

**Special Edition:**  
**Novel Technologies for a Competitive Food Industry**

Food  
Programme



# Portfolio

Technology for the Food Industry







Teagasc, as the national agriculture and food development authority, has the responsibility of supporting innovation for food companies. Our Food Technology and Knowledge Transfer Strategy describes how we will enable food companies to engage with us in various ways to support their own food innovation plans. Developing partnerships and collaborations with industry is central to our strategy.

This Portfolio of Technologies is a tool that allows us to communicate to the food industry, and wider stakeholders, details of Teagasc technology offers, emerging technology opportunities, technical services, pilot plant facilities and key contact points. It will enable the reader to understand the depth and breadth of our food research and development capabilities within the Teagasc Food Programme.

The Portfolio is to be used as a starting point (or menu) from which food companies can begin to engage with us through various innovation support channels. It will be updated regularly.

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 key technologies at various stages of development.

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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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 **Technology**

**Updates**

## Rapid Curing of Meat with Power Ultrasound

### Key External Stakeholders

Meat curing processors, food machinery manufacturers

### Practical Implications for Stakeholders

Meat curing is an important food manufacturing sector in Ireland. However meat curing is a time consuming process, as salt diffusion rate in meat is quite slow. Power ultrasound is an efficient physical method to enhance mass transfer. The present technology can considerably accelerate the curing process, improving efficiencies with comparable cured meat quality.



### Main Results

- The effect of ultrasound frequency was investigated on the diffusion rate during pork curing in a brine solution. Results showed that 33 kHz exhibited a higher diffusion coefficient than two other frequencies (25 and 45 kHz) in our ultrasound tank systems.
- The distance between the meat and the ultrasound probe exhibited significant influence on the diffusion rate and the distribution of salt in the meat. An optimal distance of 0.5cm was selected.
- A lab scale test was completed with the above optimal design parameters, to cure pork over 300g to a salt level of about 2%. The technology shortens the curing time by at least 50%, while the meat quality was comparable with control products.

### Opportunity/Benefit

The specially designed power ultrasound technology can improve efficiency of curing meat with compatible meat quality from conventional methods.

### Collaborating Institutions

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**Project Number:** 6768

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**Funding Source:** Enterprise of Ireland

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**Date:** October 2016

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**Project Dates:** 2015–2016

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### How to Proceed

**For further information access the full Technology Update at:**  
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## Protein Recovery from Fish By-Products by Non-Thermal Technologies

### Key External Stakeholders

Ingredient companies, marine processors, food companies, protein ingredient manufacturers,

### Practical Implications for Stakeholders

- Environmental benefits by waste reduction
- New source of protein with excellent nutritive properties



### Main Results

Almost 50% of the total weight of fish is considered a waste or a low-value product. These waste and by-products are 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 that currently is not harnessed and can be recovered. Most by-products from fish processing are used in composting, pet food or animal feed; however such products provide a very low value-add and there is a desire to generate alternatives with a higher value-add.

We propose a novel technique based on a substantial modification of isoelectric precipitation-solubilization (ISP) methodology. This technique allows to solubilize more than 90% of total proteins, which is a remarkably increment when compared to the previous 65% reported in bibliography. The process yields purified protein and a precipitate formed by scales and bones. The reagent consumption is not increased regardless of the additional extraction step. Expense in terms of equipment investment is not required as standard equipment is employed in the process (tanks, centrifuges, blenders, stirring equipment and pH probes).

### Opportunity/Benefit

This application can be applied for extracting proteins from solid by-products or wastes coming from food industries such as fisheries, meat and poultry processors. It results in increased protein production by a better harnessing of fish captures

### Collaborating Institutions

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

**Funding Source:** DAFM, Marine Institute, Teagasc

**Date:** October 2016

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

### How to Proceed

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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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## 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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## The Use of Novel Processing Technologies for Improving the Quality and Accelerating the Processing of Meats

### Key External Stakeholders

Meat processors, retailers.

### Practical implications

Meat curing is one of the oldest meat preservation methods and it is still widely used today to produce a range of meat products with desirable characteristics. However, brine penetration into meat is a slow process so most processors use multi-needle injectors to produce bacon and ham in a few days rather than a few weeks. However, this produces products of lower quality. We have shown that the rate of brine penetration can be speeded up by applying high intensity ultrasound (US) to the meat while it is immersed in brine. Processors could use US to shorten processing times without adversely affecting the quality. Pulsed electric fields (PEF) is another novel technology with potential, but we have found that it is not as effective as US.



### Main Results

- In lab-scale studies a range of US treatments (10, 25 or 40 min at US intensities of 4.2, 11 or 19 W cm<sup>-2</sup>) increased the salt content of pork.
- Diffusion studies confirmed that the rate of salt uptake was increased by US treatment.
- In pilot scale studies (pork pieces of 300g approx.) three US treatments (2 h; 10.7, 17.1 or 25.4 W cm<sup>-2</sup>) halved the time to reach a salt content of 2.2%
- US treatment did not affect any quality attributes.
- PEF treatment of pork prior to curing increased the salt uptake but only by about 17%
- US is easier to apply to meat pieces than PEF and it showed greater potential for reducing curing times.

### Opportunity/benefit

Ultrasound is a technology that is already in use in the food industry. Commercial systems could be adopted to reduce curing times for high quality products.

### Collaborating Institution

UCD

**Project Number:** 5962

**Funding Source:** DAFM (08/R&D/D/683)

**Date:** May 2014

**Project Dates:** Jan 2005 – Dec 2008

### How to Proceed

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## A Food Matrix Approach to Meat Product Development

### Key External Stakeholders

Primary meat processors; Ingredients companies; SMEs; Regulatory agencies: DAFM

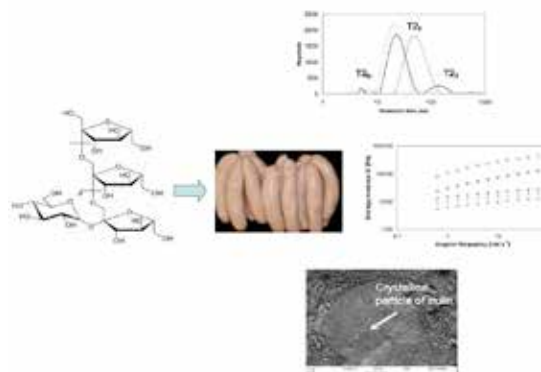
### Practical Implications for Stakeholders

Processed meat products represent complex systems that can be considered as a 'matrix' of interacting components.

Increasing consumer awareness of health issues associated with high dietary intake are driving the need for change in the products available to them. Therefore, the meat industry is examining the possibilities of meat products with reduced fat salt and additives as well as meat-based functional foods as an opportunity to improve its public image and update dietary goals.

However, the removal of traditionally used ingredients with the goal of improving health and well-being, e.g. fat and salt, in processed meat products represents a significant technical challenge.

This is due to the fundamental role they play in the structure or the formation of effective gels, allowing



them to function as cohesive meat products.

By improving our understanding of the impact of interactions between the food matrix and novel ingredients on technological and sensory performance, we are developing strategies to optimise healthier versions of traditional meat products such as reduced fat and salt products and products including bioactive compounds and prebiotic fibres.

### Main Results

- Comminuted products (burgers, breakfast sausages, and frankfurters) formulations were optimised using consumer sensory panels and instrumental measurements with regards to salt and fat levels that represented a significant decrease in their respective contents compared to their retail counterparts (controls).
- Using advanced experimental design software, both comminuted and whole muscle products formulations containing functional ingredients, such as fibre, prebiotics, omega-3 fish oils and antioxidants were optimised.
- Detailed ultra-structural analyses better elucidated the underlying forces governing overall product quality, the knowledge of which can be used in a more systematic scientific approach to new product development.

### Opportunity/Benefit

A series of templates available to industry that can be used in future to predict the effects of alteration of various parameters on microstructure, molecular interactions and their relationship with product quality.

### Collaborating Institutions

University College Cork,

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**Project Number:** 5957

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**Funding Source:** DAFM (08/RD/TAFRC/671)

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**Date:** May, 2014

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**Project Dates:** Dec 2008 – May 2014

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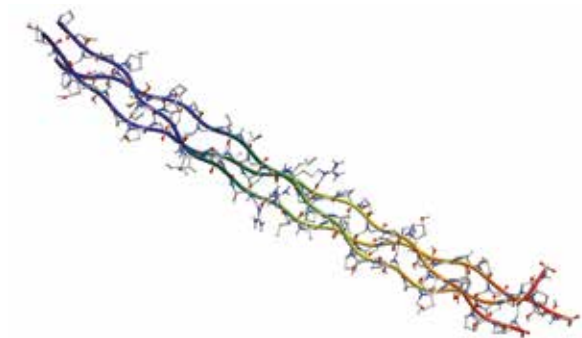
## Assessing Pig and Sheep Industry By-Products as Sources of Constituents of High Value Biomaterials

### 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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## 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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## Biocontrol of Verocytotoxicogenic *Escherichia coli* at Key Stages of the Beef Chain

### Key External Stakeholders

Beef industry.

### Practical Implications for Stakeholders

Verocytotoxigenic *Escherichia coli* (VTEC), particularly *E. coli* O157:H7 are a major food safety concern worldwide. Healthy ruminants can harbour VTEC in their gastrointestinal tract and can shed the pathogen in their faeces, leading to contamination of the hide, carcass and/or meat products posing a potential public health risk and commercial damage to the beef sector. There is a need for targeted controls against *E. coli* O157 at key points of the beef chain coupled with a demand for natural biological controls, due to increased consumer resistance to use of chemicals. The key finding from this study was that biocontrol



agents (particularly phages and carvacrol) show great potential as novel controls against *E. coli* O157:H7 at key stages of the beef chain and further research on their development and application is being pursued.

### Main Results

- Carvacrol and thymol were shown to inhibit and kill *E. coli* O157:H7 and other VTEC in a model broth system and retained their antimicrobial activities across a wide range of environmental conditions tested (e.g. temperature, pH, water activities etc).
- Carvacrol (3%) reduced *E. coli* O157:H7 numbers by 10 fold on beef hide and carcass.
- Bacteriophages e11/2 and e4/1c inhibited and killed *E. coli* O157:H7 in a model broth system and retained activity under a range of environmental conditions.
- Bacteriophage significantly reduced *E. coli* O157:H7 in a model rumen system without affecting the natural microflora or fermentation.
- Bacteriophage sprayed on to hide could reduce *E. coli* O157:H7 by 100 fold.

### Opportunity/Benefit

Advice, consultancy work and/or technical services can be provided by Teagasc in the area of pathogen biocontrols.

