

Special Edition:  
Advanced Analytical Methodologies

Food  
Programme



# Portfolio

Technology for the Food Industry





Welcome to this special edition of our Portfolio of Technologies focusing on the breadth and depth of Teagasc's analytical platforms for the food industry. This volume highlights the capability and capacity of our approaches to food analysis.

Ireland's food industry excels in international markets by having robust standards in food quality and safety. The sector needs to be supported by excellent science in disciplines such as food chemistry, microbiology, imaging, metabolomics, genomics and advanced spectral methods. This portfolio details the role of Teagasc in developing cutting-edge and state-of-the-art methodologies that allow our food industry to remain a resilient and robust sector.

The Portfolio is to be used as a starting point from which food and related companies can begin to engage with us through various innovation support channels.

Contact details of the key Teagasc specialists are given on each page. Feel free to engage with these personnel directly and/or contact our Technology Transfer Office staff at:

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A handwritten signature in cursive script that reads 'Declan Troy'.

**Declan J. Troy**

Assistant Director of Research and  
Head of Technology Transfer, Teagasc



# Portfolio

Technology for the Food Industry

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## Updates

Main findings from Teagasc food research projects focusing on the application of key analytical methodologies.

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## Expertise

Concise overviews of our high specification technical equipment and pilot plant facilities.

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## Services

Our main technical and specialist food services offered to the industry.

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## Offers

Summaries of available technology, owned or part-owned by Teagasc, that are currently open to potential users.

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## Profiles

Profiles of our staff detailing their expertise and highlighting the role they can play in providing solutions and/or opportunities for food companies.

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Updates



## Advanced Systems for the Rapid Detection of Anti-Parasitic Drugs in Food

### Key External Stakeholders

Dairy, beef and sheep farmers, primary meat and milk processors, regulatory agencies (DAFF, FSAI, IMB)

### Practical Implications for Stakeholders

Excellent progress has been made in the development of screening assays for drug residues in food. Immunochemical screening assays were developed in this project as a rapid low cost means of detecting benzimidazole residues in food, as an alternative to chemical assays. A number of assays were successfully validated. A biochip array assay was successfully developed to detect four different drug classes and shows good potential for application in specialist laboratories or at an industry level.

The milk industry is the only industry likely to apply this technology because they are the only industry that carries out monitoring at factory level. However, the scope of the assays needs to be extended to key flukicide residues (nitroxylnil, closantel, rafoxanide, clorsulon and triclabendazole) to meet industry demands if they are to be used.



With benzimidazole drugs widely used in the treatment of worm and fluke infections in food producing animals, these novel immunochemical assays are proposed as an alternative low cost means of detecting benzimidazole residues in food. These assays are applicable in specialised laboratories or at a factory level to prevent contaminated produce entering the food chain.

### Main Results

- Three working immunobiosensor assays were developed and validated to detect 17 benzimidazole residues in milk and meat.
- A novel multiplex immunoassay was developed for detecting benzimidazole and macrocyclic lactone residues in fruit juice.
- The new technologies developed were validated to meet EC 2002/657 criteria.
- These represent a rapid, low-cost, effective means of screening drug residues, and a viable alternative to chemical assays, applicable in specialised laboratories or at factory level.

### Opportunity/Benefit

Teagasc can be at the forefront of engaging with food producers relating to such low-cost screening techniques, through our extensive expertise in the field.

### Collaborating Institutions

Dublin City University

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**Project Number:** 5556

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**Funding Source:** DAFF (05/R&D/TN/355)

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**Date:** January, 2011

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**Project Dates:** Sep 2006 – Aug 2010

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## Anti-oxidant and Anti-Microbial Compounds from Dandelion Root, Fenugreek and Bitter Melon

### Key External Stakeholders

Vegetable processors, functional food manufacturers, government authorities/legislators, consumers, food research scientists

### Practical Implications for Stakeholders

- The bioactive constituents in dandelion root, fenugreek and bitter melon, offer promising leads as sources of natural alternatives to synthetic food additives/preservatives.
- In particular, the ethyl acetate extract of *T. officinale* (dandelion) root has demonstrated strong antioxidant and antimicrobial properties which may warrant further investigation in food matrices as a potential functional food ingredient.



### Main Results

- The ethyl acetate extracts (1mg/ml) of *Trigonella foenum-graecum* (fenugreek) seeds had the highest antioxidant activity (DPPH IC<sub>50</sub> = 212 µg/ml) but showed no anti-microbial activity.
- The ethyl acetate extract of *Momordica charantia* (bitter melon) exhibited antimicrobial activity against *S. aureus*, MRSA and *B. cereus* strains (MIC = 62.5 – 93.8 µg/ml) while the *n*-hexane extract and a methanol-hydrophilic dialysed extract of *M. charantia* fruit demonstrated the best antioxidant activity in comparison to all other extracts from this species (DPPH IC<sub>50</sub> = 575–648 µg/ml).
- Dandelion roots (*T. officinale*) contain 1,5-dicaffeoylquinic acid as a major antioxidant compound while its ethyl acetate extract demonstrated the strongest antimicrobial activity against *S. aureus*, MRSA and *B. cereus* strains (MIC = 250–500 µg/ml).
- A number of previously unreported compounds (4-Hydroxyphenylacetic acid derivatives of inositol) were isolated from dandelion root that could have useful biological properties not under investigation here.

### Opportunity/Benefit

Dandelion roots were shown to have substantial anti-oxidant and anti-microbial properties. The outcomes of the project demonstrated that these under-utilised plants, generally considered weeds, can be potentially exploited as natural food preservatives and for nutraceutical applications.

### Collaborating Institutions

University College Dublin

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**Project number:** 6038

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**Funding source:** Teagasc

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**Date:** November, 2015

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**Project dates:** Oct 2009 – Jan 2014

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## Antioxidant Status of Fully Processed Fruits, Vegetables and Their Products: Technology Optimisation to Minimise Losses

### Key External Stakeholders

Vegetable processors, government authorities/legislators, consumers, food research scientists

### Practical Implications for Stakeholders

Thermal and non-thermal processing effects on fruits and vegetables influence their antioxidant capacity.

The outcomes of the investigation are:

- Thermal processing such as *sous-vide* and post-processing storage decrease the antioxidant activity and concentration of antioxidant compound groups in fruits and vegetables.
- However the effect is not clear cut with some thermal and non thermal strategies resulting in an increase in antioxidant activity.



- In general post-processing storage at temperatures above 0°C resulted in a decrease in antioxidant levels.

### Main Results

- *Sous-vide* processing is a promising strategy for retaining the antioxidant capacity and colour of thermally processed carrot disks.
- High hydrostatic pressure processing at ambient temperature and pressures of 400–600 MPa is an excellent food processing technology which has the potential to retain antioxidant compounds in strawberry, blackberry, tomato and carrot puree while also ensuring the foods are effectively pasteurised.
- Blast freezing and storage at -18°C is a good technique for preserving ascorbic and antioxidant activity in broccoli and greens but not carrots, provided the samples had been blanched prior to freezing.

### Opportunity/Benefit

This project developed relatively novel processing techniques, *sous-vide* and high hydrostatic pressure processing, which are attractive options for end-users as they allow retention of antioxidants in fruits and vegetables and also aid in increasing the shelf-life of the products. Expressions of interest in this research are welcome.

### Collaborating Institutions

University of Limerick

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**Project number:** 5414

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**Funding source:** DAFF (04/R&D/UL/327)

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**Date:** March, 2012

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**Project Dates:** Jan 2005 – Sep 2010

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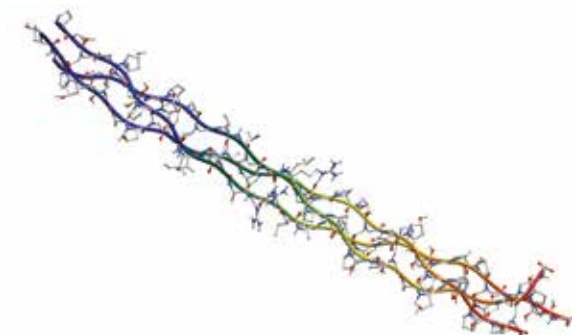
## Assessing Pig and Sheep Industry By-Products as Sources of Constituents of High Value Biomaterials

### Key Stakeholders

Meat sector, biomedical, cosmetics

### Practical Implications for Stakeholders

A dressed carcass is approximately 55% of a live animal weight resulting in 45% offal/viscera, blood, etc. While there are existing markets for some products e.g. offal many of these are low in value. Much of this material can be considered as a rich source of proteins, which have great potential for cosmetic, pharmaceutical and tissue engineering and regenerative medicine applications. This project will evaluate these meat processing streams and identify those with potential for extracting valuable proteins with regenerative medicine and pharmaceutical potential (e.g. collagens, glycosaminoglycans, proteoglycans). Sample handling and processing systems to extract out the valuable components will be



developed. The quality, purity and allergenic status of the proteins will be assessed. Industry players have expressed strong interest in this research strategy and hence this project will be carried in close communication/collaboration with industry.

### Main Results

This project will:

- Establish sample handling and processing protocols for the extraction of collagen, proteoglycans and glycosaminoglycans;
- Assessing protein quality/purity by SDS-PAGE, HPLC, amino acid analysis, western blots;
- Assess cytocompatibility by in vitro cultures with dermal and lung fibroblasts;
- Assess immune response by in vitro cultures with macrophages.

### Opportunity/Benefit

This proposal aims to address challenges facing exploitation of the opportunities presented to the meat sector, namely extracting functional components and assessing functional activity. A successful outcome to this project will provide the meat sector with clear knowledge about the best source materials for biomedical and cosmetic applications, in addition the expertise and ability to carry out this processing will be held in Ireland, which will also greatly enhance the Irish biomedical industry.

### Collaborating Institutions

Network of Excellence for Functional Biomaterials (NFB), NUI Galway.

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**Project Number:** 6577

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**Funding Source:** Teagasc WF

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**Date:** April 2014

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**Project Dates:** Oct 2014 – Sept 2018

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## Assessment of DNA Markers for Meat Quality Traits in Irish Beef and Pork

### Key External Stakeholders

Breeders, meat processors, diagnostics companies

### Practical Implications for Stakeholders

The outcomes of this project highlight the importance of investigating and understanding the molecular basis of quality traits for meat, with a view to optimisation of management systems for quality. These hold potential quality prediction tools for meat management systems and/or to provide a basis for the inclusion of meat quality in selection goals. This research validated some of the DNA markers tested in Irish crossbred cattle populations, and novel SNP markers associated with tenderness in Irish crossbred cattle identified.

- A number of candidate genes have been identified as potentially relevant to beef sensory and technological traits.
- DNA markers have been tested and were shown to be associated with quality parameters.

There is a need for tools to discriminate meat on the basis of quality and select sires for improved quality.

Variability in meat quality presents many problems for the industry and for consumer satisfaction. The underlying causes are multi-factorial in nature and are considered to include difference in the genetic profile (genotype) of the animal. Attributes of relevance to the consumer sensory experience include tenderness, colour, juiciness, flavour and texture; while those directly impacting on industry management systems include water holding capacity and colour.

Management systems to predict and optimise these attributes require clear understanding of the factors underpinning variability. Currently eating quality is a major deficiency in breeding programmes and this is reflected along the beef chain from processors to retailers, who have highlighted the necessity for tools to accurately predict quality, in particular tenderness. Water-holding capacity has additional importance due to its ability to influence processed product quality and the financial losses incurred when it is sub-optimal.

### Main Results

- Novel single nucleotide polymorphisms (SNPs) developed which are associated with tenderness (shear force on day 14 and sensory tenderness) and intra-muscular fat (flavour, juiciness) content.
- SNP in CAST, PRKAG3, GHR and SCD genes were associated with muscle colour and PRKAG3 was also shown to be associated with cook loss in beef.
- SNP in CAPN1 and ANK1 were confirmed to be associated with shear force (tenderness).
- A GHR polymorphism was associated with composition of muscle including moisture, intra-muscular fat and protein content in loin and rump muscles.
- Commercially available markers were tested (and subset validated) for association with Irish beef quality.

### Opportunity/Benefit

This research validates the genomic approach to meat quality and expansion of this research area is recommended. The further development of these and other markers for independent traits to create tools for prediction of quality would have a wide range of potential applications spanning animal production and meat management systems.

### Collaborating Institutions

University College Dublin

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**Project Number:** 5421

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**Funding Source:** DAFF (04/R&D/TN/258)

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**Date:** October, 2011

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**Project Dates:** Feb 2006 – Jul 2008

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## BASELINE: Risk Targets in Milk and Dairy Products

### Key External Stakeholders

Dairy industry, European Food Safety Authority (EFSA)

### Practical Implications for Stakeholders

The study focused on the risk posed by *Listeria monocytogenes* in raw and pasteurised milk cheese. The study showed that *L. monocytogenes* grew at a faster rate on pasteurised milk cheese compared to raw milk cheese during the storage period following ripening. A quantitative risk assessment model predicting the growth and survival of *Listeria monocytogenes* in raw and pasteurised milk cheese, from farm to fork showed that the mean level of exposure to *L. monocytogenes* in contaminated cheese was higher for raw milk cheese ( $2.22 \log_{10} \text{ cfu g}^{-1}$ ) compared to pasteurised milk cheese ( $<1 \log_{10} \text{ cfu g}^{-1}$ ). This model can support food processors to optimise conditions to reduce *L. monocytogenes* growth in cheese and to comply with EC2073/2005.

This research was carried out as part of a multi-national EU Framework project, *BASELINE* which focused on research to provide harmonised and validated sampling strategies, supporting European policies in food safety and suitable for food producers to collect comparable data, to improve quantitative risk analysis of selected biological and chemical agents.

Research by Teagasc in this project focused on the growth kinetics of *L. monocytogenes* in semisoft rind washed cheese prepared from raw and pasteurised milk, in the storage period following ripening. Additionally work focused on predicting the risk posed by the *Listeria monocytogenes* contamination arising from the farm environment as well as cross-contamination at processing and retail level, and subsequent human exposure, using a quantitative risk assessment modeling approach.

### Main Results

- *L. monocytogenes* grew at a slower rate on the raw milk cheese compared to the pasteurised milk cheese at all the storage temperatures investigated.
- The simulated quantitative risk assessment model showed that the mean level of exposure to *L. monocytogenes* in contaminated cheese was higher for raw milk cheese ( $2.22 \log_{10} \text{ cfu g}^{-1}$ ) compared to pasteurised milk cheese ( $<1 \log_{10} \text{ cfu g}^{-1}$ ).
- A model sensitivity analysis highlighted the critical factors for exposure to *L. monocytogenes* from both cheeses were the serving size of the cheese, storage days and temperature at distribution stage.
- The model showed that when the Performance Objective (PO) for *L. monocytogenes* in raw milk cheese was set at  $\leq 2 \log \text{ cfu g}^{-1}$  at retail level, nearly 10.34 % of product was predicted to exceed this PO limit, whereas the model predicted 100% of pasteurised milk cheese met the PO target.

### Opportunity/Benefit

The study showed that growth kinetic models can facilitate prediction of *L. monocytogenes* growth during shelf-life and will help to demonstrate compliance with food safety criteria (EC 2073/2005). Further, the quantitative risk assessment conducted based on a farm-to-fork approach also showed possible cross-contamination of raw milk at farm level and retail level.

Such model predictions, will allow food processors and policy makers to identify the possible routes of contamination in cheese processing and to reduce the risk posed to human health.

### Collaborating Institutions

18 international collaborators, for details contact Geraldine Duffy.

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**Project number:** 5994

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**Date:** Jan 2014

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**Funding source:** EU Seventh Framework Programme

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**Project dates:** June 2008 – November 2013

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## Beef and Dairy Farm Hazard Analysis and Critical Control Point (HACCP) with Particular Emphasis on *Salmonella* Control

### Key Stakeholders

Beef farmers, beef processors, scientists, regulatory personnel, EFSA

### Practical Implications for Stakeholders

The data generated in this research should be used to develop HACCP type systems to control the incidence and spread of pathogens on farms. This should include a control point (CP) to ensure water used for animals is clean and pathogen free. Routine monitoring of livestock including non-food animals for *Salmonella* and Verocytotoxigenic *Escherichia coli* is also recommended and the importance of ensuring those in contact with animals, especially children, wash their hands properly afterwards is highlighted.



### Main Results

- Water was identified as a source of *Salmonella* and cattle, deer and the farm dog were identified as vectors that may carry and/or spread VTEC around the farm and from farm to farm.
- *Salmonella enterica* Typhimurium DT193 was the predominant *Salmonella* serotype/phagetype detected. Although these isolates displayed a penta-resistant phenotype, this was not arranged in SG11.
- Both *Salmonella* and VTEC survived for extended periods (up to 102 days) in the farm environment.

### Opportunity/Benefit

This project provides data for risk analysis and the development of hazard analysis and critical control point (HACCP) type systems for farms, to minimize pathogen carriage in livestock. The results are available for any interested parties.

### Collaborating Institutions

University College Dublin

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**Project Number:** 5406

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**Funding Source:** US-Ireland Fund

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**Date:** June, 2012

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**Project Dates:** Nov 2004 – Oct 2007

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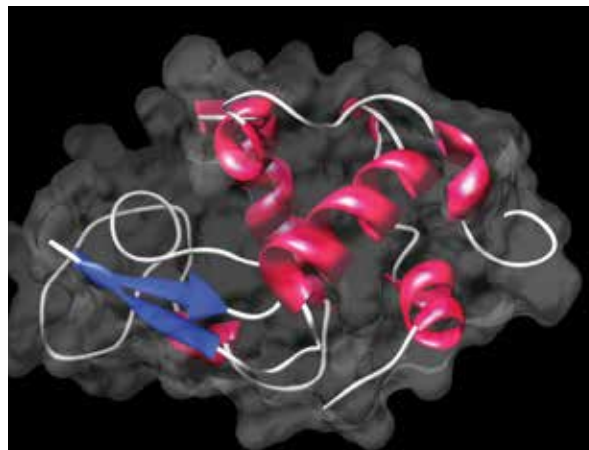
## Bioactive Dairy Protein Complexes – *In Vitro* and *In Vivo* Digestion

### Key External Stakeholders

Food, feed and pharmaceutical industry

### Practical Implications for Stakeholders

- Whey proteins can act as delivery vehicles of small molecules such as fatty acids, thereby changing their biological activity.
- *In vitro* and *in vivo* tools are available within Teagasc to assess digestibility, bioaccessibility and bioavailability of food compounds.



### Main Results

The key results were:

- $\alpha$ -lactalbumin ( $\alpha$ -la) and  $\beta$ -lactoglobulin ( $\beta$ -lg), both whey proteins, can bind small hydrophobic molecules and act as delivery vehicles to cells.
- $\alpha$ -la and  $\beta$ -lg can alter the solubility of fatty acids, thereby affecting their biological activity e.g. increasing or decreasing their anti-tumour activity or delay the uptake of fatty acids.
- *In vivo* gastric digestion of  $\alpha$ -lactalbumin in adults (n=10) provided valuable and novel insight into the mechanism and kinetics of protein breakdown.

### Opportunity/Benefit

The research team in Teagasc Moorepark has developed *in vitro* and *in vivo* tools to assess the digestive mechanism of food components. Assays such as bioaccessibility and bioavailability are now available to interested end users.

### Collaborating Institutions

Trinity College Dublin  
University College Cork

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**Project number:** 5947

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**Date:** May , 2013

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**Funding source:** FIRM 08/RD/TMFRC/650

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**Project dates:** Nov 2008 – Feb 2013

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## Bio-Actives from By-Products of Food Processing

### Key External Stakeholders

Vegetable processors, government authorities/legislators, consumers, national food research institutes

### Practical Implications for Stakeholders

Large volumes of waste are produced as a result of processing of foods. This project highlighted the potential of this waste as a source of bio-active compounds for inclusion in functional foods.



### Main Results

- Fruit and vegetable by-product and waste sources in Ireland were tested for their antioxidant activity and polyphenol content. The highest levels of antioxidants measured by both ferric reducing antioxidant power (FRAP) and diphenyl-picrylhydrazyl (DPPH) assays were detected in whole kiwifruit. Of the vegetable by-products, broccoli stems showed the best antioxidant potential.
- A pressurised liquid method for the extraction of antioxidants from apple pomace utilising 60% ethanol at a temperature of 102°C was developed.
- A solid-liquid extraction method for recovering antioxidant from apple pomace was also developed utilising 56% ethanol, 80°C and 31 min.
- Chitin extraction optimisation, using different organic acids, times and temperatures, was evaluated. The optimal conditions for chitin extraction were 2M concentration, 2h steeping time 24°C temperature which resulted in 98.86% and 90.28% purity for citric acid and lactic acid, respectively, at the ratio of 1:10.
- Optimal conditions of 75% ethanol, 80°C and 22 min for the extraction of antioxidants from potato peel were determined using solid-liquid extraction. The use of pressurised liquid extraction did not enhance the extraction of antioxidants from potato peel.

### Opportunity/Benefit

The potential of high volume fruit, vegetable and fish processing waste as a source of bio-active compounds has been highlighted. A number of methods for the recovery of bio-active compounds using food friendly solvents have been developed. The methodologies developed could be used as a basis for up-scaled methods to recover bio-active compounds from food waste for inclusion in functional foods.

### Collaborating Institutions

Dublin Institute of Technology, National University of Ireland, Galway, Trinity College Dublin, Natures Best Ltd, Keeling Fruit Importers.

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**Project number:** 5713

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**Funding source:** DAFM (06RDТАFRC519)

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**Date:** November, 2011

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**Project Dates:** Dec 2006 – Nov 2010

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## Biocide Tolerance in Foodborne Pathogens

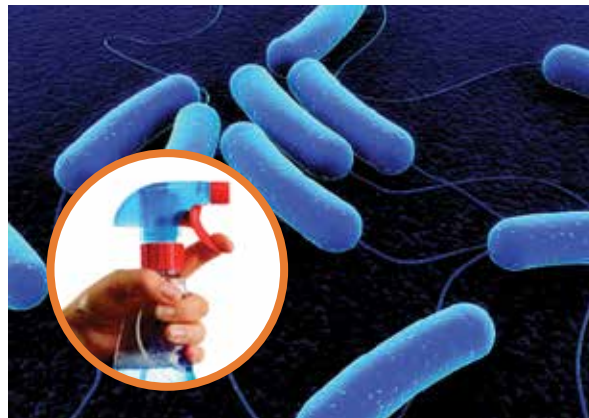
### Key External Stakeholders

Food industry, biocide producers, regulatory authorities

### Practical Implications for Stakeholders

The outcome of this project is a greater understanding of how foodborne pathogens including *E. coli* O157 and *Salmonella* spp. respond to the presence of biocidal agents, with a particular emphasis on triclosan.

- A panel of verocytotoxigenic *E. coli* (VTEC) and *Salmonella* isolates were found to have minimum inhibitory concentrations (MIC) less than the recommended working concentrations of a number of commercial biocide formulations, although some possessed an MIC of greater than 50% of the working concentration of some agents. This highlights the importance of strict adherence to manufacturer guidelines and appropriate training of personnel.
- Mutants with an enhanced tolerance to triclosan were readily obtained for both *Salmonella* and VTEC. In the case of *Salmonella* corresponding alterations to the strains' antibiotic profiles were



observed, illustrating an additional public health risk.

- A spectroscopic method was developed for the detection of quaternary ammonium compounds on stainless steel surfaces, allowing for the detection of residue build up which may constitute a risk for pathogen exposure to sub lethal concentrations of such agents. This would increase the likelihood of resistance developing.

### Main Results

A bank of foodborne pathogen isolates were tested against commercial biocide formulations. Although all isolates had an MIC below the recommended working concentration for all the biocide formulations tested a concern is that for some isolate-biocide combinations the MIC was 50% of the working concentration. Such a concentration may easily occur in real world situations, either due to over dilution, handler error or high organic load. Through this study the transcriptomic and proteomic response of triclosan tolerant *E. coli* O157 and *Salmonella* mutants in comparison with their reference strains were characterised in detail, identifying key responses for each pathogen. Subsequent phenotypic studies showed key changes which may contribute to enhanced pathogen persistence. A spectroscopic method was developed for measuring the potential buildup of biocidal agents on industrial surfaces.

### Opportunity/Benefit

The findings of this project provide a detailed analysis of the response of two key foodborne pathogens to sub lethal exposure to biocides commonly used in the farm to fork chain and how these responses may contribute to pathogen persistence in the food chain. The project findings underline the key importance of utilising biocidal

agents as directed. Furthermore, the spectroscopic method developed and validated as part of this project is readily transferable to industry for the measurement of the buildup of biocide residues on industrial surfaces.

### Collaborating Institutions

University College Dublin

**Project Number:** 5954

**Funding Source:** DAFM 08/RD/TAFRC616

**Date:** November 2012

**Project Dates:** Dec 2008-May 2012

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## BioCop – Detecting Chemical Contaminants in Food

### Key External Stakeholders

Dairy, beef and sheep farmers, regulatory agencies  
e.g. DAFF, FSAI, IMB

### Practical Implications for Stakeholders

- It is now possible to screen a large series of samples for the biological effects caused by the use of a growth promoting hormone using BioCop, a cost-efficient, protein based biomarker biosensor assay that has been developed.
- Rapid, improved diagnostic methods that are able to detect low concentrations of fluoroquinolone antibiotics have been developed and can be used in a range of animal products, including chicken muscle, eggs and fish.

BioCop addressed the issue of hormone growth promoters because they are banned for use in cattle fattening in the EU. Hormone abuse is a concern from food safety, animal welfare and law enforcement perspectives as residues in meat are a potential health threat, especially for vulnerable populations such as preadolescents. Current analytical methods are restricted, (i) to a limited number of known substances and, (ii) by the relative high cost. Therefore unexpected compounds will be overlooked and the number of samples analysed is limited by the cost.



BioCop addressed the issue of veterinary drug residues in food (fluoroquinolone antibiotics and hormone growth promoters) because overuse and/or illegal use of fluoroquinolone antibiotics in animal production is of particular concern to humans. Repeated exposure to fluoroquinolones, via the food chain, will limit the future effectiveness of these drugs by increasing the risk of antimicrobial resistance developing.

### Main Results

- New biosensor assay developed to detect fluoroquinolone antibiotics in different foods.
- A new high throughput biosensor assay was developed to detect hormone abuse in cattle.

### Opportunity/Benefit

This range of novel screening assays for chemical contaminants in food will provide the industry with a more cost effective and efficient food testing service allowing for an increase in safety and reduction in expenses. Expressions of interest in this research and the novel assays developed are welcome.

### Collaborating Institutions

Queens University Belfast

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**Project Number:** 5442

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**Funding Source:** EU (FOOD-CT-2005-006988)

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**Date:** July, 2011

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**Project Dates:** Apr 2005 – Sep 2009

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## Biomarkers to Authenticate Irish Grass-Fed Beef

### Key External Stakeholders

Regulatory agencies, Bord Bia, beef producers/processors

### Practical Implications for Stakeholders

- Biomarkers to authenticate Irish grass-fed beef have not been identified and, therefore, the marketing advantage that should accrue by being able to prove unequivocally that beef is Irish and grass-fed has not been exploited.
- This project produced a unique and extensive dataset consisting of marker elemental isotopes, molecules, and differentially expressed genes characterising (i) Irish beef produced solely off grass or off concentrates or off silage/grass/concentrate combinations and (ii) non-Irish beef.
- The approach taken will be useful for individual producers seeking to market beef produced to a unique and defined regional production system.



### Main Results

- Stable isotope analysis and fatty acid analysis permitted 100% correct classification of grass-fed beef from concentrate-fed beef and from beef from animals fed a 50:50 combination of grass and concentrates.
- Discriminant analysis of stable isotope data from 146 international samples showed that 84.9% were correctly assigned to their country of origin.
- Stable isotope analysis of bovine tail hair provided an archival record of the pre-slaughter diet of beef cattle and, importantly, of changes (e.g. grass to concentrates) to the pre-slaughter diet.

### Opportunity/Benefit

Commercialisation of this research could involve the setting up of a food authentication testing facility involving the establishment and maintenance of databases against which routine or suspect samples would be tested.

### Collaborating Institutions

University College Dublin

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**Project Number:** 5644

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**Funding Source:** DAFF (06/R&D/D/481)

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**Date:** November, 2011

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**Project Dates:** Sep 2006 – Nov 2010

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## Bio-sensitives Advanced Stabilisation

### Key External Stakeholders

- Dairy Ingredients and Nutritional Beverage Manufacturers
- Academic and Research Institutions

### Practical Implications for Stakeholders

- The research investigates processes, such as dehydration, as a way of stabilising sensitive and bioactive food components in structure-forming food matrices.
- Stabilisation of high-value ingredients requires a thorough understanding of ingredient interactions during formulation, processing, storage and distribution. The research demonstrates the effects of altering the composition of the continuous phase of emulsions on microstructure and physical properties of resultant powders such as glass transition temperature, sugar crystallisation, and lipid oxidation.



- The production of nanoemulsions, using microfluidisation for spray drying, with carbohydrate glass-formers has potential as a technique for increased retention of active components and uniformity of powder particle structure.

### Main Results

The project utilised microfluidisation equipment for the production of nanoemulsions (fat globule size ~ 150 nm), which may be used for encapsulation of lipid soluble bioactives by spray drying to produce powdered ingredients. Spray drying produced a solid, glassy matrix with sensitive components as part of the glassy material or entrapped in the structure-forming matrix (solid-oil dispersion). The research showed the impact of reducing the fat globule size on the physical properties of emulsions and powders. Spray dried nanoemulsions had altered microstructure compared to the control powders, with reduced levels of lipid oxidation but increased rates of lactose crystallisation. Partial replacement of lactose with sucrose, reduced glass transition temperature ( $T_g$ ), delayed lactose crystallization and reduced the extent of lipid oxidation in powders – a possible beneficial effect for long term storage of powders.

### Opportunity/Benefit

This research provides a comprehensive account of the fundamental properties of nanoemulsions in liquid and dried forms. The techniques described can be translated into improved product quality and stability with demonstrable benefits to the Irish industry as producers of high quality ingredients and foods for the international markets.

### Collaborating Institutions

University College Cork, UCC

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**Project number:** 5953

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**Date:** November, 2014

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**Funding source:** DAFM (08/RD/C/695)

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**Project dates:** Oct 2008 – Mar 2013

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## Campylobacter Control on Broiler Farms

### Key Stakeholders

Poultry farmers, poultry processors, scientists, regulatory personnel, EFSA

### Practical Implications for Stakeholders

- The data generated in this research should be used to revise current biosecurity measures on broiler farms.
- New information on antibiotic resistance can be used to assess the likely success of different control strategies.

This research also supports the hypothesis that quinolone and macrolide antibiotic resistance in *Campylobacter* is mutation based. While this trait may not be transferred horizontally from one organism to another, it is relatively stable in the *Campylobacter* population and can be passed vertically between parents and offspring cells. The use of antibiotics during food production will confer a selective pressure



promoting the survival and proliferation of resistant strains while susceptible organisms are eliminated from the microflora with inevitable adverse consequences for therapeutic intervention (in severe cases) and public health.

### Main Results

- Adjacent cattle and transport crates used during thinning are important sources of *Campylobacter* in broiler houses.
- Quinolone and macrolide antibiotic resistance in Irish *Campylobacter* isolates is mutation based.

### Opportunity/Benefit

This project provides data for risk analysis that may be used to provide the scientific basis for improved biosecurity of broiler farms and in the formulation of strategies to control the emergence and dissemination of antibiotic resistance determinants in *Campylobacter*. The results are available for any interested parties.

### Collaborating Institutions

University College Dublin, Cork County Council.

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**Project Number:** 5427

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**Funding Source:** Safefood 04-RESR-04

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**Date:** June, 2012

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**Project Dates:** April 2006 – Sept 2009

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## Characterisation and Enrichment of “Buttermilk” Fat Globule Membrane Composition Using Novel Technologies

### Key External Stakeholders

Dairy processors, butter manufacturers, ingredient innovators

### Practical Implications for Stakeholders

This project has demonstrated that the milk fat globule membrane (MFGM) residue contained within buttermilk possesses biological activity and offers potential for greater commercial exploitation and adding value.

A key implication for dairy producers and processors is a realisation that buttermilk as a by-product of buttermaking is presently under-utilised through processing into a relatively low-value commodity buttermilk powder.

- Expertise and analytical capability were developed, in relation to bioscience aspects and technological features of MFGM, which is key to understanding the fate of MFGM proteins and phospholipids during processing.



- Specific analytical capabilities developed during the project were made available to interested dairy processors thereafter to enable them to characterise the composition of buttermilk and MFGM fractions generated by their processes. This, in turn, led to international food and nutritional company reaction e.g. expressions of interest on the part of infant milk formula manufacturers.

### Main Results

- Analytical techniques were established which enabled, for the first time, the fate of MFGM proteins and phospholipids to be tracked during processing simulations performed on freshly-produced milk.
- MFGM proteins are partitioned mainly into buttermilk during cream churning, some of these proteins were also detected in the resulting butter. All major MFGM phospholipids, i.e. PE (phosphatidylethanolamine), PI (phosphatidylinositol), PC (phosphatidylcholine), PS (phosphatidylserine), SM (sphingomyelin), as well as high quantities of LC (lactosylceramide) were detected in the various sample streams irrespective of mechanical action and/or heat treatment of cream prior to processing.
- Significant anti-cancer effects were detected in the various buttermilk fractions produced experimentally.

### Opportunity/Benefit

Follow-on research is necessary to elaborate our scientific understanding of MFGM and document further biological evidence to support health benefit claims but the expertise developed from this project would be key to such commercially focused research and possible links with industry.

### Collaborating Institutions

Dublin City University

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**Project Number:** 5552

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**Funding Source:** DAFF (05/R&D/TD/370)

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**Date:** March, 2012

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**Project Dates:** Oct 2008 – Mar 2009

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## Chitosan Generation and Characterisation from Shell

### Key External Stakeholders

Marine processors, ingredient producers

### Practical Implications for Stakeholders

Use of by-products from marine processing and reduction in disposal at landfill costs.

Novel ingredient for use in a myriad of applications as a functional food (anti-obesity/anti-cholesterol), horticulture, plant protection.



### Main Results

- Chitosan generation and characterisation from shell material (prawn and crab).
- NMR analysis and molecular weight determination.

### Opportunity/Benefit

By-product disposal is expensive and no longer permitted under the revised CFP. We have developed methodologies to generate a high-value grade chitosan from prawn and crab shell material and methods to characterise the resultant product which has a myriad of applications in functional foods, foods, packaging and horticulture.

### Collaborating Institutions

National University of Ireland, Galway

University College Dublin

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**Project number:** NutraMara – The Marine Functional Foods Research Initiative

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**Date:** May 2015

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**Funding source:** DAFM and Marine Institute and Teagasc

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**Project Dates:** October 2009 – December 2012

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### How to Proceed

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## Culture Collections in Teagasc Food Research Centre Moorepark

### Key External Stakeholders

Dairy Industry, food manufacturers, pharm industry, research community

### Practical Implications for Stakeholders

The culture collections in the Teagasc Food Research Centre Moorepark provide banks of bacterial cultures with potential for exploitation as dairy starters, adjunct cultures and probiotics for the Food and Pharma industries and the research community.

### Main points

The main functions of the DPC and APC culture collections are:

- To provide a central repository for safe housing and cataloguing of DPC and APC Biobanks.
- To provide researchers within Teagasc and APC and interested stakeholders with accurate data regarding the potential applications, safety and quality of strains within the collections.
- To provide unambiguous traceability for IP protection and accountability.



### Main Results

DPC and APC culture collections contain 7000 and 62,000 strains respectively. The DPC culture collection predominately consists of strains of lactic acid bacteria of the genera *Lactococcus*, *Lactobacillus* and *Streptococcus*. These bacteria have been isolated over many years from a variety dairy-associated sources. In addition, this collection also houses bacteria and yeasts isolated from surface ripened cheese, many food, animal and human Class 2 pathogens and also bacteriophages isolated from both dairy and environmental sources. More recently the biobank associated with the APC contains strains isolated from human intestinal samples which have potential for exploitation as probiotics for the treatment of anti-inflammatory diseases such as IBD and IBS, anti-*Clostridium difficile* probiotics and antimicrobials in addition to strains producing bioactive metabolites such as conjugated linoleic acid and exopolysaccharides.

### Opportunity/Benefit

The DPC and APC culture collections are available to researchers in Teagasc Food Research Centre, researchers in the APC and companies for exploitation in the Food or Pharma or Veterinary arena.

### Collaborating Institutions

University College Cork

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**Project number:** 6042 and 6312

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**Date:** May 2014

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**Funding source:** SFI and DAFM

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**Project dates:** 2008–2013 and 2013

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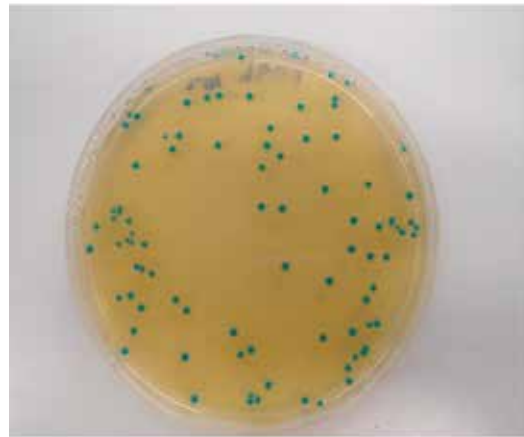
## Detection and Surveillance of *Enterobacter sakazakii* (*Cronobacter* spp.) Along the Infant Formula Food Chain

### Key External Stakeholders

Infant milk formula industry, Food Safety Authority of Ireland

### Practical Implications for Stakeholders

*Cronobacter* spp. is a key food safety issue for the infant formula sector. Apart from an obligation to meet the regulatory microbiological criteria for this pathogen, the sector would be severely damaged by any food safety scare affecting infants consuming these products. This study has focused on transmission sources and survival characteristics of *Cronobacter* spp. The study highlighted that *Cronobacter* can occur widely in the environment and are particularly associated and adapted to survive in dry environs.



### Main Results

- *Cronobacter* spp. are not 'ubiquitous' in the environment and would be best described as 'widespread but infrequent' as it appears they have found a particular niche in dry environments.
- Dry ingredients added to milk powder may have a role in transmission of *Cronobacter* spp.
- *Cronobacter* spp. are resilient, surviving the time/temperature profile experienced during spray-drying, in soil, in rumen fluid, in inulin and lecithin (ingredients in infant formula manufacture).
- An adaptive tolerance response to sub-lethal heat that confers increased heat resistance can be induced. However, the increased heat tolerance was not transferred to increased survival potential in a dry environment. Changes in the ratio of saturated to unsaturated fatty acids in the cell membrane appear to be responsible for this adaptation.

### Opportunity/Benefit

This project has generated knowledge about the transmission and survival of *Cronobacter* in the farm to fork chain which will underpin risk management of this pathogen.

### Collaborating Institutions

University College Dublin, Food Safety Authority of Ireland

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**Project number:** RMIS 5561

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**Date:** October 2013

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**Funding source:** FIRM

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**Project dates:** June 2006 – Dec 2009

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## Detection of Endocrine Disrupting Agents in Milk

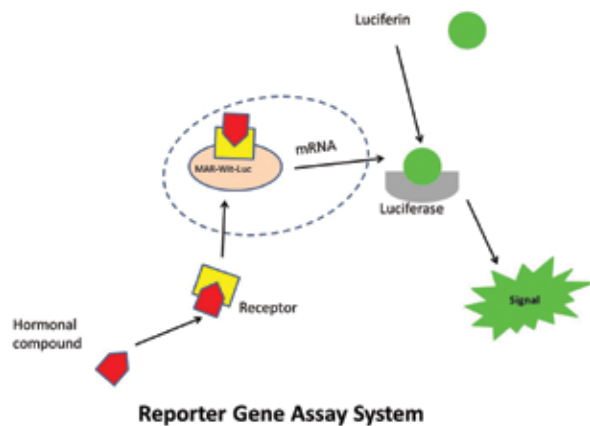
### Key External Stakeholders

Dairy industry, Dairy farmers, Agri-businesses, Policy makers

### Practical Implications for Stakeholders

Endocrine disruptor agents (EDAs) comprise of both naturally occurring and synthetic chemicals. Some of these chemicals can transfer into milk due to environmental contamination, feed contamination, leaching from milking machine components, cleaning agents or processing. This research has shown that endocrine disruptors can be successfully detected in milk using receptor assays. However, chemical analysis using liquid chromatography coupled to tandem mass spectrometry (LC-MS/MS) is required to accurately measure and identify each compound. Unfortunately, a wider range of EDAs could not be detected because there are more amenable to GC-MS analysis, which was not available at the time.

Using the technology developed on this project low



levels of EDAs were found in milk samples but further investigations should be carried out to identify the source of residues. More extensive methodology is required to properly investigate a wider range of phthalates, which have been detected in dairy products in other EU countries.

### Main points

- The technology developed on the above project provides two validated solutions for detecting EDAs in milk.
- End-users can use the technology to screen for endocrine disrupting chemicals in milk and be confident that dairy is safe for consumption.

### Main Results

- Two new methods were developed to analyse endocrine disrupting agents in milk using an estrogenic reporter gene assay and liquid chromatography coupled to tandem mass spectrometry (LC-MS/MS).
- The technologies were applied to a range of different types of milk and infant formula.
- A range of endocrine disruptors were detected in samples including the natural hormone progesterone and low levels antimicrobials, phytoestrogens and benzyl butyl phthalate.

### Opportunity/Benefit

This technology is now available as a tool to monitor the safety of milk.

### Collaborating Institutions

Queen's University Belfast

**Project number:** 6141

**Date:** November, 2014

**Funding source:** Teagasc

**Project dates:** Oct 2010–Sep 2014

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## Detection of Flukicide Residues in Milk and Meat

### Key External Stakeholders

Meat and milk processors, Irish baby food industry, regulatory agencies e.g. DAFF, FSAI, IMB

### Practical Implications for Stakeholders

- The first analytical test to detect all of the major anti-parasitic drug residues has been developed through a collaboration with the US Department of Agriculture.
- A new group of residues in milk and meat samples were detected for the first time; nitroxylnil, closantel, triclabendazole and rafoxanide were detected in milk at low levels. However, with setting of provisional Maximum Residue Limits (MRLs) for some flukicides in milk, this will become less of a problem from 2011 on.
- The technology developed under this funding has been comprehensively validated according to international guidelines and was accredited to the ISO 17025 standard. The technology has been applied to some 3000 test samples.



- The main recommendation for primary processors is that flukicide residues should be monitored in milk, particularly during the spring period post-calving.

### Main Results

- A sensitive test was developed and validated to detect 38 anti-parasitic drug residues in milk and animals tissue.
- The technology was satisfactorily evaluated through application in inter-laboratory studies.
- The technology was accredited to ISO17025 standard in 2009.
- The technology has been applied to approximately 3000 test samples.

### Opportunity/Benefit

This analytical test is now available as a tool to monitor the safety of milk and meat products through accurate determination of flukicide residue levels, and offers an opportunity for food processors to prevent contaminated product entering the food chain and potential product recalls, with all of the economic fallout this entails.

### Collaborating Institutions

US Department of Agriculture – EARC

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**Project Number:** 5579

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**Funding Source:** DAFF (06/RD/TAFCR/479)

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**Date:** January, 2011

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**Project Dates:** Nov 2006 – Nov 2009

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## Development of High Protein Bars as Vehicles for Functional Ingredient Delivery (PROBar)

### Key External Shareholders

Dairy ingredient manufacturers, nutritional food formulators

### Practical Implications for Stakeholders

- The shelf stable nature of high protein bars is largely attributable to their controlled water activity ( $a_w$ ) which creates an environment that limits the activity of spoilage microorganisms.
- Probiotic microorganisms are equally affected by such controlled  $a_w$  levels, hence this study aimed to understand how probiotic cultures such as *L. casei* may be adapted to survive when carried in a protein bar matrix. Strain adaptability was established by exposing the culture to variation in relative humidity (%RH) especially if incorporated with a prebiotic FOS/GOS mixture. Additional protection is afforded if skim milk is included in the preparation.
- Incorporation of hydrolysed protein (WPH) in bar formulations favours higher initial counts of *L. casei* (<24h) but does not sustain the initial momentum during subsequent storage at 20°C.



- Dispersal of *L. casei* in combination with a mixture of FOS-GOS and skim milk in molten chocolate prior to bar formulation provides an effective protective medium.
- Significantly better probiotics protection was afforded when co-blended with the prebiotic mixture, FOS/GOS, and dispersed in larger chocolate pieces as well as chocolate coating.

### Main Results

- A high protein bar system incorporating ingredients in an experimentally-designed formulation study was used to monitor the survival added probiotic cultures.
- Advanced analysis by means of flow cell cytometry indicated that a significant proportion of the apparently 'dead' probiotics cells following storage may be capable of revival.

### Opportunity/Benefit

A novel protocol by which probiotics may be added to high protein bars and their viability maintained during bar storage is outlined. Further extended storage tests are recommended in follow-up studies to validate the findings of this time-constrained project.

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**Project number:** 6611

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**Funding source:** FIRMplus / DAFM (13/F/513)

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**Date:** May, 2015

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**Project Dates:** Dec 2013 – April 2015

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### How to Proceed

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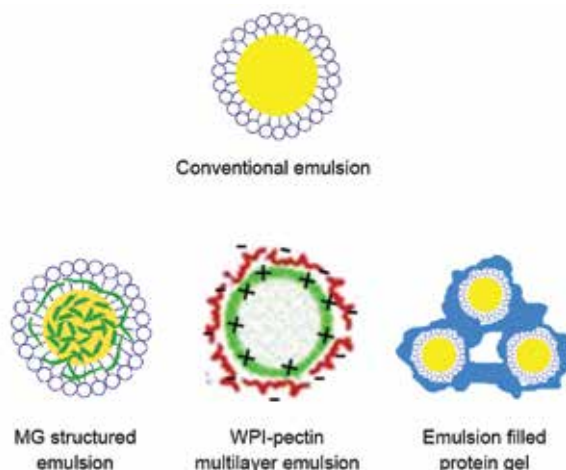
## Development of Novel Food Structures Which Deliver Engineered Flavour and Health Benefits

### Key External Stakeholders

Dairy and beverage industry, manufacturer of fat-reduced foods, academic and research institutes

### Practical Implications for Stakeholders

The study provided important information about different structured emulsions as delivery systems for flavour compounds, and on how food structure can be designed to modulate flavour release. The findings suggested that it is possible to modulate flavor release (response to different triggers) by changing emulsion structure, which could be helpful in the development of functional foods with improved flavour profile. The emulsions studied in this research may also find applications to deliver non-volatile functional ingredients.



### Main Results

- Monoglyceride formed liquid crystalline structures in the oil phase of oil-in-water emulsions, and crystalline structure worked to reduce the amount of flavour released to the headspaces.
- Headspace concentration of flavours was significantly lower in WPI-pectin multilayer emulsions than that in conventional emulsions and flavour release can be modulated by adjusting pH, salt concentration of the emulsion.
- Flavours had lower release rates and headspace concentrations in emulsion filled protein gels, and the release was more inhibited when more protein was included. Reduced flavour release in oil-reduced gels can be achieved by increasing WPI content.
- The involvement of matodextrins in the emulsions improved emulsion stability against freeze-thawing, and flavours had similar release profiles before and after freeze-thaw treatment.

### Opportunity/Benefit

This research provides profound knowledge about emulsion structures and flavor release, and the designing of flavor delivery systems. Different structured emulsions with structuring of the oil phase, water phase, and interface allow better delivery of food flavors and other functional ingredients. The findings obtained in this study provided important information on designing novel food products with specific health/function claims and improved flavor profile, e.g., fat reduced food, long shelf-life foods.

### Collaborating Institutions

University College Cork

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**Project number:** 5991

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**Funding source:** Teagasc

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**Date:** March, 2015

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**Project dates:** Oct 2010 – Dec 2014

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## Developing Novel Convenient Meat Based Products by Application of High Pressure Processing (HPP)

### Key External Stakeholders

Meat processors, chilled ready meal producers, state agencies

### Practical Implications for Stakeholders

The output of this research provides a broad range of data which can assist many players in the chilled meat product chain to understand the relevance of a minimal processing technology such as high pressure processing (HPP). Results also provide valuable information to assist in understanding, at a proteome level how, HPP exerts its effects on quality.

- Influence of different HPP treatment levels were observed with lower pressure (200MPa) being more appropriate than higher for meat.
- Higher pressure (600MPa) appeared to be more relevant for processing vegetables.



- Industry was positively disposed towards the availability of a HPP central treatment facility.

### Main Results

- Mild pressure treatments minimally influence meat quality while improving meat hygiene.
- While high pressure levels would promote lipid oxidation, mid-range levels had no impact on fatty acid profile.
- Results suggest that increases in pressure result in increased precipitation of sarcoplasmic proteins onto myofibrils.
- Processing at 600MPa and blanching were the treatments that best preserved the antioxidant capacity of vegetables.
- The enhanced nutritional profile of the chilled ready meal concept garnered higher levels of consumer acceptance especially amongst respondents in the family life stage.
- The overall result from the 300 consumer acceptance tests, indicated that a pressure treatment of 200 MPa was most acceptable to the majority of consumers.
- Further education and technical training is warranted to increase industry awareness of HPP.

### Opportunity/Benefit

This project provides valuable information for scientific and consumer audiences and provides a good starting point for further research or development by others, including industry. As a non-thermal treatment which can influence

microbial safety, HPP holds potential as a minimal process technology of relevance to the production of ready to eat meat products which are microbiologically safe and possess superior sensory and nutritional attributes. Expressions of interest in further developing this research are welcome.

### Collaborating Institutions

University College Cork

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**Project Number:** 5580

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**Funding Source:** DAFF (R&D/TAFRC/521)

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**Date:** March, 2012

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**Project Dates:** Nov 2006 – Jun 2010

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## Early Detection of Mushroom Bruising Using Imaging Technology

### Key External Stakeholders

Mushroom producers, mushroom packers, supermarket chains

### Practical Implications for Stakeholders

- The capability to identify damaged mushrooms before browning becomes visible has been developed.
- The technology has the potential to reduce acceptance problems for mushroom lots at both wholesale and retail level.

