IPARAF course is to demonstrate analytical approaches to food safety through practical application and data interpretation, as well as risk assessment and legislative considerations. Efficient teaching and demonstrations provided advanced insights into the assessment of residues and contaminants from every level of the food process. This included, sample preparative techniques; screening and confirmatory detection involving immunoassays, gas and liquid chromatography coupled to mass spectrometers; the regulation and quality assurance of data; in addition to group investigative work undertaken for risk analysis reporting of existing controversial food safety issues. The IPARAF course is funded by the European Commission DG-Trade in collaboration with five partner institutions, to impart their expertise and knowledge to

students of various international backgrounds and experience. Ruth is currently in the first year of her Ph.D. researching untargeted methods for detection of growth promoter substances in bovine plasma samples, so was able to gain experience in the utilisation of metabolomics via advanced mass spectrometry technology with input from leading EU experts in this field. Daniel is researching food fraud and edible oils, specifically the local product of cold-pressed rapeseed oil. The chromatographic aspects of the course were of particular interest to Daniel as his oils will be analysed with both liquid and gas chromatography and as he is also in the first year of his Ph.D. project, found the IPARAF course vital to expand his understanding of food science techniques. Not only did the course provide knowledge and practice, but it also offered the unique opportunity to meet with other researchers in a European wide network, sharing experience and skills, plus of course sample some delightful French cuisine.



Ruth Kinead (first on the left) and Daniel McDowell attending IPARAF in Nantes

Phosphorus: the pollutant we can't live without

Resource security is a key issue for the Northern Ireland economy. For example domestic and industrial effluent or agri-food by-products can no longer be simplistically categorised as waste but must be considered as valuable resources that can be converted into high-value bio-products. One research focus within the Institute for Global Food Security looks at how such wastes can be metabolised by microorganisms to generate valuable end products e.g. energy (methane), nutrients (phosphate, nitrogen), clean water, high value chemicals and eco-friendly materials.

Nutrients such as nitrogen and phosphorus are key components of the the global food web being absolutely essential for crop and animal production. As mineral fertiliser consumption mirrors global population growth, a continual supply of these nutrients is essential to sustain food demand and ensure global food security over the 21st century.

Phosphorus-containing rock is the only natural – and commercial – source of phosphorus. Yet these global phosphorus reserves are limited and, while timelines for 'peak phosphorus' are contentious, the phosphorus rock which remains is of undoubtedly lower grade and more difficult to access – thereby increasing processing costs. This is further exacerbated by the expected 40-50% increase in synthetic fertilizer usage over the next 50 years required to feed the increasing global population. The security of phosphorus supply to the EU is a key issue given the geopolitical situation in many phosphorus rich countries and the lack of appreciable phosphorus rock reserves in Europe. Decreasing rock quality, dwindling

resources and security of supply are all reflected in the escalating price of phosphorus which has increased by over 200% in the last decade.

An unfortunate corollary of agricultural intensification and enhanced usage of mineral fertilisers has been the increase in environmental problems associated with the disposal of phosphorus-rich wastes, which causes eutrophication in freshwaters. This leads to increased water purification costs, a decline in the recreational value of water systems, and loss of livestock and human health issues through algal blooms. Freshwater eutrophication represents one of the biggest water management issues and the most important single threat to clean water internationally. Locally, for example, Lough Neagh, which supplies approximately 40% of potable water to Northern Irish households, is eutrophication sensitive: research aimed at understanding phosphorus turnover in the Lough and its sediment is therefore a priority.

To ameliorate phosphorus discharge to freshwater the European Urban Wastewater Treatment Directive (UWTD) requires phosphorus to be removed from sewage. Implementation of this Directive, from a water company's perspective, results in the production of a phosphorus-rich waste and elevated disposal costs. However for those industries which utilise phosphorus as a raw material these sludges could potentially be a valuable resource and account for a significant 'in-house' European phosphorus reserve. A recent Canadian study concluded that 30% of the country's phosphorus needs could be met through recovery of phosphorus from waste. Recycling of phosphorus-rich

sludge, rather than the exploitation of new resources, could therefore supply a significant proportion of industry's annual phosphorus requirement.

Research within IGFS and the QUESTOR Centre has focused on identifying microorganisms that capture and store high levels of phosphate. A variety of microbes in wastewater accumulate intracellular phosphorus and store it as a biopolymer known as polyphosphate thereby removing the phosphorus pollutant and simultaneously capturing it in a high value form suitable for recycling. By understanding how this process is stimulated the Centre is developing a feasible biotechnological route to remove and recycle phosphate from wastewater. Similarly other microbial approaches are being developed to transform and maximise resource recovery from Northern Irish wastes to produce other high value end-products. Ultimately such research will decrease our reliance on the continual importation of increasingly expensive raw materials thereby, at least partly, securing our future resource needs.

IGFS academic coordinates ARUK Network Centre

From September 2013 Dr Brian Green will take on the role of Network Coordinator for Alzheimer's Research UK's Northern Ireland Network Centre – which is one of only 15 centres of dementia research excellence.