### Collaborating Institutions

N/A

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**Project Number:** 5638

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

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**Date:** November, 2010

---

**Project Dates:** Jan 2007 – Dec 2009

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## BIOCONTROL: Bio-active Ingredients for the Control of Undesirable Bacteria in Ready-to-Eat Foods

### Key External Stakeholders

Food manufacturers and processors.

### Practical Implications for Stakeholders

In 2003, the US Food and Drug Administration issued a Final Rule which explicitly states that post-processing technologies must be included to limit the growth of *Listeria* in ready-to-eat products.

The Biocontrol project has resulted in the generation of a suite of food grade antimicrobials on which future novel anti-*Listeria* biopreservative products could be based.

- The identification of nisin derivatives with enhanced activity against Gram positive pathogens, including *Listeria*, is a major breakthrough. The fact that single amino acid changes can have such dramatic impacts is particularly noteworthy. From a commercial perspective it is significant that nisin is the only bacteriocin which has been approved as a food additive and nisin derivatives may be more likely to be approved by authorities than completely new compounds. In addition, nisin has been shown to have a number of other applications in animal and human health. Thus enhanced forms of nisin have the potential to impact on food safety, health and agriculture.



- A *Lactobacillus salivarius* strain producing an ABP118-like bacteriocin, which we designated salivaricin P, was identified. The fact that bacteriocins are produced by potentially probiotic strains is relevant to industry and consumers, since such strains could potentially be employed to control pathogens in the gut or to alter the overall gut microbial composition in a beneficial way.

### Main Results

- Novel anti-*Listeria* agents were identified and developed.
- Food trials to demonstrate effectiveness were performed.
- Patented IP resulted.

### Opportunity/Benefit

A patent relating to the novel nisin derivatives was filed:  
Publication number: WO2011076903

### Collaborating Institutions

University College Cork

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**Project Number:** 5367

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**Funding Source:** DAFF (04/RD/C/232)

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**Date:** March, 2012

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

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### How to Proceed

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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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## 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

**Project number:** 5953

**Date:** November, 2014

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

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

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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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## Cheese 2030 – New Technology Platform

### Key External Stakeholders

Manufacturers of cheese and milk protein ingredients.

### Practical Implications for Stakeholders

A novel SMART cheese technology platform has been developed for the manufacture of specialised protein powders and recipes for converting these into cheeses with different functional properties. Key features of the technology include:

- Cheesemaking process without whey release in cast cheeses or limited whey release in structured cheese (e.g. ~ 25–30% of normal).
- Complete retention of any added materials (e.g. pre-biotics, minerals, vitamins ) in cast cheese types.
- Enables cheesemaking operations in regions where fresh milk is not readily available.



- Ingredient manufacturing step resulting in production of clean 'whey' ideal for the manufacture of specialised whey products e.g. functional whey protein fractions, powders for inclusion in infant milk formula.

This platform technology provides more opportunity to design/control cheese characteristics such as texture, cooking properties and greater potential for the development of new generation health cheeses.

### Main Results

A technology was developed for the manufacture of milk protein ingredients (MPI) with characteristics suited to the manufacture of cheeses with different physical properties.

The dispersion, hydration and gelation properties of the MPI were affected by mineral composition, protein concentration, time, solvent quality factors (including ionic strength, pH, temperature).

A process for the conversion of MPI into:

- 'Cast' cheese variants with dry matter levels  $\leq$  50% without whey expression.
- 'Structured' cheese variants (with  $\geq$  50% dry matter) by subjecting the cast cheese to further curd handling and whey expression steps.

The composition, physical and sensory properties of the cheeses were altered by the following process variables: formulation (type and level of MPI, salt level, pH), ingredient dispersion/blending conditions (shear, temperature, duration), sequence of ingredient addition, gelation conditions (coagulant type, pH, temperature, time), curd handling processes, and addition of polysaccharides.

### Opportunity/Benefit

This technology allows the development of prototype functional MPIs with unique technological characteristics for conversion into cheeses. Irish dairy companies have an opportunity to supply export markets with cheese ingredient solutions (MPIs and cheese conversion processes) which can be converted by *in-situ* re-hydration into local products.

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**Project number:** 5857

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**Funding source:** EI (TD/2007/0128)

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**Date:** March, 2012

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**Project Dates:** Apr 2008 – Oct 2011

### How to Proceed

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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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## 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 natural 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 further investigations should be carried out to identify the source of EDA contamination in milk. 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

- New technology is available for the detection of EDAs in milk.
- Research has shown that a number of EDAs are detectable in milk but at low parts per billion levels.
- More extensive methods need to be developed using GC-MS/MS to measure phthalate residues in milk.

### Main Results

- Two new methods were developed to screen for endocrine disrupting chemicals in milk using an estrogenic reporter gene assays 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

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**Project Number:** 6141

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**Funding Source:** Teagasc

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**Date:** November, 2014

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**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 a Highly Functional Cheese Sauce

### Key External Stakeholders

Dairy Industry, Food Manufacturers.

### Practical Implications for Stakeholders

- Ultra High Temperature (UHT) and *sous vide* cheese sauces were developed.
- A new process to create concentrated cheese flavours was developed. This new process allows a diverse range of concentrated cheese flavours to be developed from base dairy substrates.
- In addition a spray dried concentrated cheese flavour was also produced and information as to minimize losses of volatile key flavour compounds was highlighted.



### Main Results

- A method for producing retort cheese sauces.
- Novel method for the production of concentrated cheese flavours.
- A greater understanding of the flavour potential and use of dairy cheese lactic acid starter bacteria in the production of concentrated cheese flavours.
- How manipulation of pH can impact on losses of key volatile cheese flavour compounds during spray drying.
- How manipulation of pH can impact on sensory perception.

### Opportunity/Benefit

Consultancy and contract research opportunities are available to both national and international clients in the area of enzyme-modified cheese and concentrated cheese flavours.

A HPLC method to quantify short chain volatile free fatty acids was developed and is now available as a technical service to industry.

A detailed one-two day course on all aspects of enzyme-modified cheese has been developed and is available to industry on request.

### Collaborating Institutions

N/A

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**Project number:** 5115

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**Date:** May, 2011

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**Funding source:** DAFF 01/R&D/TD/189

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**Project dates:** July 2003–June 2006

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## Development of Healthier Meats and Meat Products

### Key External Stakeholders

Meat processors, retailers, ingredients companies, consumers.

### Practical implications

The outcomes of the research from this project deliver know-how to the Irish meat industry on how to develop innovative, healthy, value-added meat products of high nutritional and sensory quality. Also, the research enables Irish meat processors to make significant inroads into the functional food market and increase Irish competitiveness in this area.



### Main Results

- The effect of the plant extracts Lutein, Sesamol and Ellagic acid on quality parameters in raw and in cooked beef and pork products was investigated.
- Lutein, Sesamol and Ellagic acid reduced lipid oxidation in raw and cooked beef.
- Sesamol and Ellagic acid did not affect textural properties of cooked beef patties.
- Lutein enhanced textural properties of cooked beef patties.
- Sensory properties of cooked beef patties were unaffected by plant extract addition.
- Quality and sensorial properties in cooked sliced beef were unaffected by Lutein and Sesamol addition (via injection).
- Plant extracts reduced levels of lipid oxidation in sliced cooked beef stored aerobically and in MAP.
- Lutein and Sesamol increased sliced beef tenderness (instrumental and sensory).
- Plant extracts reduced lipid oxidation in raw pork patties.
- Lutein and Ellagic acid did not affect instrumental textural characteristics.
- Sesamol positively influenced textural characteristics of cooked pork patties.
- Sensory parameters were unaffected by plant extract addition.
- Sesamol and Ellagic acid reduced lipid oxidation in raw and cooked pork sausages.
- Sesamol increased the water holding capacity of raw pork sausages.
- Lutein and Ellagic acid positively influenced instrumental textural characteristics of cooked pork sausages.
- Sensory properties of cooked pork sausages were unaffected by plant extract addition.
- Colour and lipid stability cooked ham were unaffected by plant extract addition.

### Opportunity/Benefit

Irish meat processors can increase the desirability of their products to consumers by using natural plant extracts in place of synthetic additives. They could also create new markets by developing functional meat products using plant extracts.

### Collaborating Institution

University College Cork

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**Project number:** 5424

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**Funding source:** DAFM 04/R&D/C/236

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**Date:** April 2014

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**Project Dates:** Jan 2005 – Dec 2008

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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.

**Project number:** 6611

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

**Date:** May, 2015

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

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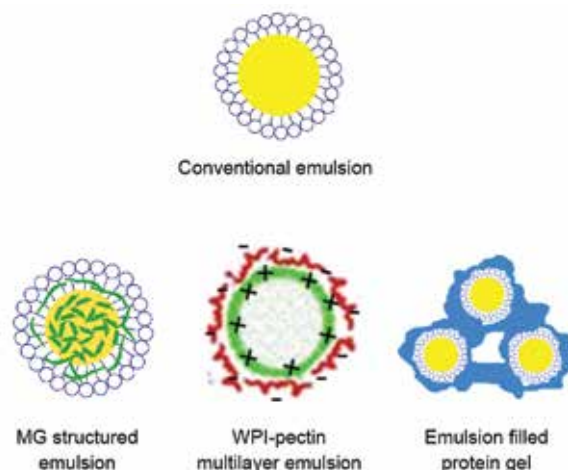
## Development of Novel Food Structures Which Deliver Engineered Flavour and Health Benefits

### 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

**Project number:** 5991

**Funding source:** Teagasc

**Date:** March, 2015

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

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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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## Engineering of High Quality Gluten-Free Breads

### Key External Stakeholders

Food manufacturers, bakeries, food ingredients companies.

### Practical Implications for Stakeholders

A number of recent studies highlighted the poor nutritional quality of gluten-free cereal-based products available on the market. This project evaluated the baking and nutritive properties of the pseudocereals amaranth, quinoa and buckwheat, and their applications as functional ingredients in a gluten-free bread formulation.

The pseudocereal flours proved to be extremely viable and should play an important part in enhancing the nutritional properties of gluten-free breads. This gluten-free project has further improved the knowledge and expertise of the cereal group at Ashtown in this significant and ever-growing area. In summary:



- Pseudocereal flours are feasible ingredients in the formulation of good quality gluten-free breads.
- Pseudocereals are important energy sources, due to their starch content, and contain good quality protein, dietary fibres and lipids rich in unsaturated fats.
- Pseudocereals have adequate levels of important minerals such as calcium and iron.

### Main Results

- Buckwheat and quinoa breads had increased bread volume.
- Pseudocereal containing breads had a softer texture than the control bread.
- Higher levels of protein, fat, fibre and minerals were found in the pseudocereal breads.
- Buckwheat breads had the highest total phenol content.
- Quinoa and buckwheat grains are rich sources of polyphenols.
- Amaranth, quinoa and buckwheat breads are excellent sources of vitamin E.