Browning of mushrooms because of damage during harvesting and transportation results in a monetary loss for the mushroom industry. This project investigated the use of a rapid, non-destructive system, near infrared (NIR) spectroscopy and hyperspectral imaging (NIR-HSI), which has the



potential to identify the damaged mushrooms before browning is visible. The technique is capable of on-line installation and operation and could eventually be deployed for screening of sample or whole lots.

### Main Results

- Conventional NIR spectroscopy can discriminate between damaged and undamaged mushrooms with almost 100% accuracy.
- Conventional NIR spectroscopy is capable of predicting post-harvest age in damaged and undamaged mushrooms with a high level of accuracy.
- NIR-HSI can discriminate between damaged and undamaged mushrooms within 1 day of harvest at rates of 72 and 86% respectively.

### Opportunity/Benefit

Expressions of interest from mushroom producers or distributors relating to exploitation of this emerging technology through engagement with Teagasc are welcome. Teagasc can develop turnkey applications for interested companies on request.

### Collaborating Institutions

Dublin Institute of Technology, University College Dublin

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**Project Number:** 5708

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**Funding Source:** DAFF (06/R&D/DIT487)

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**Date:** February, 2011

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**Project Dates:** Nov 2006 – Jul 2010

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## Emerging Verocytotoxigenic *Escherichia coli* (VTEC) on Irish Beef Farms

### Key External Stakeholders

Irish beef farmers, beef processors, FSAI, DAFF, public health personnel, epidemiologists and scientists interested in VTEC research

### Practical Implications for Stakeholders

This study discovered that VTEC were widespread on Irish beef farms and some serotypes were capable of causing serious illness in humans. A range of different VTEC serotypes were also detected on cattle hides and carcasses in the abattoir. New, more virulent serotypes are emerging and will join *E. coli* O157 in causing serious disease outbreaks in the future.



### Main Results

- VTEC are widespread on Irish beef farms.
- VTEC are present on hides and carcasses in the abattoir.
- VTEC survive well in Irish clay and sandy soils.
- Several serotypes of potential clinical significance are emerging.

### Opportunity/Benefit

The data generated, especially on non-O157 VTEC will be used to formulate new risk-based meat inspection procedures and in the development of public health protection policy. It strongly supports the case for expanding current microbiological criteria in meat monitoring and identifies novel VTEC that should be tested for in seriously ill patients not infected with O157.

### Collaborating Institutions

University College Dublin; University of Ulster, Jordanstown; US Department of Agriculture-ARS

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**Project Number:** 5554

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**Funding Source:** FIRM (06/R&D/TN/357)

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**Date:** October, 2011

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**Project Dates:** Oct 2006 – Sep 2009

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## Functional Beverages Containing Health-Promoting Prebiotic Milk Oligosaccharides

### Key External Stakeholders

IMF manufacturers, dairy/cheese industry, dairy farmers

### Practical Implications for Stakeholders

- In addition to known bovine milk oligosaccharides, detection of 18 new high-molecular weight oligosaccharides was observed in the enriched powders.
- Kg quantities of powders enriched in milk oligosaccharides can be produced using the developed membrane filtration process.
- The oligosaccharide powders produced have been shown *in vitro* to possess prebiotic activity and can prevent invasion of human cells by *Campylobacter jejuni*.



- The oligosaccharides powders also decreased number of potential pathogens *in vivo* in a mouse model.

### Main Results

- In this study, pilot-scale enrichment of oligosaccharides from whey streams using 1 kDa membranes was successful yielding as high as 17.52% enrichment of oligosaccharides as a % of lactose.
- This study revealed, for the first time, the presence of several new free oligosaccharides containing up to 10 monomers that correspond in size to the most abundant oligosaccharides present in human milk including some fucosylated structures.
- A variety of bioactivities were shown to be associated with the bovine oligosaccharides *in vitro* such as increased colonization of human intestinal cells by Bifidobacteria, prebiotic effects and anti-invasive activity against *Campylobacter*.
- Bovine milk oligosaccharides were found to reduce non-beneficial or pathogenic bacterial populations *in vivo* in the mouse GIT and have no adverse effects on the other health parameters measured.

### Opportunity/Benefit

The technologies to enrich oligosaccharides in this work are based on membrane filtration techniques. The membranes are already well established in the dairy industry and depending on the extent of use of an existing plant, it is anticipated that little additional costs would be required in terms of plant, personnel and

training investment. Furthermore, bearing in mind the potential applications of oligosaccharides if produced by such industries, the initial capital and production costs would be spread between different high value-added ingredients for diverse applications.

### Collaborating Institutions

UC Davis

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**Project number:** MD-BY-5551/Dairy Levy 5450

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**Funding source:** DAFM, Dairy Levy

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**Date:** November 2015

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**Project dates:** March 2006 – May 2012

### How to Proceed

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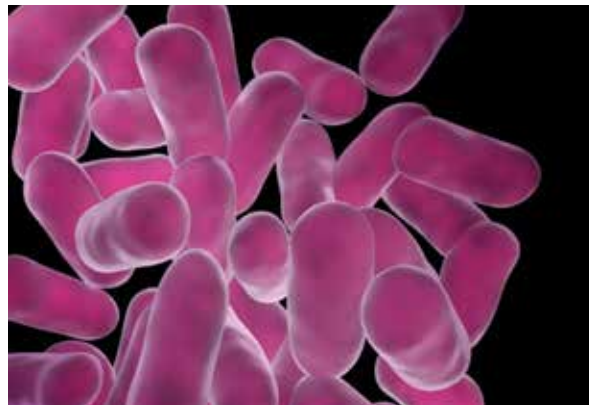
## Genomic Analysis of *Lactobacillus helveticus* DPC4571

### Key Stakeholders

Dairy industry, starter supply companies, research community

### Practical Implications for Stakeholders

Bacteria used in the manufacture of cheese play a major role in determining the flavour of the final product. The capacity to direct cheese flavour development to address specific consumer desires, through the use of such bacteria, offers the cheese manufacturer a significant advantage in the market place. Previous research at Teagasc has demonstrated that the use of *Lactobacillus helveticus* in cheese manufacture results in cheese with a very desirable sweet, nutty flavour. This project sought to use molecular biological approaches to gain a greater understanding of *Lactobacillus helveticus* and its role in cheese flavour development.



The main focus of the research was:

- Generation of the first complete genomic sequence of *Lactobacillus helveticus*.
- Exploitation of the genomic data to gain a greater understanding of the manner in which this bacterium impacts on cheese flavour development.

### Main Results

- The complete genomic sequence of *Lactobacillus helveticus* DPC4571 was assembled and analysed.
- Four genes with the potential to impact on cheese flavour were examined using molecular approaches.
- Molecular tools for the further genetic manipulation of *Lactobacillus helveticus* were developed.

### Opportunity/Benefit

This project resulted in the first published genome sequence of a *Lactobacillus helveticus* strain, thus providing a complete overview of the metabolic capabilities of what is a very successful cheese-making bacterium. The successful completion of the project has provided an insight into how this bacterium impacts on cheese flavor development during ripening and this has enabled selection of additional strains that can impact successfully on cheese flavor development. By doing so, the project supports the efforts of the Irish cheese makers to exploit markets for cheese, in particular cheeses with sweet, nutty flavours that are highly prized by the modern cheese consumer. Expressions of interest from companies involved in this area are welcome.

### Collaborating Institutions

University College Cork

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**Project Number:** 5434

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**Funding Source:** DAFM 04/R&D/TD/311

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**Date:** June, 2012

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**Project Dates:** Sept 2005 – Oct 2009

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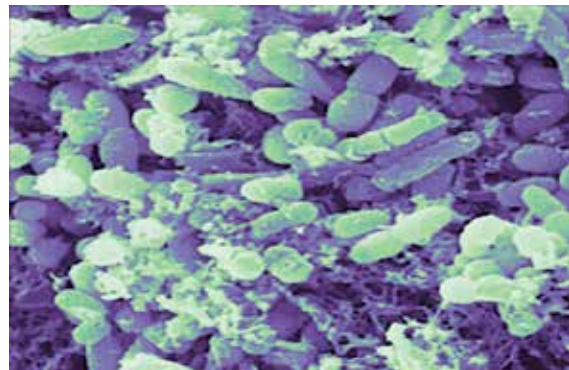
## Genomics of Gram Negative Food Poisoning Bacteria of Animal Origin

### Key External Stakeholders

Food sector (pork sector in particular), Regulators, Food Safety Authority of Ireland

### Practical Implications for Stakeholders

Approximately 40% of *Salmonella Typhimurium* isolates examined, readily attached to food contact surfaces and formed biofilms (bacterial populations on surfaces). In biofilms, *Salmonella* can persist for long periods of time, and pose a risk of contamination in food production. Research showed that particular genes and proteins needed to be expressed to allow formation of biofilms by *Salmonella*, and these could be targeted in the development of new biocides.



### Main Results

- Of the *Salmonella Typhimurium* isolates (n=172) examined, which were recovered from the pork chain in Ireland or of human clinical origin, about 40% had the ability to form biofilms on stainless steel and plastic surfaces. Among clinical isolates, 73% attached to PVC plastic compared to 53.3% of pork isolates. This indicates that the ability to persist on surfaces may be enhancing the transmission of *Salmonella* through the food chain to the consumer.
- *Salmonella* in biofilms formed at pH 5 showed increased expression of virulence genes *hilA* and *invA* compared to those from biofilms formed at neutral pH 7. This indicates that acidic environments in food production plants may enhance the ability of *Salmonella* to cause food borne illness.
- In acidic environments, genes related to *Salmonella* motility i.e. flagella structures (*Flagellin*) were down-regulated in cells from biofilms as compared to non surface attached (planktonic) cells. Genes related to cell-to-cell signaling and transport of exopolysaccharides across the outer membrane, were up-regulated and needed for successful biofilm formation. Proteomic analysis also revealed that the switch from planktonic to biofilm status required up-regulation of proteins associated with glycolysis, cell-to-cell signaling and protein transport.
- The design of biocidal agents that specifically interfere with glycolysis and cell-to-cell signaling and that enhance flagella formation could help inhibit biofilm formation by *S. Typhimurium* in food processing facilities.

### Opportunity/Benefit

The data generated in this project gives a fundamental understanding on the persistence and biofilm formation by *Salmonella* on contact surfaces used in food production. This information may support industry in the control of this pathogen and the development of novel targeted biocidal agents.

### Collaborating Institutions

University College Dublin

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**Project Number:** 5854

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**Funding Source:** DAFF (06/TNI/UCD/10)

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**Date:** September 2013

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**Project Dates:** Nov 2007 – Dec 2012

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## GLYCO-PROSPECTING: For Health Promoting Activity

### Key External Stakeholders

Food manufacturers, dairy industry, pharmaceutical companies, research communities, public health agencies and health professionals and policymakers

### Practical Implications for Stakeholders

- A major research focus has moved to identify components of bovine milk which, when isolated or concentrated, can bring added value to applications such as infant formula.
- Irish dairy research in particular is expanding in this area due to the large increase in milk volumes following the abolition of milk quotas.
- In particular, research on the complex carbohydrate structures which are inherent in bovine milk is gaining momentum.
- In the case of bovine milk glycoproteins, the larger molecular weight of these components and the



more diverse chemistries facilitates ease of purification.

- Here, the importance of the glycans on such proteins, structural changes that may occur and their relevance to the functionality of the intact glycoprotein is explored.

### Main Results

- More diverse complex-type oligosaccharides structures are present on lactoferrin during early lactation with an abundance of oligomannose type glycans in later lactation.
- Novel interactions were identified for *C. sakazakii*, *S. pneumoniae* and *P. aeruginosa* with the highest binding observed for mature milk lactoferrin in all cases, with the exception of *S. typhimurium*. The interaction between lactoferrin and these pathogens may imply a role as decoy receptors to which pathogens bind to instead of to host cells.
- Glycomacropeptide (GMP), a 64 amino acid peptide, derived from k-casein, was also selected given the current interest in this glycopeptide as a prebiotic. GMP promoted the growth of *Bifidobacterium longum* subsp. *infantis*. Transcriptional analysis of *B. infantis* following exposure to GMP revealed a substantial response to GMP relative to the controls (no GMP and GMP with disrupted glycans). These results suggest that the O-linked glycosylation of GMP is intrinsic to the growth stimulation of *B. infantis*.

### Opportunity/Benefit

Overall, this research adds to our understanding of the structural and functional importance of milk protein glycosylation. It also highlights the potential of these compositionally complex molecules as ingredients which can be exploited by the food and pharmaceutical industry.

### Collaborating Institutions

Glycoscience Group, National Centre for Biomedical Engineering Science, National University of Ireland Galway, Galway, Ireland.

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**Project number:** 5975

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**Funding source:** Core

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**Date:** November, 2015

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**Project dates:** Nov 2009 – Oct 2013

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## Identification and Molecular Characterisation of Genes Influencing Irish Pork Meat Quality

### Key External Stakeholders

Pig producers, pigmeat processors, diagnostics companies

### Practical Implications for Stakeholders

Tools to provide early prediction of the ultimate quality of meat, i.e. shortly after slaughter, would help facilitate logistical decisions of pork processors in relation to meat management. However measurements that are currently applied by industry, e.g. carcass pH measured at 45 minutes postmortem, are not considered satisfactory as accurate predictors of ultimate quality.

- Molecular approaches applied in this project have led to the identification of biological markers which are associated with quality parameters. These have considerable potential as tools to predict quality in meat management systems and/or to provide a basis for the inclusion of meat quality in selection goals.
- Gene expression profiles and novel DNA markers in these gene regions were shown to be linked



with meat quality in large pig populations representing Large White, Duroc and Pietrain breeds. Interestingly, several of the associations were breed-specific. Results have applications in meat management systems and breeding.

- Exudate from muscle was shown to be a readily accessible biological resource and a rich source of potential protein biomarkers of quality. More than two-hundred proteins/fragments were altered through postmortem ageing and are thus linked to quality. Twenty proteins were linked to drip loss. The findings provide a means for the future development of high-throughput protein diagnostics for diverse aspects of meat quality in an industrial setting.

### Main Results

- A detailed meat quality database (tenderness, fat content, water-holding capacity etc.) for three breeds (Large White, Pietrain, Duroc) was established.
- More than 600 candidate genes were identified whose expression levels were associated with tenderness, intramuscular fat content, drip loss or PSE-like/DFD-like meat.
- Many novel associations have been identified between 190 novel markers (SNPs) discovered in the most promising candidate genes and meat quality measurements in four cohorts (total 724 animals).
- 2D proteomics resulted in the identification of protein spots significantly associated with drip loss at the one day postmortem point. These have potential to serve as early biomarkers of water-holding capacity.

### Opportunity/Benefit

A panel of proteomic markers associated with a highly relevant pork quality trait for pigmeat processors, i.e. drip loss, was identified in the course of this project. The results could be further developed into rapid tests for drip loss in a commercial context. This approach could also be highly relevant for palatability traits, such as

tenderness, juiciness and flavour. Expressions of interest in further developing this research are welcome.

### Collaborating Institutions

National University of Ireland, Galway; University College Dublin.

**Project Number:** 5643

**Funding Source:** DAFF (06/R&D/NUIG/470)

**Date:** October, 2011

**Project Dates:** Jan 2007 – Jun 2010

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## Improved Biotraceability of Unintended Microorganisms and Their Substances in Food and Feed Chains

### Key External Stakeholders

Irish Farmhouse Cheesemakers (FSAI)

### Practical Implications for Stakeholders

- The data obtained contributes to a better understanding of the potential risk that *L. monocytogenes* presents to cheese producers (growth on the product, if it is contaminated) and constitutes a very useful set of data for further modelling studies in food.
- Persistent strains of *L. monocytogenes*, that are more difficult to control, were identified in some processing environments.



### Main Results

- Sixteen cheesemaking facilities were sampled during the production season at monthly intervals over a one-year period. Thirteen facilities were found to have samples positive for *L. monocytogenes* on at least one occasion.
- 19% of samples at farm level were positive for *L. monocytogenes*.
- This study demonstrates the prevalence of *L. monocytogenes* in the dairy farm and processing environments and the need for good hygiene practices to prevent its entry into the food chain.
- Predictive modeling is not always applicable to food.

### Opportunity/Benefit

- Contamination of food processing facilities (not food) was shown. There is an opportunity to use this pre-emptive knowledge to improve hygiene at processing facilities and prevent future issues with food contamination.
- Predictive modeling is not always applicable to food – challenge studies are necessary.
- A database of pulsed field gel electrophoresis (PFGE) profiles of *L. monocytogenes* isolates from Ireland was generated.

### Collaborating Institutions

Principally the Danish Technical University, Copenhagen and the University of Veterinary Medicine, Vienna. There were 45 other participants in the project.

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**Project Number:** 5691

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**Funding Source:** EU FP7 Project no. 036272

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**Date:** July 2013

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**Project Dates:** Jan 2007-Dec 2011

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## Improved Whey Permeate Drying Using High Pressure Gas/Liquid Dosing During Spray Atomisation

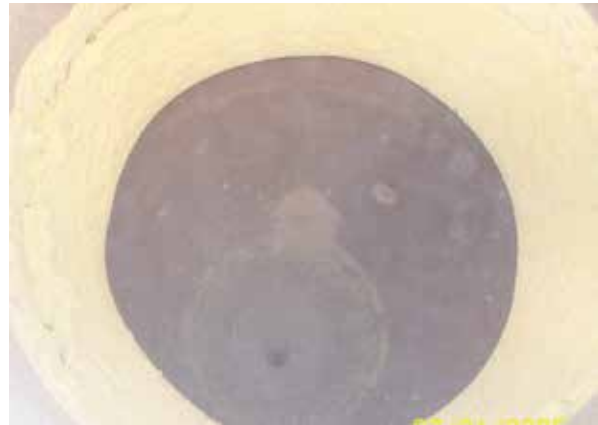
### Key External Stakeholders

Irish dairy processors and whey ingredient manufacturers on behalf of their dairy farmer members

### Practical Implications for Stakeholders

The outcome/technology or information/ recommendation is:

- Modification of the feed dosage systems using high pressure gas dosing into the concentrate line to nozzle atomisers of spray driers looks promising as a means of improving permeate drying without undue deposit formation.
- Such a high pressure gas/liquid dosing is uniquely installed on Moorepark's MTL Tall-form drier and may be availed of by stakeholders and clients to pursue more detailed R&D investigations.



*Deposits of whey permeate powder in the spray drier chamber.*

- Complementary on-site specialised analytical services such as microscopy (National Food Imaging Centre), rheology and particle size monitoring serve enable a comprehensive development programme to be pursued.

### Main Results

High pressure CO<sub>2</sub> dosing in the concentrate feed line to the spray atomiser would appear to potentially benefit whey permeate drying. It would appear that the beneficial effects may be attributable more to changes in powder physical properties rather than alteration of the glass transition states. It is recommended that careful control of the gas dosing is exercised in order not to impact negatively on the wettability behavior of the powders.

### Opportunity/Benefit

Processing conditions established during the course of the study may be used by dairy company R&D personnel in order to accomplish improved spray drying of whey permeates using novel technologies installed on the pilot plant drying facilities at Moorepark Technology Ltd. The results of such investigations would be readily scalable to industrial manufacturing scenarios.

### Collaborating Institutions

None

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**Project number:** 5986

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**Date:** Nov, 2014

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**Funding source:** Dairy Levy

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**Project dates:** Sept 2009 – Dec 2012

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## INFANTMET: Infant Nutrition for Programming the Gut Microbiota in Neonates

### Key External Stakeholders

Food manufacturers, dairy industry, pharmaceutical companies, research communities; public health agencies and health professionals; policymakers

### Practical Implications for Stakeholders

- Establishment of the intestinal microbiota commences at birth and the microbiota has a major role in protection against pathogens, maturation of the immune system and metabolic welfare of the host.
- In terms of infant health, it is imperative to understand how early infant nutrition influences the development of a healthy gut microbiota.
- Delivery mode and gestation age have significant effects on early neonatal microbiota composition.



- A bank of infant intestinal strains (mainly *Bifidobacterium* and *Lactobacillus*) has been generated as future potential probiotics for the infant nutrition and health markets.

### Main Results

- Standard Vaginally delivered Full-Term infants' microbiota remained stable at both phylum and genus levels during the first 24 week period.
- Caesarean section delivered Full-Term infants' displayed a different microbiota composition compared to Standard Vaginally delivered infants, with an increased faecal abundance of Firmicutes and decreased Actinobacteria abundance one week after birth.
- The microbiota of Caesarean section delivered infants displayed a greater flux than that seen in Standard Vaginally delivered infants over the first 24 weeks of life, and gradually progressed to a microbiota closely resembling Standard Vaginally delivered Full-Term infants over that period.
- The gut microbiota of preterm infants displayed a significantly greater abundance of Proteobacteria compared to full-term infants ( $p < 0.001$ ) at week 1.
- The data uniquely shows the longitudinal effect of preterm birth after the infant leaves the hospital environment.

### Opportunity/Benefit

The INFANTMET data provides new opportunities for optimisation of infant milk formula composition, with appropriate new bioactive ingredients such as milk

fractions, probiotics and prebiotics to effectively programme the early infant gut microbiota in a manner closer to mothers milk.

### Collaborating Institutions

APC Microbiome Institute  
University College Cork  
Cork University Maternity Hospital

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**Project number:** 6276

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**Funding source:** DAFM

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**Date:** November, 2015

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**Project dates:** Nov 2011 – Oct 2015

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## In-situ Starch Modification in Food Formulations Using Protein

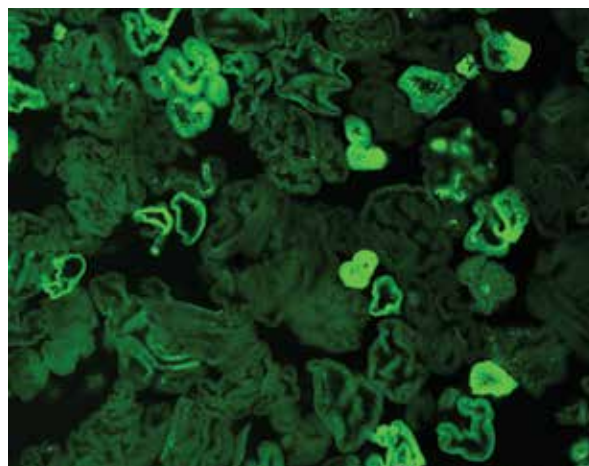
### Key External Stakeholders

- Dairy ingredients and Starch Industry
- Prepared foods and Nutritional beverage manufacturers
- Academic and Research Institutions

### Practical Implications for Stakeholders

The objective was to study the behaviour of mixed protein-starch systems with a view to understanding protein starch interactions as a possible mechanism for in-situ alternation to starch functionality.

- Structure of the starch pastes can be altered by the presence of the proteins (intact or hydrolysed).
- Gelatinisation temperature of starch and denaturation temperature of proteins can be synergistically used to create new food structures.



- A novel rheological reactor cell can be used for simultaneous measurement of viscosity and in-vitro digestion of protein-starch mixtures.

### Main Results

- The gelatinisation temperature of potato starch is lower than the temperature for whey protein denaturation/aggregation; thus in mixtures of potato starch and whey proteins, starch granules swell before denaturation/aggregation of the protein occurs, resulting in a reduction in viscosity and change in functionality.
- Hydrolysed whey protein resulted in a reduction in potato starch granule swelling during heating.
- Different blends of dairy proteins were evaluated in the presence of pre-gelatinised starch for changes in viscosity during in-vitro digestion using a newly designed rheological reactor cell. The study found that a blend of casein and  $\alpha$ -lactalbumin may provide viscosity increase and release of peptides/amino acids for use in commercial applications, e.g., anti-reflux infant formula.

### Opportunity/Benefit

New knowledge on the effect of intact and hydrolysed dairy proteins on the pasting properties of waxy maize and potato starch can be utilised for development of structure in beverage and prepared food applications. The methodologies developed in this study can be used

to evaluate ingredients under simulated (in-vitro) gastrointestinal digestion for use in development of functional, medical or therapeutic beverages.

### Collaborating Institutions

University College Cork, UCC

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**Project number:** 5950

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**Date:** Nov, 2014

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**Funding source:** DAFM (08/RDT/MFRC/636)

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**Project dates:** Nov 2008 – Feb 2014

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## Interaction of Gene Expression Pathways, Breed and Diet on the Nutritive and Flavour Aspects of Pigmeat

### Key External Stakeholders

Pig producers and pigmeat processors

### Practical Implications for Stakeholders

The outcome of this research provides more in-depth understanding of factors such as breed, muscle, sex and diet which can have a significant effect on meat quality, in particular intramuscular fat (IMF) levels.

- A number of genetic pathways which respond to these factors through alterations in their expression levels have been identified.
- Blood parameters provide potential as novel routine markers for quality characteristics with circulating triglyceride and albumin levels associated with dietary treatments.
- Many of the genes identified as differentially expressed between Duroc and Pietrain breeds are



likely to harbour genetic variability in their regulatory regions that may ultimately have applications in meat management and/or genome-assisted animal selection programmes. This project shows the potential of nutrigenomics to optimise the efficacy of pork production regimes.

### Main Results

- Generation of a knowledge baseline of quality and gene expression differences between two breeds (Duroc and Pietrain) with regard to IMF deposition.
- Demonstration, at a molecular level, that the degree of IMF deposition is as a result of a suite of diverse genomic responses with the importance of signaling pathways, lipid, fatty acid and steroid metabolism and the immune response highlighted.
- A muscle effect was highlighted, in relation to IMF content, in the influence of restricted lysine treatment on meat quality, with the *semimembranosus* (leg) muscle responding more strongly than the striploin muscle. Breed also influenced the response with Duroc muscle (both muscles) exhibiting a greater response to the restricted diet.

### Opportunity/Benefit

Information generated in the course of this project will aid the improvement of meat quality traits in Irish pork. The results highlight the importance of breeding and selection programmes and the need to emphasise improvement in meat quality without compromising the production gains from traditional selection for lean carcass and high growth rate. The new knowledge generated about the Duroc breed is highly relevant as there is a gradual increase in the proportion of genetics of breeds such as Duroc in Irish

and European commercial operations. This project may potentially open up the application of nutrigenomics to improve the efficacy of pork production regimes. The control and manipulation of these genes is a promising pathway of research for the future and Teagasc welcomes expressions of interest in this research.

### Collaborating Institutions

University College Dublin

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**Project Number:** 5420

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**Funding Source:** DAFF (04/R&D/TN/262)

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**Date:** October, 2011

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**Project Dates:** Mar 2005 – Mar 2010

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## Investigation of Bioactive Peptides in Food Through the Application of Mass Spectrometry Techniques

### Key External Stakeholders

Food producers and processors, Functional/ Nutraceutical Food Manufacturers, Consumers, Pharmaceuticals, Research Communities

### Practical Implications for Stakeholders

- Bioactive peptides are segments of dietary proteins, which can have salutary health-effects.
- Analysis of bioactive peptides is however difficult due to the complex nature of food samples and requires specialised analytical instrumentation and software.
- Various sources of bioactive peptides including meat, cereals and food-by-products have been investigated using mass spectrometry techniques.
- A facility and expertise is now available to support the food industry and collaborative research in the analysis of food bioactive peptides.



### Main Results

- Anti-oxidant peptides from bovine liver proteins were characterised.
- An ACE-I and renin inhibitory peptides from bovine blood proteins consisting of 2–4 amino acids in length were identified.
- Anti-inflammatory, ACE-I and renin inhibitory peptides from potato peel proteins were sequenced.

### Opportunity/Benefit

Mass spectrometry based analytical methods have been developed to sequence bioactive peptides in a variety of food matrix. This facility can be utilised by the food industry to identify bioactives and support functional food product development.

### Collaborating Institutions

Cork Institute of Technology  
University College Cork

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**Project number:** 5984

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**Funding source:** Teagasc

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**Date:** November, 2015

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**Project dates:** Sept 2008 – Aug 2011

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## Investigation of Stickiness of Milk Powder for the Purpose of Improved Process Control in Milk Powder Manufacture

### Key External Stakeholders

Dairy ingredient manufacturers, infant milk formula manufacturers

### Practical Implications for Stakeholders

- Partial substitution of lactose with proteins or maltodextrin can reduce stickiness problems during drying, crystallisation and storage.
- New measurement techniques have been developed and are applicable to industry.

Understanding the effects of specific formulation components (type of sugar, type of protein) on stickiness is of immense practical benefit with regard to new product development. To this end the project has demonstrated the role of different powder constituents (proteins, maltodextrins and lactose) on stickiness and has developed measurement techniques that are in use in our laboratories.



Modelling was used to show how to deal with the constraints of drying sticky products (including infant formula and other high lactose formulations) and how to optimise process control to maximise production while avoiding plant blockage (and downtime) while air humidity varies.

### Main Results

- Partial substitution of lactose with proteins (i.e. higher molecular weight components) is a means of reducing stickiness problems.
- Maltodextrin inclusion in skim milk powder decreases susceptibility to sticking during drying and crystallisation during subsequent storage.
- Modelling was used to show how to deal with the constraints of drying sticky products (including infant formula and other high lactose formulations).

### Opportunity/Benefit

Teagasc can assist interested parties in improving process efficiencies in the manufacture of dried products. The opportunity exists for further research in this area and expressions of interest from relevant companies are invited.

### Collaborating Institutions

University College Cork

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**Project Number:** 5632

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**Funding Source:** DAFF (06/RD/TMFRC/443)

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**Date:** July, 2011

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**Project Dates:** Nov 2006 – Nov 2010

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## Investigation of the Presence of Anti-Nutritional and Toxic Compounds in “Health Foods”

### Key External Stakeholders

Manufacturers, wholesalers and retailers of health food products, general public, regulatory agencies: DAFF, FSAI, IMB

### Practical Implications for Stakeholders

The objective of this project was to investigate the occurrence of microcystin (MC) and aristolochic acid (AA) toxins in algal and herbal products, respectively.

- Methods were developed and validated to detect AA and MC toxins, which can be employed to monitor the safety of health foods.
- Contaminated products were detected and removed from the Irish market.
- A number of health alerts were published worldwide including, Ireland, the UK and Canada.



### Main Results

- MC toxins were detected in Klamath Lake blue green algae (BGA) products, which are sold in health foods shops throughout the island at concentrations between <0.5 and 3 mg/kg.
- MC toxins were not detected in spirulina BGA products, which may be used as a substitute for Klamath Lake products.
- AA toxins were detected in some herbal preparations sold on the island but these products have been removed from the market.

### Opportunity/Benefit

- Stakeholders can now access analytical methods for detecting AA and MC toxins.
- A novel biosensor assay was developed for detecting MC toxins, which has the potential to be exploited as a rapid test.

### Collaborating Institutions

Xenosense Ltd., Belfast.

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**Project Number:** 5429

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**Funding Source:** DAFF (SafeFood 04CR-06)

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**Date:** January, 2010

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**Project Dates:** Oct 2005 – Oct 2008

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## Kinetic Trapping: A Novel, Energy-Efficient Approach to Designing Protein-Based Fat Replacers

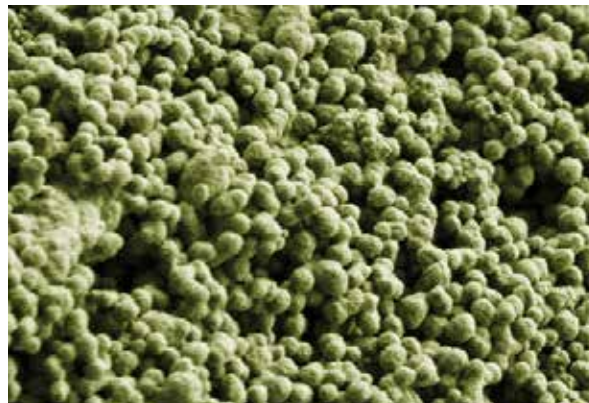
### Key External Stakeholders

Dairy & food industry, ingredient manufacturers

### Practical Implications for Stakeholders

Kinetic trapping is a novel low-energy process for producing nano- and micro-sized protein particles. The technology relies on precise process control of standard food ingredient mixtures using readily available food manufacturing equipment. The kinetic trapping process represents a **new platform technology** for producing size-controlled protein particles in the nano- and micro-size range which was developed and used in this project to produce novel fat replacer ingredients. The benefits of such ingredients when compared to other fat replacers include reduction in capital costs, lower energy demand, enhanced nutrition & functionality and improved sensory quality. Also the use of non-chemically modified i.e. natural ingredients is significant.

Because of health concerns relating to Olestra, a chemically modified oil-based fat replacer, the demand



for protein and polysaccharide based fat replacers is increasing. With the market for fat-replacers globally expected to be **280,100 metric tons** with a compound annual growth rate of 6.03% between 2011 and 2015 (Global Industry Analysts), the availability of such a novel fat replacer ingredient has significant implications for the dairy and food industry and specifically ingredient manufacturers.

### Main Results

- A new whey protein-based fat replacer ingredient was produced using kinetic trapping.
- The novel fat replacer ingredient was produced in dried form with and without konjac gum (soluble dietary fibre) and had creamy texture when added to ice cream. It was whey protein particles size-optimised (100 nm – 10 μm) and calcium enriched (~100mM Ca<sup>+</sup>).
- Conditions for production were optimised and ingredients produced in spray dried form.

### Opportunity/Benefit

This novel platform technology represents a significant advancement in production of fat replacer ingredients and a patent application is currently being filed to protect the novel process and resulting unique products. Teagasc is keen to engage with dairy and food industry and ingredient manufacturers to consider collaborative opportunities as a means of optimising, validating and ultimately commercialising this technology.

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**Project number:** 6041

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**Funding source:** EI (POC-2009–260)

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**Date:** January, 2012

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**Project Dates:** Jan 2009 – Dec 2010

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## Mining for Milk-Based Bio-Actives Using Microbial Fermentations

### Key External Stakeholders

Irish dairy industry, dairy farmers, consumers

### Practical Implications for Stakeholders

- Added functionality of casein, whey and milk based powders with health benefits beyond those associated with nutrition, increased profitability to the Irish milk sector.
- Improved health benefits to the consumer.



### Main Results

The key results were:

- Dairy associated microbes with extracellular proteolytic activity were identified.
- Fermented casein, whey and skim milk based substrates and water soluble extracts from commercial cheeses, were made into freeze-dried powders, a number of which had bioactivity across a range of health indicator assays.
- Optimized fermentation and post-fermentation heat treatments were established that retained bioactivity.

### Opportunity/Benefit

The range of bioactivities associated with the microbial fermented milk products will increase the functionality of milk-based ingredients, adding market value and extending the applications for the dairy industry. The development of products containing the bioactive ingredients will directly benefit public health. This project was a component of FHI, the primary objective of which was to attempt to release peptides from milk proteins that demonstrate bioactivity in the areas of interest to FHI.

### Collaborating Institutions

DCU, UCD, UCC, UL and the companies Carbery, Dairygold, Glanbia and Kerry

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**Project number:** 5939

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**Date:** November, 2014

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**Funding source:** EI & Industry; CC20080001

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**Project dates:** Jan 2009 – Jun 2013

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## National Food Residue Database (NFRD)

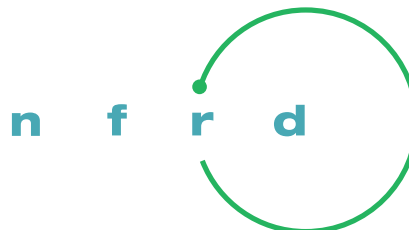
### Key External Stakeholders

Food industry, state agencies (DAFF, Pesticide Control Service, FSAI, RPII, EPA, Marine Institute, State Laboratory), scientific community, general public

### Practical Implications for Stakeholders

This funding has ensured the continued development and enhancement of the National Food Residue Database (NFRD), leading it to becoming the 'one stop shop' for chemical residue information in food in Ireland.

The project resulted in 49 new datasets being published on the NFRD website, along with two NFRD annual reports. An exposure assessment to pesticide contamination in food showed that the exposure to pesticides was well below the allowable daily intake (ADI) and the risk to the consumer from pesticides was low.



Consumer and industry confidence in food production and processing is key to the sustainability of the food industry in this country. The information contained on the NFRD can be used to promote the safety and quality of Irish food, through its use by the food industry and policy/regulatory agencies. In addition, 'country of origin' for pesticide results can aid importers of fruit and vegetable products to identify countries with safer produce. The NFRD needs to be continuously developed and maintained to help ensure that food safety is at the heart of the development of the food industry in Ireland.

### Main Results

- 49 new datasets were uploaded and published on the NFRD website over the duration of the project.
- Two issues of the NFRD Report (2007/2008 and 2009) were published.
- Exposure analyses were conducted for 10 of the most commonly found pesticides (captan, carbendazim, chlorpyrifos, diphenylamine, fenahexamid, imazalil, iprodione, malathion, prochloraz and thiabendazole).
- Results from this study showed that exposure to pesticides was well below the ADI and the risk to the consumer (both adult and child) from pesticides was low.
- Extensive dissemination was carried out during the project through publication on the NFRD website, NFRD annual reports and through a workshop.

### Opportunity/Benefit

The National Food Residue Database can be used as a reference tool by exporters, when queried about the safety of Irish food. It can also be used by importers and processors when buying products from outside of Ireland.

### Collaborating Institutions

University College Dublin

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**Project Number:** 5640

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**Funding Source:** DAFF (06RDТАFRC535)

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**Date:** January, 2012

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**Project Dates:** Nov 2006 – Nov 2009

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## New and Rapid Methods for Evaluating the Baking Characteristics of Irish Grown Wheat Varieties

### Key External Stakeholders

Millers, bakeries, food ingredients companies, food manufacturers

### Practical Implications for Stakeholders

Based on the results of this project, it is now possible for Teagasc to recommend rapid, scientific, accurate tests on grains, flours, doughs and baked products to the industry. Furthermore, researchers at Ashtown have the expertise to work with industry and increase capabilities in these areas, or to engage in confidential industry-led research, using these newly developed methodologies.

As some traditional methods are not deeply scientific, it is possible that some vital information relating to dough and baked properties had not previously been uncovered. Therefore, the methods which have been developed should be of significant advantage to the milling, baking and food industry for a complete analysis and better characterisation of their raw materials and end products, while complementing the more traditional cereal methods.



The new suite of modern and novel methods developed for use along the complete chain from the grain to the finished products includes spectroscopy, rapid flour protein fractionation, laser imaging and digital image analysis.

### Main Results

Novel methods have been developed in the following areas:

- Near infra-red spectroscopy of grain, flour, dough and bread.
- Flour protein fractionation.
- Native starch and protein properties of flours.
- Imaging of confectionary batter and cookie dough during baking.
- Laser imaging of bread dough fermentation and density properties.
- Digital image analysis of bread crumbs.

### Opportunity/Benefit

Advice, consultancy work and/or technical services, relating to the novel and/or traditional methods, in the areas of wheat chemistry, dough rheology and baking processes, can be provided through the Teagasc Food Research Centre, Ashtown.

### Collaborating Institutions

University College Dublin

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**Project Number:** 5412

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**Funding Source:** DAFF (04/R&D/TN/249)

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**Date:** June, 2011

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**Project Dates:** Jul 2005 – Jan 2009

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## Novel Fruit Products from Apples and Other Tree Fruit (IsaFruit)

### Key External Stakeholders

Vegetable processors, government authorities/legislators, consumers, food research scientists

### Practical Implications for Stakeholders

The project developed a number of fresh cut fruit salads and ready-to-eat dessert products enriched with functional ingredients to capitalise on the growing functional food market. These products incorporated a range of functional ingredients including pre- and pro-biotics. An Irish based SME was involved in the development of these products and is interested in launching them when economic conditions improve.



### Main Results

- Fruit cultivars with optimal properties for the development of fruit based desserts and fresh cut salads were selected based on their sensory, physicochemical and quality attributes.
- Novel protocols were developed for incorporation of functional ingredients using technologies such as edible films and vacuum impregnation.
- Functional ingredients were added at levels required to deliver the health benefit based on manufacturers' recommendations.
- At all points the sensory and quality attributes of the products were assessed to ensure that a real marketable product was being produced.

### Opportunity/Benefit

Fruits and fruit products are seen as healthy by consumers. However, if their market share is to grow they need to take advantage of the growing functional food market which fulfils consumer demands for products which deliver a health benefit beyond basic nutrition. This project demonstrated that fruit based functional foods with optimal functional, quality and sensory properties could be developed.

### Collaborating Institutions

University College Dublin, Nature's Best Ltd, IRTA

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**Project number:** 5548

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**Funding source:** EU FP6 (016279)

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**Date:** July, 2011

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**Project Dates:** Jan 2006 – Sep 2010

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## Novel Proteins and Peptides from Seaweeds

### Key External Stakeholders

Protein ingredient manufacturers, marine processors

### Practical Implications for Stakeholders

- Novel protein sources for use in the sports nutrition markets, Halal and Kosher as well as vegetarian markets.
- Increases essential amino acid profile of products.
- Imparts a health benefit.



### Main Results

- Bioactive peptides isolated from red seaweed were found to reduce blood pressure when tested in the lab and in spontaneously hypertensive rats (animal models).
- A novel hydrolysis and purification methodology was employed and applied to red seaweed.
- Optimal conditions for developing bread products with this hydrolysate were determined and blood pressure regulation activity was maintained.

### Opportunity/Benefit

Protein extracts developed as part of this project were examined for their essential amino acid content, ability to inhibit enzymes important in blood pressure control and suitability for use in cereal products such as bread. Extracts could have benefits in the manufacture of food products for the prevention of heart health associated problems such as blood pressure.

### Collaborating Institutions

National University of Ireland, Galway

University College London, UK

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**Project number:** NutraMara – The Marine Functional Foods Research Initiative, Teagasc Walsh Fellowship Programme and INFOGEST (EU COST Action FA1005)

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**Date:** May 2015

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**Funding source:** DAFM and Marine Institute and Teagasc

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**Project Dates:** October 2009 – October 2014

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## NOVTECH: The Use of Novel Technologies for Improving Quality and Process Efficiency in High Protein Beverage Production

### Key External Stakeholders

Food manufacturers, dairy industry, research communities

### Practical Implications for Stakeholders

- The novel technology of supersonic steam injection provides an alternative method for thermal processing of dairy products.
- An investigation into the benefits with regards to the physical and chemical properties of dairy based products processed using this technology.



### Main Results

- Steam injection is a direct method of thermal processing in which food grade steam, under pressure, is directly mixed with the food product creating a more rapid rate of heat transfer than traditional methods.
- Maklad injectors use a specialized form of de Laval nozzle to achieve supersonic flow within the injection chamber. This is to aid in the rapid mixing of product and steam streams and provides a small level of homogenization.
- The rapid heat transfer and subsequent flash cooling result in a reduced thermal load experienced by the product. This has been shown to impart reduced protein denaturation in skim milk compared to products processed using conventional indirect tubular heat exchangers.
- The use of flash cooling within the system provides an opportunity for a small level of total solids concentration. This can be controlled by altering the temperature differential between the product inlet and flash cooling outlet.
- The steam injection unit can be used to 160°C and is Teflon coated to reduce burn on from product when mixed with the steam.

### Opportunity/Benefit

this technology in conjunction with dairy based products, particularly dairy based protein beverages. This heat treatment technology has the potential to yield dairy products with improved physical and chemical characteristics compared to that of conventional indirect heat treatments.

### Collaborating Institutions

University College Cork

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**Project Number:** 6284

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**Funding Source:** DAFM

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**Date:** November, 2015

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**Project Dates:** Oct 2012 – Oct 2016

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## Nutraceutical and Functional Food Bio-active Peptides in Beef, Bovine Offals and Fermented Meat Products

### Key External Stakeholders

Beef processing sector

### Practical Implications for Stakeholders

The main outcome of this research provides support for a strategic approach to recovering value from the meat processing chain. Clear evidence has been presented that bio-active peptides can be generated from low value meat and offal. The capabilities for generating, isolating and characterising bio-active peptides from meat sources have been established at Teagasc. The assays have been optimised and are now part of a full peptide isolation, purification and characterisation infrastructure available to the Irish food industry. The potential of generating bio-active peptides from bovine offal and low value muscle has been demonstrated in this project. Research in the extraction of commercially valuable peptides from



meat and meat industry by-products is in its infancy and this project provides a solid foundation on which future development and discovery will inevitably yield scientific advancement and commercial return.

### Main Results

- Capabilities established for the generation, isolation and characterisation of bio-active peptides from meat sources.
- Antioxidant peptides successfully generated from bovine liver.
- Peptides with antioxidant and antihypertensive activity isolated from brisket fractions.
- Peptides generated from bovine lung which exhibited antioxidant, antihypertensive and antithrombotic activity.
- Heart peptide fractions displayed antioxidant and antimicrobial activity.
- Bio-active peptides generated from proteins isolated from bovine muscle.

### Opportunity/Benefit

Knowledge generated in this research will be beneficial in developing strategies to recover value from meat processing streams. Such scientific expertise and infrastructure should act as a springboard to encourage the exploitation of the protein component of offal and waste streams produced by the meat industry, as a source of high value biologically active ingredients with food and pharmaceutical applications.

### Collaborating Institutions

University College Cork

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**Project number:** 5636

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**Funding source:** DAFF (06RDТАFRC472)

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**Date:** March, 2012

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**Project Dates:** Dec 2006 – Nov 2010

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## Optimum Milk Quality Focusing Particularly on Chemical Residues

### Key External Stakeholders

Dairy farmers, Milk processors, Export markets, members of veterinary profession

### Practical Implications for Stakeholders

- The Dairy industry (milk producers and processors) and Teagasc, Moorepark have worked in collaboration since 2007 to identify and develop strategies for trichloromethane (TCM) residue reduction in milk and butter. A reduction in average milk values from 0.007 to 0.003 means that Irish butter exports will continue to compete favourably on the German market;
- Both dietary iodine supplementation and teat disinfection iodine individually result in milk iodine levels exceeding common target values of 250–300µg/kg. Both iodine treatments can frequently occur simultaneously on farm, thus supplementations should be monitored, particularly in light of infant feed formula manufacture;
- Traces of active ingredients of some flukicide



products will migrate from whole milk to skim milk powder. Therefore it is important that research be conducted to establish MRLs (maximum residue limits) in milk and dairy products, for the active ingredients in animal treatment products (e.g. flukicides) to ensure (a) avoidance of risk to public health and (b) prevention of animal health issues by allowing use of effective products (some have been banned due to the absence of an MRL).

### Main Results

- Milk TCM levels have been reduced to 0.002 mg/kg in milk in 2011, i.e. the target level in milk that ensures TCM never exceeds 0.03 mg/kg in the butter product. These low levels have to be maintained in the long term;
- Supplementation of dietary iodine at 30 and 70 mg/day significantly increased mean milk iodine concentrations from 208µg/kg to 672 and 733µg/kg, respectively. Teat disinfection post-milking and pre- + post-milking significantly increased the mean iodine concentration from 219µg/kg to 475 and 670µg/kg, respectively;
- Between 95% and 98% of Nitroxylin (active ingredient in flukicide product) migrated from whole to skim milk. The remainder was within the cream. When skim milk was converted to skim milk powder, almost 100% of Nitroxylin was transferred into the powder.

### Opportunity/Benefit

These results may be used by (i) dairy farmers to improve their milk quality on-farm, (ii) milk quality advisory personnel to solve milk residue issues on-farm and (iii) bodies such as DAFM and IDB in promoting dairy products for the export market.

### Collaborating Institutions

Cork Institute of Technology, Bishopstown, Cork.

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**Project number:** 5895

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**Funding source:** Dairy Levy Funding

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**Date:** February, 2012

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**Project dates:** Jan 2009– Dec 2011

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## Pathogenic *Escherichia coli* Network

### Key External Stakeholders

Farmers, food processors, scientists, regulatory personnel, medical doctors, veterinarians, epidemiologists, microbiologists, consumers, European Food Safety Authority (EFSA)

### Practical Implications for Stakeholders

Up-to-date information and advice on the different *Escherichia coli* pathogens, detection, epidemiology, pathogenicity, virulence, ecology and control in the farming and beef processing stages of the food chain.



### Main Results

Six reports were published on current knowledge, identifying data gaps and making a range of key recommendations designed to improve food/medical testing, epidemiological investigations, control and our overall understanding of these serious pathogens.

### Opportunity/Benefit

This project furthered the existing knowledge base by bringing together international experts on pathogenic *E. coli*, especially verocytotoxigenic *E. coli* (VTEC), to discuss and resolve issues relating to culture and molecular detection, virulence, pathogenicity, epidemiology, ecology and control.

### Collaborating Institutions

See full Technology Update

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**Project Number:** 5704

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**Funding Source:** FP6 (FOOD-CT-2006-036256)

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**Date:** June, 2011

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**Project Dates:** Jan 2007 – Jan 2010

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## Pork Food Safety

### Key External Stakeholders

Irish pork producers, Irish pork processors, regulatory agencies (FSAI & DAFM), retailers

### Practical Implications for Stakeholders

- Pig farm: Urea or ammonia may be used to disinfect *Salmonella* and/or *Yersinia enterocolitica* contaminated pig slurry.
- Pig abattoir: A time-temperature combination of 2.67 min at 60°C is required to achieve a 1 log reduction in *Y. enterocolitica* in scald tank water. The predicted equivalent at 65°C is 0.59 min.
- Pig abattoir: Cross contamination occurred in the lairage and during carcass processing. More effective sanitation is recommended.



### Main Results

The incidence and spread of *Salmonella* and *Y. enterocolitica* on Irish pig farms could be reduced through the application of urea or ammonia to disinfect animal waste. *Y. enterocolitica* contamination on pork carcasses would be reduced if the time-temperature combination in the scald tank was set at a minimum of 2.67 min at 60°C or equivalent and cross contamination of carcasses could be prevented if the lairage area was disinfected more efficiently. All of this would result in reduced pathogen contamination on pork carcasses and in pig products thus protecting public health and pork consumers.

### Opportunity/Benefit

This project provided information on the control of key pathogens in Irish pork at the farm and processor stages. Interested industry and regulatory personnel should contact Dr. Declan Bolton directly to discuss implementation. The main benefit of implementing the results of the project would be a reduced risk of pork associated illness thus protecting public health and the reputation of the Irish food industry. Furthermore, the current status of the Irish pig industry in European Food Safety Authority (EFSA) league tables would improve.