Alzheimer's Research UK (ARUK) is the UK's leading dementia research charity and their dementia research network includes over 700 scientists working on clinical and non-clinical research areas. Drs Green and Graham have twice received grant funding from ARUK to profile how the human 'metabolome' is changed by the onset of Alzheimer's disease.

Their work is uncovering new biochemical markers of disease and describing alterations in the levels of important nutrients. The team have also received Proof of Concept funding from Invest NI to investigate the development of new diagnostic tools for Alzheimer's disease.



Author of the article Dr John McGrath (centre) pictured with the two Ph.D. students, Jason Chin (left) and Darragh Hobbs (right), currently working with him on phosphorus cycling.

Microbial weeds: the biology of habitat dominance

A small minority of microbial species which behave in an ecologically aggressive manner consistently emerge, during the development of microbial communities, to dominate their respective habitats. We have studied these remarkable species throughout the past 20 years and believe that they share key characteristics with species known in the field of botany as plant weeds. We investigated the phenotypic traits and biochemical characteristics which give rise to habitat dominance by microbial 'weed' species which are key players in the production of fermented foods (e.g. *Aspergillus* spp., *Pichia anomola*, *Saccharomyces cerevisiae*, *Lactobacillus* spp.) and are also responsible for the majority of food-spoilage events. Substrates or niches (including foodstuffs) which enable the emergence of microbial weed species are essentially open habitats which are characterized by specific properties: they are open to population by diverse microbial species, promote intense competition, select for microbes able to outgrow competitors, usually lack high stressor or toxicant concentrations, and have the potential to

support the development of a substantial community/ microbial biomass. Microbial weeds may impact global food security at multiple levels, for instance some species are responsible for toxic blooms in aquatic environments (e.g. *Gonyostomum* semen and *Microcystis aeruginosa*); others can act as potent agents for biological control of pests or diseases and/or preventing food spoilage (e.g. *P. anomola*, *Rhodotorula* spp., *S. cerevisiae*, *Pseudomonas* spp., various lactic acid bacteria); and some weed species are key players in the decomposition of organic waste. Microbial weeds can utilize the chaotropicity of substances in order to inhibit or eliminate potential competitors by producing mildly chaotropic solutes in bulk (e.g. ethanol, acetone), potent chaotropes in low quantities such as ethyl acetate, 2-phenylethanol, and/or hydrophobic inhibitors that have a chaotropicity-mediated mode-of-action such as ethyl octanoate, isoamyl acetate (indeed it is these antimicrobials that typically provide fermented foods with their characteristic flavour profile). Amongst other key traits of microbial weed species are robust tolerances to

habitat-relevant stress parameters; highly efficient energy-generation systems; avoidance of or resistance to viral infection, predators and grazers; and exceptional abilities to sequester and store resources. We believe that microbial weeds represent a fraction of one percent of microbial diversity on Earth, and yet microbial biotechnology (including the production of foods and drinks) is largely based on this minute number of species. Greater familiarity with microbial-weed biology and open-habitat ecology can enable knowledge-based interventions in and manipulations of microbial systems for an indefinite number of agri-food applications.

An article by Dr John E. Hallsworth

Reference

Cray, J.A., Bell, A.N.W., Bhaganna, P., Mswaka, A.Y., Timson, D.J., Hallsworth, J.E. (September 2013) The biology of habitat dominance; can microbes behave as weeds? *Microbial Biotechnology* 6 (5):453-492.

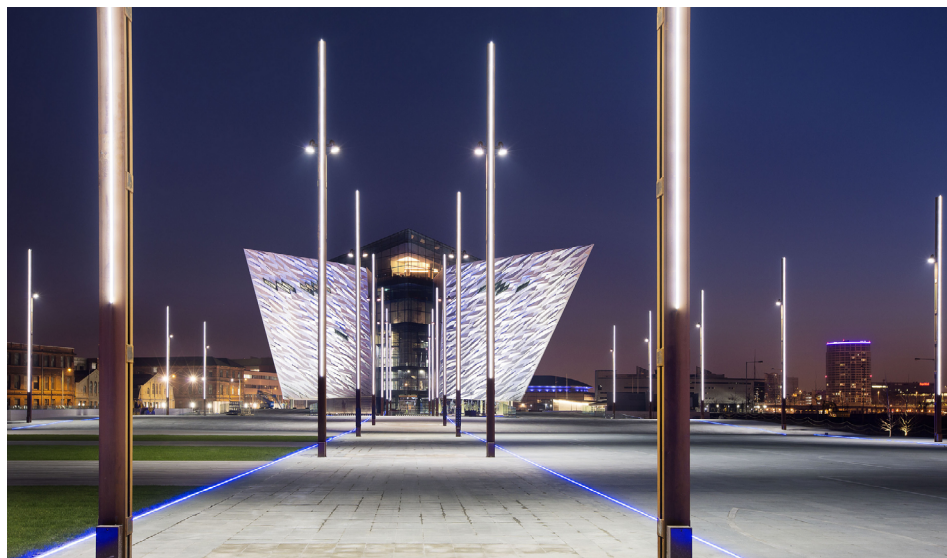
2nd Food Integrity and Traceability Conference (ASSET2014)