### Opportunity/Benefit

The opportunity exists to engage with Teagasc to produce a range of nutritionally enhanced gluten-free breads using the tested pseudocereals which may provide interested companies with a competitive advantage. Companies can access the expertise gained through services provision, with the potential also to engage in research with Teagasc researchers in order to develop these products successfully.

### Collaborating Institutions

University College Cork

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**Project Number:** 5472

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**Funding Source:** DAFF (FIRM) & EI

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**Date:** June, 2011

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

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### How to Proceed

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## Exploitation of Cheese Cultures for Flavour Diversity and Functionality

### Key External Stakeholders

Dairy industry, starter supply companies, research community.

### Practical Implications for Stakeholders

Microorganisms are critical for cheese manufacture and ripening and are a key contributor to its flavour development. Thus, application and control of the cheese microbial flora during manufacture and ripening offers the cheese manufacturer a means to develop cheeses with flavours and functionalities targeted to specific markets. This project was sought to determine the impact of various microorganisms on cheese flavour and functional properties with a view to identifying strains with beneficial traits that could be exploited by the industry.

The main issues addressed included investigations into:

- The potential of exopolysaccharide (EPS) producing starter to cheese manufacture and ripening.



- The contribution of *Streptococcus thermophilus* to Cheddar cheese flavour.
- Identification of new bacterial strains for cheese manufacture.

### Main Results

- A bank of 142 EPS producing lactic acid bacteria was assembled.
- It was clearly demonstrated that EPS producing strains have the capacity to improve cheese yield and enhance the texture properties of reduced-fat Cheddar cheese.
- *St. thermophilus* when used as a starter or starter adjunct impacted on flavour development in a strain specific manner.

### Opportunity/Benefit

The successful implementation of this project provides a range of options to cheesemakers to produce cheeses with improved and diverse flavours and functional properties. By so doing the project supports the efforts of Irish cheese makers to exploit markets for cheese with diverse and unique flavours, such as the speciality and extra mature Cheddar markets in the UK, to which only limited access is currently available. Expressions of interest from companies interested in this area are welcome.

### Collaborating Institutions

University College Cork

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**Project Number:** 5431

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**Funding Source:** DAFM (04/R&D/TD/309)

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**Date:** March, 2012

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

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## Exploration of Irish Meat Processing Streams for Recovery of High Value Protein Based Ingredients for Food and Non-Food Uses

### Key Stakeholders

Meat sector, food (human and pet), beverage, protein processors, sports, nutrition, biomedical, cosmetics.

### Practical Implications for Stakeholders

Recovery of high value protein-rich functional co-products from meat processing streams represents an area of significant opportunity to enhance the economic performance and improve the environmental impact of the Irish meat Industry. ReValueProtein will capitalize on many potential opportunities to valorise meat processing secondary, by-product or waste streams. As there is no Irish based strategic initiative to support this exploitation, there is a pressing requirement for a nationally funded effort to support the meat industry in capitalizing on this opportunity. ReValueProtein is an ambitious project which brings together a multidisciplinary team [food chemistry, biosciences, tissue engineering, process (novel and pilot scale) technologies, consumer science, food and beverage technology] to generate technical know-how to develop functional co-products with applications in food, beverage, health and biomedical engineering. Intellectual property, protocols and products



generated will have relevance across all of these sectors.

The main activities fall under **three key scientific pillars**:

- I. **Characterization** of source materials (offal, blood, trim etc), extracts and novel products;
- II. **Processing** of source materials to generate products (including assessment of novel process technology and working up to pilot scale production);
- III. Evaluation of **applications**: techno-functional (emulsification etc), health promoting, bioactive, bioavailability, tissue engineering etc.

All of these are underpinned by analysis of consumer attitudes and preferences pertaining to sustainable processing and the products generated.

### Main Results

Assessing processing technologies which are of relevance for the recovery of functional proteins from low, neutral or negative value products.

Proteins exhibiting techno-functional (emulsification) properties recovered from bovine offal.

Other raw materials reviewed with a view to extracting or generating high value functional proteins or peptides.

### Opportunity/Benefit

Recovery of value from meat processing streams holds strong potential for the meat sector to generate higher value products from existing low/neutral value products. These higher value products can have applications in a variety of arenas such as the food and beverage (emulsifiers, binders, flavour etc), sports/nutrition, biomedical (bioactive peptides, collagens for wound repair) sectors.

### Collaborating Institutions

University College Cork, University College Dublin, NUI Galway, Tralee IT/Shannon ABC

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**Project Number:** 6430

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**Funding Source:** DAFF 11F043

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**Date:** April 2014

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**Project Dates:** March 2013 – Feb 2018

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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

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## Functional Properties of Beta-glucans from Barley

### Key External Stakeholders

Food manufacturers, bakeries, food ingredients companies.

### Practical Implications for Stakeholders

- Barley fractions are feasible functional ingredients that can be used in the formulation of yeast breads of a high baking, sensory and nutritional quality.
- Barley middlings, considered a by-product or waste stream, contain high levels of beta-glucan and were successfully used to produce viable bread products that may have potential for commercialisation.

Past studies have shown barley to be an excellent source of dietary fibre and beta-glucan, a polysaccharide that when consumed regularly has important health benefits including reducing the risk of heart disease. This project studied a variety of barley cultivars and evaluated their use as low cost, high beta-glucan-containing functional ingredients. Optimisation of milling procedures generated a range of milled barley fractions that were



then blended with wheat flours and used in bread formulations which were evaluated for their rheological, textural and nutritive properties.

### Main Results

- A range of new and nutritious barley fractions were isolated by optimising the milling process.
- Barley middlings were found to be an important source of beta-glucan and can be used in the formulation of bread products.

### Opportunity/Benefit

The opportunity exists for bakers, ingredient companies and other relevant industry personnel to link with Teagasc in order to optimise milling conditions, formulate flour blends and develop functional bread products with enhanced levels of dietary fibre and beta-glucan.

### Collaborating Institutions

University College Cork, Cork Institute of Technology, University College Dublin

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**Project number:** 5715

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**Funding source:** DAFF (06/RD/C/462)

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**Date:** June, 2011

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

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## FUNLAC: Lacticin-Based Ingredients for Biopreservative and Functional Food Applications

### Key External Stakeholders

Food producers.

### Practical Implications for Stakeholders

- A genome sequence of the lacticin producing strain was completed, which allows identification of genes relevant to industrial and food safety applications. This genetic blueprint can additionally be used to identify and exploit other interesting traits (both fundamental and commercial) associated with the strain.
- A *Lactococcus lactis* strain identified as producing elevated antimicrobial activity was investigated. This is of relevance to the food industry given that the use of this strain results in elevated lacticin 3147 activity at no additional cost, thereby improving commercial value and impacting on the use of the antimicrobial lacticin 3147 in food industry applications.
- When assessed *in vivo*, lacticin 3147 was found to be degraded within the gastrointestinal tract by the enzyme  $\alpha$ -chymotrypsin. Thus, lacticin 3147 was deemed safe for ingestion, given that it would not



impact negatively on commensal gut flora. Additionally, the fact that lacticin 3147 is effective in the oral cavity provides the opportunity to influence dental health through the development of oral food applications.

- Lacticin 3147 has been demonstrated to be a robust antimicrobial with the ability to control food spoilage and pathogenic bacteria in non-dairy-foods. It was found to be particularly effective for the control of *Bacillus cereus* on beansprouts, with results indicating that it is more effective than the conventional hypochloride solutions, currently used.

### Main Results

- The genome sequence of the lacticin 3147 producing strain was completed.
- In one of the first reports of its kind, where a lantibiotic was assessed *in vivo*, lacticin 3147 was found to be degraded within the gastrointestinal tract by the enzyme  $\alpha$ -chymotrypsin. Thus, lacticin 3147 was deemed safe for ingestion.
- Lacticin 3147 was demonstrated to be a robust antimicrobial with the ability to control food spoilage and pathogenic bacteria in non-dairy foods.

### Opportunity/Benefit

Lacticin 3147 has been demonstrated to be effective against all Gram positive bacteria tested to date, and has a free from additive status. It is a natural antimicrobial that could be the solution to a broad range of microbial problems for food producers in food biopreservation and shelf life extension applications, as well as having potential for biomedical applications. Expressions of interest are welcome from such companies to optimise this technology with a view to licensing.

### Collaborating Institutions

University College Cork

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**Project Number:** 5363

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**Funding Source:** DAFF (04/R&D/TD/317)

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**Date:** December, 2010

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

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## Health Promoting Bioactives from Cider Yeast

### Key External Stakeholders

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

### Practical Implications for Stakeholders

Beta glucan is a bioactive polysaccharide which has FDA approval for the reduction of cardiovascular risk, the leading cause of death and morbidity in the EU. A cardioprotective diet enriched in dietary fiber, and in particular beta glucan is recommended to protect against the development of cardiovascular disease. Furthermore, food-derived ACE (Angiotensin-I-converting enzyme)-inhibitory peptides have been shown to reduce peripheral blood pressure and exert an antihypertensive effect *in vivo* following ingestion. In this project, bioactive components (ACE inhibitory/ antihypertensive peptides and beta glucan) were isolated and characterised from Natural Yeast, which was a by-product of the cider production process.



### Main Results

- Laboratory scale trials, involving autolysis and hydrolysis of spent cider yeast, were optimised for production of yeast extracts, enriched in free amino acids, flavour-enhancing components and bioactive ACE-inhibitory peptides.
- Pilot scale trials were performed but further technical trials are required.
- Economic and financial analysis of the prototype products developed in this project were undertaken, and results indicated that the process for their production (involving spray drying at 20%) was not commercially viable, with further technical trials required to overcome this difficulty.

### Opportunity/Benefit

The opportunity exists to further investigate the potential waste stream of Cider production in collaboration with industrial personnel. The research group benefited from improved links with industry (Cybercolors).

### Collaborating Institutions

Cybercolors

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**Project number:** 5932

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**Funding source:** EI (IP/2007/0495)

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**Date:** March, 2012

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**Project Dates:** Nov 2008 – Oct 2010

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## Healthy Cereal-Based Snacks for the Elderly

### Key External Stakeholders

Food manufacturers, bakeries, food ingredient companies.

### Practical Implications for Stakeholders

It has been widely reported that undernutrition and malnutrition are widespread among the elderly in Europe, North America and other developed countries. Older people are unable to shop and cook properly to fulfill their nutritional needs. Barriers to healthy diets which have been identified include poor cooking skills, lack of motivation for shopping and poor housing conditions. As bakery products are commonly consumed (by people of all ages), and are widely available in local shops and supermarkets, they are obvious potential carriers for a range of functional ingredients directed towards health for the elderly. At the beginning of this project, a preliminary survey of existing snack-type products on the market revealed that no products were found that specifically targeted elderly consumers.