### Collaborating Institutions

University College Dublin

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**Project Number:** 5706

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**Funding Source:** FP6 (FOOD-CT-2007-036245)

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**Date:** March, 2012

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**Project Dates:** Jan 2007 – Dec 2011

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## Potato Peels: a Rich Source of Pharmaceuticals and Bioactives

### Key External Stakeholders

Potato growers, potato processors, pharmaceuticals, functional food manufacturers, government authorities/legislators, consumers, food research scientists

### Practical Implications for Stakeholders

Large volumes of potato peels as by-products are generated as a result of processing of foods. This project highlighted the potential use of this waste as a source of bio-active compounds for bio-pharmaceutical and natural bio-control agents.



### Main Results

- A set of optimised methods for the extraction, isolation, purification and characterisation of glycoalkaloids was developed.
- The purified aglycone glycoalkaloid, solanidine, had a high potential to synthesise novel anticancer and apoptotic drugs.
- None of the 9 different cultivars exceeded the threshold of toxicity of glycoalkaloids content of 1 mg/g. As expected, room temperature storage influenced the greater production of glycoalkaloids in peels when compared to potatoes stored at chilled temperature.
- Glycoalkaloids and potato peel extracts enriched in glycoalkaloids did not possess anticancer potential nor did they induce apoptosis nor showed cardioprotective effects. However, they demonstrated anti-inflammatory and immuno-modulatory potentials. Whilst the potato peel peptides showed anti-inflammatory, anti-hypertensive and modest anti-oxidant activities.
- Pelleted potato peels rich in glycoalkaloids controlled the level of nematode *Globodera pallida* in conjunction with crop rotation or nematicide and more importantly the light treated pelleted peels had significantly higher 'suicide hatch' rate of potato nematodes.

### Opportunity/Benefit

The methods developed for the recovery of compounds from their waste streams will allow potato processors to exploit a potentially valuable resource. Information on the

levels of toxic glycoalkaloids in Irish fresh potato cultivars and the effect of commercial storage conditions used by the processing industries will be available. The outcomes of the project will also indirectly address the call for sustainable agriculture development as it seeks to find an environmentally safe solution for the control of potato nematodes, a major pest of potato crops, which cause significant damage and losses.

### Collaborating Institutions

University College Cork; Largo Foods, Ashbourne, Co. Meath; Wilson's Country, Craigavon, Co. Armagh.

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**Project number:** 5961

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**Date:** December, 2008

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**Funding source:** DAFF 08/RD/TAFRC/673

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**Project dates:** Dec. 2008 – July 2014

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## Pre-commercial Scale-up of Biologically Active Milk Protein Hydrolysates (FHI Project WP3)

### Key External Stakeholders

This Industry-led, EI-funded Food for Health Ireland (FHI) project was co-funded by 4 major Irish dairy manufacturers Glanbia, Kerry, Carbery and Dairygold. The FHI project was governed by a consortium agreement drawn-up in conjunction with all participants which set out protocols for the uptake of results.

### Practical Implications for Stakeholders

Successful precommercial scale-up work at Moorepark retained bioactivity of FHI lead functional compounds (LFCs) i.e. enzymatically-produced milk protein hydrolysates and their sub-fractions in line with their original laboratory-based protocols, and also satisfied the microbiological specification necessary for formulation of the active ingredients in human clinical trial diets (undertaken by UCD).

- Pre-commercial scale-up contributed substantively towards the compilation of technological data

which will be incorporated in scientific dossiers setting out health claims for individual LFCs to be submitted to the European Food Safety Authority (EFSA).



- In addition to the protocols and LFC's assigned by FHI, the pre-commercial scale-up team generated a novel casein-based hydrolysate and sub-fractions which was biologically active against multiple physiological functions (anti-inflammatory; endothelial and satiety-ghrelin).
- Technological developments employed to enrich biological activity during scale-up included advances in membrane separation technology e.g. charged- and electro-membrane based processes.

### Main Results

The following is a list of outputs accomplished by the FHI pre-commercial scale-up team:

- No. protocols validated (laboratory): 150.
- No. plant scale-up trials: 50 (small) and 35 (large).
- **LFC's** (Lead Functional Compounds): 6 based on the MF025 hydrolysate series
- **ACR** (Available Centre Result): 1 (Hypoallergenic Infant Dessert).
- **NPD** (Novel Product Development): 3 (Family Milk & HA Infant Dessert).
- Complementary research highlighted the benefits of protein aggregation-enhanced enzymatic hydrolysis.

### Opportunity/Benefit

Ground rules laid down in the FHI consortium agreement set out conditions for priority right of access by its Industry Partners to project outputs with commercial potential. Otherwise, expressions of interest in the scale-up and characterisation of FHI milk protein hydrolysates and their fractions will be entertained by the technology transfer officer. An FHI 'available centre result' (ACR) based on the novel formulation of a hypoallergenic infant food (desert-format) is currently licensed out for evaluation.

### Collaborating Institutions

UL, UCD, UCC, DCU

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**Project number:** 5940

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**Date:** October, 2014

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**Funding source:** Enterprise Ireland

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**Project dates:** June 2008 – May 2013

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## Predicting Beef Eating Quality

### Key External Stakeholders

Beef processors, retailers

### Practical Implications for Stakeholders

Beef processors could use the Meat Standards Australia (MSA) grading system to sort individual cuts into eating quality classes priced accordingly. Such a guarantee of expected eating quality could increase the share of the market particularly at the premium end. For optimum eating quality boning should not be carried out on the day after slaughter. Processors and retailers need to consider the negative effects of MAP on eating quality.



### Main Results

- The MSA palatability grading scheme uses a predictive model to assess the eating quality of individual cuts from each carcass and assigns them to a quality class.
- Although the model was developed in Australia using Australian consumers our research showed that it worked equally well for Irish beef and Irish consumers.
- The model was tested over a wide range of carcass types and for three cooking methods (grill, roast and thin slice) with over 1600 consumers tasting over 1100 samples.
- Factors of particular importance to the Irish beef industry (breed, sex, electrical stimulation, aitch-bone hanging, prolonged ageing) were accounted for by the model.
- Boning at 24 versus 48 hours post mortem had a small negative effect on eating quality and this was not accounted for by the model.
- PiVac, a novel method of avoiding cold shortening of hot boned beef (Tenderbound) produced meat of equal quality to cold boning.
- High resolution imaging using hyperspectral imaging can predict eating quality attributes with a high degree of accuracy.
- High oxygen MAP promotes lipid oxidation leading to off-flavours and protein oxidation leading to less tender meat.
- Irish consumers preferred meat from MAP packs with 50% oxygen despite a high level of lipid oxidation.

### Opportunity/Benefit

Irish beef processors could use the MSA system to sort beef into quality classes and supply the market with beef of guaranteed quality.

### Collaborating Institutions

UCC and UCD

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**Project Number:** 5418

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**Funding Source:** DAFM 04/R&D/TN/256

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**Date:** October, 2013

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**Project Dates:** April 2005 – June 2008

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## Prevalence and Epidemiology of Emergent Strains of Verocytotoxigenic *E. coli* (O157, O26 And O111) in Irish Food Animals at the Pre-Harvest and Harvest Levels of the Food

### Key External Stakeholders

Meat and dairy industry, Food Safety Authority of Ireland

### Practical Implications for Stakeholders

Verocytotoxigenic (VTEC) *E. coli*, and in particular serogroup O157, are highly significant food borne pathogens. More recently, other non-O157 VTEC serogroups, in particular O26 O111, O103, and O145 have emerged and been associated with human illness. This project focused on establishing the risk posed by *E. coli* O26, O111, O145, and O103 as well as O157 in ruminant food animals (cattle and sheep) and on their transmission from hide/fleece to meat carcasses during the slaughter and dressing



operations. The project also generated data on these pathogens in dairy cattle and raw milk from selected dairy herds. The key message from the study is that *E. coli* O157 remains the most common serogroup. In the meat chain, the hide and fleece are the most important sources of contamination.

### Main Results

- **Beef:** *E. coli* O157 was detected in 15.96% of hide, 2.33% of faeces, 0.59% carcass (pre-wash), 0.63% (post-wash) and 3.03% environmental samples. The majority of isolates were highly virulent. *E. coli* O26 was isolated from 0.25% of hide, 1.48% of faeces and 0.56% of environmental samples but no other sample types. *E. coli* O145 was isolated from 0.74% of faeces samples and 0.56% of environmental samples but not on carcass surfaces. *E. coli* O111 was not detected in any of these samples. Of the non O157 serogroups, only a small proportion were virulent.
- **Sheep:** *E. coli* O157 was found in 1.0% of fleece and 0.8 % of carcass samples. *E. coli* O26 was recovered from 2.4 % of fleece, 1.8% of carcass and 4.1% of environmental samples. O103 was found in 16.0% of fleece and 12.6% of carcass swabs and *E. coli* O145 was recovered from 0.2% of fleece samples. *E. coli* O111 was not detected in any of the samples processed.
- **Dairy:** 1% of dairy faecal samples contained O157, O26 or O103 strains but none of the milk or milk filter samples yielded any virulent isolates.

### Opportunity/Benefit

Advice, consultancy work and/or research can be provided by Teagasc on Verocytotoxigenic *E. coli*.

### Collaborating Institutions

University College Dublin, Cork County Council Veterinary Unit

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**Project Number:** 5555

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**Funding Source:** DAFF (05/R&D/D/364)

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**Date:** January, 2011

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**Project Dates:** Jun 2006 – May 2009

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## Probiotic Lactobacilli Survival and Impact in the Animal Gut

### Key External Stakeholders

Animal feed manufacturers; thoroughbred racehorse industry, veterinary health professionals

### Practical Implications for Stakeholders

- This project provides first time information on the microbial ecology of the equine, and other mammalian species gut.
- This project also provides information on commensal lactobacilli found in the gut microbiota of humans and animals.



### Main Results

- The project provided definitive genome-based evidence to support the fermentation patterns of sixteen strains of *Lactobacillus ruminis*, and has identified prebiotic carbohydrates with the potential to promote *L. ruminis* growth *in vivo*.
- This project identified the core faecal microbiota of ruminants, hindgut fermenters and mono-gastric animals co-localised to a single farm in Ireland.
- The project provided details for the first time, on the faecal microbiota of thoroughbred racehorses, both active and at rest.
- Analysis of the thoroughbred horse microbiota has revealed *Lactobacillus equi* to be a predominant *Lactobacillus* species in the hindgut. Genome analysis identified genes and enzymes highlighting *L. equi* adaptations to the herbivorous gastrointestinal tract of the horse, including fructan hydrolases.
- Having sequenced the genome of *Lactobacillus equi*, will help to further understand the microbial ecology of the equine hindgut and the influence lactobacilli have on it.

### Opportunity/Benefit

The outcomes of this project is of relevance for the basic understanding of commensals/probiotics, potential mammalian applications, and potential alternatives to in-feed antibiotics for the animal production industry and generation of information of direct relevance for human probiotic consumption.

### Collaborating Institutions

Teagasc and University College Cork

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**Project number:** 5972

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**Date:** Summer 2014

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**Funding source:** Science Foundation Ireland

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**Project dates:** Sept 2008 – Aug 2013

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### How to Proceed

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## Product Reformulation and *In Vitro* Testing of Low Glycaemic Breads

### Key External Stakeholders

Food ingredients companies, bakeries, millers, food manufacturers, consumers

### Practical Implications for Stakeholders

Significant findings of the research conducted in this project include detailed information on a range of low glycaemic index (GI) grains and fibres/flours, and their application in novel low glycaemic index (GI) bread formulations. How these fibres behave under mixing, proofing and baking conditions has been assessed, and their shelf life (texture) and sensory properties have been established. This project has led to the development of new, high quality, low GI bread formulations.

A large number of new bread recipes containing a range of different low GI ingredients have now been formulated, and information is now available relating to the optimal water addition and mixing characteristics,



and expected bread, shelf life and sensory properties of the products. Both quantitative and qualitative sensory trials have shown that low GI flours may be introduced into a wheat bread formulation without significantly negating the sensory properties of the resulting breads.

### Main Results

- Compositional characterisation of low GI grains.
- Flour blending and baking methods for new low GI bread formulations.
- Sensory properties of new low GI formulations.
- Fundamental rheology, baking and molecular aspects of the new formulations.
- An *in vitro* method for calculating the glycaemic index of the formulations.
- Scientific and technical publications describing the research methods and how the results and formulations may be utilised by an end-user.

### Opportunity/Benefit

Advice, consultancy work and/or technical services, relating to the methods and/or formulations developed during this project can be provided at Teagasc Food Research Centre, Ashtown, particularly in the areas of cereal chemistry, dough rheology and baking processes.

### Collaborating Institutions

University College Cork

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**Project number:** 5714

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**Funding source:** DAFF (06/R&D/TAFRC/522)

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**Date:** March, 2012

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**Project Dates:** Oct 2006 – Mar 2010

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Eimear Gallagher

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## Properties of Nano-fibrillar Whey Proteins

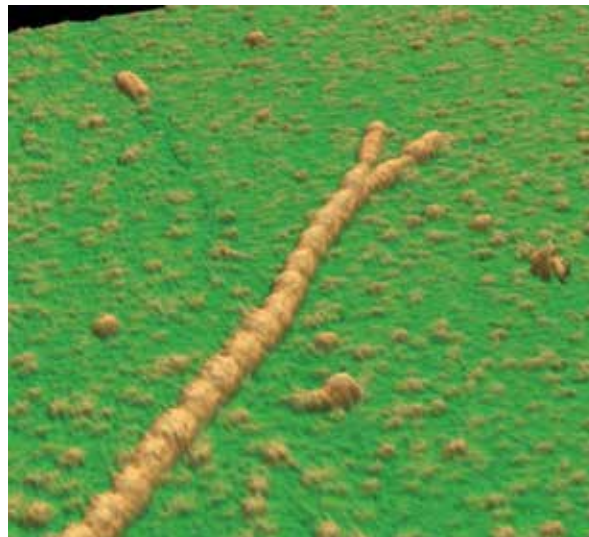
### Key External Stakeholders

- Dairy Industry
- Food and Ingredient Manufacturers
- Biotechnology companies
- Academic Institutions

### Practical Implications for Stakeholders

The main objective was to produce fibrillar whey proteins at the nano-scale and assess their potential as functional ingredients. Main outcomes included:

- Optimised conditions for producing stable nanofibrillar whey proteins.
- Nanotechnology expertise in characterising the structure and formation mechanism of fibrillar proteins.
- Shown that nanofibrils can be used to create low salt gels, foams and biofilms.
- Development of nano-fibrils into a spray dried ingredient.



- Established a research platform of expertise in food nanotechnology.

### Main Results

- Mechanism for forming nanofibrillar whey proteins has been established.
- Functionality of the nanofibrils has been assessed.
- Spray dried nanofibrils have been produced.
- New atomic force microscopy expertise has been gained.

### Opportunity/Benefit

This has established Ireland's first food nanotechnology platform based on nano-engineering food structures. Whey-based nanofibrils have unique functionality, in particular they are excellent foaming agents that can be used to replace more expensive ingredients such as egg-white. In addition, nanofibrils can be used as texturing agents in food products, for example to produce low-salt gels.

### Collaborating Institutions

Materials and Surface Science Institute, University of Limerick

Institute of Food Research, Norwich

Wageningen University

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**Project number:** 5607

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**Date:** September, 2013

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**Funding source:** DAFM (06/RDT/MFRC/432)

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**Project dates:** Oct 2006 – Mar 2010

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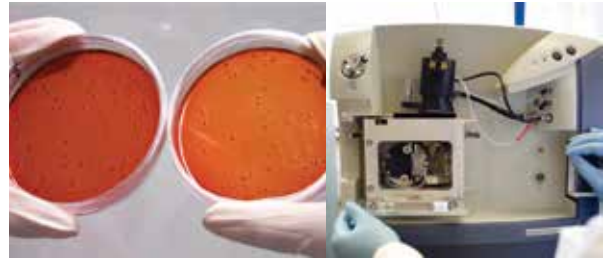
## ProSafeBeef: Assessment of Microbiological and Chemical Safety of Beef

### Key External Stakeholders

Beef sector, Regulators, FSAI

### Practical Implications for Stakeholders

This research study indicated that the risk posed by the microbial pathogens and chemical residues examined in beef was generally low. Nonetheless the study showed that the hide was an important vehicle of microbial pathogen contamination into the abattoir and would thus be a key target for risk reduction measures. A new technology for anthelmintic drug residues was developed and is now in use by the Irish national reference laboratory.



This research was carried out as part of a multi-national EU Framework project, *ProSafeBeef* which focused on research and innovation to improve beef safety and quality. Research on beef safety at Teagasc focused on the risk posed by microbial pathogens and chemical residues in beef.

### Main Results

- The occurrence of verocytotoxigenic *E.coli*, *Listeria monocytogenes*, *Campylobacter* and *Salmonella* in the beef chain was low. However many of the isolates that were recovered had traits similar to those seen in human illness-causing strains, highlighting the need for continued vigilance in the risk management of such pathogens along the beef chain (farm to fork).
- In this study *E.coli* O157, the most common type of VTEC in human illness, was also the most commonly recovered VTEC from beef. Emergent serogroups were recovered at a lower prevalence, and the majority of these isolates did not have the combination of virulence genes typically seen in human disease-causing strains.
- During slaughter, it was shown by genetic fingerprinting that, the source of pathogens on a carcass could be from an animals own hide or from the hide of other animals being slaughtered on the same day, highlighting that the hide is a key target in the chain for interventions.
- A new state-of-the art Mass Spectroscopy (UHPLC-MS/MS) method was developed for the detection of 38 anthelmintic drug residues. This accredited method was then applied to assess occurrence of anthelmintic residues in 1061 retail beef samples from across Europe over a two year period. Results showed that the risk of exposure to EU consumers from anti-parasitic drug residues in beef was negligible.

### Opportunity/Benefit

The study showed that the hide was an important vehicle of microbial pathogen contamination into the abattoir and would thus be a key target for risk reduction measures. A new technology for anthelmintic drug residues was developed and has been transferred to a number of EU laboratories, thus harmonizing the approach of residue control for beef consumed by EU consumers. This research underpins the safe image of EU beef, ensuring consumer confidence and safeguarding international investment in the sector.

### Collaborating Institutions

See full Technology Update at [www.teagasc.ie/publications](http://www.teagasc.ie/publications)

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**Project Number:** 5705

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**Funding Source:** FOOD-CT-2006-36241

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**Date:** September, 2013

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**Project Dates:** March 2007 to Dec 2012

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## Protecting Consumer Choice: Ensuring the Provenance of Artisan Foods Produced on the island of Ireland

### Key External Stakeholders

Artisan cheese producers; food processors; retailers; regulatory agencies; public analysts

### Practical Implications for Stakeholders

Protection of Brand Ireland is of critical importance for the ingredients and processed foods industries. Artisan cheese production in Ireland has grown considerably over the last decade and has established a reputation for high quality. Linkage of production to local raw materials is a key characteristic of this developing enterprise sector. Development of appropriate analytical means to confirm the provenance of such finished cheeses would represent a key support for companies and lay some of the foundations to support a geographic designation label should any such be desired in the future. Meat products are ideal vehicles for fortification with extra



protein, vitamins and minerals and reformed products will provide enhanced and targeted nutrition to promote healthy ageing and vitality in the older population.

### Main Results

- A representative sample set of Irish artisanal cheeses has been collected on two occasions over a 12 month period.
- Baseline data describing the content and variability of 11 elements (Na, Mg, P, K, Ca, Mn, Fe, Cu, Zn, Se and Mo) have been established.
- Corresponding data for ratios of naturally-occurring isotopes (H, C, O and N) are being collected.
- Preliminary results indicate that it may be possible to discriminate artisan cheeses produced on the island of Ireland from those produced on mainland Europe. Separation of cheeses produced in Ireland from those originating in Great Britain may not be possible.
- Currently, data collection and full mathematical analysis are being completed.

### Opportunity/Benefit

Any successful application for geographic origin status within the EU will require, among other things, the demonstration of a verified analytical capability to confirm the claim being made. This project aims to demonstrate one potential approach to achieve such a capability. This approach mirrors that used successfully for the monitoring of Grana Padano cheeses in Italy for geographic provenance infringements by an industrial

consortium. This general analytical approach is capable of being applied to many food products to confirm geographic origin and other authenticity characteristics.

### Collaborating Institutions

Queen's University Belfast

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**Project Number:** NFD T-0101-6557

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**Funding Source:** safefood

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**Date:** 11/05/2015

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**Project Dates:** 01/09/2013-31/07/2015

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## Proteome Analysis to Improve Meat Tenderness

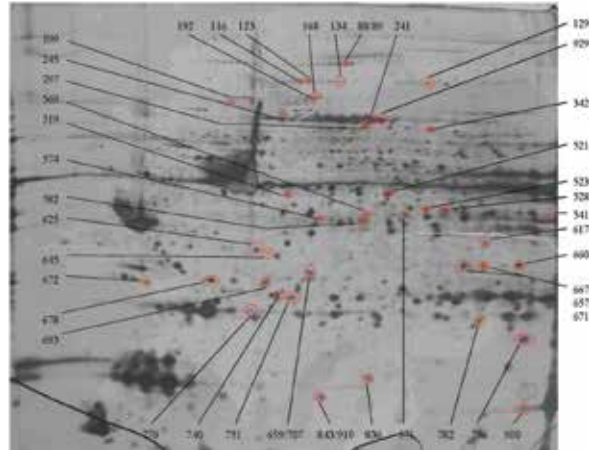
### Key External Stakeholders

Meat processors, scientific community, government agencies

### Practical Implications for Stakeholders

The main outcomes from this research relate to the increased understanding of factors underpinning variability in meat tenderness, with novel proteins identified, and information which will support optimisation of postmortem carcass management.

- Identification of a novel biochemical pathway which is of relevance to the development of tenderness in beef and pork.
- Increased understanding of known biochemical pathways influencing tenderness.
- Optimising postmortem interventions: importance of factors such as muscle composition, genetic makeup and animal age.



### Main Results

- Structural protein degradation, metabolic enzyme systems and cell defense capability in early postmortem muscle contribute to final tenderness differences in beef and pork with a novel protein identified in cell defense pathways.
- Differential protein profiling was observed in response to postmortem interventions, in particular indicating the importance of intramuscular fat levels and the genetic makeup of the animal when using electrical stimulation.
- Tenderstretch influenced collagen solubility in both muscles while the total collagen content was not change. Microstructure analysis suggests that a greater separation of the myofibres did observed following tenderstretch treatment.

### Opportunity/Benefit

Knowledge gained from this project could be beneficial in enhancing current grading systems to incorporate a tiered pricing system in terms of tenderness, and defining optimal postmortem intervention practices to provide assurance of tenderness to meet market demand.

### Collaborating Institutions

University College Dublin

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**Project Number:** 5422

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**Funding Source:** DAFF (R&D/TN/254)

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**Date:** March, 2012

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**Project Dates:** Apr 2006 – Mar 2009

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## Public Health Significance of Emergent *Campylobacter* Species in the Irish Food Chain

### Key External Stakeholders

Pork industry, poultry industry, public health laboratories, Food Safety Authority of Ireland

### Practical Implications for Stakeholders

*Campylobacter* spp. is the most common cause of bacterial food borne illness in Ireland. It was considered up the mid 2000's that infection was almost exclusively linked to just two species, *C. jejuni* and *C. coli*, but new methods capable of detecting 15 other species of the pathogen indicated that these emergent species were also causing human illness. This study investigated the occurrence and human virulence potential of emergent *Campylobacter* species in Irish pork, poultry and human clinical stool samples. The key finding was that these emergent



species are indeed widely prevalent in the food chain and have virulence factors which indicate their public health importance.

### Main Results

- *Campylobacter* was detected in pig gut (caecal) contents (34.7%), pre chill pork carcasses (17%), pork cuts (9.5%) and chicken pieces (68%) with a wide range of species present across all sample types including *C. coli*, *C. jejuni*, and emergent species *C. lari*, *C. upsaliensis*, *C. mucosalis*, *C. curvus*, *C. sputorum*, *C. concisus*, *Arcobacter butzleri*, *Arcobacter Skirrowii*.
- *Campylobacter* was found in 4.8% of previously undiagnosed human clinical samples with emergent species *C. concisus* the second most common species recovered after known species *C. jejuni*.
- The majority of emergent species isolated had virulence genes typically found in known *C. jejuni* and *coli* giving further evidence of a link to human illness.
- *Campylobacter* isolates recovered from poultry and beef were genetically identical to isolates recovered from human stools. Isolates recovered from pork were less similar, indicating that the pork has less of a role in the transmission of human disease causing strains than other commodities.

### Opportunity/Benefit

Advice, consultancy work and/or research can be provided by Teagasc on *Campylobacter*.

### Collaborating Institutions

Public Health Laboratory at Cherry Orchard Hospital

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**Project Number:** 5553

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**Funding Source:** DAFF (05/R&D/TN/356)

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**Date:** September, 2010

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**Project Dates:** Jul 2006 – Jun 2009

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## Rapid Methods for Detection of Anti-Protozoan Drugs

### Key External Stakeholders

Meat, egg and poultry sectors, feed mills, regulatory agencies, e.g. DAFF, FSAI, IMB

### Practical Implications for Stakeholders

The objective of this research was to develop and validate a range of rapid methods for detection of three key anti-protozoan drug residues – diclazuril, halofuginone and toltrazuril. The technologies currently available for residue detection are often highly specialised (and costly) and generally not suitable for application within industry. Therefore low-cost, effective means of screening such components will benefit food producers. A comprehensive liquid chromatography method was developed to detect 21 anti-protozoan and anticoccidial residues in eggs and meat and validated to meet EC 2002/657 criteria.

Anti-protozoan drugs are used in the treatment of *Eimeria* and *Cryptosporidium parvum* infections in poultry, pigs, lambs and calves. Residues of these drugs can occur in food because of feed contamination or failure to observe withdrawal periods



following administration. To date, there has been little knowledge on the incidence of antiprotozoan drug residues in food of animal origin due to the lack of suitable analytical methods and the difficulty in analysing these substances. This new development therefore has significant implications for meat, egg and poultry sectors and can be applied to the detection of anti-protozoan drug residues within food at factories, feed mills, or on-line processing monitoring in large-scale food production plants.

### Main Results

- Novel antibodies were developed to halofuginone and diclazuril.
- A range of biosensor assays were developed for these residues including a novel multiplex immunoassay, capable of simultaneous detection of diclazuril, halofuginone and toltrazuril.
- A comprehensive liquid chromatography method was developed and validated to detect 21 anti-protozoan and anticoccidial residues in eggs and meat.

### Opportunity

A new analytical test was developed and validated to detect 21 anti-protozoan and anticoccidial residues in eggs and meat. This comprehensive test is currently the best available for these residues and is now available as a commercial service to the Irish food industry to ensure that they are in compliance with HACCP and their produce is safe.

### Collaborating Institutions

Dublin City University

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**Project Number:** 5578

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**Funding Source:** DAFF (06/RDCU478)

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**Date:** July, 2011

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**Project Dates:** Sep 2006 – Aug 2010

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## Rapid Methods for Food Authentication and Quality Confirmation

### Key External Stakeholders

Food manufacturers, consumers, regulatory agencies

### Practical Implications for Stakeholders

The outcome is a clear indication of the power and utility of rapid, non-destructive spectroscopic methods for demonstrating conformance to specification of foods and food ingredients.

- Variations in raw material quality may be detected and defective material rejected.
- In-process changes may be mapped and controlled.



- Final product consistency may be measured and assured.
- This technology facilitates the application of PAT (Process Analytical Technology) in the food industry.

### Main Results

- Spectroscopic models have been developed which are capable of discriminating between closely-related food products e.g. extra virgin olive oils from Liguria and other regions in Italy, Corsican honey and honey from neighbouring territories.
- A spectroscopic method for confirming the identity of a branded product was demonstrated. Spectroscopy combined with mathematical modelling has been demonstrated to be suitable for demonstrating conformance to specification in a range of food products.

### Opportunity/Benefit

By interaction with this expertise at Teagasc Food Research Centre Ashtown, food processors can reduce variability in the functional and other characteristics of their products, and move towards a PAT approach in food processing.

### Collaborating Institutions

See full Technology Update

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**Project Number:** 5430

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**Funding Source:** FP6 (2003-Food-2A-0060942)

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**Date:** January, 2011

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**Project Dates:** Jan 2005 – Dec 2011

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## Re-engineering Process Technology for the Manufacture of Infant Formula

### Key External Stakeholders

- Dairy Ingredients and Infant Formula Sector
- Dairy Processing Equipment Manufactures
- Academic and Research Institutions

### Practical Implications for Stakeholders

The study aimed to re-engineer process technology for the manufacture of infant milk formula (IMF) by modification of formulation dynamics and use of steam shockwave Injector (Maklad-Fluid GmbH) technology:

- A greater understanding of the impact of macronutrient interaction (upon heating) on viscosity during IMF manufacture has been achieved and can be utilised for new formulation development.
- High solids infant formulations can be processed using a shockwave steam injector.
- IMF concentrate manufactured with a selectivity



hydrolysed whey protein ingredient has application in high dry matter processes for reduced energy costs and more sustainable processing.

### Main Results

The study demonstrated that heat-induced changes in infant formula associated with whey protein (denaturation, viscosity) are not only a function of concentration but are also dependent on interactions between macronutrients. Selectively hydrolysed proteins were shown to be an effective way of reducing viscosity, while maintaining good emulsification capacity, in heat-treated high solids concentrates of 1st age (0–6 months) infant formula. A new energy efficient high solids process for manufacture of infant formula with lower viscosity was developed using a shockwave steam injector.

### Opportunity/Benefit

The research provides a platform for understanding the heat-induced changes associated with macro-nutrient interactions in IMF for development of new formulations. In addition, technology has been developed for processing formulations at high solids using novel energy efficient approaches based on new ingredients and processing techniques. The new knowledge/process can be exploited by end users i.e., ingredient manufactures and infant, adult and medical nutritional beverage sectors.

### Collaborating Institutions

University College Cork, UCC

**Project number:** 5949

**Date:** November, 2014

**Funding source:** DAFM (08/RDT/MFRC/666)

**Project dates:** Oct 2008 – Feb 2014

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## Risk Assessment Network of Ireland

### Industry Impact

The study assessed the impact of two food pathogens on the safety of raw milk cheese for the benefit of raw milk cheesemakers and the public in general. The study showed that risks associated with *Staphylococcus aureus* are low, while those associated with *Listeria monocytogenes* are more significant.

### Key External Stakeholders

Raw milk cheese industry; Policymakers, Food researchers

### Practical Implications for Stakeholders

The study assessed the risk posed by two food pathogens (*Staphylococcus aureus* and *Listeria monocytogenes*) in raw milk cheesemaking. A range of samples (n=117), including milk, curds, whey and cheese, from 5 raw milk suppliers, and 4 raw milk cheesemakers were analysed for coagulase positive *S. aureus*. Of the isolates obtained, 17% had toxin producing ability and produced only Staphylococcal Enterotoxin C (SEC) which is generally animal rather than food associated. The other classical enterotoxins SEA, SEB or SED (food poisoning associated) were not produced. No toxin was produced in raw or pasteurised milk or in sterile reconstituted skim



milk stored below 14°C for 24 h and no SEC was produced during cheesemaking. *L. monocytogenes* was found at a level of 300 colony forming units/ml in the milk of one cow with sub-clinical infection. While the numbers of naturally occurring *L. monocytogenes* increased in milk and during cheesemaking, this increase did not appear to be due to growth.

This research was carried out as part of a national network, Risk Assessment Network of Ireland which focused on the application of microbial quantitative risk assessment to underpin risk management actions. Teagasc research assessed the risk posed by two pathogens on the safety of raw milk cheese.

### Main Results

- None of the *S. aureus* isolates recovered from raw milk or cheese produced the endotoxins SEA, SEB or SED, nor did they harbour the enterotoxin encoding genes *sea*, *seb*, *sed* or *see*.
- 17% of *S. aureus* isolates produced Staphylococcal enterotoxin C (SEC).
- Cheesemaking inhibited staphylococcal toxin production as did storage temperatures below 14°C.
- Optimum conditions for toxin production in reconstituted skim milk were 37°C at pH 6.5.
- *Listeria monocytogenes* was found in raw milk from one cow at a level of 300 cfu/ml, though there was with no evidence of infection in the animal.
- Although numbers of naturally occurring *L. monocytogenes* increased in milk and during cheese making, this increase did not appear to be due to growth.

### Opportunity/Benefit

The opportunity was to assess the impact of *S. aureus* and *L. monocytogenes* on the safety of raw milk cheese

for the benefit of raw milk cheesemakers and the public in general. The study showed that there were different risks associated with each pathogen.

### Collaborating Institutions

University College Dublin

**Project number:** 5855

**Funding source:** DAFM

**Date:** June, 2014

**Project dates:** Nov 2007 – Nov 2012

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## Safe and Healthy Foods

### Key External Stakeholders

Aquaculture, pork, poultry, beef, egg and honey producers; regulatory agencies, retailers, importers, animal health companies, food safety laboratories and consumers

### Practical Implications for Stakeholders

Safe & Healthy Foods programme set out to improve the safety of food consumed or produced on the island of Ireland through the development of new analytical methods and food databases.

A suite of new residue test methods were developed that cover nearly 150 different analytes. The range of compounds covered included veterinary drugs, feed additives, hormonal agents and pyrrolizidine alkaloids in different foods. The application of these tests showed that food consumed on the Ireland is generally of high purity. Residues were detected in a very small proportion of samples rendering them non-compliant. However, >99.6% of samples were residue free. A range of food safety databases were developed or updated on the project including the National Food



Residue Database, Veterinary Drug and Feed Additives Databases (VetFAD) and the Central Microbial Database. A new comprehensive food ingredient database (INFID), which has been used to estimate the intake of four sweeteners (aspartame, saccharin, acesulfame K, sucralose) were within the Acceptable Daily Intake levels for preschool children. The Irish Food Compositional Database was updated with current data on nutrients and bioactive components for a range of different foods.

### Main points

- The newly developed databases and technologies will allow stakeholders to significantly improve the safety and quality of food products produced on the island.
- The newly developed tools will allow the stakeholders to more effectively target resources and give better value for money.

### Main Results

- New multi-residue test methods developed for nearly 150 contaminant residues in food.
- New databases were developed covering the area of food safety and food consumption.
- Food surveys and exposure assessments were completed showing that the food we eat is very safe.

### Opportunity/Benefit

During the project, new knowledge and technologies have been developed that can be used to improve the quality and safety of food products consumed or produced on the island.

### Collaborating Institutions

AFBI, QUB, UUJ, UCD, CVRL-DAFM, UCC, CIT

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**Project number:** 5856

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**Date:** November, 2014

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**Funding source:** 07FHRITAFRC

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**Project dates:** Dec 2007 – Dec 2013

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### How to Proceed

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## Irish Seaweed Polysaccharides for Gut Health

### Key External Stakeholders

Consumers, society, government authorities/legislators and the food industries

### Practical Implications for Stakeholders

Seaweed is a natural source of bioactive components such as polyphenols, vitamins, antioxidants, polysaccharides and dietary fibres. This project is aimed at understanding the role of seaweed derived polysaccharides in gut health and targeting prebiotic potential of Irish seaweeds for development of functional food products.



### Main Results

- Four Irish seaweeds viz. *Laminaria*, *Fucus*, *Ulva* and *Palmaria* were collected from the west coast of Ireland and were used for extraction and separation of polysaccharides.
- A hot HCl extraction method was used for the extraction of polysaccharides. Following neutralisation the extracts were electro-dialyzed for desalination and polysaccharides were precipitated using ethanol. The extracts were then freeze dried.
- In vitro digestion using digestive enzymes was undertaken and the digests were used for testing through faecal fermenters.
- Diafiltration was used to separate the polysaccharides and oligosaccharides depending on their molecular weight cut offs.

### Opportunity/Benefit

Considering the nutritional profile of Irish seaweeds and functional food product development is the target of this project. Cost effective methods for extraction and purification of the polysaccharides and desalination are being developed. These methods will help to develop cost effective products for the food industry. Prebiotic potential studies through clinical trials would support health claims pertaining to gut health for these products.

### Collaborating Institutions

Teagasc Food Research Centre, Moorepark

National University of Ireland, Galway

Teagasc Food Research Centre, Ashtown

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**Project number:** MDBY 6588

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**Date:** May, 2015

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**Funding source:** DAFM

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**Project Dates:** July 2014 – Nov 2017

### How to Proceed

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## Sensory Acceptance of Low Salt Ready Meals

### Key External Stakeholders

Food manufacturers, food policymakers, food safety policymakers, food researchers

### Practical Implications for Stakeholders

Chilled ready meals are becoming increasingly popular but often contain appreciable amounts of salt. Food manufacturers are under increasing pressure from regulators and consumers to reduce salt in food. The present project focused on the impact of salt reduction and reformulation on sensory acceptability of low salt ready meals.

- The addition of key herbs and spices individually can help compensate for shortfalls in sensory acceptability for chilled ready-meals.
- The addition of salt substitutes into all 3 frozen ready-meals made it possible to achieve the FSAI salt reduction targets of 0.63g salt (250mg sodium) per 100g in ready-meals and 0.58g salt (230mg sodium) per 100g in soup.



- By adopting a gradual salt reduction strategy the following salt reductions could be achieved without adversely affecting sensory properties and consumer preference for the meals.

### Main Results

Sensory perceptions of low salt ready meals were investigated and the impact of reformulation on sensory acceptability was probed.

- A number of herb/spice blends were formulated that resulted in satisfactory sensory acceptability in comparison to meals with normal salt contents.
- The use of herbs and spices also increased the microbial stability of the meals and enhanced their antioxidant status.
- In conjunction with an industrial manufacturer the reformulated low salt meals were manufactured and analysed for sensory acceptability using a consumer panel. In all cases the reformulated meals were of comparable sensory acceptability to their full salt counterparts.

### Opportunity/Benefit

The outputs of this project have shown that research driven reformulation can off-set perceived losses in flavour as a result of salt reduction. The strategies developed could be applied to a range of prepared foods and identify effective measures for reducing salt levels in foods without comprising on sensory acceptability. Expressions of interest in this research are welcome.

### Collaborating Institutions

University of Limerick, Dawn Fresh Foods Ltd., All in All Ingredients

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**Project number:** 5712

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**Funding source:** DAFF (06/R&D/AFRC/519)

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**Date:** March, 2012

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**Project Dates:** Oct 2006 – Sep 2011

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### How to Proceed

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## Studies on the Microbiology and Sensory Properties of Novel Low Sodium Ethnic Ready Meals

### Key External Stakeholders

Food manufacturers, cheese producers

### Practical Implications for Stakeholders

- A ready-made meal salt reduction reformulation approach is feasible at manufacturing scale, when combined with microbiological and sensory optimization.
- A market survey revealed that salt levels in ready-made meals were  $\geq 50\%$  of the recommended daily allowances (RDA) for salt in 77% of meals evaluated, with 8 meals containing 100% of the RDA for salt.
- Market surveys also revealed that salt levels were not clearly labelled on most ready-made meals.



- The use of specific commercial salt replacers could facilitate further salt reductions in selected products.

### Main Results

- A comprehensive study was undertaken on the microbiological quality of commercial ready-made meals in comparison to reduced salt counterparts. No difference in microbiological populations was evident between ready-made meals with and without salt reduction over controlled storage conditions. This indicates that bacterial survival during commercial processing and frozen storage was not affected by the range of salt levels in full and reduced salt products.
- Evidence of bacterial migration during storage in lasagne ready-made meals was demonstrated.
- Salt levels could be reduced in selected ethnic ready meals by 29–50% without impacting on sensory quality. The difference was dependent upon the product type.
- The use of commercial salt replacers enabled a salt reduction of 48–66%.
- The impact of salt reduction on the quality of Cheddar cheese was assessed and highlighted that incorporating process changes could be used to lower salt levels without adversely impacting on quality.

### Opportunity/Benefit

Consultancy and contract research opportunities are available to both national and international clients in salt reduction in processed foods and cheese.

### Collaborating Institutions

University of Limerick

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**Project number:** 5437

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**Funding source:** DAFM

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**Date:** November, 2015

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**Project dates:** Jan 2005 – June 2008

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### How to Proceed

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## Technological Advances in Spray Drying of Functional Ingredients for Automated Beverage Vending

### Key External Stakeholders

Manufacturers of milk powders and dairy ingredients

### Practical Implications for Stakeholders

Technologies were developed to produce functional powders suitable for reconstitution/dispensing as either hot or cold beverages.

- Installing an in-line high pressure gas/liquid injection system on the concentrate feed to the spray atomiser of a milk-drier facilitated the production of dried ingredients with extensive foaming properties suitable for use in cappuccino-based beverage formulations.
- *Development of foaming powder for hot beverage formulation and vending* – a knowledge-base was established on the performance of different injection gases used and their interactions with concentrate formulation and process variables on powder characteristics.



- *Development of cold mixed smoothie-style beverages from textured dairy-fruit dry blends* – ‘smoothie’ style powders containing fruit/dairy ingredient blends with desired physical characteristics e.g. texture, viscosity and phase stability were successfully developed for dispensing in prototype vending machines.

### Main Results

The immediate effect of using either nitrogen gas or liquid CO<sub>2</sub> injection during atomisation, was improved powder agglomeration and an associated decline in bulk densities (from 0.56g/cc to 0.12g/cc) as well as reduced moisture contents. This was also reflected in changes to the particle size distribution and particle density – the latter reduced from 1.2334g/cc to 0.599g/cc.

Interrelationships were established between drying parameters and powder properties (bulk density, particle size distribution, occluded air, interstitial air, particle density, wettability, foam height using a coffee dispenser at t=0 min, foam height after 5 min, and moisture content) specific to cappuccino beverages. Significant relationships, in particular, were established between powder bulk density and cappuccino foam stability using CO<sub>2</sub> (foam stability = 5.556-(5.532\*Bulk Density)) and N<sub>2</sub> (foam stability = 5.017-(4.573\*Bulk Density)) dosing.

### Opportunity/Benefit

This research provides the opportunity to add functionality and value to spray dried ingredients. This technology may be incorporated, with some adaptation by ingredient drying manufacturers, to prepare fat-filled base or fully-formulated

powders for supply to branded food companies with channel dominance in food service markets. Relevant pilot scale technologies at Moorepark may be availed off to support technology transfer initiatives.

### Collaborating Institutions

N/A

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**Project Number:** 5435

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**Funding Source:** FIRM 04/R&D/TD/320

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**Date:** Nov, 2012

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**Project Dates:** Jan 2005-Sept 2008

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### How to Proceed

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## The Milk Proteome: A Tool for Understanding Milk Quality and Functionality

### Key External Stakeholders

Cheese manufacturers

### Practical Implications for Stakeholders

This study thus has a very high relevance for the Irish cheese industry, and its need to supply high quality products over the whole year. As milk composition changes over the lactation cycle, milk at late lactation stage is less suitable for cheese manufacturing due to the changing plasmin levels.



### Main Results

- We clearly demonstrated differences in proteolysis in cheeses made from milk taken over different stages of the lactation cycle.
- From this study, it could be seen that there are significant changes in the profile over the lactation cycle and, while similar studies have been done on this topic, the application of proteomic tools gives another a deeper insight into the specific changes occurring due to proteolysis.
- Proteomics is a very helpful tool to characterize the differences between cheese samples during ripening and also over lactation.

### Opportunity/Benefit

This project has developed significant additional research capacity in a very new field (proteomic analysis of food systems) which offers new advanced analytical capability of interest in the context of a range of new research project areas, including analysis by food companies. In addition, the project involved applying these tools to applied research questions of direct scientific and industrially-relevant interest (e.g., impact of seasonality and somatic cell count on dairy product quality). Additional knowledge on milk quality issues is of indirect economic impact by providing additional knowledge for dairy companies in Ireland.

### Collaborating Institutions

Teagasc and University College Cork

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**Project number:** 5550

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**Date:** Spring 2014

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**Funding source:** FIRM

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**Project dates:** Mar 2005 – Sept 2008

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### How to Proceed

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## Understanding the Perception of Creaminess in Dairy Foods

### Key External Stakeholders

Food and food ingredient manufacturers, dairy industry

### Practical Implications for Stakeholders

- High pressure processing was shown to enhance the creaminess of yogurts and produce low-fat yogurts as creamy, or *even creamier*, than their conventionally produced full-fat counterparts.
- A better understanding of the relationship between product structure and creaminess perception, based on composition and processing has been developed.

The results of this work have led to further funding from Enterprise Ireland under the Commercialisation Fund and Teagasc researchers are currently developing a new platform technology for manufacturing size controlled protein particles, specifically to be used as novel fat replacer



ingredients. Access to such an energy efficient and innovative food processing technology would benefit dairy and food ingredient companies greatly by allowing them to produce higher quality, low fat dairy-based products with enhanced nutrition at significantly lower production costs.

### Main Results

- High pressure milk processing (microfluidisation) was shown to significantly improve the creaminess of low fat yogurts.
- The development of a new dynamic imaging technique for assessing product quality.
- A predictive model for creaminess based on composition, rheology and microstructure.
- Increased understanding of how microstructure can be controlled to enhance creaminess.
- Demonstration that fat release from food matrices can be controlled by pH and emulsifier type.

### Opportunity/Benefit

There is an opportunity for dairy food ingredient manufacturers to partner with Teagasc to investigate the true potential of such high quality low fat dairy based ingredients using this novel approach through optimisation and validation for specific applications. Expressions of interest from relevant companies are welcome.

### Collaborating Institutions

University College Cork

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**Project Number:** 5606

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**Funding Source:** DAFF (06/RD/TMFRC/431)

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**Date:** July, 2011

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**Project Dates:** Nov 2006 – Dec 2010

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### How to Proceed

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## Water Activity Control and Texture Stabilisation of High Protein Snack Bars

### Key External Shareholders

Dairy ingredient manufacturers, nutritional food formulators

### Practical Implications for Stakeholders

- The relative susceptibility of milk protein ingredients to textural change (hardening) in high protein (35%) bar formulations over time was established under standardised conditions. Hardening in mixed protein bars resulted in a broadly linear response to ratio inclusion. However, caution is required in the application of this information because of specific variation in bar formulations.
- Different windows of concentrations were observed for individual protein ingredients depending on formulation that could be related to molecular jamming and subsequent hardening.
- Minimising water activity differences between liquid and solid components provides a means of controlling or delaying textural change.



Advanced analytical techniques developed during the course of this project may be used to support further development: FT-IR measurements show whether water or solvent-induced plasticisation of protein powders in bar matrices is sufficient for protein-ingredient interactions to occur at a molecular level. Confocal scanning laser microscopy (CSLM) techniques allow good quality imaging of physical changes in protein bars during storage.

### Main Results

- Hardening of protein bars varied with protein type e.g. decreased hardening occurred in whey protein-based bars compared to casein-based systems.
- Textural change in high-protein bars is related the hydration behaviour of individual components and the competition for available moisture.
- Powder packing behavior was also influenced by protein type. Rheological-based frequency dependent measurement of liquid-solid transitions link particle interactions to time-dependent ageing (hardening) phenomena.

### Opportunity/Benefit

The resulting database of information allows a better choice of ingredients to be made in order to ensure improved shelf-life. Such knowledge may be utilised by technical support teams of dairy ingredient companies engaged in ingredient marketing to protein bar formulators.

### Collaborating Institutions

University College Cork

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**Project number:** 5951

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**Funding source:** FIRM/DAFM (08/R&D/TMFRC/651)

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**Date:** May, 2015

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**Project Dates:** April 2009 – Mar 2013

### How to Proceed

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**Expertise**

## Analytical Capabilities for Characterisation of Bioactive Compounds

The analytical capabilities at the Nutraceutical Research Facility at Teagasc Ashtown provide expertise and services in the structural elucidation and quantification of bioactive compounds from marine, meat and terrestrial plant sources. Expertise in fractionation and enrichment technologies of bioactive compounds that can serve as potential functional food ingredients is also available.

### Background

The Nutraceutical Research programme in Teagasc plays an important role in providing leadership in research, consultancy and support to Irish food industries in the area of functional foods. Identification of the bioactive components associated with the salutary health-effects and their quantifications are essential requisite to make health claims. Teagasc, with the generous funds largely from the Food Institutional Research Measure, has significant expertise and infrastructure in the area of bioactive component fractionation and characterisation.

### Benefits to Industry

EU 2006 regulations on nutrition and health require stringent criteria to qualify novel bioactive compounds for specific health-claims. The chemical structure of the food component(s) responsible for health-promoting attributes is one key criterion. For the food components that have already been approved by EFSA for specific health-claims, or those that have the potential to be approved, Teagasc provides services and expertise in recovery (enriched fractions) and characterisation, which can be incorporated into functional foods.

### Areas of Expertise

- polyphenols.
- glucosinolates.
- carotenoids & polyacetylenes.
- proteins & peptides.
- polyunsaturated fatty acids, sterols.
- polysaccharides (beta-glucans/chitosans).



### Facilities/Equipment

- Pilot-scale rotary evaporator.
- Flash Chromatography/Preparative Chromatography.
- MALDI-Q-ToF Mass Spectrometer.
- UPLC-TQD Mass Spectrometer.
- GC-MS.

### Of Interest to

- Food growers and processors.
- Ingredient companies.

### How to Proceed

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## Analysis of Food-derived Carbohydrates

Teagasc researchers can provide specialist know-how, facilities and services in carbohydrate chemistry of foods and ingredients. This includes the application of key novel technologies including high-performance anion exchange (HPAE) developed to separate carbohydrates. Coupled with pulsed amperometric detection (PAD), this permits direct quantification of non-derivatised carbohydrates at low-picomole levels with minimal sample preparation and clean-up. Researchers at Teagasc are available to carry out contract or collaborative research with companies in the aforementioned areas with a view to the exploitation of novel technologies for food and food ingredients.

### Background

Research on food derived carbohydrates or oligosaccharides has received much attention in recent years, and there is increasing evidence of the local effects of these carbohydrates (either in free form or when attached to proteins or lipids) within the gastrointestinal tract. Such effects may include prebiotic, anti-adhesive and anti-inflammatory activities, glycome modification, an influence on brain development and growth-related characteristics of intestinal cells and other, as yet uncharacterized, effects.