Preparations are well underway for the largest food conference taking place on the island of Ireland in 2014. Registration is now open for the 2nd Food Integrity and Traceability Conference (ASSET2014) and the Call for Submissions has been published. Delegates wishing to present an oral or poster abstract have until the

6th December to submit their abstract for consideration. Students making an oral presentation will be assessed by a panel of world renowned experts with prizes awarded for the best oral and poster presentations. Students will benefit from a reduced registration fee of £75 as well as affordable accommodation at

Stranmillis College. A major part of this conference will be an interactive debate on the on the issues pertaining to the introduction of GM feeds, crops and foods into Europe. Experts will speak for and against the motion that 'GM crops are a safe and important means of improving food security in Europe'. A range of internationally renowned guest speakers have been secured and the conference will provide an opportunity to meet fellow academics as well as decision makers and representatives from industry.

Good Food NI will be working with the Organising Committee to attract local innovative producers to a special market taking place on the front lawn of QUB. The market will be open to all QUB staff and students as well as members of the public. The conference is taking place from the 8th - 10th April 2014, for more information regarding the conference or to register your attendance please visit our website: www.qub.ac.uk/asset2014



Titanic Belfast will serve as the venue for the conference dinner. The dinner will showcase the best of local produce.

Student and Staff News

The Institute for Global Food Security congratulates all students that graduated this summer (July 2013). It is delighted to acknowledge the success of our Ph.D students, Dr Anthony O’Kane, Dr Herbert Chan and in particular, Dr Ratthaphol Charlermroj. Dr Ratthaphol Charlermroj, or ‘Fluke’ to his friends, is the first Thai student to graduate from the Institute.

The Institute would also like commend our prize-winning students on their achievements. We also look forward to welcoming our new students in September.

Dr Paul N. Williams has joined IGFS as a Lecturer in Soil & Environmental Biogeochemistry. Paul obtained his Ph.D. degree in Biological Sciences from the University of Aberdeen in 2007.

Previous to working at Queen’s he has held Research Fellowships with the Chinese Academy of Sciences, Lancaster University and a Lectureship with the University of Nottingham.

Paul, an analytical and environmental chemist, has research interests orientated around the role of soils and rhizospheres in global food security. Specific interests and projects focus on the influence of soil dynamic processes and chemical speciation on trace element (both toxic and essential) uptake by plants, visualising rhizosphere micro-heterogeneity through high resolution measurements using DGT and DET techniques, and bettering in situ monitoring of the environment.

Techniques and methods that Paul uses include multi-element chromatography (IC-ICP-MS), laser-based analytical measurement (LA-ICP-MS), passive sampling (DGT, DET), optical sensors (colour ratiometric planar optodes), in-situ UV/vis spectrometry and XRF analysis.



Dr Ratthaphol Charlermroj pictured with Marie Curie Fellow Dr Nitsara Karoonuthaisiri Dr Anthony O’Kane and Dr Herbert Chan

Dr Cuong Cao has joined IGFS as a Lecturer in Food Safety Modelling. Cuong obtained his Ph.D degree in Chemical Engineering from Sungkyunkwan University in 2008.

Previous to working at Queen’s, he was employed as a Research Fellow at Technical University of Denmark and Technological University of Singapore.

He has a special interest in development of biosensors for medical diagnosis and food safety analysis. Some of his recent studies include fabrication, tailoring plasmonic response and implementation of emerging metamaterials for localized surface plasmon resonance (LSPR) and surface enhanced Raman scattering (SERS)-based biosensing.

At Queen’s, his research focus is to develop novel biosensing platforms and point-of-care microdevices that enable label-free, real-time, sensitive, specific, and rapid detection of infectious diseases, food and environmental toxins.

Dr Johnathan Dalzell will be attending a Gates Foundation Networking event in Nairobi at the end of August where he will be meeting with collaborators from Kenya and Tanzania to deal with the logistics of field trials for transformed Cassava secreting neuropeptides. Cassava is a major staple food crop of sub-saharan Africa and the wider developing world, providing a basic diet for over half a billion people.

Maeve Palmer will be joining Dr Niamh O’Connell in September to work on the FP7 project “ECO-FCE”.

Maeve will take up a 2 year post doctoral position to investigate links between production traits such as feed efficiency and leg health in pigs and poultry. Maeve graduated from the University of Edinburgh with a first class degree in Zoology and then with an MSc in Applied Animal Behaviour and Welfare. She went on to take up a scientific post at the Agri-Food and Biosciences Institute and has been heavily involved in farm animal health and welfare research there. She has conducted a part-time Ph.D through Queens, investigating links between factors such as skin permeability and susceptibility to digital dermatitis in dairy cows.

Follow us:



Institute for Global
Food Security



IGFS_Official