This project developed a range of healthy and novel baked and extruded products, which are convenient to eat, and targeted specifically at boosting the health of the elderly. The ingredients and formulations used in the project targeted specific areas of malnutrition in the elderly which have been highlighted in many current medical journals.

### Main Results

The following products were developed and optimised:

- Low GI, enhanced fibre extruded/puffed corn-based snacks with a low density (therefore easy to eat).
- Soft, yeasted products containing resistant starch flours and increased fibre content.
- Breads containing sourdough, and either teff/sorghum flours (significantly reduced in vitro predicted glycaemic index).
- Cereal-based yoghurts with excellent nutritive and sensory properties.
- Scones/quickbreads with reduced fat and sugar, and having pre-and probiotic effects.
- Soft, semi-sweet baked products with extra fibre inclusions.
- Crumbly cookies/biscuits with enhanced fibre and protein levels.

### Opportunity/Benefit

Following the use of ingredients and the development of a range of products during this project, advice, consultancy work and/or technical services can now be provided at Ashtown in this area through Teagasc's fee-paying service. Commercial trials are ongoing in the test bakery at Ashtown.

### Collaborating Institutions

University College Cork

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**Project number:** 5964

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**Funding source:** DAFM

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**Date:** November, 2015

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**Project dates:** Dec 2008 – May 2014

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## Healthy Fatty Acid-Enriched Fresh Beef: Implications for Shelf-life and Flavour

### Key External Stakeholders

Beef producers/processors, Bord Bia, Health professionals.

### Practical implications

Strategies to manipulate the fatty acid composition of beef and the implications of the modified beef on shelf-life and flavour were examined.

- The findings will assist the beef industry in the production of beef with enhanced fatty acid composition from a human health perspective, and to prevent any associated deleterious effect on shelf-life or sensory characteristics of beef.
- The findings will also assist the marketing of Irish grass-produced beef.



### Main Results

- Muscle lipids of pasture-fed cattle contained higher vaccenic acid, total and c9, t11- conjugated linoleic acid proportions than those from concentrate-fed cattle.
- Supplementation of pasture with plant/marine oils resulted in larger marginal increases in total and c9, t11- conjugated linoleic acid than supplementation of concentrate.
- The shelf-life of the modified beef was unaffected.
- The rather extreme dietary treatments had relatively small effects on shelf-life and sensory characteristics of beef.

### Opportunity/benefit

The feasibility of producing beef with an enhanced fatty acid composition from a human health perspective, beyond that found in conventionally produced beef was demonstrated. The main challenge to industry is to develop a marketing strategy to capture this potential.

### Collaborating Institution

UCD, University of Bristol, UK, MTT Finland

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**Project Number:** 5409

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**Funding Source:** DAFF (04/R&D/TN/243) & Teagasc

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**Date:** July 2013

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

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

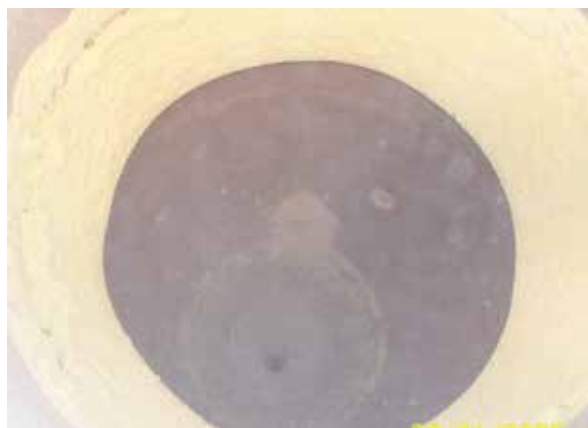
### Key External Stakeholders

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

N/A

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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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## Improving Retail Packaging of Beef

### Key External Stakeholders

Beef processors, retailers.

### Practical implications for stakeholders

A new means of vacuum skin packaging (VSP) of beef steaks which preserves a bright red colour during retail display has been developed. These packs will be as visually attractive to consumers as MAP packs without the adverse effects associated with these.

- Consumers associate a bright red colour with quality and freshness.
- High oxygen MAP packs enhance the red colour of beef steaks over an extended display period.
- Oxidation is promoted in MAP packs causing off-flavours (lipid oxidation) and less tender meat (protein oxidation)
- VSP overcomes these problems and has other advantages (longer shelf life, more compact) but



the meat is dark and unappealing to many consumers.

- Exposing the beef to an atmosphere with a low concentration of carbon monoxide (CO) prior to VSP results in steaks with an attractive bright red colour.
- The pre-treatment can be tailored to give a desired colour shelf life.

### Main Results

- Longer CO exposure times resulted in a deeper red layer and longer colour shelf life.
- A very long exposure time of 72 hours caused the CO to penetrate right through the steak.
- Lipid oxidation was very low in all VSP packs regardless of whether they were exposed to CO.
- Microbial counts were low and similar in treated and untreated VSP packs.
- Steaks exposed to CO prior to VSP packing were more red than control VSP steaks after 1, 2 and 3 weeks of storage.
- Short exposure times of up to 5 hours produced steaks that were attractive to a panel.
- Long exposure times of 24 and 72 hours produced steaks that the panel were suspicious of due to their over-developed appearance.

### Opportunity/Benefit

This new packaging technology could be exploited by processors and retailers to provide consumers with attractive VSP steaks with all the benefits of vacuum packaging while avoiding the negative effects of VSP and MAP packaging.

### Collaborating Institutions

UCC and Nofima Mat AS, The Norwegian Food Research Institute

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**Project Number:** 5717

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

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**Date:** October, 2013

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

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## Inlet Air Humidity Control Project on TFD Spray Dryer

### Key External Stakeholders

Dairy ingredient manufacturers, infant milk formula manufacturers.

### Practical Implications for Stakeholders

The outcome is:

- The pilot-scale tall-form dryer (TFD) in MTL, Moorepark, is now capable of humidity control of incoming air used in drying.
- This feature provides better control over drying conditions in R&D trials, enabling experimental variation due to air variable humidity to be removed.
- It enables the influence of air humidity in the manufacture of a new product to be investigated. This assists product development in that issues with stickiness and plant blockage can be addressed at the pilot stage.



- As a demonstration project it is a model for the uptake of such technology by the dairy ingredients manufacturing sector.
- This facility is now available to the industry and to Teagasc researchers as a development tool.

### Main Results

In commissioning it was demonstrated that air humidity can be controlled between a dew point of -8°C and 25°C. Product related results will come through other projects.

### Opportunity/Benefit

Interested parties can gain access to the TFD in order to carry out trials under controlled air humidity conditions, i.e. humid or dry conditions can be simulated, and to develop new products and ingredients.

### Collaborating Institutions

N/A

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**Project Number:** 5982

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**Funding Source:** Dairy Levy Fund

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**Date:** July, 2011

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**Project Dates:** Jul 2009–Dec 2010

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

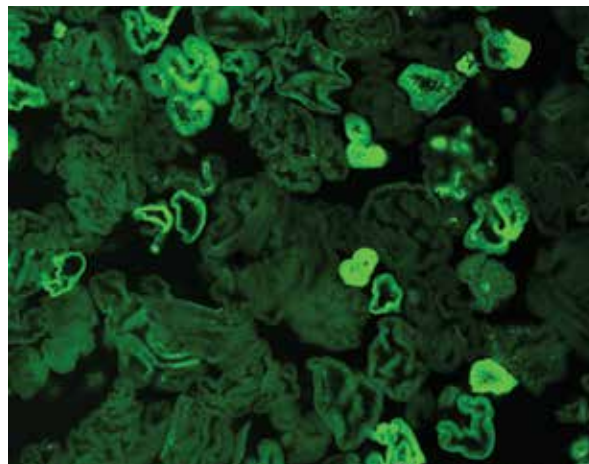
### Key External Stakeholders

- 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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## 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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### How to Proceed

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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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### How to Proceed

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

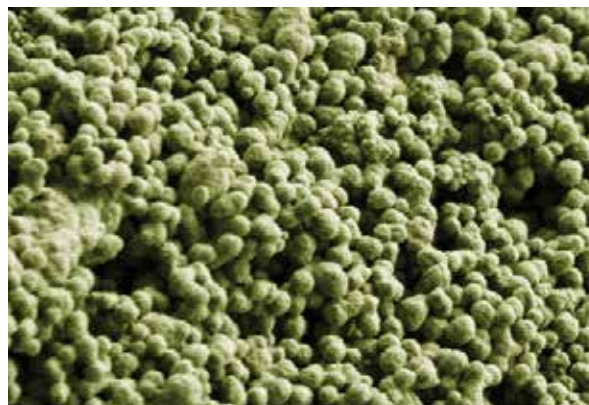
### Key External Stakeholders

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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### How to Proceed

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## National Food Residue Database (NFRD)

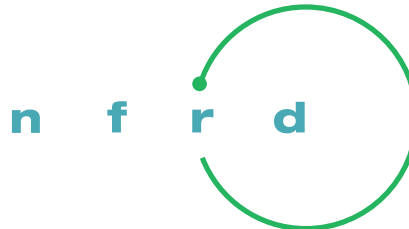
### Key External Stakeholders

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 been 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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## Natural Ingredient Cheese Solutions

### Key External Stakeholders

Dairy Industry, Food Manufacturers.

### Practical Implications for Stakeholders

Methods to augment, accelerate and diversify cheese flavour.

- A method to attenuate lactic acid bacteria for use as adjuncts to augment cheese flavour.
- Rapid methods to screen lactic acid bacteria for flavour potential.
- Database of key volatile cheese flavour compounds.
- Protocols for production of cheese concentrates, using attenuated lactic acid bacteria.
- Development of a yeast based encapsulation system to augment cheese flavour development.
- Use of camel chymosin to alter texture in low moisture part-skim Mozzarella.
- Protocols for accelerating and diversify cheese flavour in Ingredient cheese applications.



The study has highlighted a number of approaches to control, augment, accelerate and diversify cheese flavour in a range of different applications.

### Main Results

- Microfluidization is a useful technique to attenuate lactic bacteria and yeast to enhance their flavour development capability.
- Attenuated yeast can be used to entrap enzymes critical for cheese flavour development and to control their subsequent release into the cheese matrix during ripening to accelerate flavour development.
- Production of fast-ripened cheeses with diverse flavours for use in ingredient applications.
- Model system to rapidly screen lactic acid bacteria, enzymes and yeasts for cheese flavour development.

### Opportunity/Benefit

Researchers involved in this project have the experience and expertise to aid producers to alter existing cheese products or develop new cheese flavour concepts using natural lactic acid bacteria, yeasts, enzymes. Extensive knowledge and expertise exists in the flavour chemistry facility at Teagasc Food Research Centre Moorepark in the extraction, concentration and identification of cheese flavour volatiles. Consultancy and contract research opportunities are available to both national and international clients in the area of cheese flavour development.