### Benefits to Industry

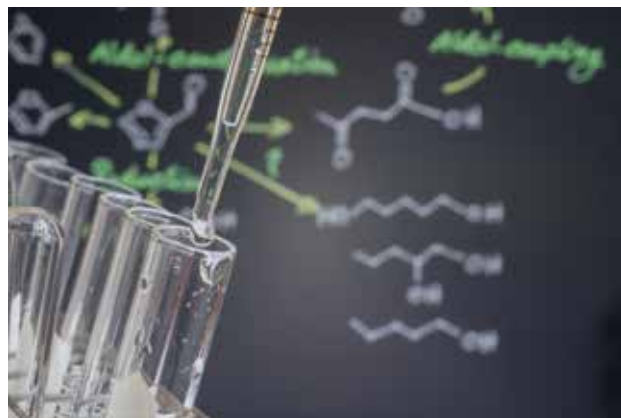
Teagasc have extensive carbohydrate chemistry capabilities and expertise. The Glyco-ingredients laboratory includes state of the art HPLC equipment with detection systems specifically tailored for the analysis of food-derived carbohydrates. These include a Dionex HPLC and a Waters HPLC with Refractive Index detector. For structural determination of unknown carbohydrates we work with our collaborators at NUIG.

### Areas of expertise

- Food oligosaccharides and glycoproteins – extraction, enrichment, fractionation and structural.
- Chromatography – Size-exclusion, Affinity and Ion Exchange Chromatography.
- Development of bioassays for investigating the bioactive properties of glycans isolated from food.

### Facilities/Equipment

- Dionex HPLC with pulsed amperometric detection
- Waters HPLC with refractive index detector
- Chromatography – size exclusion, affinity, ion exchange



### Range of solutions

There are several possibilities by which companies can engage with Teagasc, from provision of services, to contract or collaborative research.

### Of interest to

Food and ingredient companies

### How to Proceed

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## Compositional Analysis of Dairy Products

The Technical Services Laboratory at Teagasc provides chemical testing services to clients from the dairy industry worldwide. We have recently been awarded INAB accreditation in ISO17025 for chemical testing (fat, protein and moisture/total solids) of dairy powders and liquid dairy products. The techniques employed by the Technical Services Laboratory are the gold standard in wet chemistry. Our methods are based on the International Dairy Federation (IDF) reference methods which enables the delivery of accurate and quality results in a timely manner.

### Background

In order to deliver high quality products, dairy processors need to be able to deliver accurate and reliable test results. The Technical Services Laboratory in Moorepark has a long history of delivering results to clients in a friendly and efficient manner.

### Benefits to Industry

The Technical Services Laboratory can provide testing services to industry clients which are accredited to the international standard ISO17025. As well as our accredited tests, we offer a number of compositional analyses which may suit your needs including: ash, intact casein, D/L-lactic acid, non-casein nitrogen, non-protein nitrogen and amino acids. We also offer a subscription service to our weekly Milk Standards, which act as accurate reference points for creameries thereby ensuring correct payments to suppliers.

### Areas of Expertise

- Dairy chemistry.
- Wet chemistry techniques.
- International Dairy Federation techniques, specifically IDF 1, IDF 9, IDF20-3, IDF 20-4, IDF 29-1 and IDF 26.
- Milk analysis using Fourier-transform infrared spectroscopy (FTIR).
- Amino acid analysis using ion-exchange chromatography.

### Facilities/Equipment

- Kjeldahl digesters and 60 place automatic distiller.
- Jeol AminoTac amino acid analyser.
- Bentley DairySpec FT.
- Leco TGA gravimetric oven.
- Thermo Spectronic Genesis 2 UV-visible spectrophotometer.
- Gerhardt Soxtherm.



### Of Interest to

- Dairy and food industry.
- Ingredient and infant formula manufacturers.

### How to Proceed

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## Food Surfaces and Structure

Specialised knowledge, state-of-the-art facilities and services are available in Teagasc for the production and characterisation of food emulsions and foams using a range of advanced analytical techniques. Expertise includes the application of pendant drop tensiometry, emulsion particle size analysis and rheology to processing, storage and final product end-use. Knowledge of food ingredient surface activity can be successfully applied to improved formulation, stability, trouble-shooting and product development strategies. Work can be carried out as contract or collaborative research with companies.

### Background

Emulsions (mixtures of immiscible liquids) and foams play a significant role in the production, stability and quality of many food products. Examples of food emulsions include milk, infant milk formula, butter, mayonnaise and dressings. Such emulsions are inherently unstable and require a surface active material (such as milk proteins, phospholipids, monoglycerides etc.) to stabilise oil or water droplets. The physical properties of emulsions are determined largely by the nature of the interfacial layer formed at the surface of the droplets. Fundamental knowledge of such behaviours is critical to the production of emulsions, foams and surfaces in food.

### Benefits to Industry

- Characterisation of ingredient surface properties.
- Determination of emulsification, foaming and wetting properties.
- Effects of formulation and processing on the emulsion stability.
- Improved product quality and stability.

### Areas of Expertise

- Determination of droplet interfacial tension and surface pressure.
- Mechanical properties of emulsions and foams.
- Competitive surface active behaviour.
- Suitable for oil-in-water (o/w), water-in-oil (w/o), air-in-water (foams) and water/solids (redispersion/wettability of powders).

### Facilities/Equipment

- Pendant drop tensiometer.
- Particle size analysis.
- Emulsion/foam stability analysis.
- Dedicated rheology lab.
- Advanced imaging techniques.



### Range of Solutions

Various options by which companies can engage with Teagasc, include the provision of analytical services, through to contract or collaborative research.

### Of Interest to

- Food and ingredient companies.
- Academic and research organisations.

### How to Proceed

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## National Food Imaging Centre

Teagasc researchers provide specialist know-how, facilities and services in food nano- and micro-structure characterisation. The National Food Imaging Centre (NFIC) is a unique and powerful set of tools dedicated to the Irish agri-food sector. Researchers at the Teagasc Food Research Centre, Moorepark are available to perform contract or collaborative research with companies to identify and solve product quality issues and to help develop new products.

### Background

Microscopy often provides key information when troubleshooting existing food products or developing new ones. The NFIC is a major investment in state of the art imaging tools already extensively used by the food industry and other academic collaborators. The processability, texture, flavour and storage/shelf life of foods are controlled not just by chemical composition, but also by how the various ingredients are distributed and interact at the nano- and microscopic length scales. Food structures vary enormously from homogenous liquids to complex, multiphase solids containing fats, proteins, polysaccharides, salts and water in the form of fibres, droplets, crystals, glasses or networks. The size, shape and distribution of these structures greatly influence product stability as well as sensory properties and bioavailability.

### Benefits to Industry

Any food or beverage product can be examined quickly with minimal sample preparation. Typical applications include:

- Powders: morphology, occluded air, fat distribution, size, stickiness, surface features.
- Emulsions: stability – phase separation, protein aggregation, droplet sizing.
- Natural foods: fruit and vegetables, meat, fish;
- Processed foods: dairy (beverages, yogurt, cheese), meat products, bakery, confectionary, spreads.

### Areas of Expertise

- Nano/Microstructure analysis of a wide range of foods.
- Relating microstructure to process conditions and product quality.
- Solving product issues.
- Developing new food products.



### Facilities/Equipment

- Light microscopes, including high speed camera.
- Confocal scanning laser microscope.
- Scanning electron microscope (includes cryo-stage).
- Atomic force microscope.
- Image analysis.

### Range of Solutions

There are several possibilities by which companies can engage with Teagasc, from provision of services, to contract or collaborative research.

### Of Interest to

- Dairy processors.
- Ingredient companies.
- Food manufacturers across all sectors including dairy, cereals, meat, snacks, beverage, confectionery etc.

### How to Proceed

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## Process Analytical Technologies (PAT tools)

Teagasc researchers can provide specialist know-how and facilities in process analytical technologies (PAT tools). This includes the application of key PAT tools that meet industrial standards such as European Hygienic Engineering and Design Group (EHEDG). We also have expert knowledge and experience in the implementation of PAT sensors, for improving process control and quality i.e. through the use of inline/at-line multivariate flow and viscosity meters. Researchers at Teagasc Moorepark are available to carry out contract or collaborative research with companies in the aforementioned areas with a view to exploiting PAT tools to maximise process efficiencies.

### Background

The food industry has always been at the forefront in assessing the potential that new processing analytical technologies (PAT) can offer. PAT is any strategy, method or instrument that maximises efficiencies within a process and has been widely adopted in other industries e.g. the pharmaceutical and chemical industries. Implementation of PAT tools into a process is part of the wider “quality by design” framework. The adoption of cost effective, retrofittable, robust and sanitary PAT tools which offer tangible gains from process efficiencies are currently under-utilised in the dairy industry. The benefits of PAT include increased process and product understanding, by monitoring and control of the major steps in a dairy process.

### Benefits to Industry

A range of PAT tools are available in Moorepark, which can be utilised on a laboratory or pilot scale using purpose built test skids and rigs. Incorporation of such PAT tools into commercial scale processes allow for greater control and monitor of dairy concentrates, hence generating process efficiencies.

### Areas of Expertise

- Evaluation and validation of process analytical technologies (viscosity, flow, pressure).
- Rheological testing of dairy concentrate behaviour.
- Testing of heat-induced protein structural changes.

### Facilities/Equipment

- Promass I300 (Endress + Hauser -Viscometer & Flowmeter).
- Portable purpose built test skids with a small footprint.
- FloWave (Burkert) (multivariate flowmeter).
- Vismart (Sengenuity) – viscosity sensor.
- Laboratory scale test rigs.



### Range of Solutions

There are several possibilities by which companies can engage with Teagasc, from provision of services, to contract or collaborative research.

### Of Interest to

- Dairy and Food Industry.
- Ingredient and Infant Formula Manufacturers.

### How to Proceed

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## High Protein Powder Characterisation

Teagasc combines technological expertise with its state-of-the-art facilities in order to offer clients a range of innovative processing solutions for the development of ingredients using membrane filtration and spray drying technology. This extends from powders for dairy applications to nutritional formulations, with Teagasc consistently supporting a drive for research that meets client expectations, particularly around areas such as increasing high protein powder solubility through the use of novel and innovative techniques.

### Background

High protein powders are used both domestically and globally for protein standardization in fat-filled products, yogurts, therapeutic beverages and in infant milk formulas. However, while issues such as protein denaturation/aggregation and viscosity are challenges during in-process high protein ingredient manufacture, one of the most significant challenges is the subsequent rehydration of these powders. Without proper hydration and complete solubility, the functionality of these protein ingredients is dramatically decreased.

### Benefits to Industry

Teagasc Moorepark and Moorepark Technology Limited have pilot plant facilities from laboratory to semi-commercial scale allowing for research to be performed from raw milk intake all the way to the development of high protein liquid streams using membrane filtration and subsequent powder production. The benefit of such facilities allows users to tap into the existing knowledge base at Teagasc and carry out novel and exciting research in areas applicable to them. The benefit to the client also comes from the ability to use advanced methodologies and techniques for analysing powder wettability, dispersability, sinkability and solubility.

### Areas of Expertise

- High protein ingredient manufacture.
- Protein denaturation/aggregation kinetics.
- Powder Hydration.
- Ultrasound assisted powder hydration.
- Mineral chelating interactions.
- Infant milk formulation design and processing.

### Facilities/Pilot Equipment

- GEA multi-membrane pilot scale.
- Y-Tron high shear mixer.



- Cavitation Pump.
- Microthermics Tubular Heat Exchanger.
- Pilot scale Homogenizer (Niro).
- Multiple evaporation and spray drying options.
- Malvern Particle Size Analyser.
- Malvern Morphology unit.
- Surface Tension.
- Pycnometer.
- Microscopy (light, confocal and scanning electron microscopy).

### Range of Solutions

There are several possibilities by which companies can engage with Teagasc, from provision of services, to contract or collaborative research.

### Of Interest to

- Dairy ingredient and infant formula companies

### How to Proceed

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## Elemental Analysis of Dairy Products

Teagasc provides elemental analysis for a variety of dairy products (both liquid and powdered dairy samples). Scientists at Teagasc are available for contract analysis of routine and non-routine samples using a number of advanced methodologies including Inductively coupled plasma mass spectrometry (ICP-MS) and X-ray fluorescence (XRF).

### Background

Minerals are inorganic substances required by the body in small amounts for a variety of functions. These include the formation of bones and teeth; as essential constituents of body fluids and tissues; as components of enzyme systems and for normal nerve function. Minerals are often absorbed more efficiently by the body if supplied in foods rather than as supplements. Milk and dairy products are an important source of dietary minerals.

### Benefits to Industry

An understanding of the role of charged ions is important from the perspective of the food processor as the mineral content can have a key determining role in the physicochemical properties of foods, including aggregation and heat stability of food stuffs and, in particular, infant formula. It is also important to be able to support label claims, from the perspectives of nutrition and toxicity.

### Areas of Expertise

Inductively-coupled optical emission mass spectrometry (ICPOES), Inductively-coupled plasma mass spectrometry (ICPMS) and X-ray fluorescence (XRF) are now well-established methods for basic analysis. The purchase of an ICP-MS system at Teagasc has enhanced our ability to investigate the complex role played by minerals in both the processing and nutritive properties of foods. This technology advances our knowledge on the key role played by many of the counter ions present in dairy products. Teagasc also has expertise in XRF methods which can be applied to analyse solid, liquid, and thin-film samples for both major and trace (ppm-level) components. The analysis is rapid and usually sample preparation is minimal or not required at all.



### Facilities/Equipment

- ICP-MS analysis of dairy products.
- XRF and Ion chromatographic analysis.
- Atomic absorption spectroscopy of cheese samples.
- Use of classical methods such as titration and spectrophotometric methods for powders and cheeses.

### Range of Solutions

Companies can engage with Teagasc to find technical solutions to problems either as contract work or as part of collaborative research.

### Of Interest to

Food and ingredient companies

### How to Proceed

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## Meat Technologies

Teagasc, through its food research centre at Ashtown, supports innovation in the Irish meat industry through the delivery of high quality research and industry development programmes. Areas of Expertise include meat quality, process technologies increased valorisation and non-invasive predictive technologies as well as the development of healthier and more functional added value meat products. Facilities include a research abattoir, cooked meats facility, sensory unit and state-of-the-art research laboratories.

### Background

Research projects funded through DAFM, various agencies and industry collaborations have strengthened the meat research expertise and facilities at Teagasc. State-of-the-art facilities include a pilot scale meat unit incorporating a licensed abattoir, production units for meat processing and packaging under controlled refrigeration systems and a cooked meat facility for curing, smoking and cooking.

### Benefits to Industry

Teagasc supports competitiveness and sustainability in the meat sector through excellence in science, technology and management systems. Advice in areas such as packaging/labelling, legislation and food assurance standards, ingredients and equipment sourcing can be provided through collaborative projects or consultancy. Various testing services are offered on a fee-paying basis as well as access to training and skills development programmes and facilities.

### Areas of Expertise

- Enhancement of meat quality.
- Evaluation of meat quality.
- Development of healthier functional products and value added processed meat products.
- Exploitation of meat by-products and waste streams.
- Ingredient innovations and clean-label processed meat.
- Interventions for improved quality in primary processing.
- Predictive technologies for quality assessment.

### Facilities/Equipment

- Slaughtering/boning.
- Meat processing and cooking.
- Packaging.
- Chilling and freezing.
- Analytical (incl. GC, NMR, oxidative status, texture analysis, yield studies, colour analysis).
- Sensory testing facilities.
- Product development plant/incubation units.

### Testing services

- Shelf-life and microbial testing.
- Residue and chemical analysis.
- Compositional and nutritional analysis.
- Consumer and sensory studies.
- Quality testing including flavour, colour and textural analysis.

### Range of Solutions

Companies have the opportunity to pay for consultancy services, product development support, access to facilities, training programmes on an individual and confidential basis. Also, routine and speciality meat testing services are available. Collaborations in meat research with academic and industrial partners are also actively undertaken.

### Of Interest to

- Meat processors and manufacturers.
- Consumer food manufacturers incorporating meat into their products.
- Research institutes/universities seeking collaborators.

### How to Proceed

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## Innovative Dairy Flavours

Researchers based at Teagasc Food Research Centre, Moorepark have developed a strong scientific base on the understanding of dairy flavour pathways, particularly in relation to cheese, cheese concentrates, butter and yogurt which is now available for exploitation by companies. We can provide specialist know-how and analytical services in formulating and processing natural cheeses in combination with other ingredients in order to develop a range of dairy flavour ingredients to suit particular food applications in the convenience and snack-food industry.

### Background

Less personal time for food preparation has led to an increase in the consumption of prepared and semi-prepared convenience foods. Food manufacturers have to target these developments to ensure competitiveness. Dairy ingredients are an important component in many foods, used to provide flavour, functional and/or visual attributes. At Teagasc a strong scientific base has been developed on the understanding of dairy flavour pathways, particularly in relation to cheese, cheese concentrates, butter and yogurt, through years of research and commercial interaction.

### Benefits to Industry

Engagement with Teagasc by food companies provides:

- Access to expertise, state-of-the-art infrastructure and specific technological services.
- Assistance in development of new dairy flavour ingredients.

### Areas of Expertise

- Development and use of concentrated dairy and cheese flavours, and enzyme-modified cheeses.
- Selection of commercial food grade enzymes through database of key enzyme activities.
- Biotechnological approaches to flavour development.
- Selection of bacterial cultures for flavour development.
- Identification of off-flavours e.g. lipolytic & oxidative rancidity.
- Use of micro-encapsulation for flavour protection.
- Advanced microbiological, biochemical and analytical capabilities.

### Facilities/Equipment

- Pilot plant facilities incl. mixers and tall-form spray drier.
- Separation, concentration, homogenisation and heating systems.
- Analytical capability incl. advanced chromatographic techniques, GC-MS, GC-O, GC-FID, GC-PFPD, HPLC.



### Range of Solutions

There are several routes by which companies can engage with Teagasc, from provision of technological services, to consultancy, contract or collaborative research.

### Of Interest to

- Food ingredient companies involved in development of dairy flavoured ingredients.
- Food manufacturers using dairy flavours in preparation of convenience and snack-foods.

### How to Proceed

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## Bio-functional Food Engineering (BFE) Facility

The Bio-functional Food Engineering facility (BFE) is a state-of-the-art facility for food technologists to process and stabilise ingredients for use in nutritional beverages including infant formula. It provides key research infrastructure to support the Teagasc Food Research Programme and collaborations with industry and is a centre of excellence for nutritional beverage research, including infant formula.

### Background

The BFE facility, funded through the FIRM Strategic Equipment Fund 2006, is a state-of-the-art facility for food technologists to process and stabilise ingredients for use in nutritional beverages, including infant formula. Designed to fast track the transfer of ideas from the laboratory to pilot plant, the range of unit operations offered by BFE cover areas such as dehydration, separation, encapsulation and thermal processing.

### Benefits to Industry

The BFE facility provides a 'one stop facility' for dairy based beverage applications. It has unique fully integrated research pilot scale fermenters/reactors and processing capabilities with easy access to scale-up equipment at Moorepark Technology Ltd. (MTL). The equipment has been carefully matched to allow transfer of product from one bench scale process to the next, providing a highly flexible processing environment where the goal is high throughput of experiments with complex design.

The BFE provides a technological platform for use by industry at the near market stage. Ultimately, it is expected that the facility will make a key contribution to the development of foods and beverages containing bio-active ingredients with proven stability and shelf-life.

### Facilities/Equipment

- Multi-stage spray dryer with fluidising capabilities capable of drying milk derived components.
- Multifunctional membrane filtration plant suitable for separating milk and ingredients.
- Supercritical fluid extraction.
- Adsorber chromatography unit.
- Continuous decanter centrifuge for concentration and purification of bioactive substances post-fermentation, precipitation and hydrolysis of dairy and plant materials.
- Concentric nozzle encapsulator for micro-encapsulation of bio-active components 10- 1000µm.
- Microthermics heat exchanger & in-line homogeniser.



### Of Interest to

- Dairy and Food Industry.
- Ingredient and Infant Formula Manufacturers.

### How to Proceed

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## Digestion, Bioaccessibility and Bioavailability

Researchers at Teagasc Food Research Centre are available to perform contract or collaborative research with companies to map the fate of food during gastro-intestinal digestion. Expertise is available in digestion, bioaccessibility and bioavailability of food components using *in vitro* and *in vivo* animal models.

### Background

With the development of foods for health, there is a need to understand how food and its components are digested. Teagasc has developed a platform to digest food and assess if /when individual components are bioaccessible and bioavailable to the body.

### Benefits to Industry

Teagasc can assist clients in tracking food and its components during gastro-intestinal (GI) digestion. Such knowledge can be used to modify food processing, food formulation and food design to improve efficacy of bioactives and nutrients. Digested samples at various time points can be provided for further screening in bio-assays. Information can also be used as a pre-cursor or selection aid for larger, more costly human intervention studies.

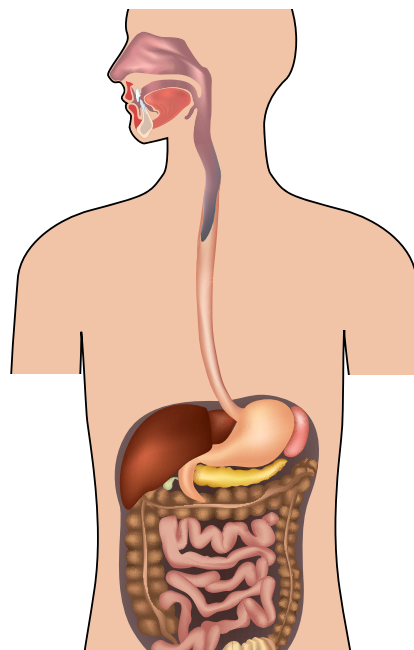
### Areas of Expertise

- Facilities/Equipment.
- Range of Solutions.

Teagasc has the capability to map the fate of food and its components during GI digestion. This can be achieved by providing information on digested food or food ingredients or by providing digested, freeze-dried samples for further testing.

### Of Interest to

Functional food/ingredient manufacturers



### How to Proceed

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## Food BioTest Capabilities

The prevalence of major diseases such as obesity, diabetes, sarcopenia and cardiovascular disease is increasing in the human population. Therefore, a major focus in the Functional Food sector is to develop food ingredients that improve health and reduce the incidence of disease. It is important to assess the functionality of the ingredients of interest by undertaking animal feeding trials representative of human consumption. Teagasc is in a position to assist companies in this process through its state-of-the-art Food Bio-test facility.

### Background

As part of Teagasc's on-going commitment to improving the health of people in Ireland, a Food Bio-test facility was established to test the efficacy of food ingredients (bioactives, nutrients, probiotics, oligosaccharides and prebiotics) in pig and/or mice. With the help of state of the art technology, we are able to assess *in vivo* the health benefits of dietary ingredients in various food matrices.

### Benefits to Industry

We can assist clients in testing efficacy of food ingredients using animal models. Animal studies are less costly than human studies and serve to predict biological functionality in humans.

### Areas of Expertise

- foods for weight management, satiety, adiposity, muscle health, gut health and pregnancy.
- physiological, biochemical and molecular assessment of health.
- dietary challenges to pigs and mice.
- digestion and bioavailability of food ingredients.

### Facilities/Equipment

- Dedicated research units to perform animal trials.
- State-of-the-art technology to measure physiological parameters such as food intake, body weight, body composition and locomotor activity, circulatory factors such as hormones, cellular activity (metabolic signals, enzymes, proteins, genes).



### Range of Solutions

We are able to perform short term (days) and long term (months) feeding trials in pigs and mice. In addition we can undertake post-prandial and gestational studies in pigs. We can investigate oral bioavailability, dosage and food formulation.

### Of Interest to

Functional food/ingredient manufacturers

### How to Proceed

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## Starter Culture Technology

Teagasc researchers can provide specialist know-how, facilities and services in starter culture selection and improvement. State-of-the-art developments in genomics and metabolomics are providing the tools for a more 'knowledge-based' approach to selection of desirable cultures. By linking genomic traits to phenotypic outputs, it is now possible to mine the metabolic diversity of starter cultures and select strains with desirable and industrially significant properties which can impact on both the production and final quality of the product.

### Background

Fermented dairy products are one of the key drivers of exports by the dairy industry. The starter cultures used for production of these products are of great industrial significance. However the drive for new products to meet consumer demands can push the boundaries of microbial performance, requiring the development of new starter culture blends with novel properties. Teagasc has developed valuable capabilities in starter selection and improvement, employing state-of-the-art genomic technologies in a more 'knowledge-based' approach to the selection and generation of desirable cultures.

### Benefits to Industry

An in-depth knowledge of properties such as phage resistance, flavour and texture can allow starter blends to be 'tailor made' to suit industry needs. This approach also allows for the potential improvement of these and other key characteristics in existing strains, strains which are at the core of the dairy industry. Applying this knowledge to starter culture development is enabling the generation of superior starters and novel products for future market expansion.

### Areas of Expertise

- Screening and selection of novel cultures.
- Starter blend deconstruction and characterisation.
- Development of starter rotation schemes.
- Food-grade approaches to starter culture improvement.
- Genomic and metabolic profiling of dairy cultures.
- Phage audits of dairy processing facilities.
- Development of phage detection systems.

### Facilities/Equipment

- Specialised equipment for monitoring key technological traits, e.g. iCinac (AMS Alliance).



- Genome sequencing capabilities.
- Dedicated flavour chemistry laboratory.
- Extensive analytical facilities (e.g. HPLC, GC-MS).

### Range of Solutions

There are several possibilities by which companies can engage with Teagasc, from provision of services, to contract or collaborative research.

### Of Interest to

- Commercial dairy companies.
- Commercial starter culture suppliers.

### How to Proceed

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## Thermal Analysis of Foods

Teagasc researchers can provide specialist know-how, facilities and services in thermal analysis of foods and ingredients. This includes food materials and product process evaluation, stability studies and sample testing. Researchers at Teagasc Food Research Centre, Moorepark are available to carry out contract or collaborative research with companies in the aforementioned areas with a view to exploitation of novel ingredients, products/processes. A range of testing services and consultancy is also offered.

### Background

An understanding of the influence of temperature on physicochemical/structural changes in food provides manufacturers with a mechanism for optimisation of processing conditions and, ultimately, improves product quality. Teagasc, with the support of the Teagasc Vision Program, recently installed state-of-the-art DSC and DMA instrumentation at Teagasc Food Research Centre, Moorepark. Methodologies have been developed and the instruments are validated for a comprehensive range of thermal analysis applications.

### Benefits to Industry

This state-of-the-art thermal analysis equipment strengthens the research and development capabilities of the Irish food industry. This equipment enables the measurement of the physical properties of food materials and products and determination of their thermal and mechanical histories. Hence, thermal analysis will assist in the optimisation of processes used in food manufacture and the stability of foods in various environments.

### Areas of Expertise

- Phase/state transitions of food ingredients.
- Crystallisation and melting behaviour of fat.
- Thermal properties of proteins, including thermal and freezing induced denaturation.
- Gelatinisation behaviour of starches and interactions with other ingredients.
- Oxidative decomposition, oxidation stability of food components.
- Mechanical relaxation of food ingredients.
- Mechanical and viscoelastic behaviour/properties of food.



### Facilities/Equipment

- Differential Scanning Calorimetry (Q2000 Tzero DSC, TA Instrument).
- Dynamic Mechanical Analyser (Q800 DMA, TA Instrument).
- Humidity Control Unit and Liquid Nitrogen Cooling system.

### Range of Solutions

There are several possibilities by which companies can engage with Teagasc, from provision of services, to contract or collaborative research.

### Of Interest to

- Dairy and Food Industry.
- Food Ingredient and Infant Formula Manufacturers.

### How to Proceed

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## Whey Processing Capabilities

Teagasc has the expertise and experience to isolate and fractionate individual components of whey with a view to adding considerable value to these sought after protein ingredients. There is considerable commercial value in fractionation of individual whey proteins with well characterised functional and biological properties for use in consumer foods, nutraceutical and therapeutic applications.

### Background

Whey protein is a mixture of a number of proteins that have their own unique nutritional, functional, physiological and nutraceutical properties. These properties are not fully exploited in whey protein concentrates and isolates, hence the value in characterising the individual whey proteins for their potential use in consumer foods, nutraceuticals and therapeutics. Teagasc, Moorepark, has extensive experience of working with companies in this area, as well as state-of-the-art facilities and equipment.

### Benefits to Industry

Teagasc can assist manufacturers of whey products and end-users who use whey protein as an ingredient in formulated foods such as infant formula, sports and other beverage applications. Expertise is available for development, scale-up, optimisation and technology transfer of whey protein separation processes based on centrifugal and membrane filtration technologies. This should allow manufacturers of whey ingredients and nutritional beverages to develop new products centred on scientifically proven functional attributes.

### Areas of Expertise

- Separation of whey protein fractions at laboratory and pilot scale and scale-up of processes.
- Optimisation/modification of existing whey protein separation processes.
- Analytical capabilities including HPLC electrophoresis, texture/rheology measurements, analysis of protein functionality, gelation, emulsification, foam formation, solubility.
- Engineering, rheology, microscopy and heat stability capabilities.

### Facilities/Equipment

- Pilot plant facilities of Moorepark Technology Ltd.
- Cross-flow membrane filtration technology (tubular, spiral-wound, plate and frame).



- Centrifugal technology.
- Electro-dialysis plant 2500l/hr whey.
- Analytical instrumentation.

### Range of Solutions

We can provide a range of solutions from technical services, contract production of whey fractions for market evaluation, consultancy and project management, to partnering in collaborative research in the area of whey processing.

### Of Interest to

- Manufacturers of dairy ingredients and nutritional beverages including infant formula, medical and sports applications.
- Any companies using or interesting in adding value to their whey protein as an ingredient, from consumer foods to nutraceuticals to therapeutic applications.

### How to Proceed

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 **Technology**      **Services**



## Residue Monitoring Services

Teagasc have extensive expertise in the area of residues analysis and provide analytical capabilities for the detection of nearly two hundred residues in food using our suite of analytical tests that have been validated on our site. We offer a range of ISO17025 accredited analysis for ~125 residues in different food matrices. Methods can be adapted to client needs on request. The laboratories use a range of modern equipment, which include six tandem mass spectrometer instruments. The methods used in our laboratories are comprehensive and sensitive to meet the demands of your clients.

### Background

In order to ensure the health of animals and good hygiene, veterinary drugs/pesticides and disinfectant are routinely used on farms. In order to ensure compliance with international food safety legislation, self-monitoring must be carried out by food companies to ensure that the products they are manufacturing are safe to put in the market place. Residue monitoring can be carried out on a risk-based approach, where residues can be monitored using a targeted approach by looking for residues where they are likely to occur. Although, priority is often placed on substances such as antibiotics and banned veterinary drugs.

### Benefits to Industry

The Teagasc residue laboratories are based in Dublin and can provide rapid analysis of samples for clients if short turnaround times are required. Once samples arrive in the laboratory results can be generated within 48 h if needed depending on the analytical test method used.

### Areas of Expertise

- Chemical analysis of residues in food;
- Veterinary drug residues including anthelmintics and antibiotics.
- Pesticides.
- Biocides including chlorates and quaternary ammonium compounds.
- Mycotoxins.

### Facilities/Equipment

- Range of sample extraction and clean-up equipment.
- Five modern laboratories.
- Five triple quadrupole mass spectrometers.
- One ultra-sensitive QTRAP mass spectrometer.
- One High resolution time of flight mass spectrometer.



### Range of Solutions

We can provide a range of advice and technical services to meet your needs.

### Of Interest to

Food and ingredient companies

### How to Proceed

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## Anthelmintic Drug Residue Testing

Teagasc researchers at Ashtown are leading experts in the area of anthelmintic drug residue detection. They offer an analytical service covering a wide range of anthelmintic residues in meat, milk and dairy products. This unique method measures 40 substances and is available for the Irish agri-food industry as a specialist service from our accredited laboratories at Ashtown.

### Background

Anthelmintics are one of the most widely used groups of veterinary medicines in the world. They are used in prophylaxis and therapeutic treatment of parasitic infections in livestock animals. The control of nematode (roundworm), cestode (tapeworm) and trematode (flake) infections in food-producing animals is essential for maintaining animal health and the financial viability of primary producers of meat. Anthelmintic drugs used in livestock production include various benzimidazole compounds, imidazothiazoles, macrocyclic lactones and flukicides.

Maximum Residue Limits (MRLs) have been set for a number of these anthelmintic residues in milk and edible tissue including muscle, liver, kidney and fat to reduce the risk to human health. Only a few products are approved for dairy animals and have limits set in milk. The remainder are unapproved and a zero tolerance is applied.

Teagasc researchers developed a test that simultaneously measures 40 veterinary drug residues and are offering this test as a service to the agri-food industry.

### Benefits to Clients

Under Directive 96/23/EC the food industry is required to have self-monitoring programmes in place to monitor for residues in food of animal origin.

By using this test you can be satisfied that you are in compliance with EU legislation and customer specifications.

This test will support industry in the export of food and gaining access to new markets.



### Testing Details

The Ashtown method has been validated in liver, meat and milk samples according to the 2002/657/EC guidelines. The method is very sensitive and has a limit of quantitation of 1 $\mu$ g/kg (ppb) for 38 residues, 2  $\mu$ g/kg for bithionol and clorsulon. The test includes avermectin, benzimidazole, flukicide and pesticide residues. The method has been accredited by the Irish National Accreditation Board.

### How to Proceed

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## Anticoccidial Residue Testing

Teagasc has developed an extensive test to measure anticoccidial residues in meat, milk and eggs. The method has been extensively validated at EU Maximum Residue Limits (MRLs) and Maximum Limits (MLs) set for non-target species.

### Background

Anticoccidial drugs are widely used as additives in feed and as veterinary drugs for the prevention and treatment of coccidiosis in poultry and other animals.

MRLs and MLs have been set for a number of these anticoccidial residues to reduce risks to human health. In 2009, new MLs were set for non-target tissues to allow for the unavoidable carry-over of anticoccidials in non-target feed.

Teagasc has developed a test based on liquid chromatography coupled to tandem mass spectrometry (LC-MS/MS) that can measure up to 23 anticoccidials in eggs, meat and milk and is offering this test as a service to food companies.

### Benefits to Clients

Under Directive 96/23/EC the food industry are required to have a self-monitoring programme in place to monitor for residues in food of animal origin.

By using this test you can be satisfied that you are in compliance with EU legislation and customer specifications.

### Service Details

The Ashtown method has been validated according to the 2002/657/EC guidelines. The method is very sensitive and has a limit of quantitation of 2.5 µg/kg or less for most analytes. The method is currently accredited in egg and avian muscle. The method was accredited in 2012 by the Irish National Accreditation Board.

**Table 1.** The anticoccidial residues that can be measured using the Teagasc test.

Residue	Classification
<b>EU Licensed</b>	
Amprolium	Veterinary Drug
Cyromazine	Veterinary Drug
Decoquinat	Feed Additive & Veterinary Drug
Halofuginone	Feed Additive & Veterinary Drug
Imidocarb	Veterinary Drug
Lasalocid	Feed Additive
Maduramicin	Feed Additive
Monensin	Feed Additive & Veterinary Drug
Narasin	Feed Additive
Nicarbazin	Feed Additive
Robenidine	Feed Additive
Salinomycin	Feed Additive
Semduramicin	Feed Additive
Toltrazuril	Veterinary Drug
Toltrazuril Sulphoxide	Veterinary Drug
Toltrazuril Sulphone	Veterinary Drug
<b>Not licensed in the EU</b>	
Arprinocid	Feed Additive
Clopidol	Feed Additive
Diaveridine	Feed Additive
Laidlomycin	Feed Additive
Nequinat	Feed Additive

### How to Proceed

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## Bioactive Peptide Discovery Unit

The Bioactive Peptide Discovery Unit at Teagasc is a world class facility, equipped to purify and characterise bioactive peptides produced by microorganisms, protein hydrolysis or fermentation. This facility and related capabilities can be accessed by research institutes, SME's, national and multinational companies with an interest in purifying, identifying, analysing or synthesising bioactive peptides at research scale for food or biomedical applications.

### Background

Many dietary proteins contain 'encrypted' peptides, released upon enzymatic cleavage, identified as having specific bioactivities of commercial interest. Examples include peptides that can influence blood pressure (anti-hypertensive), inhibit undesirable microorganisms (antimicrobial) and prevent infection (anti-infectives). The bioactive peptides associated with these biological properties may be developed as functional food ingredients or for pharma/biomedical preparations. The identification and characterisation of these molecules is the first step in their path to commercialisation.

### Competitive Advantage to Clients

The Bioactive Peptide Discovery unit is a unique facility offering a one-stop shop for those interested in any aspect of peptide identification, purification, analysis or synthesis.

### Service Details and facilities

The unit is equipped with analytical and semi-prep HPLCs, FPLCs, a MALDI TOF mass spectrometer, a peptide synthesiser, an amino acid analyser, and a DIGE 2D electrophoresis unit.

Areas of Expertise include:

- Purification of peptides using reversed phased and ion exchange HPLC and FPLC.
- Molecular mass determination of peptides and proteins, protein identification via peptide mass fingerprinting and peptide sequence confirmation of small peptides via MS/MS using MALDI TOF mass spectrometry.
- Microwave Fmoc synthesis of peptides 2–60 amino acids long at 0.1 or 0.25 mM scale.
- Free amino acid analysis of biological samples and compositional analysis of proteins.
- Whole cell protein profiling using Difference In Gel Electrophoresis (DIGE).



### Of Interest to

This facility is primarily of interest to research institutes, SME's, national and multinational companies with an interest in purifying, analysing or synthesising bioactive peptides at research scale for food or biomedical applications.

### How to Proceed

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## Blown Pack Spoilage Testing (T-Bio®)

Teagasc researchers have developed a specialist blown pack spoilage (BPS) test which is available at Teagasc Food Research Centre, Ashtown as a service to the meat industry.

### Background

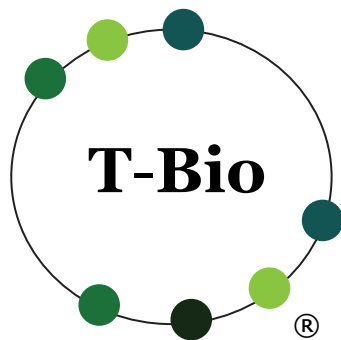
Blown pack spoilage occurs in correctly chilled batches (0 to 2°C) of vacuum packaged beef after 4 to 6 weeks and is caused by *Clostridium estertheticum* and *Clostridium gasigenes*. This type of spoilage is characterised by the production of large volumes of gas (carbon dioxide), a putrid smell and a metallic sheen on the meat. Meat spoiled in this way has no commercial value.

### Service Details

As part of the TBio technology transfer project, Teagasc (Ashtown) offers a testing service for *Clostridium estertheticum* and *Clostridium gasigenes*. Each test currently costs €15 and results are provided within 24–48 hours.

### Of Interest to

The T-Bio® test is primarily of interest to the meat industry.



### How to Proceed

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## Carbamate Pesticide Testing

This addition to Teagasc testing services allows for reliable and sensitive detection of 31 carbamate pesticides in animal tissue. This test confirmatory has now been validated to EU criteria.

### Background

Carbamate pesticides are used worldwide to protect crops against a range of pests, due to their broad spectrum of insecticidal activity, effectiveness, and the nature of non-persistence in the environment. Despite their benefits, low levels of pesticide residues may remain in the crops, animal feeds or environment leading to contamination of the food chain. Exposure to pesticide residues in food is of considerable concern to consumers, food producers and regulators due to their subacute and chronic toxicity. Carbamates are of particular concern due to their anticholinesterase activity in the nervous system, which leads to an accumulation of the neurotransmitter, acetylcholine, at nerve terminals, causing subtle and long-lasting neurobehavioral impairment in humans. Symptoms of toxicosis include abdominal cramps, nausea, diarrhoea, salivation, miosis, dizziness, tremor, anxiety and confusion.

### Service Details

By using this test you can be satisfied that you are in compliance with EU legislation and customer specifications. This will support you in exporting food and gaining access to new markets.

### Benefits to Clients

The carbamates test, developed by Teagasc, allows the analysis of 31 residues in liver tissue using liquid chromatography coupled to tandem mass spectrometry (LC-MS/MS). The method uses a rapid QuEChERS sample preparation procedure, which can give faster turnaround time on your analysis.

The carbamates method was validated in liver samples according to the 2002/657/EC guidelines. The method is very sensitive and has a limit of quantitation ranging from 2 to 7.6 µg/kg. The method has been accredited by the Irish National Accreditation Board.

**Table 1:** The 31 residues that can be measured using the carbamates test.

Carbamate residue	
2,3,5 Trimethacarb	Methiocarb
3-Hydroxycarbofuran	Methiocarb sulphone
Aldicarb	Methiocarb sulphoxide
Aldicarb sulphone	Methomyl
Aldicarb sulphoxide	Molinate
Aminocarb	Oxamyl
Bendiocarb	Oxamyl oxime
Benthiavalicarb	Pebulat
Carbaryl	Pirimicarb des methyl
Carbofuran	Pirimicarb
Diethofenocarb	Propamocarb
Fenobucarb	Propoxur
Fenoxycarb	Prosulfocarb
Indoxacarb	Thiobencarb
Iprovalicarb	Triallat
Isoprocarb	

### How to Proceed

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## Consultancy in Food Quality Assurance

Teagasc, through its Food Research Centre at Ashtown, provides a unique specialist technical service package to state bodies, regulatory agencies and industry, especially SMEs. This package encompasses specialist technical advice and standards development, technology/information transfer of research programme outputs and benchmarking through advanced technical assessment of completed processes.

### Background

Emerging stringent legislative principles and quality assurance standards clearly place the responsibility for assuring food safety on food sector management. Commercial customers and retailers are conscious of the realities of market-place incidents and seek assurance from their suppliers on the adequacy and effectiveness of the control systems that are in place.

To address these requirements, food quality management systems (incorporating food safety) must increasingly be robust to meet such demands, whilst also remaining cost effective in order to meet commercial objectives. There is an increasing focus on the quality assurance chain incorporating traceability from farm to fork. This, together with renewed government support, has provided unprecedented challenges and opportunities for the Irish food sector and supporting organisations.

### Benefits to Clients

Companies who implement and operate world class quality assurance standards enjoy the following benefits:

- Increased market access.
- Customer and consumer confidence.
- Enhanced ability to meet stringent legislative requirements.

### Service Details

This is a confidential service. We work with the client to put together the most suitable package in terms of assessment, consultancy and implementation and may include the following service options:

- Independent audits of food/feed businesses against appropriate industry standards.
- Supplier audits.
- Pre-certification audits for various standards including Bord Bia, BRC etc.



- Confidential reports on levels of compliance and non-compliance with relevant legislation/standards.
- Technology capability assessments and advice.
- Trouble-shooting/ problem-solving.

### Of Interest to

This service is relevant to food SMEs, state agencies and regulatory bodies, who wish to benefit from such specialist technical advice.

### How to Proceed

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## Flavour Profiling of Foods and Beverages

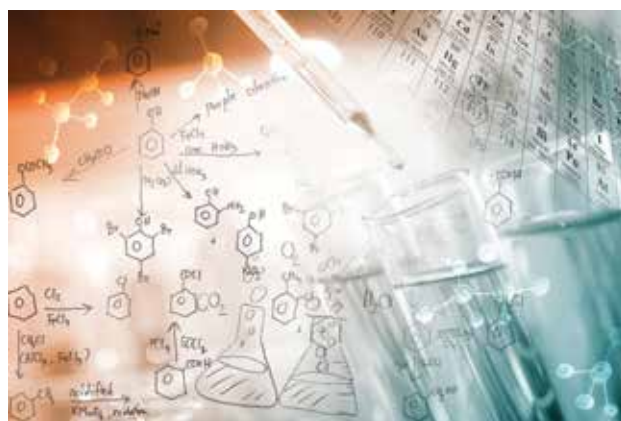
Teagasc has a state of the art flavour chemistry facility at the Teagasc Food Research Centre, Moorepark. Here, we can analyse the volatile and non-volatile components of food that directly impact on flavour perception, using a wide range of advanced chromatographic equipment and software.

### Background

Flavour is derived from approximately 75% aroma (odour) and 25% taste. The number of taste compounds is relatively limited to 'sweet', 'sour', 'salty', 'bitter' and 'umami', however other sensations and interactions exist that increase the complexity of taste, such as 'acid', 'hot', 'cooling', 'astringency' and 'mouth-coating'. The number of odour compounds is in the thousands which are made of a wide range of different chemical classes. We have extraction and separation methodologies designed to elucidate compounds that influence flavour either positively or negatively. Flavour chemistry can be used to support sensory analysis or as a standalone discipline. The flavour chemistry facility undertakes research in a wide range of food and beverages directly within Teagasc research programs but also in collaboration with external research groups. It also provides a very active service to industry and has an extensive database of flavour compounds, whose origin and odour properties are known.

### Capabilities on Offer

- Flavour profiling.
- Identification of odour active compounds.
- Olfactory analysis.
- Preference mapping.
- Product matching.
- Flavour shelf life.
- Identification of taints/off-flavours.
- Oxidative rancidity.
- Predictive modelling.
- Product quality.



### Service Details

- Advanced chromatography mass spectrometry.
- Extraction Techniques.
- Thermal Desorption, Solid Phase Micro-Extraction, InTube-Extraction, Sorptive Extraction.
- Sniffing ports.

### Of Interest to

Industry and Academia involved in food and beverages from production to packaging.

### How to Proceed

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## Grain Monitoring

Teagasc offer a National Grain Quality Monitoring Scheme to the grain trade, through Teagasc Food Research Centre, Ashdown. The purpose of this scheme is to ensure that all instruments, used in the measurement of the quality of grain at intake point during the harvest period, are providing uniform results.

### Background

As grain is sold on a weight basis one of the most important characteristics at intake is the moisture level. Teagasc facilitate a National Grain Moisture Monitoring Scheme that ensures the standardisation of methods and instruments used across the country to measure grain quality at intake point during the harvest period.

### Benefits to Clients

- Ensures moisture levels are accurate and grain producers are receiving adequate prices for their products.
- Participants of the Scheme can request additional moisture testing through Teagasc at a reduced rate.
- Protein determination is also provided at a rate of €30 per sample to Scheme participants. Protein levels are important as they can determine the end use of the grain and therefore the price.

### Testing Details

Teagasc select raw grain samples from 8 different intake points around the country and analyse the grain for moisture content. Replicate samples are then sent to participating members of the Scheme who are asked to duplicate the analysis using their own equipment and the methods provided. Each member is provided with large standard samples at the beginning of the harvest. These standard samples are approximately 400g each for oven/protimeter testing or 1000g for other moisture meters requiring a larger test sample. All samples will be provided in an airtight container to prevent moisture loss over the course of the harvest. The samples available are wheat, barley & oats.



### Of Interest to

Grain producers

Nineteen companies are currently subscribed to the Scheme.

### How to Proceed

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## High Throughput DNA Sequencing Platform

The Teagasc Sequencing Platform, available through resources at Teagasc Food Research Centre, Moorepark can bring the power of the cutting-edge technologies to your DNA sequencing projects. This technology can be employed for whole genome *de novo* sequencing, transcriptome profiling, characterisation of the microbiology of food, environmental, animal and human samples, amplicon sequencing and more. The Platform also has a dedicated, highly experienced, bioinformatics team to analyse and interpret the sequencing outputs.

### Background

DNA Sequencing technologies have been revolutionised in recent years. The Teagasc sequencing platform contains cutting-edge technologies from Illumina, Ion and Oxford Nanopore. These instruments have a range of applications:

- Whole genome sequencing.
- Targeted resequencing.
- 16S/ITS amplicon sequencing.
- Shotgun metagenomics.
- (Meta)transcriptome sequencing.
- RNA Seq.

### Benefits to Clients

- Range of different technologies available.
- Dedicated staff responsible for operating the technology and carrying out the associated bioinformatic analysis.
- Can contribute to DNA extraction, library preparation, quantification, QC where needed.
- Complementary equipment (PCR, qPCR, Qubit, Nanodrop, Bioanalyser, PCR workchambers).
- Software to facilitate analysis.
- Option of multiplexing multiple samples.
- Competitive prices.
- Dedicated bioinformatics team.

### Service Details and Facilities

Prices available on request



### Of Interest to

Institutes or bodies engaged in sequencing projects interested in accessing facilities providing improved sample throughput. There are also numerous potential industry-related applications such as assessing the impact of specific foods and ingredients on the gut microbiota and gut health, sequencing of probiotic strains, investigating animal genetics and many more.

### How to Proceed

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## New Product Development for Food SMEs

Teagasc researchers and technologists have extensive knowledge, expertise and facilities available to support food businesses in new product development at its two food research centres at Ashtown and Moorepark. There is a special focus on supporting new product development (NPD) in SME and start-up food businesses.

### Background

Advances in the food sector are accelerating the development of a wide range of new and improved, added-value products and services. The future success of the Irish food industry depends in large on its ability to be at the forefront of this scientific and innovative activity. Teagasc is committed to supporting the food processing sector and provides a range of supports including new product development services.

### Benefit to Clients

The competitive position of food businesses is very dependent on their capacity to absorb new knowledge and skills and develop innovative products. Teagasc recognises the constant challenge faced by food companies and aims to support and assist them in the new product development process.

Product development supports are backed by the wide-ranging food research programme at Teagasc which has extensive linkages with food research institutes worldwide.

### Support and Facilities

- Food development facilities are available at Teagasc Food Research Centres in Ashtown, Dublin and Moorepark, Cork.
- These include pilot and full scale regulatory approved production facilities containing modern equipment for the development of dairy, beverage, meat, bakery and prepared foods.
- Specially designed incubation units are available for sole use by client companies.
- Well-equipped and modern laboratories are available for microbiological, chemical, physical and sensory testing of products.



### Of Interest to

Product development support is of interest to food processing businesses, and to suppliers of materials, services and development support to the food processing sector.

### Service Contracts

Service contracts are agreed with clients and work is carried out on a confidential basis.

A schedule of fees is available on request for the various services provided.

### How to Proceed

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Carol Griffin

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Ciara McDonagh

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## Nitrofuran Residue Testing

The Chemical Residues Laboratory at Ashtown offers a suite of analytical testing services. One of the most important of these is the nitrofuran test method, which tests for residues of nitrofuran antibiotic drugs in meat, plasma, fish, eggs and honey. This method represents an essential service for both importers and exporters of animal products.

### Background

Nitrofurans are a class of broad-spectrum antibiotics that were widely used in food-producing animals. Concerns about their potential toxicity resulted in them being banned for use in the EU in the 1990s. Despite this, nitrofuran contaminants remain a frequent source of alerts in the EU Rapid Alert System for Food and Feed (RASFF), with 72 cases of semicarbazide (the marker residue for nitrofurazone) in shrimp in 2009.