### Collaborating Institutions

University of Limerick, University College Cork

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**Project number:** 5938

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**Date:** November, 2014

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**Funding source:** DAFF 08/TMFRC/670

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**Project dates:** Dec 2008 – July 2013

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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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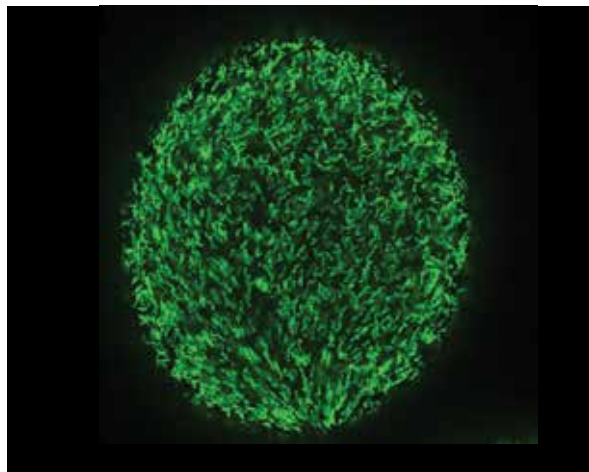
## Novel Gel-Encapsulation Technology

### Key External Stakeholders

Food/Medical food, pharmaceutical and animal feed companies, biotechnology start-up companies.

### Practical Implications for Stakeholders

- A novel gel-encapsulation technology was developed, using dairy based micro beads which would be of interest to companies wishing to incorporate sensitive components, including probiotics, into their products.
- Encapsulation matrices are suitable for incorporation into liquid of high moisture food/feed.



### Main Results

- A novel gel-encapsulation technology was developed and validated for the protection of probiotic bacteria but would also be suitable for other sensitive ingredients such as peptides or phytochemical compounds.
- Gel-encapsulation ensured high probiotic viability during extended storage in fruit-based products, such as cranberry juice.
- *In vivo* gastro-intestinal transit demonstrated delivery of high numbers of live probiotic bacteria to the lower intestine.

### Opportunity/Benefit

A patent application has been filed by Teagasc covering process conditions for generating gel microbeads and application of the encapsulation method. This provides food and related companies with the opportunity to benefit from improved cost efficiency and product shelf-life through use of this robust encapsulation process. Teagasc is seeking partners for commercialisation of the technology with a view to licensing in a number of fields of use.

### Collaborating Institutions

University College Cork

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**Project Number:** 5457

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**Funding Source:** Dairy Levy Fund

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**Date:** February, 2010

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**Project Dates:** Jul 2005–Dec 2009

### How to Proceed

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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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## Novel Strategies for Optimization of Cheddar Cheese Manufacturing Process

### Key External Stakeholders

Dairy Industry.

### Practical Implications for Stakeholders

Consistency in terms of quality and yield are vital in ensuring an economic return from the commercial production of Cheddar cheese. Seasonal variation in the lactose content of Irish milk and residual galactose accumulation in cheese arising from introduction of new starter systems have the potential to impact on Cheddar cheese quality.

- Starter culture systems were developed that can greatly reduce residual lactose levels in ripening cheese and curd washing during manufacture was demonstrated as a means of controlling lactose levels in cheese and thus improving consistency in manufacture of quality cheese.



### Main Results

Starter systems containing galactose metabolizing *St. thermophilus* and *Lb. paracasei* strains have the potential to remove residual galactose from ripening cheese and reduce some of the quality issues associated with galactose in cheese including off flavors, inconsistency in composition and browning on cooking.

Curd washing during manufacture was demonstrated as a means of reducing unfermented lactose in, and altering the sensory properties of, Cheddar cheese.

### Opportunity/Benefit

Starter systems investigated as part of this project demonstrated that levels of residual galactose that accumulate in cheese manufactured using *St. thermophilus* containing starter systems can be controlled.

The data generated clearly indicate how curd washing regimes may be applied for cheesemaking under different conditions (milk protein levels, pH at set and at whey drainage, different calcium levels) to control the level of lactose and lactic acid in the cheese from a quality perspective, and to differentiate sensory properties.

### Collaborating Institutions

UCC, UL

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**Project number:** 5952

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**Date:** November, 2014

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**Funding source:** DAFM 08/RD/C/604

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**Project dates:** Nov 2012 – Sep 2013

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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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## 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 synthesize 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

### How to Proceed

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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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## Properties of Nano-fibrillar Whey Proteins

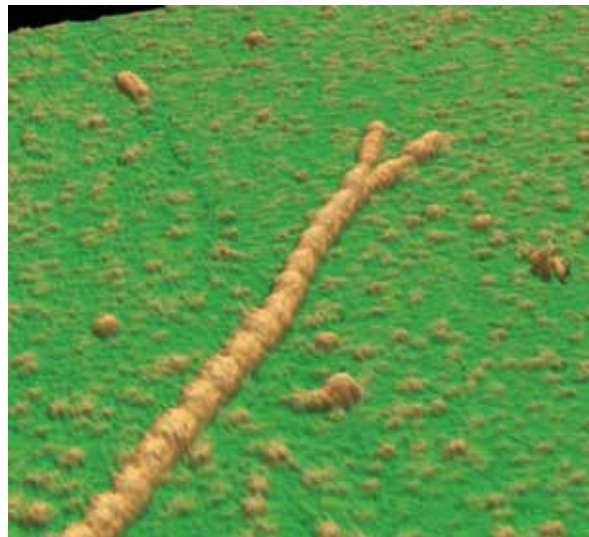
### Key External Stakeholders

- 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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## 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:** NFDI-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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## Ready-to-bake Mixes Containing Healthy Flours Generated from Food Processing By-products

### Key External Stakeholders

Food manufacturers, bakeries, food ingredient companies.

### Practical Implications for Stakeholders

The by-product material from food processing, and their use as functional ingredients, is an area that is currently attracting much interest. Information available on the characteristics of food by-products is comprehensive; however, information on the stability and shelf-life of food by-products is limited. The research findings from this project add to the scientific and technical knowledge base, and are of value to those in the scientific/research community and food industry who have an interest in the area of functional ingredients.

The project took an innovative research approach in assessing the properties of by-products as ingredients in bakery mixes, and when packaged using different materials. This resulted in the development of new 'ready to bake' mixes containing novel ingredients.



### Main Results

Flours derived from the dried by-products of food processing, in particular apple pomace, orange pomace and brewer's spent grain, were incorporated as baking ingredients into the following ready-to-bake mixes:

- A soda bread mix containing 10% brewer's spent grain (BSG) flour (flour weight basis) and wheat flour.
- A yeasted brown bread mix containing 10% BSG and wheat flour.
- A scone mix containing 10% apple pomace (AP) flour and wheat flour.
- A cake/muffin mix containing 3.5% orange pomace flour (OP) and wheat flour. OP flour also replaced 40% of the fat normally used in a cake recipe.

The by-product flours were found to be suitable for incorporation into ready-to-bake mixes. These novel mixes offer a distinct advantage of producing baked products with enhanced nutritional quality (rich in dietary fibre and bioactive compounds) using natural functional ingredients. The flour mixes were stored using a range of different packaging materials, and their shelf life was observed to be highly stable.

### Opportunity/Benefit

Outputs from this project include the production of fully characterised and optimised novel bakery mixes ready for evaluation/validation/scale-up by flour/baking companies at a commercial level, while generating a potential profitable market for waste products for the bakery industry.

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**Project number:** 6594

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**Funding source:** DAFM

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**Date:** November, 2015

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**Project dates:** April 2014 – March 2015

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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 1<sup>st</sup> 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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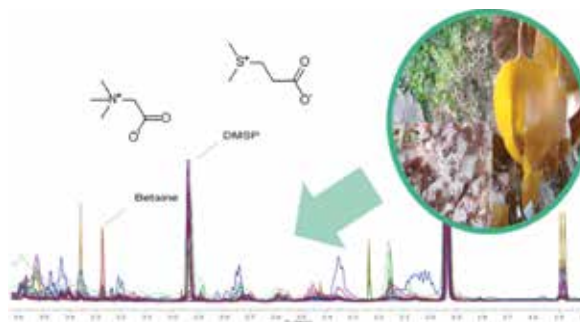
## Seaweed Derived Glycine Betaine and DMSP

### Key External Stakeholders

Ingredient companies, marine processors, biochemical companies, food companies.

### Practical Implications for Stakeholders

Seaweeds are an abundant resource present around the Irish coastline. We have assessed a number of Irish seaweeds, which were harvested by our research partners in NutraMara – NUI Galway. Researchers at Teagasc determined the glycine betaine and DMSP levels in these seaweeds using NMR and MS methodologies.



Glycine betaine obtained a health claim under article 13 of EFSA in 2011 in relation to maintenance of normal homocysteine levels and therefore can be used for this purpose as a functional food ingredient/ capsule ingredient.

### Main Results

- Two green seaweeds, harvested from around the Irish coast contained glycine betaine and DMSP.
- A novel, cost-efficient, environmentally friendly methodology was employed to generate fractions containing these zwitterionic compounds.
- NMR method developed to assess the level of glycine betaine and DMSP in the extracts.

### Opportunity/Benefit

These extracts could be used in supplements or in functional foods to control homocysteine levels in the blood.

### Collaborating Institutions

National University of Ireland, Galway  
Teagasc

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

**Date:** May 2015

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

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

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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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## Status of the Phytochemical Compound, Falcarinol, in Minimally Processed Vegetables

### Key Stakeholders

Vegetable processors, government authorities/legislators, consumers, research community.

### Practical Implications for Stakeholders

Recently a group of falcarinol type polyacetylenes were shown to be protective against tumour development in humans. In comparison to other compounds with cancer protective effects, relatively little was known about the occurrence of these compounds in plant foods or the effect of industrial or domestic processing on their retention. This project examined the effect of various production processes (peeling, washing, cutting, packaging and storage) on the level of polyacetylenes in a selection of vegetables



including carrots, parsnips and fennel. Protocols have been developed for the maximum retention of these polyacetylenes in minimally processed vegetables.

### Main Results

- The initial washing stage had no effect on polyacetylene levels.
- Significant losses occurred after peeling in carrots.
- The best retention of polyacetylenes was observed in shredded carrots.
- Polyacetylenes were not susceptible to further degradation when subjected to low or high oxygen MAP (modified atmosphere packaging) and stored for 7 days under chill conditions.
- The use of an air-breathable film as opposed to a conventional polyester-polypropylene film did not have a significant effect on levels of polyacetylenes in stored products.

### Opportunity/Benefit

The results of this project will allow vegetable processors to optimise processing protocols for the retention of health promoting polyacetylenes in vegetables including carrots, parsnips and fennel.

### Collaborating Institutions

NUI Galway, Natures Best Ltd., Wonderfoods Ltd.

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**Project Number:** 5473

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**Funding Source:** DAFF 06RDTAFRC518

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**Date:** August, 2012

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

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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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## Survival of *Mycobacterium avium* Subspecies *paratuberculosis* (MAP) in a Raw Milk Smear Type Cheese

### Key External Stakeholders

Artisanal farmhouse cheese producers, dairy industry, dairy farmers.

### Practical Implications for Stakeholders

Johne's disease is caused by *Mycobacterium avium* subspecies *paratuberculosis* (MAP) and affects cattle, sheep and goats. Because of the similarity of the pathogenesis of Johne's disease in cattle and Crohn's disease in humans there is ongoing debate regarding the potential of animal derived MAP in the food chain to cause Crohn's disease in humans however, this link has never been definitively established.

The main recommendation from this research is that milk from cows suffering from Johne's disease and shedding large numbers of MAP should not be used



for the manufacture of smear type cheese made from unpasteurised milk as these bacteria will survive cheese manufacture and ripening.

### Main Results

To establish the fate of MAP in a raw milk smear type cheese the survival of MAP in a smear type cheese made from raw milk and the effect of the natural antimicrobial lactacin 3147 on the survival of MAP were assessed during manufacture and ripening.

- MAP can survive the manufacturing and ripening conditions employed in the making of a raw milk smear type cheese when the milk is artificially contaminated before cheese manufacture.
- The use of a lactacin 3147 producing starter did not affect MAP numbers after 4 weeks of ripening when compared to the control.

### Opportunity/Benefit

This research provides important information as the results show that raw milk from cows suffering from Johne's disease and shedding *Mycobacterium avium* subspecies *paratuberculosis* should not enter the food chain if the milk is to be used to make unpasteurised smear type cheese.

### Collaborating Institutions

See full Technology Update

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**Project Number:** 5654

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**Funding Source:** EU FP6 (023106)

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**Date:** August, 2011

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

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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

**Project Number:** 5435

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

**Date:** Nov, 2012

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

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## Technology for Healthier Pork Products

### Key Stakeholders

Meat processors, ingredient companies, consumers

### Practical Implications for Stakeholders

Traditional meat products such as sausages and cooked ham are often high in fat, salt and contain additives to prolong shelf life, improve colour and prevent oxidation. The information generated in this project will assist meat processing companies to develop healthier products, such as sausages and luncheon role, containing less salt and/or fat and containing natural ingredients that will appeal to consumers.



### Main Results

- High pressure processing (HPP) can be used to reduce the salt content of pork sausages from 2.5% to 1.4% without a noticeable change in sensory and functional properties.
- A phytosterol ester (*Vegapure*) was used successfully to improve the organoleptic properties of a reduced salt pork breakfast sausage.
- Grape seed extract (GS) and rosemary-pomegranate (RP) extract were added to sausages without any negative effect on the sensory quality of the products, demonstrating the potential of natural flavonoid containing extracts in the development of novel healthy functional meat products.
- Half the nitrite in a pork luncheon roll was replaced with tomato powder without negatively affecting sensory attributes.

### Opportunity/Benefit

Meat products are commonly perceived by consumers as unhealthy due to their high fat, salt and artificial ingredient content. This research has shown that healthier versions of traditional meat products, such as sausages and pork luncheon roll, can be produced that are just as acceptable to consumers as standard versions of the same products. There are opportunities for the meat industry to:

- Reduce the salt, fat and nitrite levels in certain processed pork products,

- Replace artificial antioxidants with natural ones,
- Incorporate phytosterol esters with positive health associations.

Teagasc can offer assistance in the development of these products.

### Collaborating Institutions

IRTA Spain, University of Copenhagen, University of Helsinki

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**Project number:** 5718

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**Funding source:** EUFP6

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**Date:** November, 2012

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**Project Dates:** Jan 2010 – Dec 2011

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## The Anti-inflammatory Effect of Algal Lipid Extracts

### Key External Stakeholders

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

### Practical Implications for Stakeholders

Inflammation is a biological process that contributes strongly to a number of chronic diseases such as cardiovascular disease. Seaweeds and microalgae are potent sources of bioactive ingredients such as omega-3 polyunsaturated fatty acids (n-3 PUFA) and pigments which, as dietary ingredients have shown strong potential to prevent inflammation. This project identified the anti-inflammatory effect of algae extracts from the Irish coast.



### Main Results

- Lipid extracts of four algal species contained a broad range of fatty acids including n-3 PUFA (34–62g/100g total fatty acids) and a broad range of pigments including chlorophyll *a* and  $\beta$ -carotene.
- *Palmaria palmata* extract significantly inhibited the production of the inflammatory cytokine IL-6 and IL-8 and *Pavlova lutheri* extract significantly inhibited the production of the inflammatory cytokine IL-6 in lipopolysaccharide stimulated human THP-1 macrophages.
- Moreover, all four extracts (*Pavlova lutheri*, *Palmaria palmata*, *Porphyra dioica* and *Chondrus crispus*) downregulated the expression of a number of inflammatory genes in the macrophages.
- Out of the four species tested, *P. lutheri* posed the greatest potential as a functional anti-inflammatory ingredient.
- This study suggests that algal lipid extracts may inhibit the production of inflammatory cytokines and the expression of inflammatory genes and thereby alleviate the symptoms of inflammatory disease.

### Opportunity/Benefit

The algae extracts studied exhibited anti-inflammatory effects and are natural sources of bioactive components. The present study identifies the potential of these extracts for use as functional food ingredients aimed at inhibiting chronic disease-associated inflammation.

### Collaborating Institutions

Teagasc Food Research Centre, Moorepark

National University of Ireland, Galway

University College Dublin

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**Project number:** MFFRI/07/01

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**Date:** November, 2015

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**Funding source:** Marine Institute and DAFM

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**Project Dates:** 2007–2013

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## The Potential of Yoghurt as a Functional Food Matrix for an Omega-3 PUFA-rich Algae Extract

### Key External Stakeholders

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

### Practical Implications for Stakeholders

Omega-3 polyunsaturated fatty acids (n-3 PUFA) are bioactive ingredients that have anti-inflammatory, cardioprotective and cognition-enhancing properties. Seaweeds and microalgae are potent sources of n-3 PUFA and provide a novel vegetarian source of these ingredients over fish. This project identified the potential of yoghurt as a carrier-food for omega-3 rich algae extracts.



### Main Results

- A lipid extract from the microalgae *Pavlova lutheri* was obtained and analysed for its fatty acid content (51g n-3 PUFA/100g total fatty acids)
- Addition of the extract (at 0.25% or 0.5%) to the yoghurt did not significantly affect pH, rheology, whey separation, starter culture survival or macronutrient composition over 28 days.
- Colour of the yogurt was significantly affected by addition of the extract at 0.25% and 0.5%
- Addition of the extract to the yoghurt at both concentrations was associated with altered sensory properties.
- n-3 PUFA concentrations were significantly increased following addition of the extract to the yoghurts at 0.25% and 0.5%.

### Opportunity/Benefit

Addition of a *P. lutheri* lipid extract to yoghurt did not impact the techno-functional properties of the yoghurt, while colour and sensory properties were significantly altered. The present study suggests yoghurt as a potentially suitable food-carrier for algal extracts and as a novel vegetarian source of n-3 PUFA.

### Collaborating Institutions

Teagasc Food Research Centre, Moorepark

National University of Ireland, Galway

University College Cork

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**Project number:** MFFRI/07/01

---

**Date:** November, 2015

---

**Funding source:** Marine Institute and DAFM

---

**Project Dates:** 2007–2013

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## The $\alpha$ -amylase and $\alpha$ -glucosidase Inhibitory Effects of Irish Seaweed Extracts

### Key External Stakeholders

Diabetic patients, consumers, society, government authorities/legislators and the food industries.

### Practical Implications for Stakeholders

Antidiabetic effects can be achieved through inhibiting the carbohydrate hydrolysing enzymes involved in digestion and absorption using  $\alpha$ -amylase and  $\alpha$ -glucosidase inhibitors. Seaweeds and their bioactive principles such as antioxidant and polyphenols also plays role in antidiabetic effects. This project led to identification of seaweed extracts useful for diabetic care.



### Main Results

- The cold water and ethanol extracts of *Ascophyllum nodosum* had the strongest  $\alpha$ -amylase inhibitory effect with IC<sub>50</sub> values of 53.6 and 44.7 lg/ml respectively.
- Moreover, the extracts of *Fucus vesiculosus Linnaeus* were found to be potent inhibitors of  $\alpha$ -glucosidase with IC<sub>50</sub> values of 0.32 and 0.49 lg/ml.
- Out of 15 seaweeds, brown seaweed extracts (in particular *F. vesiculosus* and *P. canaliculata*) showed stronger efficacy to inhibit enzymes involved in intestinal carbohydrate digestion and assimilation.
- This study revealed that brown seaweed extracts may limit the release of simple sugars from the gut and thereby alleviate postprandial hyperglycaemia.

### Opportunity/Benefit

Due to antioxidant and phenolic content, seaweed extracts showed antidiabetic effects. The present study reported the potential of algal extracts for use in functional food applications aimed at lowering glycaemic response. These extracts are natural sources of  $\alpha$ -amylase and  $\alpha$ -glucosidase inhibitors, and represent alternatives to drugs for diabetic care.

### Collaborating Institutions

Teagasc Food Research Centre, Moorepark  
University of Limerick  
Teagasc Food Research Centre, Ashtown

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**Project number:** MFFRI/07/01

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**Date:** November, 2015

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**Funding source:** Marine Institute and DAFM

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**Project Dates:** 2007–2013

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### How to Proceed

**For further information access the full Technology Update at:**  
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## Understanding and Exploiting the Biogenesis of Cheese Flavour

### Key External Stakeholders

Cheese producers, dairy industry, food manufacturers.

### Practical Implications for Stakeholders

The project investigated mechanisms to control and accelerate Cheddar cheese flavour and the information generated within this project has significantly enhanced the understanding of flavour generation in Cheddar cheese which can also be applied to many other cheese varieties.

- This research has provided invaluable information on a range of factors that influence cheese quality and the rate of cheese ripening.
- Factors which impact on the activity of chymosin were elucidated.
- Mechanisms to enhance lipolysis in Cheddar cheese were identified.
- The performance of commercial accelerating ripening agents in Cheddar cheese were evaluated.