Teagasc have developed an assay that employs liquid chromatography coupled to tandem mass spectrometry (LC- MS/MS) to detect and quantify in a single analysis the metabolites of four of the main nitrofuran drugs (shown below). We are offering this test as a service to food companies. The test can ensure the absence of nitrofuran drug residues down to extremely low levels.

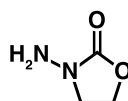
### Benefits to Clients

Under Directive 96/23/EC the food industry are required to have a self-monitoring programme in place to monitor for residues in food of animal origin.

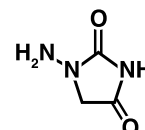
By using this test you can be satisfied that you are in compliance with EU legislation and customer specifications.

### Testing Details

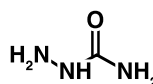
The Nitrofurans test has been validated in liver, muscle, fish, plasma, egg and honey samples according to the 2002/657/EC guidelines. The method is very sensitive and has a limit of detection of <0.10 µg/kg for all four residues in most matrices. The method has been accredited by the Irish National Accreditation Board.



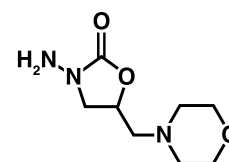
3-Amino-2-oxazolidinone (AOZ)



1-Aminohydantoin (AHD)



Semicarbazide (SEM)



3-Amino-5-morpholinomett  
2-oxazolidinone



### How to Proceed

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## Sensory Analysis

Teagasc, through its researchers and technologists at both its food research centres at Ashtown and Moorepark, has extensive knowledge, expertise and facilities available to identify the sensory requirements of food businesses and devise suitable testing methodologies.

### Background

Sensory analysis is a scientific discipline used to measure and interpret reactions to foods as they are perceived by the senses (sight, sound, smell, taste and touch). It provides valid and accurate information on sensory characteristics using precise, documented techniques. People closely involved with a product frequently find it difficult to be objective when comparing it with those of competitors. Sensory analysis is used to judge the acceptability of products at many stages of product development (from concept to launch) and in quality control and quality assurance.

### Benefits to Clients

Sensory Analysis provides a powerful tool in terms of new product development, and can be used anywhere in the NPD process from concept to launch and beyond in terms of quality assurance.

Teagasc sensory staff work closely with other Teagasc experts to correlate sensory and instrumental data. Off-flavour investigation is carried out in conjunction with our flavour chemists. Each client's needs are assessed and advice given on appropriate test methodology.

### Service Details

- We carry out the full range of discrimination tests including triangle tests, tetrad, duo trio, paired comparison, and other tests as required.
- We have a trained descriptive panel experienced in the sensory analysis of a range of products.
- We provide expert advice to food businesses and help them devise the most suitable methodologies for their needs.
- Bespoke sensory training courses can also be developed on request.

### Facilities

- We have state-of-the-art food preparation and sensory facilities.
- The testing facility comprises 8 individual booths each equipped with Compusense® 5.0 software for sensory data collection from panellists.

- The area is equipped with adjustable lighting and the temperature, ventilation and odour can be controlled.
- Training and conference rooms are also available for panellist training sessions and focus groups.



### Of Interest to

Sensory evaluation is relevant to food processing businesses, ingredient manufacturers and suppliers, food service companies, retailers and distributors.

### Service Contracts

Contracts are agreed with clients and work is carried out on a confidential basis. Cost is dependent on the method of testing used and sample numbers involved.

### How to Proceed

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## Specialised Training and Seminars

Teagasc provides specialised technical training and seminars for the food sector, in areas that include food safety, quality management, compliance with food legislation, and product development, through its Food Industry Training Programme. This programme is offered as a schedule of public courses to industry, development agencies and competent authorities each year. Delivery of customised training to companies is available on request. Seminars are also held each year covering topical issues of interest.

### Background

The food sector is a knowledge intensive industry sector, with a continual need to upgrade knowledge and skills. The environment in which the industry operates is constantly changing in relation to regulatory, customer requirements, product lines and innovations. The Teagasc Food Industry Training Programme, through effective knowledge transfer and certification, enables the sector to keep abreast of these changes. The programme is quality assured, and course topics are updated regularly to reflect the changing needs of the sector.

### Benefits to Clients

The Teagasc Food Industry Training Programme provides food businesses with up-to-date knowledge and skills required to keep up to date with changes in legislation, technology and good practice. This enables clients to compete effectively in the sector.

Courses are updated to ensure information is current and represents best practice. All trainers are highly qualified and experienced and many of the courses on offer are certified through the National Framework Quality Qualifications Ireland (QQI).

### Service Details

The programme includes training in the following areas:

- Food Safety Management (HACCP).
- Quality Management (based on Third Party Standards).
- Systems Auditing.
- Laboratory Quality Management & Auditing.
- Trainer Skills.
- Compliance with Legislation & Labelling.
- Innovation Management and NPD.
- Dairy Product Manufacture & Cheese-making.



- Dairy Plant Operation, Spray-drying etc.
- Meat Processing & Butchery Skills.

A range of seminars are scheduled annually. Themes are chosen based on current topical issues and input from the food sector. Expert speakers are drawn from competent authorities, industry and the retail sector.

### Of Interest to

This service is relevant to food industry personnel involved in technical or quality management, as well as supervisory staff, business owners & entrepreneurs, regulatory and development agency staff.

### How to Proceed

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Visit: [www.teagasc.ie/food](http://www.teagasc.ie/food)

## Technical Food Information Support

Teagasc provide a food information service that can help address the technical and practical questions that arise in the food industry. This is a key service for many food companies where keeping up-to-date may seem impossible with the amount of information being produced and the number of journal articles being published each week.

### Background

Teagasc Food Research Centre, Ashtown provides an Information Service to help meet the continuous need of food companies for reliable and expert information. The service aims to address the technical and practical questions that can arise for the food industry. Topics include food safety issues, new developments and technologies, food marketing and food legislation.

### Benefits to Clients

Teagasc have access to external databases and other information sources, including information generated from the extensive research programme of Teagasc plus national and international scientific linkages. These can be used to provide rapid food information solutions to companies operating in a competitive sector.

### Service Details

Teagasc can provide the following Food Information Solutions:

- We can work with bespoke projects whether it is a food safety issue or processing problem.
- We can carry out an information search on a range of topics and provide a customised review to suit a product sector.
- We offer advice on accessing technology information sources.
- We can supplement a company's own resources and help to fill knowledge gaps.

This is a confidential service where we will work with the client to put together the most relevant information solution.

An appropriate fee will be agreed in advance.



### Of Interest to

This service is of benefit to any food and related industries who need assistance in keeping up-to-date with technical and practical issues arising in the food industry.

### How to Proceed

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## Testing for Agrochemical Residues

Teagasc is offering a range of analytical tests for the food industry for the detection and quantification of agrochemical residues in foods, through their well established laboratories at Teagasc Food Research Centre, Ashtown. Tailored analytical solutions can be developed upon request to provide more cost effective analysis.

### Background

Veterinary drugs, feed additives and pesticides are used in the treatment of infections in food producing animals and can result in undesirable levels of residues in food. Regulatory agencies such as the Committee for Veterinary Medicinal Products and the European Food Safety Authority have set maximum residue limits (MRLs) for a range of agrochemical residues in food. The purpose of these MRLs is to protect public health and promote trade between countries.

Product labels on agrochemical products have been carefully prepared to ensure good agrochemical practice including application rates of products and withdrawal periods. If label claims are not carefully followed, non-compliant levels of residues can occur in food. The European Commission require each member state within the European Union to carry out national surveillance of their food production annually and demonstrate compliance with legislation. In addition, there are requirements on industry to carry out self-monitoring for residues, and it forms a basic part of a company's HACCP plan.

### Competitive Advantage

- Teagasc has a long history in veterinary drug residue detection and the laboratories at our Food Research Centre, Ashtown have been accredited for this work for over 25 years.
- State-of-the-art ultra high performance liquid chromatography coupled to tandem mass spectrometry is used in the majority of such analyses, giving the best possible result to clients.
- Tailored analytical solutions can be developed on request to provide more cost effective analysis.



### Testing Details

Some of the drug residues that we cover include:

- **Nitrofurans antibiotics** – 4 residues in liver, meat, eggs, honey and aquaculture products.
- **Anticoccidials** – 21 residues in eggs and meat.
- **Anticoccidials** – 8 residues in liver.
- **Anthelmintics** – 40 residues in liver, meat, milk.
- **Carbamate pesticides** in eggs, honey and liver.
- **Pyrethroid pesticides** in egg, fat and honey.

### Of Interest to

These tests are relevant to all sectors of the Irish food industry. If we do not carry out a specific type of testing on site we can outsource the work at a highly competitive rate.

### How to Proceed

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**Offers**

## Toddler Milk

Teagasc and University College Cork (UCC) researchers have developed a method for production of a low-protein milk product, in reduced and full-fat formats, based on adaptation of cow's milk to meet toddlers' nutritional needs but usable by the whole family. We are seeking a commercial partner within the infant nutrition/dairy industry to optimise and commercially exploit this technology.

### Summary

Levels of childhood obesity continue to increase as part of the European obesity epidemic. Toddlers in the Western World typically have a far greater intake of protein than they need, and studies have shown a significant association between high protein intake in early childhood and a later risk of obesity.

To address potential issues for toddlers with high protein intake, Teagasc/UCC researchers, in collaboration with key opinion leaders in the infant nutrition space, have developed a process that adapts cow's milk to meet such toddlers' nutritional needs, but which can also cater for the whole family.

### Problem Addressed

Dairy products play an important role in toddler nutrition and are by far the lowest cost source of dietary calcium and riboflavin. However, studies have shown that infants in the Western World have an average protein intake of approximately 2.5g/kg of body weight/day, which exceeds the recommended intake of 1–1.5g/kg of body weight/day. Documented observational data increasingly indicates a link between high protein intake during early childhood and a risk of obesity in later life. Many such toddlers are fed formulated toddler milk with altered nutritional and taste profile when compared to natural milk, and at a premium cost to consumers. To date there has been an absence of natural milk product alternatives in this growing and premium toddler market, which this technology aims to address.

### Solution

This invention relates to a process enabling the production of a novel natural reduced-fat, or full-fat, low-protein dairy product from cow's milk, which has been tailored to meet a toddler's typical nutritional needs. As the product is based on cow's milk, it has a superior taste that is much closer to natural cow's milk than competing formulated toddler milk. Hence this novel product should represent an opportunity for the producer, purchaser and end-user to benefit from such an innovation.

### Competitive Advantage of Technology

1. Through the application of mild processing technologies, a natural low-protein alternative to cow's milk tailored to the nutritional profile of toddlers' needs, but without altering the great taste of cow's milk is possible.
2. As this toddler milk, which is producible as both full-fat and reduced-fat products, tastes just like regular cow's milk, it can be consumed by the whole family.
3. This resulting milk product can be produced in fresh, Ultra-High Temperature (UHT) and powder formats, and is easily scalable.
4. This product is suitable as a carrier for fortification of other nutrients not naturally abundant in milk, but often lacking in toddlers' diets, for example iron.

### Stage of Development

A prototype has been developed to a pre-commercial scale, with positive consumer feedback on taste. Available in fresh, UHT and powder formats.

### Opportunity

Teagasc, as lead, wish to partner with a company in the infant nutrition and/or dairy industry in optimising and commercialising this process and resulting product, through a collaborative/licensing arrangement.

### Intellectual Property Status

A patent application was filed by Teagasc and UCC in 2015, claiming a novel dairy product, based on cow's milk, suitable as a substitute milk for a toddler.

### Funding

Food for Health Ireland (Enterprise Ireland)

### How to Proceed

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## Rapid Detection of Toxin-Encoding *Bacillus Cereus*

Teagasc is seeking partners within the diagnostics industry to exploit a novel qPCR-based test capable of rapid, simultaneous detection of all *Bacillus cereus* toxin encoding genes ("CereusToxTest"), of benefit to the food industry.

### Summary

Teagasc researchers have developed a novel q-PCR based assay capable of rapid, simultaneous detection of all *Bacillus cereus* toxin encoding genes. This assay offers significant advantages in time and specificity compared to what is currently commercially available.

### Value Proposition

Rapid and reliable detection of this target species is necessary to identify *B.cereus*-contaminated food and thereby reduce/prevent such food poisoning outbreaks in consumers, and lessen economic losses and reputational damage to food producers, caused by such recalls and/or outbreaks.

*Bacillus cereus* is a pathogenic, spore-forming soil-dwelling bacterium that is commonly encountered in raw milk and subsequent dairy products. It is resistant to industrial pasteurisation processes due to the presence of endospores and is therefore a major concern for the dairy industry. The various strains of *B.cereus* produce several potentially pathogenic substances, linked to foodborne emetic and diarrhoeal syndromes and are known causative agents of food poisoning for over forty years. The emetic syndrome is caused by cereulide, (synthesised by a non-ribosomal peptide synthetase encoded by the *ces* gene), while the diarrhoeal syndrome is caused by at least three known heat-labile enterotoxins.

No commercially available kits (immunoassays or molecular kits) are capable of simultaneously detecting the 4 toxins produced. Existing assays either detect only a subset of toxins or do not reliably distinguish between *B.cereus* and closely related, harmless bacteria, leading to false negatives and positives, which this assay circumvents.

### Solution

CereusToxTest is a probe-based qPCR approach to simultaneously detect and quantify levels of each of the 4 toxin gene types. It is a multiplex assay based on bespoke fluorophore-labelled probes, whereby detection and quantification of the 4 toxins is possible in a 2 –hour real-time PCR run.

### Competitive Advantage of Technology

- Addresses the issues associated with the non-specificity (leading to false positives) or excessive specificity (detection of a subset of toxins only, leading to false negatives) of other tests.
- More rapid than existing assays and avoids the need for downstream analysis, such as melting curve analysis and monitoring of PCR replicon size.
- Offers simultaneous detection and quantification of all 4-toxin encoding gene types in a high throughput single assay. Toxin profiling may allow for more informed treatment options.

### Status/Development Stage

Fully functional multiplex real-time PCR assay, available through licensing of know-how

### Fields of Application

Development of kits for molecular biology/DNA-based diagnostics for testing of food production and processing environments, raw materials, foods and food ingredients to ensure food safety.

### Funding



 Irish Dairy Board

### How to Proceed

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## Detection of Cause of Pink Discolouration Effect in Cheeses

Teagasc is seeking partners within the diagnostics industry to exploit a novel qPCR-based test for supply of assay/kit for detection of the bacterial cause of pinking discolouration defect, to the dairy and cheese industry.

### Summary

Teagasc researchers have developed a novel q-PCR based test capable of detecting the bacterial cause of pinking discolouration defect in the dairy and cheese industry for the first time. This technology helps to solve a significant problem for the global dairy industry and will be of interest to the diagnostics industry.

### Value Proposition

Pinking discolouration defect, primarily in cheese, is a global problem for dairy producers. Such pinking defect, which can manifest itself in various forms, on block surfaces or below the surface, can lead to downgrading or rejection of cheeses, and hence significant economic losses to the producer. To date, the cause of the defect has been unknown, but subject to much debate. By understanding and being able to identify the cause and origin of such a defect, this would facilitate removal/treatment of the cause at the source, thereby significantly reducing the occurrence of costly pinking defect discolouration events and increasing efficiencies and quality of cheese manufacturing plants. This hasn't been possible to date, as the cause of such discolouration defect remained unknown.

### Technology & Opportunity

By discovering the source of pink discolouration to be bacteria not associated with cheese production, and developing an assay to identify sources of such defect through identification of the causing bacteria, this invention provides a method of assaying cheese manufacturing plants, at ingredients and cheese processing plants level to identify the source of the pinking defect. Such testing of cheese systems, for the risk of pinking in cheese, will allow timely treatment of either ingredient or machinery/plant surfaces to eliminate the bacteria, before the defect arises, thereby minimizing/avoiding the occurrence of such pinking discolouration defects at commercial scale.

### Competitive Advantage of Technology

- A novel method of determining presence in cheese sample of source of pink discolouration defect.
- A method of testing a cheese manufacturing system for a risk of pinking discolouration, allowing modification of system to remove/ treat the origin of the defect.
- Resulting qPCR assay, and/or a kit comprising a diagnostic reagent, to detect the source.

### Opportunity

This technology would be a valuable addition to laboratories providing diagnostic solutions to dairy industry to develop kits/assay based on this invention, and is available to licence.

### Intellectual Property Status

A patent application was filed in 2014, (UK Application No. 1410948.2), claiming a method to determine the presence of such a source, due to the presence of the novel bacteria.

### Funding



### How to Proceed

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## Highly Efficient Protein Recovery from Food By-products

Teagasc is seeking commercial partners within various food processing industries to exploit a novel technology for extracting proteins from solid by-products or waste from food (fish, meat, poultry), with over 95% protein recovery, based on improved sequential isoelectric solubilisation.

### Summary

Teagasc researchers have developed a highly efficient protein recovery technology from food by-products with greater than 95% protein recovery. This technology is ready for scale-up and Teagasc is seeking companies to exploit this novel technology.

### Value Proposition

This technology addresses the issue that almost 50% of the total weight of fish is considered a waste or a low-value product, composed mainly of heads, internal organs, tail, fins, frames and skin. Protein content and amino acid profile in these by-products are similar to that in fillets hence there is a significant amount of high quality protein currently not harnessed. As most by-products from fish processing are used in composting, pet food or animal feed, so provide a very low value-add, there is a desire to generate alternatives with a higher value-add. This represents an opportunity to such industries to significantly increase total protein recovery from such waste, with significant costs implications, through increased profits through generation of protein-based added-value products.

This novel technique, allows solubilisation of more than 95% of total proteins, a significant improvement compared to the previous 65% reported. Furthermore, reagent consumption is not increased despite the additional step of extraction, and no expensive equipment investment is required, since regular equipment are employed in the process (tanks, centrifuges, blenders, stirring and pH probes), rendering this easily transferable to industry.

### Technology

This invention is based on a substantial modification of isoelectric precipitation-solubilisation (ISP) methodology, whereby protein from by-products are extracted in alkaline conditions and the remaining insoluble proteins are subsequently extracted under acidic conditions. Finally, both solutions are mixed to reach a pH close to 5.5 where all proteins precipitate and thus can be easily recovered by centrifugation or filtration. The process yields purified protein and a precipitate formed by scales and bones.

### Competitive Advantage of Technology

- 95% of total proteins extracted from fish by-products, significant improvement from 65% previously.
- No expensive equipment required, or increased reagent consumption.
- Should be easily scalable and transferable to industry, and can be combined with other extraction processes.

### Fields of Application

Although specifically developed using fish by-products, this could be applied to solid by-products or meat processing and poultry wastes and is ready for scale-up.

### Intellectual Property Status

An EPO patent application was filed by Teagasc (July 2015), claiming a novel method of sequential isoelectric solubilisation of animal by-products.

### Funding



### How to Proceed

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## LABocol: Cholesterol Lowering Probiotic Yogurt

Teagasc and UCC researchers have developed an invention which allows a novel Lactic acid bacterial (LAB) strain, *Lactobacillus mucosae*, to be used in a nutritional approach to lowering cholesterol, e.g. in a probiotic yogurt. Teagasc and UCC seek a commercial partner in the functional food space to further develop this technology with a view to commercialisation and further validation of the supporting health claims.

### Summary

Globally, a third of ischemic heart disease is attributable to high cholesterol, with raised cholesterol estimated to cause 2.6 million deaths annually.

Teagasc and UCC researchers have produced scientific data showing that a novel probiotic yogurt containing novel exopolysaccharide (EPS) producing *Lactobacillus mucosae* DPC6426 can lower blood cholesterol, a risk factor in the development of coronary heart disease, by 53% in 12 weeks.

### Problem Addressed

The invention broadly relates to a LAB strain that has been found to express an EPS and confers cardio-protective properties when consumed. It provides for the use of DPC 6426 as a possible nutritional approach to lowering cholesterol.

LAB strains are widely added as starter cultures in the dairy industry and have a long history of safe use. The presence of EPS in dairy products improves texture, decreases the risk of syneresis (whey separation) and improves the techno-functional properties of the products. It has been suggested that EPS produced by LAB interacts with cholesterol in a manner like dietary fibre.

Significantly increased cholesterol excretion was found for the probiotic yogurt fed group.

### Competitive Advantage of Technology

1. LAB are generally regarded as safe (GRAS) according to the FDA.
2. In-situ production of EPS throughout storage resulted in higher quality yogurt with improved textural and rheological qualities compared to other yogurts.
3. Blood cholesterol reduced by 53% in 12 weeks.

### Opportunity

There is an opportunity to partner with Teagasc/UCC in developing and commercialising a cholesterol lowering probiotic yogurt, including:

- Establishing the efficacy of the cholesterol lowering properties and effects on plaque stability of the probiotic in animal studies.
- Determining the mechanism of action and benchmarking against plant sterol esters and oat beta-glucan.
- Conducting a human intervention trial to compile a dossier to support a health claim application.

### Intellectual Property Status

A patent application was filed by Teagasc and UCC in 2012.

### Partners



### Funding



### How to Proceed

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## Whey-less Cheese Manufacture Based on Novel Cheese Technology Platform (NCTP)

Teagasc is seeking industrial partners within the ingredient and retail cheese industry to assist in refinement of NCTP for innovative cheese ingredient solutions and health cheeses tailored to specific customer requirements.

### Summary

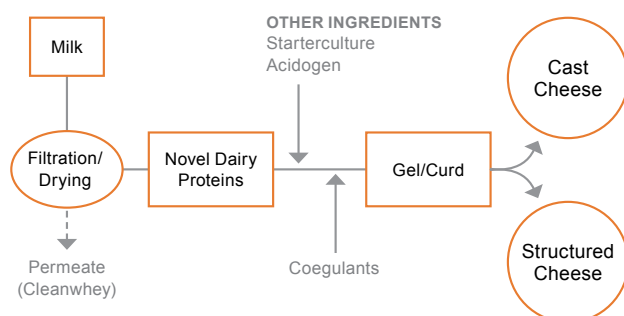
The rapidly growing market for ingredient cheese is currently being served by sourcing traditionally-manufactured table cheeses. Teagasc has developed a dedicated 2-step process for direct manufacture of ingredient cheese tailored to customer requirements. Without the need for whey expulsion it lends itself to the development of new generation health cheeses and increased control of cheese characteristics.

### Problem Addressed

Conventional manufacture of natural cheese is quite limited in terms of cost-competitive, customised ingredient solutions, reliance on a source of fresh milk and a large volume of 'unclean' whey, i.e. loss of added materials (e.g., prebiotic materials). Until now, it has not been possible, due to technological constraints and functional limitations, to reconstitute available dairy ingredients in the concentrated form that corresponds to the final compositional specification of targeted cheese types, thereby allowing increased control of ingredient cheese solutions.

### Solution

This NCTP provides a platform for design and manufacture of cheeses with varying dry matter content and customised properties using three basic steps. The concept relies on customising the functionality of a milk protein-based ingredient and its subsequent transformation into cheese according to demand. Resultant cheeses may be either cast cheese (<48% dry matter, DM) formed by rennet/acid treatment of re-assembled milk in final package and/or structured cheese (up-to 60% DM) formed by further curd treatment (see figure below).



### Competitive Advantage of Technology

1. NCTP capable of making cheese without fresh milk source.
2. No (or very limited) whey expulsion (cast cheeses)
3. Complete retention of any added materials, with potential for development of new generation health cheeses.
4. Greater opportunity to design/control cheese characteristics of ingredient cheeses.

### Opportunity

This technology allows the development of a novel range of prototype, functional, casein-based ingredients whereby the pH, buffering capacity and casein-to-whey protein ratio of the resultant cheese can be targeted.

The aim is to link up with relevant cheese ingredient manufacturers to prepare and evaluate prototype cheeses (at moisture levels > 53% with functionality suitable for ingredient cheese applications) with a view to licensing this technology.

### Intellectual Property Status

PCT patent Application WO 2009/1 50183.

### Funding



### How to Proceed

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## Probiotic Cocktail as Animal Feed Additive (“Live5”)

Teagasc and UCC researchers are seeking a commercial partner within the animal feeds industry to exploit a new technology. Based on a natural probiotic mix, for growth and good health promotion in animals (specifically pigs), the objective is to develop stable and commercially relevant probiotic product prototypes ready for market.

### Summary

The microbial feed additive (or direct-fed microbial), is based on a five strain mix “Live5”. It is a natural probiotic mix that can be used as an alternative to chemicals and antibiotics in pig husbandry, both as a means of controlling pathogen carriage and improving growth rate and feed conversion. The five live beneficial bacteria help maintain a healthy intestinal balance for optimum animal performance.

### Problem Addressed

Antibiotic growth promoters are currently being phased out of use because they impose a selection pressure for bacteria that are resistant to antibiotics. There is a need for alternative solutions that do not depend on antibiotic usage.

Subclinical salmonellosis is a relatively common problem in pigs, usually causing no obvious animal health problems. Affected pigs are carriers of *Salmonella*, and can excrete large numbers of *Salmonella* organisms intermittently, and particularly when stressed. *Salmonella* in pigmeat has long been associated with outbreaks of foodborne illness.

### Solution

The mixture (*Lactobacillus murinus* DPC6002 and DPC6003, *Lactobacillus pentosus* DPC6004, *Lactobacillus salivarius* DPC6005 and *Pediococcus pentosaceus* DPC6006) has been shown to be effective in reducing *Salmonella* shedding in pigs, in protecting against the clinical signs associated with *Salmonella* infection, and in improving growth rates. Live5 has also demonstrated the potential to modulate host immunity in pigs.

### Competitive Advantage of Technology

Live5 offers huge potential for use in pig production; in enhancing health status, reduction of subclinical carriage of pathogens (gram negative *Salmonella* and *E.coli* in particular) and in acting as an alternative to antibiotic therapy. Furthermore, one of the Live5 microbes, *L. salivarius* DPC6005, produces a heat stable, two-

component bacteriocin, Salivaricin P, which is highly active against a number of gram positive bacteria, including *Enterococcus* sp. and *Listeria innocua*.

### Opportunity

It is in the interests of both industry and consumers to reduce the significance of *Salmonella Typhimurium* as a pigmeat-associated food borne pathogen.

The potential fields of applications in animal health include:

- Microbial animal feed additive.
- Alternative to antibiotic growth promoters.
- Therapeutic application.

### Intellectual Property Status

A patent application was filed by Teagasc and UCC and the patent “Probiotic composition suitable for animals” was recently granted in the US and Europe.

### Partners



### Funding



### How to Proceed

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## Enhanced Derivatives of Nisin

Teagasc and UCC are seeking commercial partners within the food and pharmaceutical industries to further develop and commercialise superior derivatives of nisin bacteriocins, for applications in the food areas of bio-preservation and medical devices.

### Summary

Teagasc and UCC have developed foodgrade derivatives of nisin A, and producers thereof, with greatly enhanced antimicrobial activity. This offers potential in a greater range of food products and other products within medical/ medical device areas, when compared to commercial nisin A.

### Problem Addressed

Nisin A is an antimicrobial peptide which is used as a natural food biopreservative in over 50 countries. Nisin and nisin-producing foodgrade *Lactococci* are extensively used in food nisin is the only peptide to have been added to the European food additive list (E234) and approved by the US Food and Drug Agency (FDA) and World Health Organisation. Despite its success, its application is limited in some instances due to its relative inactivity against particular target species and strains and/or its poor activity at non-acidic pHs.

### Solution

Recently developed foodgrade derivatives of nisin and its producers have been found to display greatly enhanced antimicrobial activity against problematic pathogenic and spoilage microbes. They are also active at non-acidic pHs and are effective not only against a broader range of gram positive bacteria but also some gram negative bacteria. With the added benefit of being effective at non-acidic pH, this ingredient has the potential to be applied in a greater range of food products. The availability of enhanced forms of nisin could result in the replacement of nisin A and make other applications a reality.

### Competitive Advantage of Technology

1. Enhanced antimicrobial activity.
2. Active at non-acidic pHs.
3. Extended applications of nisin.

### Opportunity

This technology would be of interest to companies in the fields of food biopreservatives and medical devices and it is currently being evaluated by a company in the animal health field. Companies are invited to discuss this technology with a view to further development in the following areas:

- Demonstration of safety of variants.
- Demonstration of shelflife extension properties.
- Development of foodgrade applications.
- Scale-up manufacturing.

### Intellectual Property Status

Patent applications on the various nisin derivatives have been filed by Teagasc and UCC.

### Partners



### Funding



### How to Proceed

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## Probiotic-based Treatment of Mastitis

Teagasc and University College Cork researchers are seeking a commercial partner within the animal health industry to exploit a novel technology involving the treatment of bovine mastitis with foodgrade probiotic bacteria – a natural and effective alternative to antibiotic therapy.

### Summary

This technology represents a biological approach to mastitis prevention and is based on live foodgrade cultures of probiotic bacteria, specifically a proprietary strain of *Lactococcus lactis*, effective in treating animal and human infectious diseases and proven to be at least as effective as antibiotics, in the treatment of mastitis.

### Problem Addressed

Current treatments for mastitis rely heavily on antibiotics, both for prophylaxis and therapy. This strategy is costly and frequently ineffective. Additionally there are concerns regarding the overuse of antibiotics in veterinary medicine, as it may contribute to the increased spread of antibiotic resistance to human and animal pathogens. Recent legislation in the EU curtailing the use of antibiotics in animal feed should lead to greater controls and limitations in their use. Use of antibiotics may be limited to situations where they are deemed critical.

### Solution

There are several advantages to this treatment regime. The bacterium can be produced cheaply in large quantities and it is a foodgrade organism with GRAS status and hence should not require significant withholding periods for the milk produced by recovering animals, as in the case of treatment with antibiotics.

### Competitive Advantage of Technology

1. Natural, effective alternative to antibiotic therapy for treatment of both mild and severe mastitis. Effective against mastitis caused by gram positive and negative bacteria.
2. Using live preparation, cure rates of subclinical and clinical infections were comparable to standard antibiotic therapy
3. Based on use of a foodgrade organism, significant withholding periods should not be required for milk produced by recovering animals, thereby reducing milk losses.
4. Could improve milk quality from clinically infected quarters.

### Opportunity

Mastitis causes significant economic losses to the dairy industry. Economic loss in Ireland is estimated at €189.56 per cow, in severe cases, and €45.31 in mild cases. Taking the average incidence of mastitis as 25%, a mean economic value per case of mastitis of €71.84 is estimated (EBI 2007). With an Irish dairy herd population of 1.1m, this gives an estimated annual cost of €20m in Ireland alone.

This represents a significant opportunity for an animal health company to validate and commercialise this technology.

### Intellectual Property Status

Patent granted in US and in selected European countries, "Use of Probiotic bacteria in treatment of infection".

### Partners



### Funding



### How to Proceed

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 **Technology**

**Profiles**



## Declan J. Troy

Assistant Director of Research and Head of Technology Transfer

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### Education

M.Sc. (Biochemistry) University College Dublin. 1987.  
Graduateship of Royal Society of Chemistry, RSC, UK. 1982.

### Career

2010–Present: Assistant Director of Research, Teagasc.  
Head of Centre, Ashtown Food Research Centre, Teagasc.  
Head of Meat Technology Department, Ashtown Food Research Centre, Teagasc.  
Principle Research Officer, Ashtown Food Research Centre, Teagasc.

### Expertise

Declan has published over 100 scientific peer reviewed publications, book chapters and scientific articles, mainly in the area of food/meat quality. The main focus of his research was on the biochemistry of muscle proteins and their effects on meat tenderness. Declan has always encouraged the up-take of science based innovations by the food industry and has interacted widely with the sector to this end. His work has contributed to the introduction of new technologies at industrial level particularly in Irelands competitive beef sector.

He has coordinated numerous EU meat science projects and has coordinated *ProSafeBeef*, a €20 million project with 41 transnational partners aimed at advancing beef safety and quality through research and innovation. This landmark project included close interaction with the meat science and industry community. He also coordinated two EU Framework Marie Curie Training Sites for early stage career meat science Ph.D. students in meat biochemistry and functional meat products. Currently he is the Director of the Marine Functional Food Research Initiative (NutraMara) a multidisciplinary programme aimed at discovering bioactive components from Irish

marine sources for use in added value functional food products. He has collaborated in his research programme with many different research groups from all around the world including Australia, Korea and USA. He has been invited to speak at many international scientific conferences and industry seminars. He has supervised numerous Ph.D. students to completion. Declan sits on many national and international committees formulating research priorities in food science and advising state agencies and companies. Currently as Assistant Director of Research and Head of Technology Transfer, Declan is leading the Teagasc Technology Transfer Strategy.

### Selected Publications

1. Byrne, C.E., Troy, D.J. and Buckley, D.J. (2000). Postmortem changes in muscle electrical properties of bovine *M.longissimus dorsi* and their relationship to meat quality attributes and pH fall. *Meat Science*, 54, 23–34.
2. Byrne, C.E., Downey, G., Troy, D.J. and Buckley, D.J. (1998) Non-destructive prediction of selected quality attributes of beef by near-infrared reflectance spectroscopy between 750 and 1098nm. *Meat Science*, 49 (4), 399–409.
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4. Troy, D. J. and Kerry, J. (2010) Consumer perception and the role of science in the meat industry. *Meat Science*, 86, (1), 214–226.
5. Juárez, M., Marco, A., Brunton, N., Lynch, B., Troy, D.J. and Mullen, A.M. (2009). Cooking effect on fatty acid profile of pork breakfast sausages enriched in conjugated linoleic acid by dietary supplementation or direct addition *Food Chemistry*, 117, (3), 1 393–397.



## Dr. Mark Fenelon

Head of Food Research Programme

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### Education

Diploma in Process and Chemical Engineering University College Cork. 2007.

Ph.D Food Science and Technology, University College Cork. 2000.

B.Sc. Dairy and Food Science, University College Cork. 1994.

Higher Diploma in Food Science and Technology. 1993.

### Career

March 2015–Present: Head of Food Programme (Ashtown and Moorepark Centres), Teagasc Food Research Centre, Moorepark, Fermoy, Co. Cork

Jun 2010–Present: Head of Food Chemistry & Technology Department, Teagasc Food Research Centre.

2004–2010: Principal Research Officer, Teagasc Food Research Centre, Moorepark, Fermoy, Co. Cork.

2000–2004: Food Technologist/ Project Manager at Wyeth Nutritionals, Askeaton, Co. Limerick.

### Expertise

- Current programme focuses on ingredient interaction, i.e., protein – protein, protein – carbohydrate and protein – mineral interactions and impact during processing. Research includes improving the functional aspects of re-formulated foods in the nutritional beverage sector.
- Responsible for the recent development and implementation of the new separations/dehydration and ingredients facility located at Teagasc Food Research Centre, Moorepark.
- Experience includes chemistry and process related knowledge of dairy products including cheese, ingredients and infant formula. Knowledge of project management systems from both an academic and industrial perspective.

### Selected Publications

1. Maher G. P., M. A. Auty, Y. H. Roos, L.M. Zychowski and M. A. Fenelon. 2015. Microstructure and lactose crystallization properties in spray dried nanoemulsions. *Food Structure* Vol 3; 1–11.
2. Murphy, E.G., Y. H. Roos, S. A. Hogan, P. G. Maher, C. G. Flynn, and M. A. Fenelon. 2015. Physical stability of infant milk formula made with selectively hydrolysed whey proteins. *International Dairy Journal* 40; 39–46.
3. Maher G. P., Y. H. Roos and M. A. Fenelon. 2014. Physicochemical properties of spray dried nanoemulsions with varying final water and sugar contents. *Journal of Food Engineering*. Volume 126; 113–119.
4. Murphy, E.G., M.A. Fenelon, Y.H. Roos and S. A. Hogan. 2014. Decoupling Macronutrient Interactions during Heating of Model Infant Milk Formulas. *Journal Agricultural & Food Chemistry* 62; 10585–10593.
5. McCarthy, N. A., P. M. Kelly, P. G. Maher and M. A. Fenelon. 2014. Dissolution of milk concentrate (MPC) powders by Ultrasonication. *Journal of Food Engineering*. 126; 142–148.





## Dr. Olivia McAuliffe

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### Education

PhD Microbiology (1995–1999), University College Cork.

BSc Microbiology (1991–1995), University College Cork.

### Career

2017–Present: Principal Research Officer, Teagasc Food Research Centre, Moorepark.

2009–2017: Senior Research Officer, Teagasc Food Research Centre, Moorepark.

2003–2009: Research Officer, Teagasc Food Research Centre, Moorepark.

2000–2003: Post-Doctoral Research Fellow, North Carolina State University, Raleigh, NC, USA.

1999–2000: Post-Doctoral Research Fellow, National Food Biotechnology Centre, University College Cork.

### Expertise

Olivia is a Principal Research Officer in the Dept. of Food Biosciences at Moorepark. Her research programme focuses on bacterial cultures for fermentation and biotransformation, and the bacteriophages that infect them. Her research group has developed valuable capabilities in strain discovery, selection and improvement, implementing a genomics-based approach to studying these organisms, their metabolism and their potential applications in food fermentations. She has published over 90 peer-reviewed publications on these topics. She works closely with a number of high profile national and international companies, providing research services and delivering 'knowledge-based' solutions to the selection and generation of desirable cultures for new product development.

### Selected Publications

1. Stefanovic E, Kilcawley KN, Rea MC, Fitzgerald GF, McAuliffe O. 2017. Genetic, enzymatic and metabolite profiling of the *Lactobacillus casei* group reveals strain biodiversity and potential applications for flavour diversification. *Journal of Applied Microbiology* 122(5):1245–1261.
2. Stefanovic E, Thierry A, Maillard MB, Bertuzzi A, Rea MC, Fitzgerald G, McAuliffe O, Kilcawley KN. 2017. Strains of the *Lactobacillus casei* group show diverse abilities for the production of flavor compounds in 2 model systems. *Journal of Dairy Science* 100(9):6918–6929.
3. Stefanovic E, Fitzgerald G, McAuliffe O. 2017. Advances in the genomics and metabolomics of dairy lactobacilli. *Food Microbiology* 61:33–49.
4. Casey A, Jordan K, Coffey A, Fox EM, McAuliffe O. 2016. Comparative genomic analysis of two serotype 1/2b *Listeria monocytogenes* isolates from analogous environmental niches demonstrates the influence of hypervariable hotspots in defining pathogenesis. *Frontiers in Nutrition* 3:54.
5. Casey A, Jordan K, Neve H, Coffey A, McAuliffe O. 2015. A tail of two phages: genomic and functional analysis of *Listeria monocytogenes* phages vB\_LmoS\_188 and vB\_LmoS\_293 reveal the receptor-binding proteins involved in host specificity. *Frontiers in Microbiology* 6:1107.
6. Cavanagh D, Casey A, Altermann E, Cotter PD, Fitzgerald GF, McAuliffe O. 2015. Evaluation of non-dairy *Lactococcus lactis* with potential dairy applications reveals extensive phenotype-genotype disparity: implications for a revised species. *Applied and Environmental Microbiology* 81:3961–3972.



## Dr. Paul Cotter

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### Education

1996 B.Sc. (Hons) 1st class Microbiology, University College Cork (UCC), Ireland (Graduated in 1st position)

2001 Ph.D. Molecular Biology, University College Cork (UCC), Ireland

### Career

2016 Head of Food Biosciences Department, Teagasc Food Research Centre

2009 Principal Research Officer, Teagasc Food Research Centre

2009 Manager of Teagasc Next Gen DNA Sequencing platform

2009 PI, APC Microbiome Institute

2007–09 Lecturer Microbiology Dept., UCC

2002–06 Post-Doc/Senior Research Fellow UCC

### Expertise

- Microbiology of foods and the role of microbes in health, spoilage and disease.
- Microbiology of the gut and its modulation by diet and exercise.
- Food grade antimicrobials to control spoilage and pathogenic bacteria.
- Next generation DNA sequencing technologies.
- Spore-forming bacteria; control and testing.

### Selected Publications (of >200)

1. Quigley L, O'Sullivan DJ, Daly D, O'Sullivan O, Burdikova Z, Vana R, Beresford TP, Ross RP, Fitzgerald GF, McSweeney PLH, Giblin L, Sheehan JJ, Cotter PD. 2016. Thermus and the pink discoloration defect in cheese. *mSystems* 1:e00023–16
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3. O'Sullivan, D., P.D. Cotter, O. O'Sullivan, L. Giblin, P. McSweeney and J.J. Sheehan. 2015. Temporal and spatial differences in microbial composition during the manufacture of a Continental-type cheese. *Appl Environ Microbiol*. 81:2525–33.
4. Field, D., N. Gaudin, F. Lyons, P.M. O'Connor, P.D. Cotter, C. Hill and R.P. Ross. 2015. A bioengineered nisin derivative to control biofilms of *Staphylococcus pseudintermedius*. *PLoS One* 10:e0119684.
5. Walsh, C.J., C.M. Guinane, P.W. O'Toole and P.D. Cotter. 2014. Beneficial modulation of the gut microbiota. *FEBS Letts Epub*. doi: 10.1016/j.febslet.2014.03.035
6. Doyle, C.J., D. Gleeson, K. Jordan, T.P. Beresford, R.P. Ross, G.F. Fitzgerald and P.D Cotter. 2014. Clostridia and their significance with respect to milk and dairy products. *Int J Food Microbiol*. 197:77–87.



## Dr. John Tobin

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### Education

Ph.D. Food Science and Technology, University College Cork (UCC), Ireland. 2012

B.Sc. (Hons) Food Science and Technology, University College Cork. 2006

### Career

2016–Present: Head of Food Chemistry and Technology Department, Teagasc Food Research Centre, Moorepark, Fermoy, Cork

2014–2015: Senior Process Technologist – Danone Nutricia Early Life Nutrition – Utrecht NL

2011–2013: Process Specialist – Danone Nutricia Early Life Nutrition – Utrecht NL

2009–2011: Research Officer – Teagasc Food Research Centre, Moorepark, Fermoy, Cork, Ireland

### Expertise

Dr. Tobin's primary research interests include the links between dairy science, process technology and process engineering. Process technology platforms he is involved in include thermal processing, evaporation, spray drying, homogenisation, high shear technologies and separation/fractionation technologies. In particular his primary areas of expertise revolve around the complete deconstruction of milk by filtration and separation technologies, coupled with mapping of the physical partition of milk components during fractionation. He is also extensively involved in thermal processing particularly relating to the controlled denaturation and aggregation of protein streams in both low and high dry matter environments. His experience in thermal processing covers both direct (PHE/THE) and indirect (steam injection/infusion) technologies and also delves into the stability and interactions of complex nutritional formulations within all facets of thermal and concentration processes.

### Selected Publications

1. Tobin, J. T., Heffernan, S. P., Mulvihill, D. M., Huppertz, T., & Kelly, A. L. (2015). Applications of High-Pressure Homogenization and Microfluidization for Milk and Dairy Products. *Emerging Dairy Processing Technologies: Opportunities for the Dairy Industry*, 93.
2. Tobin, J. T., Fitzsimons, S. M., Chaurin, V., Kelly, A. L., & Fenelon, M. A. (2012). Thermodynamic incompatibility between denatured whey protein and konjac glucomannan. *Food Hydrocolloids*, 27, 1, 201–207.
3. Tobin, J. T., Fitzsimons, S. M., Kelly, A. L., & Fenelon, M. A. (2011). The effect of native and modified konjac on the physical attributes of pasteurized and UHT-treated skim milk. *International Dairy Journal*, 21, 790–797.
4. Tobin, J. T., Fitzsimons, S. M., Kelly, A. L., Kelly, P. M., Auty, M. A. E., & Fenelon, M. A. (2010). Microparticulation of mixtures of whey protein and inulin. *International Journal of Dairy Technology*, 63, 32–40.
5. Murphy, E. G., Tobin, J. T., Roos, Y. H., & Fenelon, M. A. (2013). A high-solids steam injection process for the manufacture of powdered infant milk formula. *Dairy Science & Technology* 93, 463–475.



## Dr. Geraldine Duffy

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### Education

Ph.D. on “Development of rapid methods for the isolation and detection of *Listeria monocytogenes* from meat”  
University of Ulster, Jordanstown, N.I. (1994)

Bachelor of Science Degree, University College Dublin,  
Belfield, Dublin 4.

### Career

Head of Food Safety, Teagasc, Food Research Centre,  
Ashtown, Dublin (2005 to present)

Principal Research Officer, Teagasc Food Research  
Centre, Ashtown, Dublin

OECD Postdoctoral fellowship, Eastern Regional  
Research Centre, Agricultural

Research Service, U.S.D.A., Philadelphia (1996)

Post Doctoral Fellowship at University of Nottingham and  
Unilever, UK (1994)

EU training fellowship, TNO, The Netherlands  
Organisation for Applied and Scientific Research (1993)

### Expertise

Research focuses on transmission, behaviour and control of microbial pathogens, in particular verocytotoxigenic *E. coli*, *Salmonella* and *Campylobacter* along the farm to fork chain. The research is applied to the development of food safety management systems including quantitative risk assessment models and novel interventions for control of known and emergent food borne pathogens. She has published widely in the field of microbial food safety with over 100 publications including books and book chapters. Dr. Duffy has considerable experience in the co-ordination of national and international research programmes and under the European Commission Framework Research Programme she has co-ordinated a 41 partner multi-national European Union Framework

integrated research project on beef safety and quality (*Prosafebeef*). She is member of a number of professional committees including the Scientific Committee of the Food Safety Authority of Ireland and has served as a food safety expert for the European Food Safety Authority (EFSA) W.H.O/FAO and I.L.S.I. (International Life Science Institute).

### Selected Publications

1. Burns AM, Duffy G, Walsh D., Tiwari, B, Grant, J., Lawlor, P.G., and Gardiner GE, (2016). Survival characteristics of monophasic *Salmonella* Typhimurium 4,[5],12:i: strains derived from pig feed ingredients and compound feed. *Food Control* 64, 105–114.
2. Lawal, D., Burgess, C., McCabe, E., Whyte, P. and Duffy, G. (2015). Development of a quantitative real time PCR assay to detect and enumerate *Escherichia coli* O157 and O26 serogroups in bovine recto-anal swabs *J. Micro methods* 114:9–15.
3. O’Leary, D., McCabe, E.M., McCusker, M.P., Martins, M., Fanning, S. and Duffy, G. (2015). Acid environments affect biofilm formation and gene expression in isolates of *Salmonella enterica* Typhimurium DT104. *Int J Food Microbiol.* 3; 206: 7–16
4. Thomas, K.M., McCann, M., Collery, M.M, Logan, A., Whyte, P., McDowell, D.A. and Duffy, G, (2013). Transfer of Verocytotoxigenic *Escherichia coli* O157, O26, O111, O103 and O145 from Fleece to Carcass during Sheep Slaughter in an Irish export abattoir. *Food Micro.* 34 (1) 38–45.
5. Thomas, K.M., McCann, M., Collery, M.M, Logan, A., Whyte, P., McDowell, D.A. and Duffy, G, (2012). Tracking Verocytotoxigenic *Escherichia coli* O157, O26, O111, O103 and O145 in Irish Cattle at slaughter. *Int J. Food Micro* 153(3):288–96



## Dr. Eimear Gallagher

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### Education

Ph.D. University College Cork (2005)

M.Sc. University College Cork (2000)

B.Sc. University College Cork (1997)

### Career

2017–Present: Principal Research Officer, Teagasc Research Centre, Ashtown, Dublin 15

2016–Present: Head of Food Quality and Sensory Science Department, Teagasc Food Research Centre, Ashtown, Dublin 15

2000–2017: Senior Research Officer, Teagasc Research Centre, Ashtown, Dublin 15.

1999–2000: Research Scientist, Scientific Support team, Nestlé PTC, York, YO1 1XY, England. (7 month contract).

1997–1997: Research Assistant, Dept. of Food and Nutritional Sciences, National University of Ireland, Cork.

### Expertise

Dr. Gallagher's expertise lies predominantly in cereal and bakery research. She has extensive experience in grain milling, empirical dough rheology, confocal and scanning microscopy, digital imaging and sensory analysis. She has developed a particular capability in the gluten-free area, where she has conducted research in product reengineering, instrumental texture analysis, fundamental rheology and nutritional profiling. She is also a coordinator of Sensory Food Network Ireland, a national network of excellence in sensory food science. As well as conducting publicly funded research, Dr. Gallagher also has a number of confidential, industry-led short-term projects

### Selected Publications

1. O'Shea, N., Kilcawley, K. and Gallagher, E. (2016). Influence of  $\alpha$ -amylase and xylanase on the chemical, physical and volatile compound properties of wheat bread supplemented with wholegrain barley flour. *European Food Research and Technology* DOI: 10.1007/s00217-016-2651-y.
2. Ktenioudaki, A., Alvarez, L., Kilcawley, K., Gallagher, E. (2015). Application of bioprocessing techniques (sourdough fermentation and technological aids) for brewer's spent grain breads. *Invited paper for the special issue of Food Research International*, doi:10.1016/j.foodres.2015.03.008.
3. O'Shea, N., Ktenioudaki, A., Smyth, T.P., McLoughlin, P., Doran, L., Auty, M., Arendt, E.K. and Gallagher, E. (2015). Physicochemical assessment of two fruit by-products as functional ingredients: Apple and orange pomace. *Journal of Food Engineering*, 153: 89–95.
4. Ktenioudaki, A., Alvarez-Jubete, L. and Gallagher, E. (2015). A review of the process-induced changes in the phytochemical content of cereal grains: The breadmaking process. *Critical Reviews in Food Science and Nutrition*. 55(5):611–9.
5. Ktenioudaki, A., Crofton, E., Scannell, A.G.M., Hannon, J.A., Kilcawley, K.N. and Gallagher, E. (2013). Sensory properties and aromatic composition of baked snacks containing brewer's spent grain. *Journal of Cereal Science*, 57 (3): 384–390.





## Ciara McDonagh

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### Education

M.Sc. (Agricultural Science) 1998–2000  
National University College Dublin (UCD).

B.Sc. (Applied Sciences – Food Science and Technology)  
1993–1997. Dublin Institute of Technology, Kevin St. –  
awarded by Trinity College Dublin.

### Career

2010–Present: Food Industry Development, Teagasc  
Food Research Centre, Ashtown.

2005–2010: Innovation Unit Manager, Teagasc Food  
Research Centre, Ashtown.