- Microfluidisation was identified as a practical method to create specific populations of attenuated lactic acid bacteria for use as adjuncts in cheese production.
- Microfluidisation was identified as a suitable method to create food grade liposomes which can be used to deliver exogenous enzymes in cheese curd, with minimum losses to the whey.
- Factors governing the encapsulation efficiency of enzymes and cell free extracts in liposomes were determined.

### Main Results

This project investigated a range of factors that influence the ripening of Cheddar cheese. The major areas of focus were enhancing lipolysis and proteolysis through addition of exogenous enzymes, use of adjunct cultures and process manipulation of cheesemilk to control and accelerate cheese ripening.

### Opportunity/Benefit

The capacity and expertise generated within this project is readily available and can be utilised for specific cheese applications by contacting the relevant researchers involved.

### Collaborating Institutions

University College Cork; University of Limerick; Institute of Chemical Technology Prague; McGill University

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**Project Number:** 5433

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**Funding Source:** DAFF(04/R&D/C/238)

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**Date:** March, 2011

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

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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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## Updating Cheesemaking Efficiency

### Key External Stakeholders

Irish Cheese and Dairy Industry.

### Practical Implications for Stakeholders

Manufacturing efficiency is a key aspect of cheese manufacture which influences cheese composition, milk component recoveries and plant profitability.

A major outcome of this project is the provision of new information on the comparative effects of bovine chymosin and camel chymosin on Cheddar cheese making efficiency, and the effects of the high heat treatment of milk at different pHs on its rennet gelation and curd forming characteristics. It also provides an extensive compendium on the effects of milk quality and



cheese manufacturing conditions on cheese making efficiency and quality in the form of 2 monographs (Moorepark Monographs 1 and 2) published in 2010.

### Main Results

- The use of chymosin of camel origin (*Camelus dromedarius*) or *Rhizormucor miehei* rennet in place of bovine chymosin (*Bos taurus*) as coagulant in the experimental manufacture of Cheddar cheese had significant effects on the recovery of fat from milk to cheese, cheese yield, and age-related changes in primary proteolysis and texture. These effects depended on the level of coagulant (number of milk clotting activity units added) and firmness of the milk gel at cutting.
- The effects of increasing pH from 6.6 to 7.5 during high heat treatment of milk (80 °C for 5 min) resulted in depletion in the content of k-casein on the casein micelle and an increase in the level in the milk serum to an extent depending on pH. Desk-top cheesemaking studies indicated that increasing the milk pH during heating accentuated the adverse effects of high heat treatment on the rennet coagulability of the milk at pH 6.55 and its cheesemaking characteristics.
- Two monographs (Moorepark Monograph 1. Cheese manufacture: Quality Characteristics of the milk; Moorepark Monograph 2. Cheese Manufacture: Control and prediction of quality characteristics), on the effects of milk quality and cheese, manufacturing conditions on cheese making efficiency and quality were prepared and distributed to Irish Dairy industry in 2010.

cheesemaking parameters on manufacturing efficiency and cheese quality. The comparative study on different coagulants provides statistically validated, practically-applicable information on the impacts of the bovine chymosin, camel chymosin and *Rhizormucor miehei* coagulants on cheesemaking efficiency and changes in the proteolysis and texture of Cheddar cheese during maturation. The cheese manufacture monographs provide a user-friendly reference source of practical information directly applicable to optimisation of cheese manufacturing efficiency and quality.

### Collaborating Institutions

N/A

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**Project Number:** 5979

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**Funding Source:** Dairy Levy

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**Date:** November, 2012

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**Project Dates:** Jan 2010–Dec 2011

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### Opportunity/Benefit

The research makes available to the dairy industry a database of information on the effects of key

### 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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## The Control of *Campylobacter* in Irish Poultry

### Key External Stakeholders

Poultry farmers, Poultry processors, FSAI, DAFM, Retailers, Safefood, Consumers.

### Practical Implications for Stakeholders

The main outcomes of this research are data that supports the argument that all birds harvested post first-thinning should be subject to *Campylobacter* mitigation activities and a combination technology that has the potential to kill between 10,000 and 100,000 *Campylobacter* per cm<sup>2</sup> on chicken carcasses.



### Main Results

- Thinning introduces *Campylobacter* into broiler flocks; caecal counts in birds at second thinning are similar, regardless of flock status at first thinning and reducing the time between first and second thinning to a maximum of 4 days is not an effective control strategy. All post-first thinning birds should be considered to be high risk and subject to logistic slaughter and possibly carcass freezing.
- The sequential treatment of trisodium phosphate and capric acid in conjunction with ultrasonication at 80 kHz will kill 10,000 *Campylobacter* per cm<sup>2</sup> on chicken carcasses.

### Opportunity/Benefit

Processors could improve the safety of poultry and poultry products by subjecting all post first thinning broiler carcasses to crust freezing.

Using a combination of ultrasonication and chemical treatments, processors could significantly reduce *Campylobacter* on broiler carcasses. Although these are not currently permitted under EC legislation, the situation is under review and the data generated in this project should help inform a positive outcome.

### Collaborating Institutions

University College Dublin

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**Project Number:** 6123

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**Funding Source:** Teagasc

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**Date:** Jan 2016

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**Project Dates:** Jun 2011 – Oct 2014

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## Campylobacter Control in Irish Broilers

### Key External Stakeholders

Poultry farmers, poultry processors, DAFM, FSAI and poultry consumers.

### Practical Implications for Stakeholders

The main outcome from this research is an innovation in biosecurity, the 'biosecurity cube' that will protect broilers from a range of avian diseases including infection with *Campylobacter*. The key recommendations, based on our updated understanding of the pattern of *Campylobacter* infection in broilers, are:

- Before restocking, all *Campylobacter* (carry-over from the previous flock) must be effectively eliminated from the house and surrounding environment. Feeder and drinker equipment disinfection present a particular challenge in this regard. A cleaning and disinfection SOP for this equipment has been developed by this project.
- The application of the 'biosecurity cube' concept to the entirety of the broiler house would significantly improve food safety, animal welfare and productivity.
- If commercially feasible, thinning should cease. If this is not feasible then stringent biosecurity & hygiene must be applied.



### Main Results

This research mapped the sources and spread of *Campylobacter* on Irish broiler farms. It developed and delivered a 'biosecurity cube' that protected the birds from *Campylobacter* while at the same time improving their feed conversion efficiency and general welfare. Our work also demonstrated the rapid growth of these organisms in poultry, developed a standard operating procedure (SOP) for cleaning and disinfection of farms after harvest and validated current poultry litter composting to ensure these processes do not contribute to the spread of infection.

### Opportunity/Benefit

This project was undertaken with the full cooperation of the poultry sector, farmers and processors. The information and technologies developed will greatly reduce the risk of future broiler flocks being infected with *Campylobacter*.

### Collaborating Institutions

University College Dublin and the Food Safety Authority of Ireland (FSAI).

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**Project Number:** 6418

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**Funding Source:** DAFM (FIRM)

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**Date:** March 2016

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**Project Dates:** Feb 2013 - Jan 2016

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### How to Proceed

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## Design and Development of Realistic Food Models with Well-Characterised Micro- and Macro-Structure and Composition (DREAM)

### Key External Stakeholders

Cheese and Dairy Industry

### Practical Implications for Stakeholders

The outcomes of this work include:

- A procedure for the preparation of a semi-hard rennet-curd model cheese in which composition is precisely controlled and which can be used to validate the growth/survival of microorganisms under different conditions.
- A database on the effects of varying salt concentration and pH in model cheese on the survival of probiotic bacterial strains and on the chemical and rheological properties.



- A database on the survival of probiotic bacterial strains in full-salt and reduced-salt cheddar cheeses during maturation.

### Main Results

- A model cheese-making system was designed for the manufacture of semi-hard rennet-curd cheese in which salt (1.2, 2.2 or 3.5%) and pH (4.8, 5.3 or 5.8) could be systematically controlled.
- The survival of probiotic bacteria *Bifidobacteria* (BB12), incorporated into the model cheese at a level of ~108cfu/g, was independent of variations in NaCl and pH at ripening times up to 96days. However, after 150days storage, the mean count of BB12 had decreased significantly in the high-salt (3.5%) high-pH (5.8) cheese but not in the other cheeses.
- The survival of probiotic strain *Lactobacillus casei* (LC-01), incorporated at ~108 cfu/g, was independent of pH variation in the high salt cheese (3.5%) at ripening times up to 47days but decreased significantly in the low pH cheese (pH 4.8) after longer ripening times (96-150days). However, the survival of LC-01 was not affected by pH in the cheese with lower salt levels (1.2 and 2.2%).
- A study on the survival of these probiotic strains (BB12 and LC-01) in cheddar cheese showed that both strains grew in the cheese during ripening, and were unaffected by salt content of the cheese.

### Opportunity/Benefit

The research makes available to the dairy industry a database on the effects of salt and pH on the survival of two probiotic bacterial strains in a semi-hard model cheese (47% dry matter) and cheddar cheese in addition to information on the chemical, rheological and viscoelastic properties of model cheese.

### Collaborating Institutions

INRA; ADRI Development; Campden BRI; Consiglio Nazionale delle Ricerche, Istituto di Scienze delle Produzioni; Actalia- Produits Laitiers; KOKI, Központi Élelmiszer-tudományi Kutatóintézet; INRA Transfert; Campden, BRI;CNRS, Centre National de la Recherche Scientifique; IRTA, Institut de Recerca I Tecnologia Agroalimentàries Alimentari; IFR, Institute of Food Research; TI Food and Nutrition, Stitching Top Institute Food and Nutrition; United Biscuits (UK) Limited; VTT, Valtion Teknillinen Tutkimuskeskus; Soredab, Soredab SAS; University of Ljubljana; Wageningen University.

**Project Number:** 5983

**Funding Source:** EU FP7

**Date:** Nov 2014

**Project Dates:** Jun 2009 - May 2013

### How to Proceed

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**Expertise**

## Novel Technologies Platform

Teagasc researchers can provide specialist know-how, facilities and services in nonthermal processing of foods and ingredients. This includes the application of key novel technologies including high pressure processing, ultrasound and cold plasma technologies for improving food quality while maintaining the food safety profile. Researchers at Teagasc, Ashtown 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

The food industry has always been at the forefront in assessing the potential that new processing technologies can offer. Consumer demand for safe and nutritious products has gained much attention in recent years. These technologies offer numerous advantages including an improved product safety profile, as well as enhancing the shelf-life, nutritional and sensory aspects of foods. Novel technologies can be employed to extend shelf-life, where mild processing can provide a significant benefit for short shelf-life products but with minimal effects on quality parameters particularly for products valued for their taste and nutritional profiles.

### Benefits to Industry

This state-of-the-art novel technologies platform strengthens the research and development capabilities of the Irish food industry. Application of novel technologies can enhance the quality, shelf life and safety of products whilst increasing productivity. Teagasc have significant expertise in novel food processing technologies including high pressure processing, ultrasound processing, cold plasma and novel thermal processing technologies. These processing technologies can be used to manufacture innovative, safe, sustainable and of the highest-quality food products and shape the future of the food industry.