2001–2004: Research Officer, Meat Technology  
Department, Teagasc.

2000–2001: Research Assistant, National Food  
Biotechnology Centre, NUI, Cork.

### Expertise

Ciara plays an integral role in the food industry development programme, providing direct technology development support to the food processing industry through product development, contract research, training, consultancy and information services. Working with the Technology Transfer Office, Ciara has developed the Teagasc Portfolio of Technologies to ensure the early transfer to industry of knowledge generated from the Teagasc food research programme. She is also responsible for the delivery of the Food Innovation Gateways Events, showcasing these technologies to industry. In addition, she manages the Teagasc Customer Relationship Management System, which has been developed to support interactions with industry, streamline information exchange and ensure innovation needs are being met.

### Selected Publications

1. McDonagh, C. (2009). Technology Transfer Guides for the Meat Sector
2. McDonagh, C., Sommerfield, A., O'Neill, E., and McCarthy, P. (2006). From Concept to Completion – A Roadmap for Entrepreneurs.
3. Mc Donagh, C., Mullen, A.M, Kerry J.P. & Troy, D.J. (2006). Evaluation of inherent variation in porcine *M. thoracis et lumborum* and *M. semimembranosus*. *Journal of the Science of Food and Agriculture*. 86(2), 292–298.
4. Mc Donagh, C., Kerry J.P., Troy, D.J. & Mullen, A.M. (2005). Relationship between the subjective and objective assessment of pork *M. semimembrosus* and prediction of further processed pork quality. *Food Science and Technology International*. 11(2), 149–154
5. 2005–2012: Confidential Research Reports for client companies.



## Dr. Mark A. E. Auty

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### Education

Ph.D. Dairy Chemistry (University College Cork) 2004.

B.Sc. Microbiology (Surrey) 1985.

Fellow of the Royal Microscopical Society.

### Career

1997–Present: Senior Research Officer, Food Chemistry and Technology Department, Moorepark; manager of the National Food Imaging Centre. Since joining Teagasc, Mark has published 71 peer reviewed scientific articles and from 2006 has been awarded in excess of €5.5m in research funding.

1985–1996: Senior Scientist at Leatherhead Food International.

### Expertise

Dr. Auty is a food microstructure expert with many years' experience in applying microstructural analysis to understanding food functionality. Particular research interests include food nanotechnology, microscopy and relating the microstructure of food ingredients and products to processing and consumer quality. Dr. Auty provides specialist expertise for a wide range of projects at Teagasc, including projects on protein functionality, powders, cheese, probiotics, fermented milks, cereals and meat products. His expertise is in regular demand from the food industry. With a strong international reputation, he gives many invited and keynote presentations worldwide and is associate editor of the Food Structure scientific journal.

### Selected Publications

1. Zychowski, L.M., Logan, A., Augustin, M-A., Kelly, A.L., Zabara, A., O'Mahony, S.A., Conn, C.E. and Auty, M.A.E. 2016. Effect of phytosterols on the crystallization behaviour of oil-in-water milk fat emulsions, *Journal of Agricultural and Food Chemistry*, 64: 6546–6554.
2. Oboroceanu, D., Wang, L., Magner, E. & Auty, M.A.E. 2014. Fibrillization of whey proteins improves foaming capacity and foam stability at low protein concentrations. *Journal of Food Engineering*. 121: 102–111.
3. Ciron, C.I.E., Kelly, A.L. and Auty, M.A.E. (2012). Modifying the microstructure of low-fat yogurt by microfluidization of milk under different pressures to enhance rheological and sensory properties. *Food Chemistry*, 130: 510–519.
4. Abhyankar, A.R., Mulvihill, D.M. and Auty, M.A.E. (2011). Combined microscopic and dynamic rheological methods for studying the structural breakdown properties of whey protein gels and emulsion filled gels. *Food Hydrocolloids*, 25: 275–282. (8th out of top 25 hottest topic articles in 2011).
5. Ciron, C.I.E, Kelly, A.L., Auty, M.A.E. (2011). Effect of microfluidization of heat-treated milk on rheological and sensory properties of reduced-fat yogurt. *Food Hydrocolloids*, 25: 1470–1476.



## Dr. Ramón Aznar Roca

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### Education

PhD Analytical Chemistry. Technical University of Madrid (UPM), Spain 2016

M.Agr.Sc. (Earth Science), Technical University of Madrid (UPM), Spain 2014

M.Agr.Sc + B.Agr.Sc. (Earth Science), Technical University of Valencia (UPV), Spain 2010

### Career

2017–Present: Research Assistant, Nutraceutical Food Bioscience, Teagasc, Ireland

2016: Post-Doc Trinity College Dublin (TCD), Ireland

2015: Pre-Doc Visiting Scientist, Joint Research Centre (JRC) of European Commission (EU), Ispra, Italy

2013–2016: Research Assistant and PhD Student, Spanish National Institute for Agricultural and Food Research and Technology (INIA), Madrid, Spain

### Expertise

The research interests of Dr. Aznar include applying and developing novel analytical techniques, to detect emerging contaminants in complex environmental matrices and bioactive compounds in food matrices.

Dr. Aznar has contributed actively to different European and national funded projects (Spain, Italy and Ireland). As an example, previous research work has focused on assessing the ubiquitous presence of pharmaceutical compounds in the environment, developing and validating new analytical methods by gas chromatography-mass spectrometry (GC-MS) and tandem mass spectrometry (GC-MS/MS), and method development and validation to detect Silver nanoparticles (NP-Ag) in food contact materials and medical devices at Joint Research Centre (JRC) of the European Commission, using a novel technique entitled single particle-inductively coupled plasma-mass spectrometry (SP-ICP-MS).

In previous roles, Dr. Aznar has gained extensive knowledge in method development, optimization and validation, using a wide range of equipment (spectrophotometers, gas and liquid chromatography, ICP) with different detectors (UV, MS, MS/MS and QTOF).

Dr. Aznar recently joined Teagasc as a Research Lab Technician in the Nutraceutical Research Facility at Ashtown and is interested in investigating the extraction, characterisation and quantification of health-beneficial molecules from primary food sources, focusing in Irish seaweed.

### Selected Publications

1. Aznar, R. Barahona, F. Geiss, O. Ponti, J. Tadeo, J.L. and Barrero-Moreno, J (2017). Quantification and size characterisation of silver nanoparticles in environmental aqueous samples and consumer products by single particle-ICPMS. *Talanta*, 175, 200–208.
2. Aznar, R. Albero, B. Sánchez-Brunete, C. Miguel, E. Martín-Girela, I and Tadeo, J.L (2017). Simultaneous determination of multiclass emerging contaminants in aquatic plants by ultrasound assisted matrix solid phase dispersion and GC-MS. *Environmental Science and Pollution Research*, 24, 7911–7920.
3. Aznar, R. Moreno-Ramón, H. Albero, B. Sánchez-Brunete, C and Tadeo, J.L (2016). Spatio-temporal distribution of pyrethroids in soil in Mediterranean paddy fields. *Journal of Soil and Sediments*, 17, 1503–1513.
4. Aznar, R. Sánchez-Brunete, C. Albero, B. Rodríguez, J.A. and Tadeo, J.L. (2014). Occurrence and analysis of selected pharmaceutical compounds in soil from Spanish agricultural fields. *Environmental Science and Pollution Research*, 21, 4772–4782.



## Dr. Gerard Barry

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### Education

Ph.D. Factors Affecting Milk Protein Composition, 1980

B.Sc. Biochemistry with Microbiology, 1977

### Career

1988–Present: Food Industry Development, Teagasc Food Research Centre, Ashtown

1982–1986: Technical & Operations Management Meat Processing Sector

1980–1982: Teagasc Researcher, Dairy Research Centre, Moorepark.

### Expertise

- Design, development and delivery of training courses.
- Food Safety Systems/HACCP.
- Implementation of Quality Management Systems in.
- Food, Feed & Laboratory areas.
- Internal & Third Party auditing of Food Safety & Quality Management Standards.
- Internal auditing in Competent Authorities.
- Standards Development.

### Projects include:

- Development of Certified Training Programmes.
- Design & delivery of specialised training to Competent Authorities and Development Agencies.
- Delivery of training across a range of food safety related topics including microbiology, HACCP, food standards, auditing, laboratory accreditation etc.
- Organisation and delivery of a range of seminars on topics of interest to the food industry.
- Addressing varied client queries in the area of food safety & quality, including legislative and standards requirements (e.g. BRC, Bord Bia, ISO 22000 etc).
- Problem solving and shelf-life extension.

### Selected Publications

1. Barry G, Clancy M (1998) Food Catering, A Serious Business. *Hotel and Catering Times* October/November Ed. P 4–7.
2. Doyle T, Barry (1994). Food Safety The Systematic Approach. *Food Ireland*, June Edition, P17–20.
3. Barry G (2010). Ensuring Good Food Standards, *TResearch*, Volume 5, Number 1, Spring 2010 Pages 20–21 (ISSN 1649–8917).
4. Barry (2012) Shelf-life of Food, *TResearch*, Volume, Number 1, Spring 2012 Pages 20–21 (ISSN 1649–8917).



## Dr. Tom Beresford

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### Education

B.Sc. University College, Cork, Ireland. 1985

Ph.D. University College, Cork, Ireland. 1991

### Research Experience

1990–1991: Post Doctoral Research Scientist  
BioResearch Ireland, University College Cork.

1991–1993: Post Doctoral Research Scientist New  
Zealand Dairy Research Institute.

1993–2000: Research Officer.

2000–2002: Senior Research Officer.

2002–2005: Principal Research Officer.

2005–Present: Senior Principal Research Officer  
Teagasc Food Research Centre, Moorepark.

### Management Experience

2000–2004: Acting Head, Cheese Department.

2004–2009: Head, Food Cultures & Safety Department.

2009–2016: Head, Food Biosciences Department.

### Expertise

Dr. Beresford's primary research interests relate to aspects of cheese microbiology, in particular, the influence of various starter and non-starter organisms on the biochemistry of cheese ripening. Of particular interest is the contribution of *Lactobacillus helveticus* as a cheese ripening organism. As part of this work the complete sequence of DPC4571, an *L. helveticus* strain with interesting technological characteristics from the Moorepark culture collection, has been elucidated. A particular focus of his current research relates to the potential of bacterial exopolysaccharide to impact on both the techno – and bio-functionality of dairy products. In addition, he is interested in microbial fermentation with particular reference to the capacity of a range of bacteria to release bioactive peptides from protein molecules. He also undertakes research on microbial quality of milk.

### Selected Publications

1. Callanan, M.J., Kaleta, P., O'Callaghan, J., O'Sullivan, O., Jordan, K.N., McAuliffe, O., Sangrador-Vegas, A., Slattery, L., Fitzgerald, G. F., Beresford, T.P., Ross, R.P. (2008) Genome sequence of *Lactobacillus helveticus*, an organism distinguished by selective gene loss and insertion sequence element expansion. *Journal of Bacteriology*, 190, 2, 727–735.
2. Kaleta, P., O'Callaghan, J., Fitzgerald, G.F., Beresford, T.P., Ross, R. P. (2010) Crucial role for insertion sequence elements in *Lactobacillus helveticus* evolution as revealed by interstrain genomic comparison. *Applied & Environmental Microbiology* 76, 1, 212–220.
3. Costa, N.E., Hannon, J.A., Guinee, T.P., Auty, M.A.E., McSweeney, P.L.H and Beresford, T.P. (2010) Effect of exopolysaccharide produced by isogenic strains of *Lactococcus lactis* on half-fat Cheddar cheese. *Journal of Dairy Science* 93, 3469–3486.
4. Slattery, L., O'Callaghan, J., Fitzgerald, G.F., Beresford, T.P., and Ross, R.P. (2010) Invited review: *Lactobacillus helveticus* – A thermophilic dairy starter related to gut bacteria. *Journal of Dairy Science* 93, 4435–4445.
5. Quigley, L., O'Sullivan, O., Beresford, T., Ross, R.P. Fitzgerald, G.F. and Cotter, P. (2011). Molecular approaches to analyzing the microbial composition of raw milk and raw milk cheese. *International Journal of Food Microbiology* 150, 81–94.





## Dr. Declan Bolton

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### Education

B.Sc. University College Dublin, Ireland. 1991

Ph.D. University College Dublin, Ireland. 1995

Grad. Dip. Business, NCEA, Ireland. 1996

### Career

Research Assistant (University College Dublin) (1990)

Research Scientist (USDA-ERRC, Philadelphia) (1996)

Research Officer, Teagasc (1996–2003)

Senior Research Officer, Teagasc (2003–2006)

Principal Research Officer, Teagasc (2006 to date)

Member of the European Food Safety Authority,  
Biohazard Panel, Parma, Italy, (2012 to date)

Expert Consultant, FAO/WHO, Rome, Italy (2015)

### Expertise

- **Food safety microbiology** including *Campylobacter*, *Escherichia coli* O157/VTEC, *Salmonella* and other foodborne bacterial pathogens.
- **Food spoilage microbiology** including blown pack spoilage (*Clostridium estertheticum*, *Clostridium gasigenes*, etc.) and shelf-life.
- **Food safety, shelf-life, HACCP and pre-requisites (GMP and GHP)** for beef, pork lamb, poultry, fish and foods of non-animal origin (vegetables, cereals, fruit, etc.) including primary production, processing, transport, retail and catering.

### Selected Publications

1. Leonard Koolman, Paul Whyte, Joseph Meade, James Lyng, Declan Bolton (2014). Use of chemical treatments applied alone and in combination to reduce *Campylobacter* on raw poultry. *Food Control*, 46, 299–303.
2. Declan J. Bolton (2015) *Campylobacter* virulence and survival factors. *Food Microbiology*, 48, 99–108.
3. Leonard Koolman, Paul Whyte, Catherine Burgess and Declan J. Bolton (2015). Distribution of virulence-associated genes in a selection of *Campylobacter* isolates. *Foodborne Pathogens and Disease*, 12 (5), 424–433.
4. Declan J. Bolton, Des Walsh and Joan Carroll (2015). A four year survey of blown pack spoilage *Clostridium estertheticum* and *Clostridium gasigenes* on beef primals. *Letters in Applied Microbiology*, 61(2), 153–157.
5. Leonard Koolman, Paul Whyte, Catherine Burgess and Declan Bolton (2016) Virulence gene expression, adhesion and invasion of *Campylobacter jejuni* exposed to oxidative stress (H<sub>2</sub>O<sub>2</sub>). *International Journal of Food Microbiology*, 220, 33–38.
6. Tara Battersby, Paul Whyte and Declan J. Bolton (2016) The pattern of *Campylobacter* contamination on broiler farms; external and internal sources. *Journal of Applied Microbiology*, 102, 1108–1118.
7. Tara Battersby, Paul Whyte and Declan Bolton (2016). Protecting broilers against *Campylobacter* infection by preventing direct contact between the farmer and broilers. *Food Control*, 69, 346–351.



## Kevin Brennan

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### Education

M.Sc. Food Science, University of Reading (UK).

Food Microbiology, Institute of Technology, Co. Carlow.

Certificate in IT (computer systems) Institute of Technology, Blanchardstown.

Certificate in Equine AI and veterinary treatment.

### Career

Current since 1996: Teagasc Food Research Centre, Ashtown, Dublin 15.

SGS Yarsley Ltd, Leopardstown Business Park, Co. Dublin.

Bioresearch Ireland Ltd, National Biotechnology Research Centre, University College Cork.

SGS Yarsley UK Ltd, Redhill, Surrey, UK.

### Expertise

- Providing specialised training, consulting & independent contract technical auditing services (Bord Bia MPQAS, BRC and contract internal auditing) to the food sector, regulatory authorities and development agencies.
- Development and implementation of food safety and quality assurance standards. (incorporating: animal welfare, farm to fork traceability, food safety and quality).
- Technology/knowledge transfer of ready to use food safety research outputs to SMEs.
- Development of practical interpretative guides for SMEs in relation to application of food safety legislation.
- Animal welfare training and competency assessment in line with current animal welfare regulations.

### Selected Publications

1. Brennan, K.A. (2013) Traceability and identification of Horse meat, *Teagasc TResearch*.
2. Brennan, K.A. (2012) Quality assurance and microbiological criteria regulations, *Teagasc TResearch*.
3. Brennan, K.A., Compliance with EC reg 2073/2005 – red meat sampling, Institute of Food Science and Technology 'Food Science and Technology Ireland' Volume 2, July 2008.
4. Brennan, K.A., Guidance note NFC/3/2007 'Microbiological Criteria for Food Stuffs – red meat specific', April 2007, ISBN 1 84170 449 0.
5. Brennan, K.A. & Langan J.W. (2003), Guidance Note on the implementation of the microbiological testing procedures and interpretation of results as required by European Communities (Fresh Meat and Poultry Checks on General Hygiene) Regulations 2003 (redmeat specific), Training Guidance Note No: NFC/Meat/1/2003, ISBN 1 84170 331 1.
6. Brennan, K.A. (2003), Guidance Note on the implementation of the microbiological testing procedures and interpretation of results as required by European Communities (Fresh Meat and Poultry Checks on General Hygiene) Regulations 2003 (poultry specific), Training Guidance Note No: NFC/Meat/2/2003, ISBN 1 84170 346 X.
7. Brennan, K.A., Food Safety Management and Audit, proceedings of EU-RAIN international conference, Dublin December 1–2nd 2006.
8. Brennan, K.A. (1999), HACCP Certification and I.S. 343, Proceedings of International Quality Conference, Dublin, October 1999.
9. Brennan, K.A. (1998), Dissemination of Food Safety and Quality Research in Europe, Proceedings of International Meat Conference, Madrid, Spain.



## Dr. André Brodkorb

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### Education

1995: Degree in Chemistry, Friedrich Schiller Universität Jena, Germany

2001: Ph.D. in Bio-physical Chemistry, Université Libre de Bruxelles, Belgium

### Career

2001–2002: Post-doctorate in Bio-physical Chemistry, Trinity College Dublin

2002–Present: Research officer in Teagasc Food Research Centre, Moorepark

### Expertise

- Protein Structure/Function relationship; Structure = molecular structure (primary, secondary and tertiary), modification, and aggregation; Function = physico-chemical properties (e.g. gelation, viscosity, emulsification, hydrophobicity), bio-activity.
- *In vivo* and *in vitro* gastro-intestinal digestion of food and food components.
- Bioencapsulation – protection of sensitive food ingredients e.g. probiotic bacteria, during processing, storage and gastro-intestinal digestion.
- Bioactivity and structure of novel protein/ligand complexes.
- Separation and fractionation of proteins/peptides – development and evaluation of novel chromatographic and non-chromatographic purification and fractionation of mainly globular proteins and proteolytic fractions thereof.
- Food colloids – structure, stability and function.

### Selected Publications

1. Gough, R., O'Connor, P. M., Rea, M. C., Gómez-Sala, B., Miao, S., Hill, C., & Brodkorb, A. (2017). Simulated gastrointestinal digestion of nisin and interaction between nisin and bile. *LWT – Food Science and Technology*, 86, 530–537.
2. Minekus, M., Alming, M., Alvito, P., Ballance, S., Bohn, T., Bourlieu, C., Brodkorb, A. (2014). A standardised static *in vitro* digestion method suitable for food – an international consensus. *Food & Function*, 5(6), 1113–1124.
3. O'Loughlin, I. B., Murray, B. A., FitzGerald, R. J., Brodkorb, A., & Kelly, P. M. (2014). Pilot-scale production of hydrolysates with altered biofunctionalities based on thermally-denatured whey protein isolate. *International Dairy Journal*, 34, 146–152.
4. Sullivan, L. M., Kehoe, J. J., Barry, L., Buckley, M. J. M., Shanahan, F., Mok, K. H., & Brodkorb, A. (2014). Gastric digestion of  $\alpha$ -lactalbumin in adult human subjects using capsule endoscopy and nasogastric tube sampling. *British Journal of Nutrition*, 112, 638–646.
5. Doherty, S. B., Auty, M. A., Stanton, C., Ross, R. P., FitzGerald, G. F., & Brodkorb, A. (2012). Survival of entrapped *Lactobacillus rhamnosus* GG in whey protein micro-beads during simulated ex vivo gastrointestinal transit. *International Dairy Journal*, 22(1), 31–43.
6. Kehoe, J. J., Wang, L., Morris, E. R., & Brodkorb, A. (2011). Formation of non-native  $\beta$ -lactoglobulin during heat-induced denaturation. *Food Biophysics*, 6(4), 487–496.



## Dr. Kaye Burgess

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### Education

Ph.D. Microbiology, University College Cork  
B.Sc. (Hons) Microbiology, University College Cork (1H)

### Career

March 2017–Present: Senior Research Officer, Teagasc Food Research Centre Ashtown

Sept 2005–Feb 2017: Research Officer, Teagasc Food Research Centre Ashtown

June 2005–Aug 2005: Postdoctoral researcher, Department of Microbiology, University College Cork

### Expertise

Dr. Burgess's research focus is on using molecular tools to provide an understanding of the behaviour and virulence of microbial pathogens, in particular Gram-negative pathogens, along the farm to fork chain. She is particularly interested in the role that stresses encountered in the food chain may have on the virulence and persistence of foodborne pathogens, such as verocytotoxigenic *E. coli* (VTEC). Current activities include coordination of projects on identifying traits which contribute to persistence of VTEC in the primary production environment and reducing *L. monocytogenes* biofilm formation on food industry surfaces. She is a work package leader on the EU FP7 funded project *Aquavalens*, which is focused on technologies to ensure the safety of European drinking water supplies. Other areas of interest include novel detection methods for pathogens and spoilage organisms, the use of biological agents for the control of foodborne pathogens and antimicrobial resistance and horizontal gene transfer in food production.

### Selected Publications

1. Lenahan M., Sheridan A., Morris D., Duffy G., Fanning S., and C.M. Burgess (2014). Transcriptomic analysis of triclosan-susceptible and – tolerant *Escherichia coli* O157:H19 in response to triclosan exposure. *Microb Drug Resist.* 20(2): 91–103.
2. Sheridan Á., Lenahan M., Condell O., Bonilla-Santiago R., Sergeant K., Renaut J., Duffy G., Fanning S., Nally J.E., and C.M. Burgess. (2013) Proteomic and phenotypic analysis of triclosan tolerant verocytotoxigenic *Escherichia coli* O157:H19. *J Proteomics* 80: 78–90.
3. Sheridan Á., M. Lenahan, G. Duffy, S. Fanning and C.M. Burgess (2012). The potential of biocide tolerance in *Escherichia coli* and its impact on the response to food processing stresses. *Food Control*, 26:98–106.
4. Murphy S, Gaffney M, Fanning S and Burgess CM (2016) Potential for transfer of *Escherichia coli* O157:H7, *Listeria monocytogenes* and *Salmonella* Senftenberg from contaminated food waste derived compost and anaerobic digestate liquid to lettuce plants. *Food Microbiol* 59:7–13.
5. Burgess CM, Gianotti A, Gruzdev N, Holah J, Knøchel S, Lehner A, Margas E, Esser SS, Sela Saldinger S, Tresse O (2016). The response of foodborne pathogens to osmotic and desiccation stresses in the food chain. *Int J Food Microbiol* 221:37–53.
6. Nyambe S, Burgess CM, Whyte P, O'Kiely P and Bolton D (2017). The fate of verocytotoxigenic *Escherichia coli* C600φ3538(Δvtx2 ::cat) and its vtx2 prophage during grass silage preparation. *J Appl Microbiol.* 122(5):1197–1206.
7. Lawal D, Burgess CM, McCabe E, Whyte P, Duffy G. (2015). Development of a quantitative real time PCR assay to detect and enumerate *Escherichia coli* O157 and O26 serogroups in bovine recto-anal swabs. *J Microbiol Methods* 114:9–15.



## Sarah Cahalane

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### Education

BA. Natural Science, Trinity College Dublin, 2002

M.Sc. Dublin City University, 2004

### Career

2004–2006: Immunology Research Assistant, St. Vincent's University Hospital, Dublin 4

2006–2008: Research Funding and Lab Manager, Comparative Immunology Lab, Trinity College Dublin, Dublin 2

2008–2010: Evaluation Officer, Teagasc, Carlow

2010–Present: Intellectual Property Support Officer, Teagasc, Carlow

### Expertise

Sarah's scientific background is essential to her position within the Teagasc Technology Transfer Office (TTO). In her role in the TTO she assists and provides support to the Head of the Intellectual Property (IP) Management unit and facilitates interactions between Teagasc research staff, Industry and other research performing organisations through the use of transparent, consistent and equitable IP management and technology transfer policies.

Sarah is involved in drafting, reviewing and negotiating research agreements which range from simple non-disclosure agreements to more complex consortium agreements, contract research and collaboration agreements. She is responsible for presenting the Teagasc TTO's capabilities and activities on our website ([www.teagasc.ie/research/collaboration](http://www.teagasc.ie/research/collaboration)) and she actively participates in the promotion of Teagasc's technologies at Technology Transfer events.

### Selected Publications

1. Higgs, R., Cormican, P., Cahalane, S., et al. (2006) Induction of a novel chicken toll-like receptor following *Salmonella enterica* serovar *Typhimurium* infection. *Infection and Immunity* 74, 1692–1698.
2. Higgs, R., Lynn, D.J., Cahalane, S., et al. (2007) Modification of chicken avian beta-defensin-8 at positively selected amino acid sites enhances specific antimicrobial activity. *Immunogenetics* 59, 573–80.
3. Meade, K.G., Cahalane, S., Narciandi, F., et al. (2008) Directed alteration of a novel bovine beta-defensin to improve antimicrobial efficacy against methicillin-resistant *Staphylococcus aureus* (MRSA). *International Journal of Antimicrobial Agents* 32, 392–97.
4. Cormican, P., Meade, K.G., Cahalane, S., et al. (2008) Evolution, expression and effectiveness in a cluster of novel bovine beta-defensins. *Immunogenetics* 60, 147–56.





## Dr. Alka Choudhary

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### Education

PhD. National Institute of Pharmaceutical Education and Research, S.A.S. Nagar, India, 2015.

M.S. (Pharm.) Natural Products, National Institute of Pharmaceutical Education and Research, S.A.S. Nagar, India, 2011.

### Career

2016–Present: Postdoctoral fellow, Food Biosciences Department, Teagasc Food Research Centre, Ashtown

2015–2016: Research Associate, ICAR-CIPHET, India

### Expertise

At Teagasc, Dr. Alka Choudhary is involved in characterization of bioactives from marine bacteria using mass spectrometry. She completed her PhD on natural products where she focused on phytochemical investigations including qualitative and quantitative analysis using various spectroscopy and spectrometry techniques. She is interested in structure elucidation of natural and synthetic compounds based on MS, UV, FT-IR, and NMR techniques. She has also worked on the development of food biopolymer-based micro- and nano-scale delivery systems for bioactive ingredients in functional foods.

### Publications

1. Choudhary, A., Mittal, A. K., Radhika, M., Tripathy, D., Chatterjee, A., Banerjee, U. C., Singh, I. P. Two new stereoisomeric antioxidant triterpenes from *Potentilla fulgens*. *Fitoterapia* 2013, 91, 290–297.
2. Choudhary, A., Manukonda, R., Chatterjee, A., Banerjee, U. C., Singh, I. P. Qualitative and quantitative analysis of *Potentilla fulgens* roots by NMR, Matrix-assisted Laser Desorption/Ionisation with Time-of-Flight MS, Electrospray Ionisation MS/MS and HPLC/UV. *Phytochemical Analysis* 2015, 26, 161–170.
3. Choudhary, A., Kumar, R., Srivastava, R. B., Surapaneni, S. K., Tikoo, K., Singh, I. P. Isolation and characterization of phenolic compounds from *Rhodiola imbricata*, a Trans-Himalyan food crop having antioxidant and anticancer potential. *Journal of Functional Foods*, 2015, 16, 183–193.
4. Choudhary, A., Naughton, L.M., Montánchez, I., Dobson, A.D.W., Rai, D.K. Current Status and Future Prospects of Marine Natural Products (MNPs) as Antimicrobials. *Marine Drugs* 2017, 15, 272.



## **Bernard Corrigan**

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### **Education**

Diploma in Food Science

B.Sc in Biochem. And Analytical Science

### **Career**

Technologist Teagasc Food Research Centre,  
Moorepark, Fermoy, Co. Cork

Previously worked in the pharma. Industry UK including  
Genzyme and Glaxo.

### **Expertise**

- Elemental Analysis of dairy products.
- Analysis of dairy products esp powder testing.
- Protein.
- Chromatography



## Sarah Cooney

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### Education

B. Sc. In Food Science and Technology, University College Cork. 2009

Higher Certificate in Good Laboratory Practice and Core Skills, Waterford Institute of Technology. 2017

### Career

2014–Present: Laboratory Technician, Food Chemistry and Technology Department, Teagasc, Moorepark, Co. Cork

2014–2014: Assistant Quality Manager, Irish Bacon Slicers, Ballincollig, Co. Cork

2014–2014: Technical Manager, Glenisk, Killeigh, Co. Offaly

2011–2013: Quality Assurance, Dew Valley Foods, Thurles, Co. Tipperary

### Expertise

- Preparation of the Milk Standards which are sent to Co-ops and creameries across the country.
- ISO standard methods for analysis of milk, cheese and dairy powders. Including Kjeldahl for protein analysis and Rose-Gottlieb for fat analysis.
- Operation and calibration of the DairySpec FT for rapid analysis of raw milk.
- Technical Manager for the laboratory which was recently awarded INAB accreditation for standard ISO 17025:2005. The scope of this accreditation includes, fat and protein on liquid milk and dairy powders. Moisture on dairy powders and total solids on liquids.
- Laboratory Health and Safety Compliance Supervisor for the Technical Services Laboratory.
- Conducts the Split Sample Appeal Scheme for Co-ops and dairy farmers.
- Performs analysis including ash content, % intact casein, % non-protein nitrogen and % non-casein nitrogen.



## Dr. Fiona Crispie

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### Education

BA Nat. Sci. Trinity College Dublin

Ph.D. Microbiology University College, Cork.

### Career

2001–2002: Post-Doctoral Researcher, University College Cork.

2002–2006: Post-Doctoral Researcher, University College Cork/Teagasc.

2006–2009: Research Officer, Teagasc.

2009–2017: Senior Post-Doctoral Researcher, Next Generation Sequencing Platform, APC (Teagasc).

2017–Present: Technologist, Teagasc Food Research Centre

### Expertise

- Next generation DNA sequencing technologies.
- Microbiology of the gut.
- Antimicrobials to control spoilage and pathogenic bacteria.

### Selected Publications

1. Pusceddu MM, El Aidy S, Crispie F, O'Sullivan O, Cotter P, Stanton C, Kelly P, Cryan JF, Dinan TG. 2015. N-3 Polyunsaturated Fatty Acids (PUFAs) Reverse the Impact of Early-Life Stress on the Gut Microbiota. *PLoS One*. 10(10):e013972.
2. Golubeva AV, Crampton S, Desbonnet L, Edge D, O'Sullivan O, Lomasney KW, Zhdanov AV, Crispie F, Moloney RD, Borre YE, Cotter PD, Hyland NP, O'Halloran KD, Dinan TG, O'Keefe GW, Cryan JF. 2015. Prenatal stress-induced alterations in major physiological systems correlate with gut microbiota composition in adulthood. *Psychoneuroendocrinology*. 60:58–74.
3. Desbonnet L, Clarke G, Traplin A, O'Sullivan O, Crispie F, Moloney RD, Cotter PD, Dinan TG, Cryan JF. 2015. Gut microbiota depletion from early adolescence in mice: Implications for brain and behaviour. *Brain Behav Immun*. 48:165–73.
4. Davey KJ, Cotter PD, O'Sullivan O, Crispie F, Dinan TG, Cryan JF, O'Mahony SM. 2013. Antipsychotics and the gut microbiome: olanzapine-induced metabolic dysfunction is attenuated by antibiotic administration in the rat. *Transl Psychiatry* 1;3:e309.
5. Dobson A, Crispie F, Rea MC, O'Sullivan O, Casey PG, Lawlor PG, Cotter PD, Ross P, Gardiner GE, Hill C. 2011. Fate and efficacy of lacticin 3147-producing *Lactococcus lactis* in the mammalian gastrointestinal tract. *FEMS Microbiol Ecol*. 76(3) 602–14.
6. Rea MC, Dobson A, O'Sullivan O, Crispie F, Fouhy F, Cotter PD, Shanahan F, Kiely B, Hill C, Ross RP. 2011. Effect of broad – and narrow-spectrum antimicrobials on *Clostridium difficile* and microbial diversity in a model of the distal colon. *Proc Natl Acad Sci U S A*. 108(1):4639–44.



## Dr. Emily Crofton

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### Education

PhD in Sensory and Consumer Science, University College Dublin (2009–2013).

Postgraduate Diploma in Education (PGDE), NUI Maynooth (2007–2008).

BSc in Food Science, University College Dublin (2003–2007).

### Career

2016 – present: Research Officer, Teagasc Food Research Centre, Ashtown, Dublin 15.

2014–2016: Manager – Sensory Food Network Ireland, Teagasc Food Research Centre, Ashtown, Dublin 15.

Sep – Dec 2014: Online Tutor for the Principles of Sensory Science module as part of the MSc in Food, Nutrition and Health, University College Dublin.

2009–2010: Sensory Analysis Lecturer, UCD Institute of Food and Health, University College Dublin.

2007–2008: Secondary School Teacher in Biology and Science, St. Joseph's Secondary School, Dublin 7.

### Expertise

Dr. Emily Crofton is a research officer at Teagasc. She has extensive experience in applying a range of sensory evaluation techniques for both product development and quality control applications, in addition to using both qualitative and quantitative research methods to study consumer behaviour. Emily also spent time as a postdoctoral researcher, managing the development of a national sensory science network called Sensory Food Network Ireland. She has over 10 years teaching experience, having designed and delivered sensory analysis courses within an academic and industry setting. Her interests lie broadly in utilising sensory and consumer methods to enhance consumer-led product development initiatives. Emily is currently leading a project which aims to capture the complexity of how different production systems impact the sensory profile, consumer liking and emotional appeal of beef. Emily is also passionate about science communication, and has organised and spoken at many events in this area.

### Publications

1. Crofton, E.C., Markey, A. and Scannell, A.G.M. (2014). Perceptions of healthy snacking among Irish adolescents: A qualitative investigation. *International Journal of Health Promotion and Education*, 52: 188–199.
2. Crofton, E.C., Markey, A. and Scannell, A.G.M. (2013). Consumers' expectations and needs towards healthy cereal based snacks: An exploratory study among Irish adults. *British Food Journal*, 115: 1130–1148.
3. Ktenioudaki, A., Crofton, E., Scannell, A.G.M., Hannon, J.A., Kilcawley, K.N. and Gallagher, E. (2013). Sensory properties and aromatic composition of baked snacks containing brewer's spent grain. *Journal of Cereal Science*, 57 (3): 384–39.





## Dr. Martin Danaher

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### Education

Ph.D. in Analytical Chemistry, University College Cork 2003.

B.Sc. Industrial Chemistry, University of Limerick, 1997.

### Career

2002–Present: Teagasc Food Researcher.

1997–1998: R&D Chemist, Gerard Laboratories.

1998–2002: Ph.D. student – “Teagasc Walsh Fellow.”

### Expertise

- Analytical chemistry: Chromatographic separations, sample purification, mass spectrometry, biosensors and immunoassays.
- Residue analysis: Agrochemical, environmental, natural toxins and medicinal adulterants.
- Databases: Coordinator of Ireland’s “National Food Residue” and “Veterinary Drug and Feed Additive” Databases.
- Exposure and Risk Assessment: Exposure and risk assessment to contaminants from food.

### Selected Publications

1. O’Mahony, J., Moloney, M., McConnell, R.I., Benchikh, E.O., Lowry, P., Furey, A., and Danaher, M., (2011). Simultaneous detection of four nitrofurans metabolites in honey using a multiplexing biochip screening assay. *Biosensors and Bioelectronics* 26 (10), pp. 4076–4081.
2. Vinogradova, T., Danaher, M., Baxter, A., Moloney, M., Victory, D. and Haughey, S.A. (2011). Rapid surface plasmon resonance immunobiosensor assay for microcystin toxins in blue-green algae food supplements. *Talanta*, 84 (3), pp. 638–643.
3. Whelan, M., Kinsella, B., Furey, A., Moloney, M., Cantwell, H., Lehotay, S.J. and Danaher, M. (2010). Determination of anthelmintic drug residues in milk using ultra high performance liquid chromatography-tandem mass spectrometry with rapid polarity switching *Journal of Chromatography A*, 1217 (27), pp. 4612–4622.
4. Kinsella, B., Lehotay, S.J., Mastovske, K., Lightfield, A.R. and Danaher, M. (2009). New method for the analysis of flukicide and other anthelmintic residues in bovine milk and liver using liquid chromatography-tandem mass spectrometry. *Analytica Chimica Acta*, 637(1–2), pp. 196–207.
5. Kinsella, B., O’Mahony, J., Malone, E., Moloney, M., Cantwell, H., Furey, A. and Danaher, M. (2009). Current trends in sample preparation for growth promoter and veterinary drug residue analysis. *Journal of Chromatography A*, 1216(46), pp. 7977–8015.



## Dr. Gonzalo Delgado-Pando

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### Education

PhD. Universidad Complutense de Madrid, Spain, 2013

M.Sc. (Food Safety and Biotechnology), Universidad de Burgos, Spain 2007

B.Sc. (Food Science and Technology), Universidad de Burgos, Spain 2006

### Career

2017–Present: Research Officer, Meat Technology Ireland, Food Quality and Sensory Department, Teagasc

2015–2017: Postdoctoral Researcher, Food Quality and Sensory Department, Teagasc

2013–2015: Research fellow, Institute for Global Food Security, Queen's University Belfast

### Expertise

The research interests of Dr. Delgado-Pando include functional foods, novel technologies and meat products. Gonzalo joined Teagasc as a postdoctoral researcher for the DAFM-funded project called PROSSLOW. Within this project he worked on obtaining successful ways of reducing the salt content of traditionally processed Irish cured meats without impacting the consumer acceptance, quality and safety of the products. During previous roles, Dr. Delgado-Pando has gained a strong knowledge of novel technologies such as high pressure processing, cold plasma and novel continuous microwave and how these technologies affect the technological and nutritional properties of the food products. He also has strong skills regarding development of functional meat products, chemometrics and multivariate analysis. Dr. Delgado-Pando recently joined Meat Technology Ireland, at Teagasc, working on novel meat characterisation technologies with potential to be implemented for in-line use. Some of the technologies under scrutiny are: video imaging analysis, ultrasound, computed tomography, and dual-energy x-ray absorptiometry. The objective of this MTI project is to improve process efficiency in the Irish meat industry.

### Selected Publications

1. Delgado-Pando, G., Fischer, E., Allen, P., Kerry, J. P., O'Sullivan, M. G., & Hamill, R. M. (in press). Salt content and minimum acceptable levels in whole-muscle cured meat products. *Meat Science*
2. Delgado-Pando, G., Stratakos, A., & Koidis, A. (2016). Nutritional Properties of Ready-to-Eat Pasta Salads: Effect of Processing and Storage Conditions. *Journal of Food Processing and Preservation*. doi:10.1111/jfpp.13124
3. Stratakos, A., Delgado-Pando, G., Linton, M., Patterson, M.F., & Koidis, A. (2016). Industrial scale microwave processing of tomato juice using a novel continuous microwave system, *Food Chemistry*, 190(1), 622–628
4. Stratakos, A. C., Delgado-Pando, G., Linton, M., Patterson, M. F., & Koidis, A. (2015). Synergism between high-pressure processing and active packaging against *Listeria monocytogenes* in ready-to-eat chicken breast. *Innovative Food Science & Emerging Technologies*, 27, 41–47
5. Delgado-Pando, G., Celada, P., Sanchez-Muniz, F. J., Jimenez-Colmenero, F., & Olmedilla-Alonso, B. (2014). Effects of improved fat content of frankfurters and pates on lipid and lipoprotein profile of volunteers at increased cardiovascular risk: a placebo-controlled study. *Eur J Nutr*, 53(1), 83–93.
6. Jiménez-Colmenero, F., & Delgado-Pando, G. (2013). 16 – Fibre-enriched meat products. In J. A. D. Poutanen (Ed.), *Fibre-Rich and Wholegrain Foods*, (pp. 329–347): Woodhead Publishing.



## Kieran Downey

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### Education

BSc. Food Science, University of Cork. 2003

Diploma in Project Management. 2007

MBS. Business Practice, IMI. 2015

### Career

2000–2003: Laboratory/Production – Dairygold

2003–2005: Assistant Production Manager – Carbery Group

2005–2008: Research Technologist – Wyeth Nutritionals

2008–2009: Food Technologist – Teagasc

2010–2011: Technical Manager – Moorepark Technology Ltd (MTL)

2011–Present: General Manager – Moorepark Technology Ltd (MTL)

### Expertise

Kieran Downey was appointed General Manager in 2011 of Moorepark Technology Ltd (MTL) which is a Food Industry Pilot Plant Facility with seven operating units. MTL's core business is the rental of the pilot plant to food companies and public research institutions for the purposes of carrying out product and process development, training, or small scale start-up manufacture.

Kieran leads a staff of sixteen, comprising food technologists, process engineers and plant operators and maintains MTL as a leading international provider of pilot-plant services, with particular expertise in wet processing, separation technologies and spray drying.

### Competencies include the following food technology areas:

- Dairy technologies
- Infant formula technologies
- Separation technologies: mechanical and membrane separation – UF, MF, NF, clarification, decantation
- Evaporation and spray drying technologies
- Wet processing – HTST/UHT, homogenisation equipment

### The main focus of Kieran's research and development work has been:

- New product development
- Product optimisation
- Cost optimisation
- Contract research
- Process engineering and efficiency
- Client training courses



## Dr. Anna Fenelon

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### Education

PhD. National University Ireland, Maynooth, 2003

B.Sc. (Chemistry), National University Ireland, Maynooth, 1999

### Career

2008–Present: Technologist, Environment, Soils and Land Use Department, Teagasc

2004–2008: R&D Engineer, Hewlett Packard Manufacturing, Leixlip, Co. Kildare, Ireland

2003–2004: Post Doctoral Researcher, National University Ireland, Maynooth, Ireland

### Expertise

Dr. Fenelon is the laboratory manager in the Teagasc Environmental Research Centre, Johnstown Castle. She manages a team of 8 experienced technical staff who work in combination with the research team across a suite of laboratories to deliver project goals of the Teagasc Environmental Research programme.

In addition to management duties, Dr. Fenelon's research area of interest is Analytical Chemistry. She is focused on mid/near-infra red spectroscopy and X-ray fluorescence spectroscopy for the application of rapid analysis techniques. In recent work, Dr. Fenelon has developed a rapid, multi-element method for the analysis of major nutrients in grass using energy dispersive X-ray fluorescence. This work is now being extended to trace analysis in grass and other matrices, such as soil, dairy waste and milk powders. Dr. Fenelon is also currently part of a team developing methods which predict chemical parameters such as % organic matter, particle size and cation exchange capacity using molecular spectroscopy techniques. This work is comprised of scanning samples in the MIR and NIR region of the electromagnetic spectrum and combining chemometric techniques to build calibration models which predict these parameters.

### Selected Publications

1. Daly, K. and Fenelon, A. 2017. A rapid and multi-element method for the analysis of major nutrients in grass (*Lolium perenne*) using energy dispersive X-Ray fluorescence spectroscopy. *Irish Journal of Agriculture and Food Research*. 1–11. DOI: 10.1515/ijafr-2017-0001
2. Dunne, K. Holden, N., Fenelon, A. and Daly, K. 2017. The application of DRIFT in mid-Infrared spectroscopy for the prediction of soil phosphorus sorption capacity. 18th ICNIRS (International Conference on Near Infrared Spectroscopy) – NIR Spectroscopy at work in Industry, 2017. 11th – 15th June 2017, Bella Center, Copenhagen, Denmark.
3. Massey, P., O'Connor, C., Sills, P., Fenelon, A., Moloney-Finn, Stone, D. Reidy, B. and Creamer, R. Irish soil Information system: Laboratory Standard Operating Procedures, *STRIVE report*; 2014.



## Laura Finnegan

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### Education

B.A. Human Genetics, Trinity College Dublin (2015)

### Career

2016–Present: Technician, Next Generation Sequencing Platform, APC (Teagasc).

2012–2015: Guinness Storehouse, St James' Gate, Dublin

### Expertise

The Next Generation Sequencing Facility in Teagasc is one of the platform technologies of the APC – a national institute which aims to study the complexity of the gastrointestinal bacterial community and its links to human health, disease and mental well-being. The centre features Illumina NextSeq and MiSeq platforms, as well as Ion Torrent PGM and Proton sequencers and an Oxford Nanopore MinION. In her role as NGS technician, Laura is primarily involved in DNA library preparation, library QC and sequencing on the selected platform. While in this position, Laura has developed expertise in the following areas:

- DNA and RNA extraction – from food and human/ animal samples.
- EMA extraction – for removal of dead bacteria DNA from a sample.
- 16S and ITS metagenomic library preparation and sequencing.
- Whole-genome shotgun library preparation and sequencing.
- Library QC – using nanodrop, Qubit quantification, Agilent Bioanalyser and qPCR.
- Total bacterial quantification by qPCR.

- Scientific Communication – through involvement in Education and Public Engagement programmes organized with the aim of informing society, engaging with industry and inspiring future young scientists. Laura has represented Teagasc and the APC Microbiome Institute at UCC open days and family-focused events in Cork city and surrounding towns, giving talks to primary school children on the importance of a good diet for a healthy microbiome, as well as mentoring transition year and third-level students during work placements.





## Dr. Linda Giblin

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### Education

Ph.D. University College Cork, Ireland. 1989

B.Sc. Biotechnology, Dublin City University, Ireland 1995

### Career

2002–Present: Senior Research Officer, Food BioSciences Department, Teagasc Food Research Centre, Moorepark, Ireland.

1999–2002: Research/Senior Scientist, Xanthon Inc (biotech start-up), Research Triangle Park, North Carolina, U.S.A.

1997–1998: Post-doctoral Scientist, Institute of Molecular BioSciences, Massey University, New Zealand.

1994–1997: Wellcome Post-doctoral Scientist, Biochemistry Department, University College Cork, Ireland.

### Expertise

- Foods for Health, Food Bioactives.
- Life Stage Nutrition: Foods for pregnant women, foods for the elderly, foods for the infant.
- Food Bioavailability and Bioaccessibility.
- Foods for weight management, in particular satiety.
- Adipocyte and muscle health.
- Genotype-phenotype interactions.
- Large animal trials: Porcine post-prandial studies, Porcine models for pregnancy, Bovine mammary challenges.

### Selected Publications

1. Kondrashina, A., Papkovsky, D., Giblin L. (2017). Physiological Gut Oxygenation Alters GLP-1 Secretion From the Enteroendocrine Cell Line STC-1. *Mol Nutr Food Res.*, doi10.1002/mnfr.201700568.
2. McCarthy, T., Bruen, C., O'Halloran, F., Schellekens, H., Kilcawley, K., Cryan, J. F., Giblin, L. (2017). Aroma compound diacetyl suppresses glucagon-like peptide-1 production and secretion in STC-1 cells. *Food Chem.*, 228, 35–42.
3. Giblin, L., McGrath, B. A., Murray, B. A., le Roux, C. W., Docherty, N. G., McSweeney, P.L., Kelly, A.L. (2017). Letter to the Editor Regarding Equivalent Increases in Circulating GLP-1 Following Jejunal Delivery of Intact and Hydrolysed Casein: Relevance to Satiety Induction following Bariatric Surgery. *Obes Surg.*, 27, 816–817.
4. O'Halloran, F., Beecher, C., Chaurin, V., Sweeney, T., Giblin, L. (2016). Lactoferrin affects the adherence and invasion of *Streptococcus dysgalactiae* ssp. *dysgalactiae* in mammary epithelial cells. *J Dairy Sci.*, 99(6), 4619–28
5. Schellekens, H., De Francesco, P. N., Kandil, D., Theeuwes, W. F., McCarthy, T., van Oeffelen, W. E., Perello, M., Giblin, L., Dinan, T. G., Cryan, J. F. (2015). Ghrelin's Orexigenic Effect Is Modulated via a Serotonin 2C Receptor Interaction. *ACS Chem Neurosci.*, 6, 1186–1197.
6. Power-Grant, O., Bruen, C., Brennan, L., Giblin, L., Jakeman, P., FitzGerald, R. J. (2015). In vitro bioactive properties of intact and enzymatically hydrolysed whey protein: targeting the enteroinsular axis. *Food Funct.*, 6(3),972–80.
7. O'Sullivan, D. J., Fallico, V., O'Sullivan, O., McSweeney, P. L., Sheehan, J. J., Cotter, P. D., Giblin, L. (2015). High-throughput DNA sequencing to survey bacterial histidine and tyrosine decarboxylases in raw milk cheeses. *BMC Microbiol.*, 15, 266-doi10.1186/s12866-015-0596-0.
8. Giblin, L., Darimont, C., Leone, P., McNamara, L. B., Blancher, F., Berry, D., Castañeda-Gutiérrez, E., Lawlor, P. G. (2015). Offspring subcutaneous adipose markers are sensitive to the timing of maternal gestational weight gain. *Reprod Biol Endocrinol.* 13–16 doi10.1186/s12958-015-0009.



## Carol Griffin

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### Education

M.Sc. (Agr.) Degree in Food Science & Technology  
UCD 1993.

Graduate Diploma in Food Science & Technology  
(IFST, UK) DIT, Kevin St. 1991.

B.Sc. (Biochemistry, Physiology, Human Nutrition)  
NUI, Galway 1989.

### Career

Jan 2010–Present: Food Industry Support (NPD &  
Sensory Analysis) – Teagasc, Food Research Centre,  
Ashtown.

Jan 2008–Jan 2010: Artisan Meat Technologist –  
Teagasc, Food Research Centre, Ashtown.

Feb 2002–Jan 2008: Food Safety Consultant & Trainer,  
Teagasc, Food Research Centre, Ashtown.

Sep 2000–Feb 2002: Food Safety Consultant with Verner  
Wheelock Associates (VWA).

Jan 1999–Sep 2000: Food Safety Consultant (self  
employed).

Mar 1994–Dec 1998: Quality Assurance Manager  
Goldstar Meats (renamed Kepak, Glasnevin).

Jun 1992–Mar 1994: Quality Technician – Batchelors Ltd.  
Bannow Road, Cabra, Dublin 7.

### Expertise

#### Areas of expertise include:

Working as part of the Food Industry Development  
Department to support food businesses through advice,  
consultancy, auditing and training, in the areas of sensory  
analysis, product development, innovation, food safety,  
labelling and food business technical process  
development.

#### Consultancy projects undertaken include:

- Product reformulations, new product development  
from concept to production trials, sensory analysis of  
a wide range of food products for food businesses  
and to support the research programme in Teagasc.  
A major proportion of product and process  
development projects undertaken focus on shelf life  
extensions through product, process and packaging  
re-design.
- Development, delivery, piloting and validation of  
certified training programmes for all sectors of the  
food industry to meet client's customer & legislative  
requirements (topics include product & process  
development, food legislation, food labelling, hygiene,  
food safety, HACCP, plant design & food assurance  
standards, NPD and sensory).
- Descriptive Sensory Panel set up and training.
- Management of the Sensory Analysis Unit in  
Ashtown.
- Implementation of quality assurance and food safety  
management systems in a wide range of food  
businesses.
- Providing a technical advisory service to the meat &  
speciality food sector through mentoring, training and  
consultancy in the areas of food product and process  
development, food safety management systems and  
regulatory compliance.



## Prof. TP Guinee

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### Education/Career

Professor Timothy P. Guinee is a Principal Research Officer in Food Chemistry and Technology at Teagasc Food Research Centre, Moorepark, Fermoy, Co. Cork, Ireland. He graduated with a B.Sc. in Dairy Science (1980) and a Ph.D. in Dairy Chemistry (1985) from University College Cork. He was employed as a lecturer in Food – and Environmental – sciences at Sligo Regional Technical College between 1984–1986. From 1986 to 1990, he worked in commercial R&D, as a Senior Researcher Scientist in Ireland, Germany and US on various aspects of cheeses (natural, processed, analogue types) and applications of milk protein ingredients in cheese and fermented milk products. He was appointed as a Senior Research Officer in Teagasc in 1990 and was promoted to Principal Research Officer in 2000.

### Expertise

His particular interests include the study of the rheology and functional properties (e.g., viscosity, gelation, texture, heating behaviour) of composite high protein food matrices, and the exploitation of these properties in food manufacture and assembly/formulation, with particular emphasis on gels and cheese-based systems. He has investigated the influences of various factors on the properties of cheeses, including milk composition/treatments, gelation conditions, processing treatments, added ingredients, cheese composition and maturation conditions. A key aspect of his research involves the optimization of protein-protein, protein-mineral and protein-water interactions for the control of structure-functional relationships of foods, such as texture and heat stability. This approach has been applied in the development of reduced-fat cheese and a new cheese technology platform (based on gelation of reassembled milks). He has been an editorial board member for *International Dairy Journal* (from 2005) and formerly a co-editor. In 2011, he was appointed Adjunct Professor to the College of Science, Engineering and Food Science, University College Cork.

### Selected Publications

- Guinee, T.P. (2016). Protein in cheese products: structure-function relationships. In P.L.H. McSweeney and S.A. O'Mahony (Eds), *Advanced Dairy Chemistry, Vol. 1 B Proteins: Applied Aspects* (4th ed.) Springer Science+Business Media, New York, 347–415.
- Guinee, T.P. and O'Callaghan D.J. (2013). Effect of increasing the protein-to-fat ratio and reducing fat content on the chemical and physical properties of processed cheese product. *J. Dairy Sci.* 6830–6839.
- Guinee, T.P., Pudja, P., Miočinić, J., Wiley, J., & Mullins, C.M. (2015). Textural and cooking properties and viscoelastic changes on heating and cooling of Balkan cheeses. *Journal of Dairy Science*, 98, 7573–7586.
- Henneberry, S., Kelly, P.M., Kilcawley, K.N., Wilkinson, M.G., Guinee, T.P. (2015). Interactive effects of salt and fat reduction on composition, rheology and functional properties of Mozzarella-style cheese. *Dairy Science and Technology*, 95, 613–638.
- Henneberry, S., O'Sullivan, M. G., Kilcawley, K. N., Kelly, P. M., Wilkinson, M. G., & Guinee, T. P. (2016). Sensory quality of unheated and heated Mozzarella-style cheeses with different fat, salt and calcium levels. *International Journal of Dairy Technology*, 69, 38–50.
- Hickey, D.K., Guinee T.P., Hou, J., and Wilkinson M.G. (2013). Effects of variation in cheese composition and maturation on water activity in Cheddar cheese during ripening. *Int. Dairy J.* 30, 53–58.
- Hou, J., Hannon, J.A., McSweeney, P.L.H., Beresford, T.P. and Guinee, T.P. (2012). Effect of curd washing on composition, lactose metabolism, pH, and the growth of non-starter lactic acid bacteria in full fat Cheddar cheese. *Int. Dairy J.*, 25, 21–28.
- Hou, J., Hannon, J.A., McSweeney, P.L.H., Beresford, T.P. and Guinee, T.P. (2014). Effect of curd washing on cheese proteolysis, texture, volatile compounds, and sensory grading in full fat Cheddar cheese. *Int. Dairy J.*, 34, 190–198.



## Dr. Ruth Hamill

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### Education

Ph.D. (Population Genetics), School of Biology and Environmental Science, UCD

B.Sc. (Zoology, 1H1), School of Biology and Environmental Science, UCD

### Experience

2006–Present: Research Officer, Muscle Molecular Biology, Teagasc Food Research Centre, Ashtown

2002–2005: Post-doctoral Research Fellow, Population Genetics, University of St Andrews, Scotland

### Expertise

Dr. Hamill's expertise focuses on muscle biology and meat science with a view to increasing understanding of the biological processes underpinning meat quality, the development of biological (genomic) markers of quality and understanding the structure/function relationship in meat products. Her research programme is collaborative and nationally (FIRM/RSF) and European (FP7/COST) funded and she has also worked on confidential industry projects. She is currently a collaborator on a number of active projects in the healthier meat products area (e.g. Prosslow) and is a PI and Co-ordinator of a FIRM-funded project (Meat4Vitality) focused on developing novel meat products targeting the specific nutritional needs of older people and has previously co-ordinated a project (MeatMatrix) in this area focused on applying spectroscopic, microscopy, calorimetric and rheology techniques in model meat and myofibrillar systems to enhance understanding of the molecular mechanisms underpinning technological and sensorial quality. Through these projects the aim is to help facilitate the adoption of a more knowledge-based approach to the generation of targeted food systems and novel meat products delivering desired characteristics.

### Selected Publications

1. Keenan, D. F., Resconi, V. C., Smyth, T. J., Lefranc, C., Botinestean, C., Kerry, J. P., Hamill, R. M. (2015). The effect of partial-fat substitutions with encapsulated and unencapsulated fish oils on the technological and eating quality of beef burgers over storage. *Meat Science*, available online, doi:10.1016/j.meatsci.2015.04.013
2. Tobin, B. D., M. G. O'Sullivan, R. Hamill and J. P. Kerry (2014). European consumer attitudes on the associated health benefits of neutraceutical-containing processed meats using Co-enzyme Q10 as a sample functional ingredient. *Meat Science* 97(2): 207–213.
3. Keenan, D. F., Auty, M. A. E., Doran, L., Kerry, J.P., Hamill, R. M. (2014). Investigating the influence of inulin as a fat substitute in comminuted products using rheology, calorimetric and microscopy techniques. *Food Structure*, 01: 2014
4. Hamill, RM, Aslan, O, Mullen, AM, O'Doherty, JV, McBryan, J, Morris, DG and Sweeney, T (2013). Transcriptome analysis of porcine *M. semimembranosus* divergent in intramuscular fat as a consequence of dietary protein restriction. *BMC Genomics*. 2013, 14:453
5. McArdle, R, Hamill, R.M. and Kerry, J.P. (2011). Utilisation of hydrocolloids in processed meat systems. In: *Processed meats: improving safety, nutrition and quality*, p. 243–269. Edited by J.P. Kerry and J.F. Kerry, Woodhead Publishing.



## Dr. Maria Hayes

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### Education

B.Sc. University College Dublin, Ireland. 2002

Ph.D. University College Cork, Ireland. 2007

Leadership Development Diploma. 2016

### Career

May 2016–July 2016: Guest researcher at Chalmers University of Technology, The Biology and Biological Engineering Unit, Gothenburg, Sweden.

February–March 2015: Hosted researcher at NMBU, Oslo, Norway.

October 2008–Present: Natural Products Chemist, Teagasc Food Research Centre, Ashtown, Dublin 15

October 2008–Present: Guest lecturer Dublin Institute of Technology module TFFP3055 Nutraceutical Product development.

June 2007–October 2008: Researcher at the Centre of Applied Marine Biotechnology, Letterkenny Institute of Technology, Donegal, Ireland.

December 2006–June 2007: Researcher at Teagasc Moorepark Biotechnology Centre and University College Cork.

### Expertise

- High quality scientific research skills.
- Novel proteins from marine, meat and cereal sources – WP leader on NutraMara, ReValueProtein and NutriCereals Ireland.
- Isolation and characterization of techno-functional and health ingredients.
- Project management/evaluation.
- Technology & knowledge transfer.
- Innovation and new product development.
- Bioassay development – Heart health, renin, PAF-AH, ACE-I inhibitory, diabetes, mental health, antimicrobial PEP inhibitory, anti-oxidative, opioid.

- Allergenicity – member of EU COST Action ImPARAS EU FA1402.
- Seaweed and microalgae – member of EU COST Action EU ALGAE EU 1408.
- Event organization and moderation (conferences & workshops).
- Book editor and writer.

### Selected Publications

1. Lafarga, T., & Hayes, M. (2016), Meat-derived bioactive protein hydrolysates and peptides as food ingredients: overcoming current challenges. *Food Reviews international*, DOI: <http://dx.doi.org/10.1080/87559129.2016.1175013>.
2. Dave, L. A., Hayes, M., Mora, L., Montoya, C. A., Moughan, P. J., Rutherford, S. M. (2016), Gastrointestinal endogenous protein-derived bioactive peptides: An in vitro study of their gut modulatory potential. *International Journal of Molecular Sciences*, 17, 482; doi:10.3390/ijms17040482.
3. Dave, L. A., Hayes, M., Montoya, C. A., Rutherford, S. M., Moughan, P. (2016), Human gut endogenous proteins as a source of angiotensin-I-converting enzyme (ACE-I), renin inhibitory and antioxidant peptides. *Peptides*, 76, 30–44. doi:10.1016/j.peptides.2015.11.003.
4. Dave, L. A., Hayes, M., Moughan, P. J., Rutherford, S. M. (2016), Novel Dipeptidyl Peptidase IV inhibitory and antioxidant peptides derived from human gastrointestinal endogenous proteins. *Int. J. Pept. Res. Ther.* 1–15. DOI 10.1007/s10989–016–9515-y.
5. Gangopadhyay, N., Wynne, K., O'Connor, P., Gallagher, E., Brunton, N. and Hayes, M. (2016), In silico and in vitro analysis of the angiotensin-I-converting enzyme inhibitory activity of hydrolysates generated from crude Barley (*Hordeum vulgare*) protein concentrates. *Food Chemistry*, 203, 367–374.





## Dr. Rita Hickey

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### Education

2008 FETAC Level 6 Advanced Certificate in Agriculture.

2003 Ph.D. Microbiology from NUI Cork (UCC).

1998 B.Sc. Hons (1H) from NUI Dublin (UCD).

### Career

2007–Present Senior Research Officer, Teagasc Food Research Centre, Moorepark, Fermoy, Co. Cork, Ireland.

2005–2007 Process Specialist, Abbott Diagnostics, Sligo.

2004–2005 Research Officer, APC, Teagasc, Ireland.

2003–2004 Postdoctoral Researcher, MFRC, Teagasc, Ireland.

### Expertise

Dr. Hickey's main research interests focus on the investigation of the biological properties of sugars isolated from food sources. She is the lead PI on the FHI Infant Nutrition workpackage for Food for Health Ireland and was a funded PI on the SFI-funded Alimentary Glycobiology Research Cluster (AGRC). She is a faculty member of the APC Microbiome Institute (APC). She has close linkages with Prof. Joshi's group in NUIG, through various AGRC- and DAFM-funded projects. Rita also collaborates with Prof. Douwe van Sinderen and Dr. Seamus O'Mahony in UCC. A major area of interest is the effect of food derived oligosaccharides on host-microbial interactions in the gut. For instance, milk oligosaccharides can alter intestinal glycosylation, which in turn contributes to early immune development and maturation of the newborn intestinal tract. Rita's research team focus on the development of strategies to characterise and produce food derived carbohydrates.

- Food oligosaccharides and glycoproteins – extraction, enrichment, fractionation and structural analysis.
- Development of bioassays for investigating the bioactive properties of glycans isolated from food sources.
- Manager of tissue culture facilities at Moorepark.
- Chromatography – Size-exclusion, Affinity and Ion Exchange Chromatography.

### Selected Publications

1. O'Riordan N., Kilcoyne M., Joshi L. and Hickey R.M. (2017) Exploitation of SPR to Investigate the Importance of Glycan Chains in the Interaction between Lactoferrin and Bacteria. *Sensors* 17, 1515 (1–10).
2. Kavanaugh, D., O' Callaghan J. C., Kane, M., Joshi, L. and R. M. Hickey. (2015). The intestinal glycome and its modulation by diet and nutrition. *Nutrition Reviews*. Special article. (6):359–75.
3. O'Riordan, N., Kane, M., Joshi, L., Hickey, R. M.\* (2014). Structural and functional characteristics of bovine milk protein glycosylation. *Glycobiology* 24: 220–236. Most downloaded article from 2014 in Glycobiology
4. O'Riordan, N., Kane, M., Joshi, L. and Hickey, R. M. (2014). Glycosidase activities in bovine milk over lactation. *International Dairy Journal*, 35 (2): 116–121.
5. Kavanaugh, D., O'Callaghan, J., Buttò, L. F., Slattery, H., Lane, J. A. Clyne, M., Kane M., Joshi, L. and R. M. Hickey. (2013). Exposure of *Bifidobacterium longum* subsp. *infantis* to milk oligosaccharides increases adhesion to epithelial cells and induces a substantial transcriptional response. *PLoS ONE* 8(6):e67224.



## Dr. Sean Hogan

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### Education

PhD. University College Dublin, Ireland. 2000.

MSc.Agr.Sc. (Food Science), University College Dublin, Ireland. 1995.

### Career

2007–Present: Research Officer, Food Chemistry and Technology Department, Teagasc

2001–2006: Post-Doctoral Researcher, Department of Food Technology, University College Cork.

1995–2000: Teaching Assistant, Department of Chemistry, DIT, Bolton Street.

### Expertise

Dr. Sean Hogan has extensive research experience in dairy chemistry, formulation and processing. His career with Teagasc has focused on the relationships between composition and behaviour during spray drying, ingredient interactions in concentrated dairy systems, development of functional lipid structures and the effects of diet on dairy product quality and functionality. His current research interests include the development of human milk-fat substitutes for infant formula manufacture, identification of nutri-biomarkers in whey, dietary influences on fatty acid and phospholipid profiles of milk and the application of novel technologies to milk processing and dairy products analysis. He is also involved in projects on valorization of dairy co-products through concentration and drying technologies and development of an *in vitro* infant digestion model. He is also focused on the development of a lipid chemistry platform to enhance analytical capabilities within Teagasc. His areas of expertise include colloidal and macro-ingredient interactions in dairy systems, formulation, rheology and food structure.

### Selected Publications

1. Kondor, A., and Hogan, S. A. (2017). Relationships between surface energy analysis and functional characteristics of dairy powders. *Food Chemistry*, 237, 1155–1162.
2. Hogan, S.A. O'Loughlin, I.B. and Kelly, P.M. Soft matter characterization of whey protein powders systems. (2016). *International Dairy Journal*, 52, 1–9.
3. Murphy, E. G., Fenelon, M.A., Roos, Y. H. and Hogan, S. A. (2014). Decoupling macronutrient interactions during heating of model infant milk formulas. *Journal of Agriculture and Food Chemistry*, 62, 10585–10593.
4. Murphy, E. G., Roos, Y. H. Hogan, S. A. Maher, P. G., Flynn C.G. and Fenelon, M.A. Physical stability of infant milk formula made with selectively hydrolysed whey proteins. (2015). *International Dairy Journal*, 40, 39–46.
5. Hogan, S.A. and O'Callaghan, D.J. (2013). Moisture sorption and stickiness behaviour of hydrolysed whey protein/lactose powders. *Dairy Science & Technology*, 93, 205–221.



## Dr. Mohammad B. Hossain

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### Education

MSc. Leibniz University of Hannover, Germany. 2006

PhD. Dublin Institute of Technology, Ireland. 2012

### Career

2010–Present: Research Officer, Food Biosciences,  
Teagasc Food Research Centre, Ashtown.

### Expertise

Dr. Hossain's research focuses primarily on the extraction, enrichment and characterisation of antioxidant, antimicrobial, anti-inflammatory, anticarcinogenic and cholesterol-lowering phytochemicals from plant sources. His research involves utilisation of various novel extraction techniques such as pressurised liquid extraction, ultrasound assisted extraction, pulsed electric field assisted extraction and enzyme assisted extraction for efficient and environmentally friendly extraction of these compounds with a view to valorising the low – or no-value agro-industrial by-products. His expertise includes a range of separation and analytical techniques such as size exclusion, ion exchange, normal phase, reversed phase, hydrophilic interaction liquid chromatography combined with various detection systems such as mass spectrometry, UV-Vis, fluorescence and refractive index.

### Selected Publications

1. Hossain, M. B., Rai, D. K., & Brunton, N. P. (2015). Optimisation and validation of ultra-high performance liquid chromatographic-tandem mass spectrometry method for qualitative and quantitative analysis of potato steroidal alkaloids. *Journal of Chromatography B*, 997, 110–115.
2. Hossain, M. B., Aguiló-Aguayo, I., Lyng, J. G., Brunton, N. P., and Rai, D. K. (2015). Effect of pulsed electric field and pulsed light pre-treatment on the extraction of steroidal alkaloids from potato peels. *Innovative Food Science & Emerging Technologies*, 29, 9–14.
3. Hossain, M. B., Camphuis, G., Aguiló-Aguayo, I., Gangopadhyay, N., and Rai, D. K. (2014). Antioxidant activity guided separation of major polyphenols of marjoram (*Origanum majorana* L.) using flash chromatography and their identification by liquid chromatography coupled with electrospray ionization tandem mass spectrometry†. *Journal of Separation Science*, 37(22), 3205–3213.
4. Hossain, M.B., Patras, A., Barry-Ryan, C., Martin-Diana, A.B. and Brunton, N.P. (2011). Application of principal component and hierarchical cluster analysis to classify different spices based on *in-vitro* antioxidant activity and individual polyphenolic antioxidant compounds. *Journal of Functional Foods*, 3, 179–189.
5. Hossain, M.B., Barry-Ryan, C., Martin-Diana, A.B. and Brunton, N.P. (2010). Optimisation of accelerated solvent extraction of antioxidant compounds from rosemary (*Rosmarinus officinalis* L.), marjoram (*Origanum majorana* L.) and oregano (*Origanum vulgare* L.) using response surface methodology. *Food Chemistry*, 126, 339–346.
6. Hossain, M.B., Rai, D.K., Brunton, N.P., Martin-Diana, A.B. and Barry-Ryan, C. (2010). Characterization of phenolics composition in Lamiaceae spices by LC-ESI-MS/MS. *Journal of Agricultural and Food Chemistry*, 58, 10576–10581.
7. Kenny, O. M., McCarthy, C. M., Brunton, N. P., Hossain, M. B., Rai, D. K., Collins, S. G., Jones, P. W., Maguire, A. R., & O'Brien, N. M. (2013). Anti-inflammatory properties of potato glycoalkaloids in stimulated Jurkat and Raw 264.7 mouse macrophages. *Life Sci*, 92(13), 775–782.



## Dr. Kieran Jordan

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### Education

B.Sc. (University College Galway).

M.Sc., Ph.D. (University College, Cork).

Teagasc Food Research Centre.

### Expertise

Dr. Jordan works on survival and occurrence of foodborne pathogens in dairy products, including *Listeria monocytogenes*, *S. aureus* and pathogenic *E. coli*, including adaptive tolerance responses and applications of molecular methodology in the study of foodborne pathogens.

Recent research projects funded include:

- Translating fundamental research on *Listeria monocytogenes* for the benefit of a multi-sectoral ready-to-eat food industry.
- Assuring the safety of mushrooms by the introduction of novel processes to reduce *Listeria monocytogenes* biofilms and environmental contamination in mushroom production facilities.
- Dairy Processing Technology Centre.
- Milk quality for a changing dairy industry.
- Safe and Healthy Foods.
- Risk assessment in relation to coagulase positive *Staphylococcus aureus*.

### Selected Publications

1. Robin Condrón, Choreh Farrokh, Kieran Jordan, Peter McClure, Tom Ross and Olivier Cerf. 2015. Guidelines for experimental design protocol and validation procedure for the measurement of heat resistance of microorganisms in milk. *International Journal of Food Microbiology* 192, 20–25.
2. Kieran Jordan. 2014. Monitoring occurrence and persistence of *Listeria monocytogenes* in foods and food processing environments in the Republic of Ireland. *Frontiers in Microbiology* 5, 436.
3. Kieran Jordan, Marion Dalmasso, Juergen Zentek, Annelise Mader, Geert Bruggeman, John Wallace, Dario De Medici, Alfonsina Fiore, Estella Prukner-Radovic, Maja Lukac, Lars Axelsson, Askild Holck, Hanne Ingmer and Mindaugas Malakauskas. 2014. Microbes versus microbes: control of pathogens in the food chain. *Journal of the Science of Food and Agriculture*, 94, 3079–3089.
4. Karen Hunt, Francis Butler and Kieran Jordan. 2014. Factors affecting Staphylococcal Enterotoxin C bovine production in milk. *International Dairy Journal* 39, 41–46.
5. David O'Beirne, E. Gleeson, M. Auty and K. Jordan. 2014. Effects of processing and storage variables on penetration and survival of *Escherichia coli* O157:H7 in fresh-cut packaged carrots. *Food Control* 40, 71–77.



## Dr. Kieran Kilcawley

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### Education

BSc. University of Westminster, UK. 1994

PhD. University College, Cork, Ireland. 2002.

### Career

1990–1996: Research Technician, Imperial Biotechnology Ltd, London, UK

1996–2004: Research Officer, Teagasc Food Research Centre, Moorepark

2004–2008: Senior Research Office

2008–Present: Principle Research Officer

### Expertise

Dr. Kilcawley's research interests are primarily focused on the impact of volatile compounds on sensory perception of foods and beverages. Most of his experience is directly related to biochemistry and enzymology of foods with a particular emphasis on cheese flavour. He is actively involved in flavour research and in providing a service to industry. The flavour chemistry facility has extensive gas chromatography mass spectrometry capability, including gas chromatography olfactory and uses a range of different automated volatile extraction techniques.

Dr. Kilcawley is a member of the Sensory Food Network Ireland, International Dairy Federation, American Dairy Science Association and Irish Mass Spectrometry Society.

Dr. Kilcawley has published >50 peer review research articles and 11 book chapters. He is a member of the editorial board for Dairy Science & Technology and the Journal of Dairy Research. He is a reviewer for a wide number of international peer reviewed journals.

Dr. Kilcawley was actively involved in the organisation of the Eight & Ninth International Cheese Symposia in Cork in 2011 & 2014 in association with the French National Institute for Agricultural Research (INRA) and University College Cork, Ireland (UCC). He was a member of the scientific committee for the IDF Symposia on Cheese in 2016.

### Selected Publications

1. Faulkner, H., O'Callaghan, T.F., McAuliffe, S., Hennessy, D., Stanton, C., O'Sullivan, M.G., Kerry, J.P & Kilcawley, K.N (In Press). Impact of different forage types on the volatile and sensory properties of bovine milk. *J. Dairy Sci.*
2. O'Callaghan, T.F. Hennessy, D, McAuliffe, S, Kilcawley, K.N, O'Donovan, M, Dillon, P., Ross, R.P, Stanton, C (2016). Effect of pasture versus indoor feeding systems on raw milk composition and quality over an entire lactation. *J. Dairy Sci*, 99, (12), 9424–9440.
3. Mannion, D.T. Furey, A, Kilcawley, K.N (2016). Comparison and validation of 2 analytical methods for the determination of free fatty acids in dairy products by gas chromatography with flame ionization detection. *J. Dairy Sci*, 99, 5047–5063.
4. Yarlagadda, A.B., Wilkinson, M.G., Ryan, S.P., Doolan, I.A., O'Sullivan, M.G., & Kilcawley, K.N (2014). Utilisation of a cell-free extract of lactic acid bacteria entrapped in yeast to enhance flavour development in Cheddar cheese. *International J. Dairy Tech*, 67, 1, 21–30.
5. Rulikowska, A. Kilcawley, K.N, Doolan, I.A. Alonso-Gomez, M. Nongonierma, A.B. Hannon, J.A, Wilkinson, M.G (2013). The impact of reduced sodium chloride content on Cheddar cheese quality. *Int. Dairy J*, 28, 45–55.
6. Kilcawley, K.N, Nongonierma, A.B, Hannon, J.A, Doolan, I.A, Wilkinson, M.G (2012). Evaluation of commercial enzyme systems to accelerate Cheddar cheese ripening. *Int. Dairy J*. 26, 50–57.
7. Hickey, D.K, Kilcawley, K.N, Beresford, T.P, Sheehan, E.M, Wilkinson, M.G. (2006) Starter bacteria are the prime agents of lipolysis in Cheddar cheese. *J. Agri. and Food Chem*, 54, 8229–8235.
8. Kilcawley, K.N, Wilkinson, M.G, Fox, P.F. (1998). Review enzyme-modified cheese. *Int. Dairy J*. 8: 1–10





## Dr. Valentyn Maidannyk

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### Education

PhD. University College Cork, Ireland. 2017

M.Sc. (Colloid Chemistry), Lomonosov Moscow State University, Moscow, Russian Federation. 2012.

### Career

2017–Present: Post-Doctoral researcher, Food Chemistry and Technology Department, Teagasc.

### Expertise

Research interests include Food Material Science, Food Technology, Microscopy, Food Processing and Colloid Chemistry. Dr. Maidannyk has extensive experience and practical skills in preparation, analysis and dehydration of various carbohydrate; carbohydrate-protein; carbohydrate-protein-lipid and partially crystalline systems. Previous research work includes creation and developing of a new fundamental approach, named “Strength” concept (including mathematical definition and statistics). The main methods: DSC, DMA, DEA, Volume Rheology, Light Optical Microscopy, Confocal Laser Scanning Microscopy and Scanning Electron Microscopy which were employed to characterize varied food systems. The FIRM-funded project (11-F-001) involved experimental design, scale-up and analysis of various technological properties of modelled food and dairy systems.

### Selected Publications

1. Maidannyk, V. A., Roos, Y. H. (2016). Modifications of the WLF model for characterization of the relaxation time-temperature relationship in trehalose-whey protein isolate systems. *Journal of Food Engineering*, 188, 21–31.
2. Nurhadi, B., Roos, Y.H., Maidannyk, V. (2016). Physical properties of maltodextrin DE 10: Water sorption, water plasticization and enthalpy relaxation. *Journal of Food Engineering* 174, 68–74.
3. Maidannyk, V. A., & Roos, Y. H. (2017). Water sorption, glass transition and “strength” of lactose–Whey protein systems. *Food Hydrocolloids*, 70, 76–87.
4. Maidannyk, V. A., Nurhadi, B., & Roos, Y. H. (2017). Structural strength analysis of amorphous trehalose-maltodextrin systems. *Food Research International*, 96, 121–131.
5. Maidannyk, V. A., Roos, Y. H. (2018). Structural strength analysis of partially crystalline trehalose. *LWT-Food Science and Technology*, 88, 9–17.



## David T. Mannion

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### Education

MSc. Cork Institute of Technology, Ireland. 2015

B.Sc. (Chemical Instrumentation and Analytical Science),  
Limerick Institute of Technology, Ireland. 2009

### Career

2016–Present: Technologist, Food Quality and Sensory  
Department, Teagasc

2015–2016: Technician, Food Bioscience Department,  
Teagasc

2013–2015: Walsh Fellow, Food Bioscience Department,  
Teagasc

Feb 2013–Nov 2013: Technician (Intern), Food Bioscience  
Department, Teagasc

### Expertise

David's main research interests are related to instrumentation and analytical method development, particularly in relation to flavour in food and beverages, fatty acid profiling and lipid oxidation. His key interests involve identification of aroma compounds involved in sensory perception, measuring of fatty acids for product quality and flavour impact, identification of biomarkers responsible for food authentication and traceability, effect of lipid oxidation on product stability, particularly in dairy products. He is involved in the provision of gas chromatography and mass spectrometry analysis and cover areas of advanced extraction techniques for isolation and detection of compounds, method development and validation, data processing and chemometrics.

### Selected Publications

1. Mannion, David T., Ambrose Furey, and Kieran N. Kilcawley. "Free fatty acids quantification in dairy products." *International journal of dairy technology* 69.1 (2016): 1–12.
2. Mannion, David T., Ambrose Furey, and Kieran N. Kilcawley. "Comparison and validation of 2 analytical methods for the determination of free fatty acids in dairy products by gas chromatography with flame ionization detection." *Journal of dairy science* 99.7 (2016): 5047–5063.



## Dr. Mariarosaria Marotta

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### Education

Certified Diploma in Project Management, Institute Project Management, Ireland. 2015

PhD. Second University of Naples, Italy. 2005

Post-grad degree (Clinical Biochemistry and Chemistry), Second University of Naples, Italy. 2001

M.Sc. (Biological Sciences), University 'Federico II', Naples, Italy. 1997

### Career

2013–Present: Research Officer, Food Biosciences Department, Teagasc (Food for Health Ireland)

2009–2013: Research Officer, University College Cork (Food for Health Ireland)

2008–2009: Research Officer, Food Biosciences Department, Teagasc

2005–2007: Science Teacher, Secondary Schools, Italy

### Expertise

Dr. Marotta's research focuses on the sourcing of milk carbohydrates with health promoting properties for inclusion in infant formula. Previous research work has included investigating anti-infective properties of milk carbohydrates and enzymes for application in the food industry. Dr Marotta has vast experience in assay development (enzymatic, cell-based, quantitative and qualitative), chromatography and ultrafiltration/diafiltration methods from laboratory to pilot scale.

In 2009, Dr Marotta joined Food for Health Ireland and she is currently working as the Programme Manager for the Infant Nutrition workpackage.

### Selected Publications

1. Ross S., Lane J.A., Marotta M., Kavanaugh D.W., Ryan J.T. Joshi L. and Hickey R.M. (2016) "The role of oligosaccharides in host-microbial interactions for human health" *Journal of Clinical Gastroenterology* 50 Suppl 2, S131-S132
2. Marotta M., Ryan J.T. and Hickey R.M. (2014) "The predominant milk oligosaccharide 6'-sialyllactose reduces the internalisation of *Pseudomonas aeruginosa* in human pneumocytes" *Journal of Functional Foods* 6: 367–373
3. Mehra R., Barile D., Marotta M., Lebrilla C.B., Chu C. and German J.B. (2014) "Novel high-molecular weight fucosylated milk oligosaccharides identified in dairy streams" *PLOS ONE*: 8;9(5):e96040
4. Marotta M. and Hickey R.M. (2014) "The role of human milk oligosaccharides in preventing respiratory infections in infants". In: *Oligosaccharides: Food Sources, Biological Roles and Health Implications*, Nova Science Publishers, Inc., New York, pp. 115–142
5. Mariño K., Lane J.A., Abrahams J.L., Struwe W., Harvey D., Marotta M., Hickey R.M. and Rudd P.M. (2011) "Method for milk oligosaccharide profiling by 2-aminobenzamide labelling and hydrophilic interaction chromatography (HILIC)" *Glycobiology* 21(10): 1317–1330
6. Barile D., Marotta M., Chu C., Mehra R., Grimm R., Lebrilla C.B. and German J.B. (2010) "Neutral and acidic oligosaccharides in Holstein-Friesian colostrum during the first 3 days of lactation measured by high performance liquid chromatography on a microfluidic chip and time-of-flight mass spectrometry" *Journal of Dairy Science* 93: 3940–3949



## Anne Marie McAuliffe

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### Education

B.Sc. (Food Science and Technology), University College Cork, Ireland. 2009

QQI Level 5 in Safety and Health at Work. 2017

### Career

2011–Present: Laboratory Technician, Food Chemistry and Technology Department, Teagasc, Moorepark

2010–2011: Microbiologist, Newmarket Co-Op, Newmarket, Co. Cork

### Expertise

- Dairy Support Technician in the Technical Services Laboratory.
- Quality manager of an ISO17025 accredited laboratory.
- Technical support to the Teagasc Food Programme and to industry clients.
- Production of milk reference standards for the Irish Dairy industry.
- Compositional analysis of dairy products using International Standards, specifically % Protein by Kjeldahl, % Fat by Rose Gottlieb, % Total solids on liquid dairy products and % moisture on dairy powders.
- Performance of multiple other techniques including D/L-lactic acid assay, % ash, % non-casein nitrogen, % non-protein nitrogen and intact casein.
- Amino acid composition using ion-exchange chromatography.
- Administrator of the Moorepark split sample appeal scheme for dairy farmers.
- Health and safety co-ordinator for the Food Chemistry and Technology Department.



## Dr. Noel McCarthy

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### Education

Ph.D. Food Science and Technology – 2013, University College Cork. (Title: The impact of protein profile on the physical stability of infant formulae)

B.Sc. Food Science and Technology (2008), University College Cork.

### Career

2014–Present: Research Officer (Teagasc Food Research Centre, Moorepark, Fermoy, Co. Cork)

2013–2014: Food Technologist – Abbott Nutrition (Cootehill, Co. Cavan)

2012–2013: Post-Doctoral Researcher (Teagasc Food Research Centre, Moorepark, Fermoy, Co. Cork)

### Expertise

- Emulsification and rheological properties of dairy systems.
- Separation and purification of milk protein fractions by membrane filtration.
- Factors affecting powder characteristics and functionality during spray drying.
- Protein powder solubility and dispersion mechanisms.

### Selected Publications

1. McCarthy, N. A., Kelly, A. L., O'Mahony, J. A., Hickey, D. K., Chaurin, V., & Fenelon, M. A. (2012). Effect of protein content on emulsion stability of a model infant formula. *International Dairy Journal*, 25, 80–86.
2. McCarthy, N.A., Kelly, A.L., O'Mahony, J.A., Fenelon, M.A., (2013). The physical characteristics and emulsification properties of partially dephosphorylated bovine  $\beta$ -casein. *Food Chemistry*, 138, 1304–1311.
3. McCarthy, N. A., Kelly, A. L., O'Mahony, J. A., & Fenelon, M. A. (2014). Sensitivity of emulsions stabilised by bovine  $\beta$ -casein and lactoferrin to heat and CaCl<sub>2</sub>. *Food Hydrocolloids*, 35(0), 420–428.
4. McCarthy, N.A., Kelly, A.L., O'Mahony, J.A., Fenelon, M.A., (2013). The physical characteristics and emulsification properties of partially dephosphorylated bovine  $\beta$ -casein. *Food Chemistry*, 138, 1304–1311.
5. McCarthy, N. A., Kelly, P. M., Maher, P. G., & Fenelon, M. A. (2014). Dissolution of milk protein concentrate (MPC) powders by ultrasonication. *Journal of Food Engineering*, 126(0), 142–148.





## Dr. Sinéad McCarthy

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### Education

Dr. Sinéad McCarthy graduated with a B.Sc from UCC in 1993. She also completed an M.Sc in UCC in 1996, where she studied dietary vitamin E and lipid stability in turkey tissues. In 2003, she graduated from UCC with a Ph.D., in the area of public health nutrition which examined the predictors and prevalence of obesity in Irish adults.

### Career

For nearly two decades, Sinéad has been involved in many areas of nutrition research, with a focus on food and health and has published extensively.

Sinéad's first research post in UCC was the area of human nutritional physiology, examining the anti – oxidative effects of carotenoid and fish oil consumption, as a part of two multi centred EU projects. In 1997, Sinéad moved to TCD as a research officer on the Irish National Food Consumption programmes, from which she was awarded her Ph.D. and attained funding to conduct additional food consumption surveys. She was the Scientific Officer on the Framework 6 Lipgene project and was actively involved in the human nutrition dietary intervention work-package of Lipgene. In 2007, Sinéad joined Teagasc at Ashtown Food Research Centre, where she is responsible for leading Teagasc's consumer behaviour research programme in relation to food and health. She is actively involved in the area of consumer food choice determinants and its potential impact on health. Sinéad is a member of the Food Safety Authority of Ireland Public Health Nutrition sub-committee and the Nutrition and Health Foundation Scientific committee. She is also an active member of the Nutrition Society.

### Expertise

Sinéad has significant expertise in the areas of consumer behaviour in relation to nutrition, food and health. She has extensive experience in designing national food consumption surveys in addition to designing and validating consumer behaviour questionnaires. She is

experienced in qualitative research techniques such as focus groups and in-depth interviews and has extensive analytical skills using large consumer databases and biostatistics. She has developed a reputation in this area both nationally and internationally and this has been demonstrated in her success in securing external funding. She is involved in many on-going projects covering sensory science, consumer food and health behaviour, food expenditure patterns, consumer acceptance of novel food technologies, consumer acceptance of marine derived functional foods and drivers of cheese consumption. Sinéad is also one of the co-ordinators of the newly formed Sensory Food Network Ireland.

### Selected Publications

1. McCarthy SN. Weekly patterns, diet quality and energy balance *Physiology & Behaviour* 2014:555–59.
2. Greehy, G.M.; McCarthy, M.B.; Henchion, M.M.; Dillon, E.J.; McCarthy, S.N. Complexity and conundrums. Citizens' evaluations of potentially contentious novel food technologies using a deliberative discourse approach *Appetite*, 2013:37–46.
3. Newcombe M, McCarthy M, Cronin JM, McCarthy SN, "Eat like a man": A Social Constructionist Analysis of the Role of Food in Men's Lives. *Appetite*, 2012:391–8.
4. Shaw D, Tierney A, McCarthy S, Upritchard J, Vermunt S, Gulseth H, Drevon CA, Blaak E, Saris WHM, Karlstrom B, Helal O, Defoort C, Gallego R, Lopez – Miranda J, Siedlecka D, Malczewska-Malec M, Roche HM and Lovegrove JA. LIPGENE food-exchange model for alteration of dietary fat quantity and quality in free-living participants from eight European countries. *British J Nutr* (2009), 101, 750–759.
5. Joyce T, McCarthy SN, Gibney MJ. Relationship between energy from added sugars and frequency of added sugars intake in Irish children, teenagers and adults. *Br J Nutr*. 2008 May;99(5):1117–26.



## Dr. Ciara McDonnell

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### Education

PhD. University College Dublin, Ireland. 2013

B.Agr.Sc. (Food Science), University College Dublin, Ireland. 2009

### Career

2016–Present: Research Officer, Food Quality and Sensory Science, Teagasc.

2014–2016: Research Manager, AllinAll Ingredients.

2013–2014: Technical Manager, Mark & Chappell.

2013: Research Assistant, University College Dublin.

### Expertise

Ciara McDonnell (Ph.D.) is a Research Officer at the Teagasc Food Research Centre, Ashtown. Following completion of her PhD on novel meat processing technologies, Dr. McDonnell spent three years working in the food industry. During her time as Research Manager for a leading ingredient supplier to the processed meat industry, Dr. McDonnell assisted various meat processors in overcoming technical issues through ingredient and process innovations.

Her research interests are strongly focused on technologies for improved meat production in both the fresh and processed meat sectors. This includes technologies for carcass evaluation with the objective of improved product consistency and predictive output. In the processed meat sector, Dr. McDonnell is leading projects on clean processing technologies for the development of healthier processed meats, produced by environmentally friendly and efficient processes.

Dr. McDonnell was the co-ordinator of the 63rd International Congress of Meat Science and Technology and is Guest Editor for the international journal, Meat Science.

### Selected Publications

1. McDonnell, C. K., Allen, P., Duane, G., Morin, C., Casey, E., Lyng, J. G. (2018). One-directional modelling to assess the mechanistic actions of power ultrasound on NaCl diffusion in pork, *Ultrasonics Sonochemistry*, 40, 206–212.
2. Warner, R.D., McDonnell, C.K., Bekhit, A.E.D., Claus, J., Vaskoska, R., Sikes, A., Dunshea, F.R., Ha, M. (2017) Systematic review of emerging and innovative technologies for meat tenderisation, *Meat Science*, 132, 72–89.
3. McDonnell, C. K., Tiwari, B. K. (2017). Ultrasound: A clean, green extraction technology for bioactives and contaminants (2017), *Comprehensive Analytical Chemistry*, Volume 76, Pages 111–129.
4. McDonnell, C. K., Allen, P., Arimi, J. M., Lyng, J.G. (2014). Optimisation of pilot-scale production of ultrasound-accelerated pork curing. *Innovative Food Science and Emerging Technologies*, 26, 191–198
5. McDonnell, C. K., Allen, P., Morin, C., Lyng, J. G. (2014). The effect of ultrasonic curing on meat protein and water-protein interactions in meat. *Food Chemistry*, 147, 245–251.
6. McDonnell, C. K., Lyng, J. G., Allen, P. (2014). The use of power ultrasound for accelerating the curing of pork. *Meat Science*, 147, 142–149
7. McDonnell, C. K., Allen, P., Duggan, E., Arimi, J. M., Casey, E., Duane, G., Lyng, J. G. (2013). The effect of salt and fibre direction on water dynamics, distribution and mobility in pork muscle: a low field NMR study. *Meat Science*, 95, 51–58.
8. McDonnell, C. K., Allen, P., Chardonnerau, F., Arimi, J. M., Lyng, J. G. (2013). The use of pulsed electric fields for accelerating the curing of pork. *LWT – Food Science and Technology*, 59, 1054–1060



## Lauren McMaster

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### Education

Professional Diploma in Digital Marketing, Digital Marketing Institute, 2016

MSc. Communications for Rural Business with Strategic Marketing Management, Queen's University Belfast, 2014

BSc. Consumer Studies, University of Ulster, 2010

### Career

2017–Present: Manager Sensory Food Network Ireland, Teagasc

2015–2017: International Marketing Executive, CDE Global

2012–2015: Coordinator **safe**food Knowledge Networks, **safe**food

2008–2009: Marketing Assistant, Livestock and Meat Commission for Northern Ireland

### Expertise

Lauren is the manager of Sensory Food Network Ireland. The Network delivers a comprehensive sensory science service to the food and beverage industry on the island of Ireland by fostering collaboration between industry and research organisations and by driving performance improvements throughout the Network.

Combining her experience in food industry support and commercial marketing roles, Lauren is focussed on the growth and further development of the Network. This includes expanding the dissemination programme for the Network to include workshops, articles, digital campaigns and outreach activities.

Lauren is the point of contact for Sensory Food Network Ireland for any sensory-related industry enquiries from the food industry.



## Dr. Song Miao

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### Education

Ph.D. in Food Science and Technology, National University of Ireland, University College Cork, Ireland

M Sc. in Food Technology, Shanghai Ocean University, China

B. Eng. in Food Engineering, Shanghai Ocean University, China

### Careers

May 2009–Present: Senior Research Officer (Permanent), Department of Food Chemistry and Technology, Teagasc Food Research Centre, Moorepark, Fermoy, Co. Cork, Ireland.

Dec 2014–Present: Adjunct Professor, College of Food Science, Fujian Agriculture and Forestry University, China

Feb 2006–May 2009: Research Manager/Drying Granulation Scientist, Foods Structural Design, Unilever Food and Health Research Institute, Unilever R&D Vlaardingen, the Netherlands.

Jan 2005–Feb, 2006: Postdoctoral Research Officer, Biotechnology Centre, Moorepark, Teagasc, Fermoy, Co. Cork. Ireland

Oct 2001–Dec 2004: Research Scientist/Ph.D. Candidate, Department of Food and Nutritional Sciences, University College Cork, Ireland.

Jan 1995–Sep 2001: Senior Lecturer, Faculty of Food Science and Technology, Shanghai Fisheries University.

Jan 1996–Sep 2001: Senior Research Fellow, Faculty of Food Science and Technology, Shanghai Fisheries University.

### Expertise

- Physico-chemical properties of biomaterials.
- Dehydration and granulation.
- Novel foods structural and textural designs.
- Stickiness and flowability of powders.

- State transition and phase transition in foods.
- Encapsulation and functional food ingredients.
- Structured emulsions for functional delivery.
- Stabilization of probiotics.
- Dairy ingredients.

### Selected Publications

1. Like Mao, Yrjö H. Roos, Costas G. Biliaderis and Song Miao\*. 2015. Food Emulsions as Delivery Systems for Flavor Compounds – A Review, *Critical Reviews in Food Science and Nutrition*, in Press. DOI: 10.1080/10408398.2015.1098586
2. Mao, L.; Roos, Y.H.; Miao, S.\* , 2015, Effect of maltodextrins on the stability and volatile release behavior of oil-in-water emulsions subjected to freeze-thaw treatment, *Food Hydrocolloids*, 50: 219–227.
3. Lu, W., Kelly, A.L., Miao, S.\* , 2016, Emulsion-based encapsulation and delivery systems for polyphenols, *Trends in Food Science and Technology*, 47:1–9
4. Li, R., Roos, Y. H., Miao, S.\* 2016. Flavor release from spray-dried amorphous matrix: effect of lactose content and water plasticization. *Food Research International*, 86, 147–155.
5. Ji, J., Fitzpatrick, J., Cronin, K., Maguire, P., Zhang, H., Miao, S.\* , 2016. Rehydration behaviours of high protein dairy powders: The influence of agglomeration on wettability, dispersibility and solubility. *Food hydrocolloids* 58, 194–203.
6. Ji, J., Cronin, K., Fitzpatrick, J., Maguire, P., Zhang, H., Miao, S.\* , 2016. The structural modification and rehydration behaviours of milk protein isolate powders: The effect of granule growth in the high shear granulation process. *Journal of Food Engineering* 189, 1–8.
7. Fitzpatrick, J.J., van Lauwe, A., Coursol, M., O'Brien, A., Fitzpatrick, K.L., Ji, J., Miao, S.\* , 2016. Investigation of the rehydration behaviour of food powders by comparing the behaviour of twelve powders with different properties. *Powder Technology* 297, 340–348.



## Dr. Mary Moloney

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### Education

B.Sc. University of Limerick, Ireland. 2000

Ph.D. University of Limerick, Ireland. 2004

### Career

2002: R&D Analyst, Clonmel Healthcare

2004: Research Assistant, University of Limerick

2004–2005: Quality Analyst, Medtronic Vascular, Galway

2005–2006: Research Officer, Residue Laboratories, Teagasc Food Research Centre, Ashtown

2006–Present: Laboratory Technologist, Residue Laboratories, Teagasc Food Research Centre, Ashtown

### Expertise

Dr. Moloney assists in the management of the Residues laboratories as Deputy Head of Laboratory and Deputy Quality Manager. The Residue laboratories are accredited to ISO 17025 and function as a national reference laboratory.

Her expertise is primarily in the area of contaminant analysis, focussing on foods of animal origin. She has worked extensively in the area of coccidiostat feed additives and veterinary drugs developing and validating multi-residue methods for the determination of coccidiostats in target and non-target tissues. Other areas of interest include nitrofurans, nitroimidazoles, carbamates and anthelmintics. She is currently working on multi-residue methods for antibiotics in aquaculture and pesticides in animal fat in particular the pyrethroid pesticides. Dr. Moloney works primarily with UHPLC coupled to tandem mass spectrometry but also has some experience screening technologies.

### Selected Publications

1. Moloney, M., Clarke, L., O'Mahoney, J., Gadaj, A., O'Kennedy, R., Danaher, M. (2012) Determination of 20 coccidiostats in egg and avian muscle tissue using ultra high performance liquid chromatography coupled to tandem mass spectrometry. *Journal of Chromatography A*, 1253, 94–104.
2. Clarke, L., P., Moloney, M., O'Mahoney, J., O'Kennedy, R., Danaher, M. (2013) Determination of 20 coccidiostats in milk, duck muscle and non-avian muscle using UHPLC-MS/MS. *Food Additives and Contaminants, Part A*, 30, 6, 958–969.
3. Whelan, M., Kinsella, B., Furey, A., Moloney, M., Cantwell, H., Lehotay, S.J., Danaher, M (2010) Determination of anthelmintic drug residues in milk using ultra high performance liquid chromatography-tandem mass spectrometry with rapid polarity switching. *Journal of Chromatography A*, 1217, 27, 4612–4622.
4. Radovnikovic, A., Moloney, M., Byrne, P., Danaher, M. (2011) Detection of banned nitrofurans metabolites in animal plasma samples using UHPLC-MS/MS. *Journal of Chromatography B*, 879, 2, 159–166.
5. Vinogradova, T., Danaher, M., Baxter, A., Moloney, M., Victory, D., Haughey, S.A. (2011). Rapid surface plasmon resonance immunobiosensor assay for microcystin toxins in blue green algae food supplements. *Talanta*, 84, 3, 638–643.





## Dr. Sheila Morgan

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### Education

B.Sc., NUI Maynooth.

Ph.D., University College Cork.

### Career

1997–Present: Teagasc, Food Research Centre, Moorepark.

1995–1997: Microbiology Department, University College Cork.

### Expertise

- Antimicrobial research (food and biomedical).
- Antimicrobial powder development.
- Gut microbiology and the effect of antimicrobials on gut populations.
- Scientific administration and project management.

Sheila currently works as a project manager for a number of large funded projects including the APC Microbiome Institute ([www.apc.ucc.ie](http://www.apc.ucc.ie)), Food for Health Ireland ([www.fhi.ie](http://www.fhi.ie)) and the Dairy Processing Technology Centre ([www.dptc.ie](http://www.dptc.ie)).

### Selected Publications

1. Fate of the two-component lantibiotic lactacin 3147 in the gastrointestinal tract. Gardiner GE, Rea MC, O’Riordan B, O’Connor P, Morgan SM, Lawlor PG, Lynch PB, Cronin M, Ross RP, Hill C. *Appl Environ Microbiol.* 2007 73: 7103–9.
2. A lactacin 3147 enriched food ingredient reduces *Streptococcus mutans* isolated from the human oral cavity in saliva. O’Connor EB, O’Riordan B, Morgan SM, Whelton H, O’Mullane DM, Ross RP, Hill C. *J Appl Microbiol.* 2006 100:1251–60
3. Sequential actions of the two component peptides of the lantibiotic lactacin 3147 explain its antimicrobial activity at nanomolar concentrations. Morgan SM, O’Connor PM, Cotter PD, Ross RP, Hill C. *Antimicrob Agents Chemother.* 2005 49: 2606–11.
4. Evaluation of a spray-dried lactacin 3147 powder for the control of *Listeria monocytogenes* and *Bacillus cereus* in a range of food systems. Morgan SM, Galvin M, Ross RP, Hill C. *Lett Appl Microbiol.* 2001 33: 387–91.
5. Efficient method for the detection of microbially-produced antibacterial substances from food systems. Morgan SM, Hickey R, Ross RP, Hill C. *J Appl Microbiol.* 2000 89: 56–62.



## Dr. Anne Maria Mullen

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### Education

B.Sc. Biochemistry (1991), University College Galway  
Ph.D. (1995) Pharmacology, University College Galway

### Career

Current: Principal Research Officer, Teagasc Food Research Centre, Ashtown

1996–1998: Contract Research Officer, Teagasc Food Research Centre, Ashtown

### Expertise

Dr. Mullen is currently overseeing the research programme for recovery of value from meat by-product and waste streams. Her research interests also address issues relating to various aspects of meat processing (post slaughter interventions) and meat quality (technological, eating etc.). In particular she has focused on biochemical and molecular factors underpinning variability in meat quality and the impact of post-mortem process interventions on product quality. Dr. Mullen was responsible for expanding the meat research programme to incorporate the application of relevant genome and proteome platforms in addressing issues of importance in meat quality. She has co-ordinated and collaborated on projects funded through EU Framework, FIRM (Irish) and Enterprise Ireland. In addition, Dr. Mullen served as Head of Department leading a staff of up to 20 comprising permanent and contract researchers, technical personnel and students. Publications relate to molecular basis of meat quality, recovery of value from meat processing streams, and general meat quality. She has presented her research on many occasions at international and national conferences; she is a member of the Enterprise Ireland – Global Skills Team (Pet Food). She regularly contributes to proposal and Ph.D. evaluations at national and international levels and is also involved with training and information programmes in meat technology for the Irish meat industry and relevant agencies.

### Selected Publications

1. Mullen, A.M. and Álvarez C. (2016) Offal: Types and Composition, In *Encyclopedia of Food and Health*, Academic Press, Oxford, Pages 152–157, ISBN 9780123849533.
2. Lomas, A.J., Ryan, C.N.M., Sorushanova, A., Shologu, N., Sideri, A.I., Tsioli, V., Fthenakis, G., Tzora, A., Skoufos, G., Quinlan, L., O’Laighin, G., Mullen, A.M., Kelly, J.L., Kearns, S., Biggs, M., Pandit, A., Zeugolis, D.I. (2015) ‘The Past, Present and Future in Scaffold-based Tendon Treatments.’ *Advanced Drug Delivery Reviews*. 84, 257–277.
3. Anne Maria Mullen, Carlos Álvarez, Milica Pojić, Tamara Dapčević Hadnadev and Maria Papageorgiou (2015) Chapter 2 – Classification and target compounds, In *Food Waste Recovery*, edited by Charis M. Galanakis, Academic Press, San Diego, Pages 25–57, ISBN 9780128003510.
4. Marcos, B. and Mullen, A.M. (2014) High pressure induced changes in beef muscle proteome: Correlation with quality parameters, *Meat Science*, Volume 97, Issue 1, May 2014, Pages 11–20.
5. Claire C. O’Flynn, Malco C. Cruz-Romero, Declan Troy, Anne M. Mullen, Joe P. Kerry (2014), The application of high-pressure treatment in the reduction of salt levels in reduced-phosphate breakfast sausages, *Meat Science*, Volume 96, Issue 3, Pages 1266–1274.
6. Di Luca, A, Elia, G., Hamill, R. and Mullen, A.M. (2013). 2-D DIGE proteomic analysis of early post mortem muscle exudate highlights the importance of the stress response for improved water-holding capacity of fresh pork meat. *Proteomics* 13, 9, 1528–1544.
7. Hamill, R., Ozlem Aslan, Mullen, A.M., O’Doherty, JV, McBryan, J, Morris, D.G. and Torres Sweeney (2013). Transcriptome analysis of porcine M. semimembranosus divergent in intramuscular fat as a consequence of dietary protein restriction. *BMC Genomics* 14:453–467.



## Dr. Sean Mulvany

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### Education

PhD. University College Dublin, Ireland. 2003

### Career

2017–Present: Head of Technology Transfer, Teagasc

2015–2016: ICT Technology Transfer Case Manager,  
Trinity College Dublin

2006–2015: Commercialisation Specialist, Enterprise  
Ireland

2004–2006: Founder and Director of Berand Ltd.

### Expertise

Sean has worked at the cutting-edge of industry relevant innovation as it arises in public research performing organisations for many years. In that time, he inhabited each of the key stakeholder roles. As a basic researcher investigating how the brain encodes memories, he moved as a postdoc into discovering new therapeutic targets to treat disorders of memory, such as Alzheimer's, in partnership with Wyeth (now part of Pfizer). As an entrepreneur, he cofounded a university spinout based on state-funded research capability. Latterly, he has supported research and innovation in universities and companies through his position in Enterprise Ireland. As a Technology Transfer Case Manager in Trinity College, he had responsibility for driving industry collaboration from initial problem statement to closing deals on research funding, contracts and IP access. In Teagasc, Sean leads the Technology Transfer team with responsibility for the identification, protection and commercialisation of Teagasc innovations and works collaboratively with companies to ensure these innovations are commercialised to maximum societal and economic impact in Ireland.



## Dr. Eoin Murphy

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### Education

PhD. University College Cork, Ireland. 2015

B.Eng (Hons). Chemical and Biopharmaceutical Engineering, Cork Institute of Technology, Ireland. 2008

### Career

2016–Present: Research Officer, Food Chemistry and Technology Department, Teagasc

2015–2016: Senior Process Technology, Danone Nutricia Early Life Nutrition

2013–2015: Product Technologist, Biostime Pharma

2009–2013: Walsh Fellow, Teagasc

### Expertise

The research interests of Dr Murphy include novel processing technologies, powdered food ingredients and nutritional formulations. His main research focus is in the area of optimisation of spray drying processes and development of next generation dehydration technologies. Previous research work has focused on the interactions between processing and composition during the manufacture of Infant Milk Formula (IMF) powders. The research demonstrated the potential to improve efficiency during IMF manufacture by understanding the effects of processing on physicochemical properties of formulations e.g. protein aggregation, viscosity. Dr Murphy has worked in the IMF industry, gaining a strong knowledge of new product development, novel process design and quality issues related to dairy ingredients and nutritional formulations. Main areas of expertise/interest:

- Spray drying.
- Evaporation.
- Membrane processing.
- Novel process development.
- Dairy process engineering.
- Powder functionality.

### Selected Publications

1. Murphy EG, Tobin JT, Roos YH, & Fenelon MA (2011). The effect of high velocity steam injection on the colloidal stability of concentrated emulsions for the manufacture of infant formulations. *Procedia Food Science*, 1, 1309–1315.
2. Murphy EG, Tobin JT, Roos YH, & Fenelon MA (2013). A high-solids steam injection process for the manufacture of powdered infant milk formula. *Dairy Science & Technology*, 93, 463–475.
3. Murphy EG, Fenelon MA, Roos YH & Hogan SA (2014). Decoupling Macronutrient Interactions during Heating of Model Infant Milk Formulas. *Journal of agricultural and food chemistry*, 62, 10585–10593.
4. Murphy EG, Roos YH, Hogan SA, Maher PG, Flynn CG, & Fenelon MA (2015). Physical stability of infant milk formula made with selectively hydrolysed whey proteins. *International Dairy Journal*, 40, 39–46.



## Dr. Kanishka N. Nilaweera

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### Education

PhD Neuroscience, University of Aberdeen, UK. (2002).

BSc, University of Aberdeen, UK. (1998).

### Career

2009–Present: Senior Research Officer, Teagasc Food Research Centre, Fermoy, Cork, Ireland.

2007–2009: Post-doctoral Research Associate, School of Biomedical Sciences, University of Nottingham, UK.

2005–2007: Post-doctoral Research Associate, Rowett Research Institute, Aberdeen, UK.

2002–2005: Post-doctoral Research Assistant, Rowett Services Ltd, Aberdeen UK.

1996–1997: Industrial Student Placement, Molecular and Cell Biology Department, Zeneca Pharmaceuticals, UK.

### Expertise

Dr. Nilaweera's research aims to identify nutrients and their bioactive components that reduce weight gain, so that these can be commercialised as Functional Food ingredients to tackle the obesity problem. The work involves animal feeding trials and related molecular biology work. Utilising this approach, he has shown that intake of dairy whey proteins reduces the expression of nutrient transporters in the intestine and alters the composition of the gut microbiota, important for harvesting energy from ingested food. The impact on the gut appears to underlie how the whey proteins reduce weight gain.

### Selected Publications

1. Nilaweera KN, Cabrera-Rubio R, Speakman JR, O' Connor PM, McAuliffe A, Guinane CM, Lawton E, Crispie F, Aguilera M, Stanley M, Boscaini S, Joyce S, Melgar S, Cryan JF, Cotter PD. Whey protein-effects on energy balance link the intestinal mechanisms of energy absorption with adiposity and hypothalamic neuropeptide gene expression. *Am J Physiol Endocrinol Metab.* 2017 Jul 1;313(1):E1-E11
2. McManus BL, Korpela R, Speakman JR, Cryan JF, Cotter PD, Nilaweera KN. Bovine serum albumin as the dominant form of dietary protein reduces subcutaneous fat mass, plasma leptin and plasma corticosterone in high fat-fed C57/BL6J mice. *British Journal of Nutrition* 2015 August;114 94); 654–662.
3. McAllan, L, Speakman, J.R., Cryan, J.F. and Nilaweera, KN. Whey protein isolate decreases murine stomach weight and intestinal length and alters the expression of Wnt signalling associated genes. *British Journal of Nutrition* 2015, January; 113 (2); 372–379.
4. McAllan L, Skuse P, Cotter P, O' Connor P, Cryan JF, Ross RP, Fitzgerald G, Roche HM and Nilaweera KN. Protein quality and the protein to carbohydrate ratio within a high fat diet influences energy balance and the gut microbiota in C57BL/6J mice. *PLoS One*,2014 Feb 10;9(2):e88904.





## Tom O'Callaghan

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### Education

PhD. University College Cork 2014–Present (Pending)

B.Sc. (Food Science), University College Cork, 2014

### Career

2017–Present: Research Officer, Food Chemistry and Technology Department, Teagasc

2014: Assistant production manager Carbery Food Ingredients Ltd.

### Expertise

Tom O'Callaghan recently joined Teagasc as a Dairy Chemistry Scientist. Tom is manager of the Dairy Chemistry Laboratory in Teagasc Moorepark. His research interests focus on the effects of primary production systems on the composition and quality of milk and dairy products and the effects of food processing technologies on the quality and functionality of dairy ingredients.

Previous research work has included examining the effects of pasture versus indoor total mixed ration feeding systems on the nutritional composition, characteristics and sensory quality of milk and dairy products. This project demonstrated the beneficial effects of pasture feeding on the fatty acid profile of products with increased proportions of CLA and Omega 3 fatty acids.

These projects have also investigated various methods for verification of pasture derived milk and dairy products which include fatty acid profiling and NMR metabolomics.

Tom has an on-going collaboration with the University of Alberta, where he is a guest researcher and has carried out research in collaboration with The Metabolomics Innovation Centre examining the rumen and milk metabolome.

During previous roles, Tom has gained a strong knowledge of analytical chemistry, product development and dairy processing for the production of high value dairy products.

### Selected Publications

1. O'Callaghan, T. F., H. Faulkner, S. McAuliffe, M. G. O'Sullivan, D. Hennessy, P. Dillon, K. N. Kilcawley, C. Stanton, and R. P. Ross. 2016. Quality characteristics, chemical composition, and sensory properties of butter from cows on pasture versus indoor feeding systems. *Journal of Dairy Science*.
2. O'Callaghan, T. F., D. Hennessy, S. McAuliffe, K. N. Kilcawley, M. O'Donovan, P. Dillon, R. P. Ross, and C. Stanton. 2016. Effect of pasture versus indoor feeding systems on raw milk composition and quality over an entire lactation. *Journal of Dairy Science*.
3. O'Callaghan, T. F., D. T. Mannion, D. Hennessy, S. McAuliffe, M. G. O'Sullivan, N. Leeuwendaal, T. P. Beresford, P. Dillon, K. N. Kilcawley, J. J. Sheehan, R. P. Ross, and C. Stanton. 2017. Effect of pasture versus indoor feeding systems on quality characteristics, nutritional composition, and sensory and volatile properties of full-fat Cheddar cheese. *Journal of Dairy Science* 100(8):6053–6073.
4. Murphy, K., D. Curley, T. F. O'Callaghan, C.-A. O'Shea, E. M. Dempsey, P. W. O'Toole, R. P. Ross, C. A. Ryan, and C. Stanton. 2017. The Composition of Human Milk and Infant Faecal Microbiota Over the First Three Months of Life: A Pilot Study. *Scientific Reports* 7:40597.
5. Ntemiri, A., F. N. Chonchúir, T. F. O'Callaghan, C. Stanton, R. P. Ross, and P. W. O'Toole. 2017. Glycomacropeptide Sustains Microbiota Diversity and Promotes Specific Taxa in an Artificial Colon Model of Elderly Gut Microbiota. *Journal of Agricultural and Food Chemistry* 65(8):1836–1846.



## Paula O'Connor

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### Education

M.Sc. University College Cork, Ireland. 1992

B.Sc. (Hons) in Food Microbiology, University College Cork, Ireland. 1989

### Career

1995–Present: Research Technician, Food Biosciences Department, Teagasc

1993–1995: Laboratory technician, Waterford Foods plc.

1991–1993: Microbiologist, Slaney Cooked Meats

### Expertise

Paula runs the Bioactive Peptide Discovery Unit (BPDU) which is a unique facility designed to purify and characterise bioactive peptides from a number of sources. Her main areas of expertise are peptide purification, MALDI TOF mass spectrometry, peptide synthesis and amino acid analysis. She is interested in the development of novel antimicrobials as alternatives to antibiotics with a particular interest in bacteriocins which are small peptides produced by bacteria that kill closely related strains (narrow spectrum) or different genera (broad spectrum). She routinely purifies known bacteriocins such as nisin, lactacin and thuricin using reversed phase HPLC and ion exchange chromatography. Her expertise in peptide purification has been further enhanced through the purification and characterisation of 11 novel bacteriocins to date. Paula is also a skilled peptide chemist and routinely synthesises peptides from 2–60 amino acids in length. Her work allows her to collaborate extensively with other research institutes and industry and she has published extensively in her fields of expertise. She is currently doing a part time PhD entitled 'Bacteriocins from the mammalian gut' and through her studies purified and characterised a novel nisin variant, nisin H, from a porcine streptococcal isolate. She has also identified the key residues and structures required for activity within the anti-staphylococcal bacteriocin Bactofencin A using a peptide synthesis approach.

### Selected Publications

1. Collins F.W.J., O'Connor P.M., O'Sullivan O., Gomez-Sala B., Rea M.C., Hill C and Ross R.P. (2017) Bacteriocin Gene-Trait matching across the complete *Lactobacillus* Pan-genome. *Scientific Reports* DOI: 10.1038/s41598-017-03339-y
2. Collins F.W.J., O'Connor P.M., O'Sullivan O. Rea M.C., Hill C. and Ross R.P. Formicin-a novel broad-spectrum two-component lantibiotic produced by *Bacillus paralicheniformis* APC 1576 *Microbiology*: 162:1662–1671
3. O'Connor P.M., O'Shea E.F., Guinane C.M., O'Sullivan O., Cotter P., Ross R.P. and Hill C. (2015) Nisin H is a new nisin variant produced by the gut-derived strain *Streptococcus hyointestinalis* DPC6484. *Applied and Environmental Microbiology* 81:3953–3960
4. O'Connor P.M, Ross R.P., Hill C. and Cotter P.D. (2015) Antimicrobial antagonists against food pathogens; a bacteriocin perspective. *Current Opinion in Food Science* 2:51–57
5. O'Shea E.F., O'Connor P.M., O'Sullivan O., Cotter P.D., Ross R.P. and Hill C. (2013) Bactofencin A, a new type of cationic bacteriocin with an unusual cognate immunity protein. *mBio* 4:1–13 doi:10.1128/mBio.00498-13
6. Rea M.C., O'Connor P.M., Crispie F., Hill C. and Ross R.P. (2010) Thuricin CD, a posttranslationally modified bacteriocin with a narrow spectrum of activity against *Clostridium difficile*. *Proceedings of the National Academy of Sciences* 107:9352–9357
7. Cotter P.D., O'Connor P.M., Draper L.A., Lawton E.M., Deegan L.H., Hill C. and Ross R.P. (2005) Posttranslational conversion of L-serines to D alanines is vital for optimal production and activity of the lantibiotic lactacin 3147. *Proceedings of the National Academy of Sciences* 102:18584–18589



## Dr. Norah O'Shea

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### Education

BSc. University College, Cork, 2008

MSc. University College, Cork, 2009

PhD. University College, Cork, 2014

### Career

2016–Present: Research Officer, Food Chemistry and Technology Department, Teagasc

2016–2017: Post-Doctoral Research Scientist (DPTC)

2014–2016: Post-Doctoral Research Scientist  
Teagasc Food Research Centre, Ashtown

### Expertise

The research interests of Dr O'Shea include:

- Process analytical technologies (PAT, inline viscometers) for process improvements in the development of dairy concentrates and production of dairy powders.
- Assessing how to implement and validate PAT instruments and sensors at a pilot and commercial scale.
- Development of rheological test methods to evaluate PAT tools (process viscometers).
- Gaining an understanding of the rheological properties of dairy structures e.g. dairy concentrate behavior, heat induced protein changes.

Dr O'Shea has previously worked on FIRM funded projects that looked at cereal ingredients and food structures (gluten-free formulations, cracker, extrudates and bread formulations). Part of this work included investigating the nutritional (composition), rheological (dough structure), texture and sensory properties of the different formulations.

### Selected Publications

1. O'Shea, N., Kilcawley, K.N. and Gallagher, E. (2017) Aromatic Composition and Physicochemical Characteristics of Crackers Containing Barley Fractions. *Cereal Chemistry* 94:3, 611–618.
2. O'Shea, N., Ktenioudaki, A., Smyth, T.P., McLoughlin, P., Doran, L., Auty, M.A.E., Arendt, E.K., Gallagher, E. (2015) Physicochemical assessment of two fruit by-products as functional ingredients: Apple and orange pomace. *Journal of Food Engineering*, 153, 89–95.
3. O'Shea, N., Roessle, C., Arendt, E.K., Gallagher, E. (2015) Modelling the effects of orange pomace using response surface design for gluten-free bread baking. *Food Chemistry*, 166, 223–230
4. O'Shea, N., Arendt, E.K., Gallagher, E. (2014) State of the art in gluten-free research. *Journal of Food Science*, 79, 6, R1069
5. O'Shea, N., Arendt, E.K., Gallagher, E. (2014) Enhancing an extruded puffed snack, by optimising die head temperature, screw speed and apple pomace inclusion. *Food Bioprocess Technology*, 7, 1767–1782
6. O'Shea, N., Doran, L., Auty, M.A.E., Arendt, E.K., Gallagher, E. (2013) The rheology, microstructure and sensory characteristics of a gluten-free bread formulation enhanced with orange pomace. *Food & Function* 4, 1856–1863



## Dr. Orla O'Sullivan

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### Education

BSc. University College, Cork, Ireland. 2000

PhD. University College, Cork, Ireland. 2001

### Career

2004: Post-Doctoral Research Scientist, Conway Institute, University College Dublin

2005: Senior Demonstrator/Lecturer, Department of Biochemistry, University College Cork

2006–2007: Research Officer, Teagasc Food Research Centre, Moorepark

2008–2013: Researcher, ELDERMET, University College Cork and Teagasc Food Research Centre, Moorepark

2014: Research Fellow, Alimentary Pharmabiotic Centre and Teagasc Food Research Centre, Moorepark

2014–Present: SIRG Research Fellow, Teagasc Food Research Centre, Moorepark

### Expertise

Orla is a bioinformatician working on the food programme in Teagasc. Her primary research focus is on the genomics of single bacteria and phage and metagenomics of various environments including human gut and lung, rumen and food. Understanding the genomes of bacteria and phage can aid in the identification of genes responsible for certain traits including flavour and textures in food and probiotics and antibiotic resistance in health. Metagenomic analysis allows both the community profiling and functional analysis of the microbiota of an environment and lends itself to identifying fluxes in bacterial populations in health versus disease, at stage of life (e.g. infant versus elderly) and causative factors in food spoilage. Of particular interest to her is the role of exercise and diet, particularly whey protein, on the human gut microbiome in elite athletes, and in healthy and diseased cohorts.

### Selected Publications

1. Claesson, M. J., Jeffery, I. B., Conde, S., Power, S. E., O'Connor, E. M., Cusack, S., Harris, H. M., Coakley M., Lakshminarayanan, B., O'sullivan, O., Fitzgerald, G. F., Deane, J., O'Connor, M., Harnedy, N., O'Connor, K., O'Mahony, D., Van Sinderen, D., Wallace, M., Brennan, L., Stanton, C., Marchesi, J. R., Fitzgerald, A. P., Shanahan, F., Hill, C., Ross, R. P. & O'Toole, P. W. (2012) Gut Microbiota composition correlates with diet and health in the elderly. *Nature*, 488, 178–84.
2. Clarke, S. F., Murphy, E. F., O'Sullivan, O., Lucey, A. J., Humphreys, M., Hogan, A., Hayes, P., O'Reilly, M., Jeffery, I. B., Wood-Martin, R., Kerins, D. M., Quigley, E., Ross, R. P., O'Toole, P. W., Molloy, M. G., Falvey, E., Shanahan, F. & Cotter, P. D. (2014) Exercise and associated dietary extremes impact on gut microbial diversity. *Gut*, 63, 1913–20.
3. O'Sullivan, O., Rea, M. C., Shanahan, F., O'Toole, P. W., Stanton, C., Ross, R. P. & Hill, C. (2012) *Clostridium difficile* carriage in elderly subjects and associated changes in the intestinal microbiota. *J Clin Microbiol*, 50, 867–75.
4. Lavelle, A., Lennon, G., O'Sullivan, O., Docherty, N., Balfe, A., Maguire, A., Mulcahy, H. E., Doherty, G., O'Donoghue, D., Hyland, J., Ross, R. P., Coffey, J. C., Sheahan, K., Cotter, P. D., Shanahan, F., Winter, D. C. & O'Connell, P. R. (2015) spatial variation of the colonic microbiota in patients with ulcerative colitis and control volunteers. *Gut*.
5. O'Sullivan, O., Cronin, O., Clarke, S. F., Murphy, E. F., Molloy, M. G., Shanahan, F. & Cotter, P. D. (2015) Exercise and the Microbiota. *Gut Microbes*, 6, 131–6.



## Dr. Dilip Rai

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### Education

Ph.D.: Karolinska Institute, Stockholm, Sweden. 2003.

B.Sc.: Trinity College Dublin, Ireland, 1998.

Diploma: DIT Kevin Street, Dublin, Ireland, 1998.

### Career

2009–Present: Senior Research Officer, Teagasc Food Research Centre, Ashtown, Dublin 15.

2013–Present: Adjunct Lecturer, School of Chemistry and Chemical Biology, University College Dublin.

2014–Present: Scientific Committee Member of the EU COST Action FA1403: Plant Bioactives inter-Individual Variation.

2003–2008: Post-Doctoral Research Scientist, Centre for Synthesis and Chemical Biology, University College Dublin.

### Expertise

Dr. Rai leads a research team in the field of nutraceuticals in recovering and characterising food molecules that possess health-promoting effects. He has published numerous research articles in assessing the effect of various food-processing (domestic, industrial and novel physical) technologies on the levels of health-benefiting plant – molecules with emphasis on Irish grown plant foods such as barley, carrots, broccoli, mushrooms and onions. He currently leads research projects focusing on valorisation of food-processing by-products to generate sustainable sources of functional food ingredients (molecules) and bio-fuels.

### Selected Publications

1. Hossain, M.B., Brunton, N.P., and Rai, D.K. (2016). Effect of drying methods on the steroidal alkaloid content of potato peels, shoots and berries. *Molecules*, 21(4): 403–413.
2. Gangopadhyay, N., Rai, D.K., Brunton, N.P., Gallagher, E., and Hossain, M.B. (2016). Antioxidant-guided isolation and mass spectrometric identification of the major polyphenols in barley (*Hordeum vulgare*) grain. *Food Chemistry*, 210, 212–220.
3. Lafarga, T., Rai, D.K., O'Connor, P., and Hayes, M. (2016). Generation of bioactive hydrolysates and peptides from bovine hemoglobin with in vitro renin, angiotensin-I-converting enzyme and dipeptidyl peptidase-IV inhibitory activities. *Journal of Food Biochemistry*, DOI: 10.1111/jfbc.12259.
4. Gangopadhyay, N., Wynne, K., O'Connor, P., Gallagher, E., Brunton, N.P., Rai, D.K., and Hayes, M. (2016). In silico and in vitro analyses of the angiotensin-I converting enzyme inhibitory activity of hydrolysates generated from crude barley (*Hordeum vulgare*) protein concentrates. *Food Chemistry*, 203, 367–374.
5. Aguiló-Aguayo, I., Suarez, M., Plaza, L., Hossain, M. B.; Brunton, N.; Lyng, J.G.; and Rai, D.K. (2015). Optimization of pulsed electric field pre-treatments to enhance health-promoting glucosinolates in broccoli flowers and stalk. *Journal of the Science of Food and Agriculture*, 95 (9): 1868–1875.





## Dr. Mary Rea

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### Education

B.Sc., M.Sc. and Ph.D. in Microbiology from University College Cork.

### Career

1976–1977: Research Assistant Clinical Biochemistry Department, St Finbarr's Hospital Cork.

1977–1981: Contract Research Officer, An Foras Taluntais, Moorepark.

1989–2008: Contract Research Officer, Cheese Microbiology and Biotechnology Departments and member of the SFI funded Alimentary Pharmabiotic Centre.

2008–Present: Principal Research Officer in the Biosciences Department, Teagasc Food Research Centre, Moorepark. Platform leader APC Microbiome Institute

### Expertise

- Food preservation and biomedical applications of bacteriocins.
- Mining the GIT for antimicrobial producing bacteria targeting gut pathogens including *Clostridium difficile*, *Salmonella* sp, *Listeria monocytogenes* and *Cronobacter sakazakii*.
- Cheese microbiology including the microflora of smear ripened cheese.
- *Mycobacterium avium paratuberculosis*: survival in dairy foods.

### Selected Publications

1. Mesa-Pereira B, O'Connor PM, Rea MC, Cotter PD, Hill C, Ross RP (2017) Controlled functional expression of the bacteriocins pediocin PA-1 and bactofencin A in *Escherichia coli*. *Sci Reports*. 8;7(1):3069. doi: 10.1038/s41598-017-02868-w.
2. Fergus W. J. Collins, FW, O'Connor, PM., O'Sullivan, O., Gómez-Sala, B., Rea, MC., Hill, C., & Ross, RP. (2017). Bacteriocin Gene-Trait matching across the complete *Lactobacillus* Pan-genome. *Scientific Reports* | 7: 3481 | DOI:10.1038/s41598-017-03339-y
3. Gough, R., Gómez-Sala, B., O'Connor PM., Rea, MC., Miao, S., Hill, C. and Brodtkorb. A. (2017). A Simple Method for the Purification of Nisin. *Probiotics & Antimicrobial Proteins*. DOI 10.1007/s12602-017-9287-5
4. Bertuzzi, A.S., Guinane, C.M., Crispie, F., Kilcawley, K.N., McSweeney, P.L.H. and Rea, M.C. (2017). Genome Sequence of *Staphylococcus saprophyticus* DPC5671, Strain Isolated from Cheddar Cheese. *J. bacteriology Genome Announc*. Apr; 5(16): e00193-17
5. Bertuzzi, AS., Kilcawley, KN., Sheehan, JJ., O'Sullivan, M.G., Kennedy, D., McSweeney, PLH. and Rea. M.C. (2017). Use of smear bacteria and yeasts to modify flavour and appearance of Cheddar cheese. *International Dairy Journal* 72: 44–54
6. Stefanovic E., Kilcawley, K.N., Rea, M.C., Fitzgerald G.F. and McAuliffe, O. (2017). Genetic, enzymatic and metabolite profiling of the *Lactobacillus casei* group reveals strain biodiversity and potential applications for flavour diversification. *J. Applied Microbiology*. 122: 1245–1261



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### Education

Ph.D. Food Science and Technology (Food Chemistry).  
M.Sc. Food Science and Technology (Food Technology).  
B.Sc. Food Science and Technology.

### Career

2011–Present: Programme Manager – Cheese, Dairy Innovation Centre.

2001–Present: Research Officer, Teagasc. 1995–2001: Cheese Technologist, M.T.L. /Teagasc.

### Expertise

Diarmuid's research programme is focused on technological and biochemical aspects of cheese manufacture and ripening key to enabling diversification of a predominantly Cheddar based Irish cheese industry. His research is also focused on investigation of factors influencing cheese quality and consistency. In particular, his research seeks to determine the influence of varying cheese manufacture parameters on localised variability in curd microstructure, compositional profile, physico-chemical parameters and on bacterial profiles and metabolic activity. This serves to underpin development of (i) novel hybrid cheeses, combining characteristics of diverse cheese types but capable of manufacture on Cheddar-type process plants and (ii) diverse continental cheese types for manufacture on plants with brine salting facilities. In addition his programme focuses on determining the influence of underlying biochemical and microbial factors on specific quality issues (e.g. pink defect, eye quality and split defects) of continental – type cheeses manufactured from a seasonal Irish milk supply.

### Selected Publications

1. Hickey, C. D., Auty, M.A.E., Wilkinson, M.G., and Sheehan, J.J. (2015). The influence of cheese manufacture parameters on cheese microstructure, microbial activity and their interactions during ripening: A Review. *Trends in Food Science and Technology* (In press).
2. El-Bakry M, and Sheehan, J.J. (2014). Analysing Cheese Microstructure: A Review of Recent Developments, *Journal of Food Engineering*, 125, 84–96.
3. Sheehan, J.J. (2013). Milk quality and cheese diversification. *Irish Journal of Agricultural and Food Research*, 52, 243–253.
4. O'Sullivan, D., Giblin, L., McSweeney, P.L.H., Sheehan, J.J., and Cotter, P. D. (2013). Nucleic acid-based approaches to investigate microbial-related cheese quality defect, *Frontiers in Microbiology*, [http://www.frontiersin.org/Journal/Abstract.aspx?s=441&name=food\\_microbiology&ART\\_DOI=10.3389/fmicb.2013.00001](http://www.frontiersin.org/Journal/Abstract.aspx?s=441&name=food_microbiology&ART_DOI=10.3389/fmicb.2013.00001).
5. Daly, D.F.M., McSweeney, P.L.H. and Sheehan, J.J. (2010). Split defect and secondary fermentation in Swiss-type cheeses – a review. *Dairy Science and Technology*, 90, 3–26.



## Dr. Sharon Sheahan

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### Education

B.Sc. Biotechnology (Hons), National University of Ireland (Galway), Galway, 1996

Ph.D. University of Edinburgh, Edinburgh, 2002

### Career

2003–2005: Post-doctoral Research Scientist, The University of Glasgow, Glasgow

2005–2007: Post-doctoral Research Scientist, The University of Oxford, Oxford

2007–2014: Intellectual Property Manager, Alimentary Pharmabiotic Centre, University College Cork

2014–Present: Commercialisation Manager, Teagasc TTO

### Role and Responsibilities

In 2013, Teagasc, UCC and Cork IT TTOs formed the UCT Consortium, supported by Enterprise Ireland through the Technology Transfer Strengthening Initiative (TTSI), whereby Teagasc TTO benefits from the close partnership and experience of its partners to increase efficiencies in technology and knowledge transfer. Dr. Sheahan's role as Commercialisation Case Manager under this Consortium is to facilitate the commercialisation of Intellectual Property developed by Teagasc. This involves identifying and creating opportunities to develop and protect novel IP and innovations, the goal being to maximise exploitation of research outputs. This is becoming an increasingly important part of National policy, to optimise return on investment in publicly-funded research, to develop benefits of economic and social importance, and to improve competitiveness in industry.

Responsibilities include performing invention, technology, patentability and commercial evaluations, prior art and market analysis, drafting and negotiation of agreements for research collaborations, technology licensing, confidential disclosures, and material transfers, as well as providing grant application support. This requires

extensive interaction and communication across a broad spectrum of researchers, funding agencies, industry representatives, technology transfer professionals, and patent attorneys, to deliver impact in the area of agri-food.

### Selected Publications

1. Jansson, M., Durant, S.T., Cho, E.C., Sheahan, S., Edelmann, M., Kessler, B., La Thangue, N.B. (2008). Arginine methylation regulates the p53 response. *Nat. Cell. Biol.* 12, 1431.
2. Sheahan, S., Bellamy, C.O., Harland, S.N., Harrison, D.J., Prost, S. TGF- $\beta$  induces apoptosis and EMT in primary hepatocytes independently of p53, p21Cip1 or Rb status. (2008). *BMC Cancer* 8, 191.
3. Sheahan, S., Bellamy, C.O., Dunbar, D.R., Harrison, D. J., Prost, S. (2007). Deficiency of G1 regulators P53, P21Cip1 and/or PRb decreases hepatocyte sensitivity to TGF- $\beta$  cell cycle arrest. *BMC Cancer* 7, 215.
4. Sheahan, S., Bellamy, C.O.C., Treanor, L., Harrison, D.J., Prost, S. (2004). Additive effect of p53, p21 and Rb deletion in triple knockout primary hepatocytes. *Oncogene* 23, 1489.
5. Prost, S., Sheahan, S., Rannie, D., Harrison, D. J. (2001). Adenovirus-mediated Cre deletion of floxed sequences in primary mouse cells is an efficient alternative for studies of gene deletion. *Nucleic Acids Res.* 29, E80.
6. Prost, S., Sheahan, S., Rannie, D. (2000). Induced deletion of the retinoblastoma gene (Rb) from mouse hepatocytes rapidly changes p53, cell cycle and polyploidy regulation. *Journal of Pathology*, 190, 63A.



## Dr. Paul James Simpson

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### Education

Hull University 1983–1986, B.Sc. (Hons) Biology, Second Class, Division One.

University College Cork, 1986–1988, M.Sc. Biotechnology.

Antibiotic inhibition of fungal pathogens by root colonizing fluorescent *Pseudomonas* species.

University College Cork, 2002–2005, Ph.D. Microbiology.

Pediococci and Bifidobacteria: Isolation, Genomic Characterisation and Evaluation for Probiotic Applications in Humans and Animal.

### Career

1999–Present: Research Officer, Teagasc Food Research Centre, Moorepark, Fermoy, Co. Cork.

1995–1999: Higher Scientific Officer, Medical Research Council, Radiation and Genome Stability Unit, Harwell, Oxon, England.

1988–1995: Scientific Officer, Medical Research Council, Radiation and Genome Stability Unit, Harwell, Oxon, England.

### Expertise

Dr. Simpson's principle areas of expertise include the isolation, characterization and fermentation of bacteria, relating to probiotic applications and functional food ingredients. Techniques encompass the use of molecular genetic methods such as Pulse-Field-gel-Electrophoresis and PCR, proteomics, specifically 2D Gels, HPLC, Gas Chromatography, Mass Spectroscopy, Spray and Freeze-drying.

### Selected Publications

1. Simpson, P.J., Stanton, C., Fitzgerald, G. F., and Ross, R.P. Genomic diversity within the genus *Pediococcus* as revealed by randomly amplified polymorphic DNA PCR and pulsed-field gel electrophoresis. *Appl. Environ. Microbiol.*, 68: 765–771, 2002.
2. Simpson, P.J., Stanton, C., Fitzgerald, G. F., and Ross, R.P. Genomic diversity and relatedness of bifidobacteria from a porcine cecum. *J. Bacteriology*, 185: 2571–2581, 2003.
3. Simpson, P.J., Fitzgerald, G. F., Ross, R.P., and Stanton, C. The evaluation of a mupirocin based selective medium for the enumeration of bifidobacteria from probiotic animal feed *J. Microbiol. Methods*, 57:9–16, 2004.
4. Simpson, P.J., Fitzgerald, G. F., Ross, R.P., and Stanton, C. *Bifidobacterium psychraerophilum* sp. nov. and *Aeriscardovia aerophila* gen. nov., sp. nov., isolated from a porcine caecum. *Int. J. System. Evol. Microbiol.*, 54:401–406, 2004.
5. Simpson, P. J., C. Stanton, G. F. Fitzgerald, and R. P. Ross. Intrinsic tolerance of Bifidobacterium species to heat and oxygen and survival following spray drying and storage. *J. Appl. Micro.* 99:493–501, 2005.



## Helen Slattery

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### Education

NCEA Certificate Applied Chemistry, CIT, 1979.

### Career

1990–Present: Research Technician, Teagasc Food Research Centre, Moorepark, Fermoy, Co. Cork.

1986–1990: Research Assistant, Food Chemistry Dept., UCC.

1983–1986: Research Technician, Biocon Biochemicals, Carrigaline, Co. Cork.

1979–1983: Technician, Research Department, Kerry Co-op, Ardfert, Co. Kerry.

### Expertise

Helen's expertise relates to the identification and quantification of oligosaccharides and other sugars using various HPLC methods. Earlier research projects involved the fractionation and separation of oligosaccharides from various whey streams using membrane filtration and chromatographic processes.

Previous research projects involved the purification and analysis of different milk and whey proteins to enhance their functional properties.

Other projects have involved development of HPLC methods to measure biogenic amines in cheese and for the analysis of phospholipids and triglycerides.

### Selected Publications

1. Slattery, H, Fitzgerald, R.J., (1998). Functional properties and bitterness of sodium caseinate hydrolysates prepared with a *Bacillus* proteinase. *Journal of Food Science*, No. 63, Vol 3, 1998.
2. O'Halloran, F, Slattery, H, Fitzgerald, G, Ross, R.P., and Stanton, C. (2004). Development of bioactive whey protein hydrolysates for fortification of beverages. *Poster (2004)*.
3. Ryan, J.T., Slattery, H., Hickey, R., Marotta, M. (2017). Bovine Milk Oligosaccharides as anti-adhesives against the respiratory tract pathogen *Streptococcus pneumoniae*. *International Dairy Journal 2017*. *submitted*.





## Prof. Catherine Stanton

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### Education

B.Sc (Hons, 2.1) Nutrition/Food Chemistry, (1983)  
University College Cork (Awarding Body: NUI).

M.Sc Nutrition (1986) University College Cork (NUI)  
(Awarding Body: NUI).

Ph.D Biochemistry (1988) Bournemouth University, UK  
(Awarding Body: Council for National Academic Awards,  
CNAA, UK).

D.Sc. (2008) National University of Ireland (Awarding  
Body: NUI).

### Career

2016: Research Professor, College of Medicine and  
Health, University College Cork.

2012: Adjunct Professor, College of Medicine and Health,  
Dept. of Psychiatry, University College Cork.

2003–Present: Principal Investigator, Alimentary  
Microbiome Institute, (APC)

2003–Present: Principal Research Officer, Teagasc,  
Moorepark, Fermoy, Co. Cork

2001–2002: Senior Research Officer, Teagasc,  
Moorepark, Fermoy, Co. Cork

1994–2000: Research Officer, Teagasc, Moorepark,  
Fermoy, Co. Cork

1992–1994: Research Associate, Wake Forest Univ.  
Medical Center, NC, USA

1990–1992: Postdoctoral Fellow, Wake Forest University  
Med. Center, NC, USA

1989–1990: Senior Research Scientist, Johnson &  
Johnson UK, Glasgow, Scotland

### Expertise

- Nutritional aspects of dairy foods, functional foods.
- Probiotic cultures: health benefits, bioactive metabolite production and host health.

- Infant gut microbiota: Influence of Dietary and Environmental Factors.
- Probiotics: technological aspects, development of functional foods.
- Bioactive lipids: Microbial production of bioactive FA, CLAs, SCFA, n-3 FA, lipids and health benefits.
- Bioactive peptides.

### Selected Publications

1. Marques TM, Patterson E, Wall R, O'Sullivan O, Fitzgerald GF, Cotter PD, Dinan TG, Cryan JF, Ross RP, Stanton C. (2016). Influence of GABA and GABA-producing *Lactobacillus brevis* DPC 6108 on the development of diabetes in a streptozotocin rat model. *Benef Microbes*. Mar 25:1–12. [Epub ahead of print]
2. Ryan PM, Burdíkóvá Z, Beresford T, Auty MA, Fitzgerald GF, Ross RP, Sheehan JJ, Stanton C. (2015). Reduced-fat Cheddar and Swiss-type cheeses harboring exopolysaccharide-producing probiotic *Lactobacillus mucosae* DPC 6426. *J Dairy Sci*. Dec;98(12):8531–44. doi: 10.3168/jds.2015–9996. Epub 2015 Sep 26.
3. Ryan PM, Ross RP, Fitzgerald GF, Caplice NM, Stanton C. (2015). Functional food addressing heart health: do we have to target the gut microbiota? *Curr Opin Clin Nutr Metab Care*. Nov;18(6):566–71. doi: 10.1097/MCO.0000000000000224.
4. Robertson RC, Guihéneuf F, Bahar B, Schmid M, Stengel DB, Fitzgerald GF, Ross RP, Stanton C. (2015). The Anti-Inflammatory Effect of Algae-Derived Lipid Extracts on Lipopolysaccharide (LPS)-Stimulated Human THP-1 Macrophages. *Mar Drugs*. Aug 20;13(8):5402–24. doi: 10.3390/md13085402
5. Marques, T. M., Wall, R., O'Sullivan, O., Fitzgerald, G. F., Shanahan, F., Quigley, E. M., Cotter, P. D., Cryan, J. F., Dinan, T. G., Ross, R. P. & Stanton, C. (2015). Dietary trans-10, cis-12-conjugated linoleic acid alters fatty acid metabolism and microbiota composition in mice. *British Journal of Nutrition*, 113: 728–738.



## Dr. Brijesh Tiwari

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### Education

B.Sc. Govind Ballabh Pant University of Agriculture and Technology, India. 2001

M.Sc. Central Food Technological Research Institute, India, 2003

Ph.D. University College Dublin, Ireland, 2009

### Career

2017–Present: Principal Research Officer, Teagasc Research Centre, Dublin

2013–2017: Senior Research Officer, Teagasc Food Research Centre, Dublin

2015 –Present: Adjunct Senior Lecturer, Dublin Institute of Technology, Dublin

2011–2013: Senior Lecturer, Manchester Metropolitan University, UK

2010–2011: Lecturer, Manchester Metropolitan University, UK

2008–2010: Lecturer, University College Dublin, Ireland

2004–2006: Research Scientist, Indian Institute of Crop Processing Technology, India

### Expertise

Dr. Tiwari's primary research interests relate to novel food processing, extraction and preservation technologies, with a strong focus on investigation of biochemical and microbial kinetics in food and food products. He is particularly interested in the investigation of technological aspects (nutritional, microbial, enzymatic and chemical inactivation phenomena) in thermal and non-thermal processing studies.

A particular focus of his current research relates to the investigation of green and sustainable solutions to food industry challenges. In addition, he is interested in extraction technologies with particular reference to extraction of biomolecules from food processing by-products and waste streams.

### Selected Publications

1. Ojha, K. S., Mason, T. J., O'Donnell, C. P., Kerry, J. P., & Tiwari, B. K. (2017). Ultrasound technology for food fermentation applications. *Ultrasonics sonochemistry*, 34, 410–417.
2. Ojha, K. S., Kerry, J. P., Alvarez, C., Walsh, D., & Tiwari, B. K. (2016). Effect of high intensity ultrasound on the fermentation profile of *Lactobacillus sakei* in a meat model system. *Ultrasonics sonochemistry*, 31, 539–545.
3. Ojha, K. S., Alvarez, C., Kumar, P., O'Donnell, C. P., & Tiwari, B. K. (2016). Effect of enzymatic hydrolysis on the production of free amino acids from boarfish (*Capros aper*) using second order polynomial regression models. *LWT-Food Science and Technology*, 68, 470–476.
4. Ojha, K. S., Keenan, D. F., Bright, A., Kerry, J. P., & Tiwari, B. K. (2016). Ultrasound assisted diffusion of sodium salt replacer and effect on physicochemical properties of pork meat. *International Journal of Food Science & Technology*, 51(1), 37–45.
5. Hayes, M., & Tiwari, B. K. (2015). Bioactive Carbohydrates and Peptides in Foods: An Overview of Sources, Downstream Processing Steps and Associated Bioactivities. *International Journal of Molecular Sciences*, 16(9), 22485–22508.
6. Kadam, S. U., O'Donnell, C. P., Rai, D. K., Hossain, M. B., Burgess, C. M., Walsh, D., & Tiwari, B. K. (2015). Laminarin from irish brown seaweeds *ascophyllum nodosum* and *laminaria hyperborea*: Ultrasound assisted extraction, characterization and bioactivity. *Marine drugs*, 13(7), 4270–4280.
7. Tiwari, B. K. (2015). Ultrasound: A clean, green extraction technology. *TrAC Trends in Analytical Chemistry*, 71, 100–109.



## Dr. Miriam Walsh

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### Education

B.Sc. (Hons), Analytical Science, Dublin City University (DCU) 1992

Ph.D. (Chem), DCU, 1997

M.Sc. (Technology Management), UCD, 2005

Diploma in IP and Technology Law, 2014

### Career

1996–1997: Assistant Lecturer, Dublin City University

1997–2000: Technical Support Chemist, Chemoran,

2001–2002: Technical Support, Unitech, Dublin

2003–2005: Programme Manager, Chemistry Dept., UCD

2005–2006: IP Officer, Trinity College Dublin

2006–Present: Teagasc Technology Transfer Office

### Role and Responsibilities

Teagasc Technology Transfer Office (TTO), aims to be a conduit for technology transfer of Teagasc research outputs. From 2013, Teagasc TTO with UCC and Cork IT TTOs formed the UCT consortium, supported by Enterprise Ireland through Technology Transfer Strengthening Initiative (TTSI), whereby Teagasc TTO benefits from close partnership and experience of its partners to increase efficiencies in knowledge transfer.

As head of the Intellectual Property (IP) unit, her role involves working closely with the head of TTO, Declan Troy, to ensure an effective TTO through implementation of transparent and consistent policies and procedures for management of IP and technology transfer, in line with best practice and National IP policy.

They strive to facilitate the professional management of research outputs through strategic management, by close alignment with the research and technology transfer strategic priorities and by evidence of impact on research community and related industry.

Dr. Walsh manages the unit involved in negotiating research agreements emanating from formal links with Irish and international companies and peer research institutes, especially within agri-food space. This ranges from non-disclosure agreements, to collaboration and license agreements. This unit also manages Teagasc patent and IP portfolio, facilitating the licensing of such IP to industry and other end users. They also provide support and guidance to Teagasc staff in this area, including applying for commercially focused state funding. Other important responsibilities include close engagement with key stakeholders, including all funding agencies, Knowledge Transfer Ireland (KTI), the government, collaborating parties and tracking and reporting on the performance of Teagasc research directorate in terms of predefined metrics of technology transfer activities.

Teagasc uses a range of mechanisms in order to engage with industry/stakeholders at varying levels of complexity, ranging from consultancy provision and commercial services to large scale collaborations and licenses. While they use National IP protocol and template agreements to facilitate formalisation of such interactions, they are flexible in the specifics of the interaction and happy to discuss various options with each individual party.

### Relevant Articles

1. "Harnessing the Power of IP", *TResearch*, vol 2, no 1, Spring 2007.
2. "Encouraging Innovation", *TResearch*, vol 5, no 2, Summer 2010.
3. "Gateways to Technology Transfer", *TResearch*, vol 7, no 2, Summer 2012.



## Ita White

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### Education

M.Sc. Education & Training Management, Dublin City University 2002.

M.Sc. Agricultural Chemistry, University College Dublin 1990.

B.Sc. Industrial Microbiology, University College Dublin 1986.

### Career

2011–Present: Food Industry Development, Teagasc Food Research Centre, Ashtown.

2004–2010: European Commission Food & Veterinary Office.

1998–2004: Food Safety & Quality Consultant & Trainer, Teagasc Food Research Centre, Ashtown.

1994–1998: Quality/ Regulatory Affairs Manager, Medical Devices Industry.

1991–1994: Medical Devices Directorate, Department of Health (UK).

1990–1991: Irish Sea Fisheries Board (BIM).

### Expertise

- Delivery of consultancy, auditing and training projects to food industry clients.
- Design & delivery of specialised training and events including microbiology, hygiene, HACCP, food standards development, auditing, food law, and labelling.
- Providing training to support change management and delivery to multi-cultural groups.
- Establishing and updating quality management systems.
- Auditing and developing internal audit procedures and systems.

- Addressing varied client queries in the area of food safety & quality including legislative compliance, standards requirements and product development.
- Initiating and organising multi-agency projects to better serve the food industry.
- Developing industry standards.

### Selected Publications

1. White, I. (2014) Food Labelling & Allergen Awareness, *TResearch* Volume 9: Number 1, Spring 2014 pp30–31
2. White, I. (2013) Tips for Producers & Suppliers of Packaging to the Food Industry, *The Irish Packaging Directory*
3. White, I. (2012) Facing the Future for Food Labelling Laws, *The Irish Packaging Directory*, pp18–21
4. White, I. (2011) Package Your Way to New Markets, *TResearch* Volume 6: Number 4, Winter 2011, pp 14–15
5. European Commission Decisions (2008/654/EC) (2007/363/EC) (2006/677/EC) relating to auditing, developing and reporting on multi-annual national control plans within Member States' Competent Authorities.