### Areas of Expertise

- High pressure processing
- Ultrasound assisted curing
- Ultrasound technology to improve food safety profile
- Extraction of bioactives from food processing by-products
- Microbial safety and quality evaluation of foods
- Nonthermal processing techniques for enhanced shelf life of foods
- Clean and green extraction techniques for bioactives
- Mechanical and viscoelastic behaviour/properties of food

### Facilities/Equipment



- Ultrasound processing (probe based, bath type and airborne acoustics operating at various frequencies)
- Cold atmospheric plasma and microwave plasma system
- High pressure processing equipment
- Light based technologies

### 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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## 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 including mixers and tall-form spray drier.
- Separation, concentration, homogenisation and heating systems.



- Analytical capability including 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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## Consumer Behaviour and Food Marketing

Improving strategic marketing performance of the Irish agri-food sector is the main objective of the Consumer and Market Insights Research team at Teagasc Food Research Centre, Ashtown. We carry out both consumer and market research on many food related topics and use qualitative and quantitative research techniques. The team provide advice on consumer behaviour, innovation management, new product development, market development and food policy.

### Background

Through internally and externally funded research Teagasc researchers have developed significant expertise in the area of consumer behaviour and food marketing. Numerous collaborations with third level institutions and companies have produced many successful research outputs, and we continue to encourage such links and to work with companies to assist in new product development through market insights and understanding the target consumer.

### Benefits to Clients

Knowledge and insights regarding consumers' wants, needs and perceptions are essential for focusing innovation efforts developing and marketing new products. The market insights covers innovation management, strategic market planning, marketing channels, and supply chain and relationship management.

### Areas of Expertise

- Consumer-led new product development.
- Segmentation and consumer profiling.
- Insights into consumers e.g. behaviour and attitudes.
- Risk perception and communication.
- Market analysis and planning.

### Facilities/Equipment

- Quantitative research.
  - Consumer surveys
  - Product testing
- Qualitative research.
  - Individual depth interviews
  - Mini-group discussions
  - Telephone depth interviews
  - Focus groups
- Executive interviews.



### Range of Solutions

Depending on the nature of work requested and the inputs from each party, contract research or collaborations can be considered. This can range from surveys to smaller focused studies to market trends and reviews.

### Of Interest to

Expertise and services will be of interest to

- Food manufacturers.
- Food retailers.
- Business start-ups.
- Public agencies and policy makers.
- Researchers interested in commercialising their research.

### 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 and safety, process 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 especially through DAFF, but also Enterprise Ireland and industry 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 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.

### Facilities/Equipment

- Slaughtering/boning.
- Meat processing and cooking.
- Packaging.
- Chilling and freezing.
- Analytical (incl. GC, GC-MS, HPLC, NMR).
- 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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## Seafood Technology

Teagasc, through its food research centre at Ashtown, supports innovation in the seafood sector through delivery of high quality, commercially-relevant research. Researchers and technologists have wide-ranging expertise and work closely with industry to develop innovative concepts with unique selling points and world-leading technologies.

### Background

As an island country, off the mainland of Europe, Ireland has a vast marine biodiversity that can be exploited in a variety of ways. Over twenty years of seafood research funded by DAFF, Enterprise Ireland, Bord Iascaigh Mhara (BIM), EU funding and private industry has provided world-class knowledge in the areas of packaging, ingredients and processing technologies. Teagasc works closely with BIM to ensure that Irish seafood SME's have access to emerging technologies and assistance in applying them within their businesses. The Marine Functional Food Research Initiative, led by Teagasc Ashtown, is focused on the identification of novel marine food ingredients and products which will allow for diversification into new markets. Teagasc is currently investigating the use of fish processing waste, the sustainable exploitation of underutilised species of fish and seaweed, and the development of value-added products from finfish and shellfish.

### Benefits to Industry

Research staff and technologists at Teagasc, Ashtown recognise that viable seafood concepts are underpinned by strong science and an understanding of the interactions between the product, process and packaging. The wide ranging expertise and interdisciplinary team approach ensures solutions can be developed to maximise product quality and eating experience. Teagasc works closely with industry and has established linkages with international experts in the field of seafood R&D including NOFIMA, CSIC, SEAFISH-UK and other world-class institutions. Industry-relevant workshops ensure companies are kept up to date with relevant packaging, labelling, food safety and processing developments and Teagasc scientists ensure that knowledge is transferred from research to industry via close interactions with BIM and seafood sector businesses.

### Areas of Expertise

- Processing technologies.
- Packaging technologies.
- Temperature mapping.
- Effect of processing on eating quality and nutrition.
- Interaction of multi-component ready meal solutions.
- By-product utilisation and nutraceutical development.



### Facilities/Equipment

- Seafood processing and cooking equipment.
- Packaging equipment.
- Chilling, freezing and freeze-drying facilities.
- Analytical equipment (GC, GC-MS, HPLC, NMR).
- Sensory testing facilities.
- Product development plant/incubation unit.

### Range of Solutions

Teagasc provides a range of services to seafood companies and undertakes collaborative/contract research incorporating new product development, pilot scale trials, packaging solutions, ingredient sourcing, consumer research and testing (microbial, quality, sensory, residue etc.).

### Of Interest to

- Seafood processors and related companies.
- Seafood ready-meal manufacturers.
- Food industry companies wishing to incorporate marine ingredients.

### How to Proceed

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## Cereal and Bakery Technologies

Teagasc researchers can provide specialist know-how, facilities and services in cereal science and bakery technology. This includes, but is not limited to, product formulation, innovation and sample testing. Researchers at Teagasc are available to provide consultancy or carry out contract/collaborative research for companies in the aforementioned areas with a view to exploitation of novel products/processes in bread and baked goods markets. A range of testing services is also offered from shelf life to microbial to residue analysis.

### Background

Through internally and externally funded research Teagasc researchers have developed significant expertise in the area of baked goods and cereals technology. Numerous collaborations with third level institutions and companies have produced many successful research outputs, and we continue to encourage such links and to work with companies to assist in product innovation, new product development and service provision.

### Benefits to Industry

The expertise and facilities, primarily at Teagasc Food Research Centre in Ashtown allows millers, bakers and food companies access to state-of-the-art facilities and specialist knowledge, as well as offering a range of specialist and routine services.

### Areas of Expertise

- Wheat flour chemistry and rheology.
- Gluten-free formulations.
- Low glycaemic breads.
- Beta-glucan enriched breads.
- Health/functional snacks.

### Facilities/Equipment

- Mill Room.
- Test bakery.
- Dough rheology laboratory.
- Access to National Imaging Centre.
- Sensory testing facility.
- Product development plant/incubation units.



### Range of Solutions

Depending on the nature of work requested and the inputs from each party, contract research or collaborations can be considered. This could range from new product development, to pilot scale trials. Ingredient sourcing, consumer research and testing services (shelflife, microbial, quality testing, residue analysis etc.) are other options available.

### Of Interest to

- Millers, bakers and those in the snack food industry who incorporate cereal and flours into their products.
- Niche baked goods manufacturers.
- Health food specialists in breads/confectionary/baked goods market.

### 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.

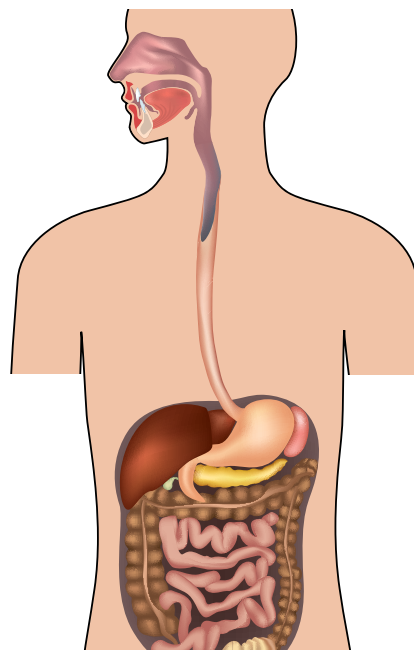
### Areas of Expertise

- 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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## 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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## Bioactive Research

Teagasc researchers can provide specialist know-how, facilities and services in bioactive discovery, validation and characterisation. Expertise available includes the discovery of bioactive fractions from a myriad of food sources including milk, meat, fish, cereals, plants and food waste streams. Researchers at the Teagasc Food Research Centre are available to carry out contract or collaborative research with companies to identify bioactive compounds and functional food agents, to assess their bioactivities *in vitro* and *in vivo*, to characterise mechanisms of action, to scale-up production and include in carrier foods.

### Background

Teagasc has significant expertise and infrastructure in the area of bioactive and functional foods research. Numerous collaborations with third level institutions and companies have led to many successful research outputs. We work with companies to assist in product innovation, new product development and service provision.

### Benefits to Industry

Teagasc Food Research Centre allows food companies to access state-of-the-art facilities and expertise to screen for bioactive fractions, to validate efficacy *in vitro* and *in vivo*, to identify bioactive compounds, to investigate survival during gut transit, to validate in animal models, to understand mechanism of action, to scale up production, to include in carrier foods, to investigate sensory aspects and to determine shelf-life.

### Areas of Expertise

- Proteins, peptides, carbohydrates, lipids, micronutrients, polyphenols.
- Bioassays (high to low throughput) that target heart health, obesity, diabetes, muscle health and satiety. Bioassays are also available to determine probiotic, prebiotic, anti-bacterial, immunomodulatory, anti-oxidant and anti-proliferative activities.
- Bioactive generation and fractionation.
- Bioactive bioavailability.
- Scale-up & formulation.

### Facilities/Equipment

- HPLC, H-NMR, FPLC, GC, GC-MS, Flash chromatography, TLC, MALDI-TOF, ESI-MS/MS, amino acid analyser, peptide synthesizer.
- State-of-the-art tissue culture facility.
- Pilot plant.



- Mice and pig research facilities.
- Sensory testing.

### 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 Beverage Manufacturers.
- Food SMEs.
- Ingredient and Infant Formula Manufacturers

### How to Proceed

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## CheeseBoard 2015

Teagasc is harnessing the resources of all institutions engaged in cheese research in this all-Ireland collaborative initiative in order to create a critical mass of expertise with which to address priority issues set out by Irish cheese manufacturers. The multidisciplinary approach embraces consumer interaction and lifestyle changes, technological innovation, new investigative tools at molecular level, specialist analytical capabilities and a nutritional study investigating the health benefits of a 12-week diet containing Vitamin D-fortified, reduced-fat Cheddar cheese.

Researchers at Teagasc Food Research Centre, Moorepark and associated CheeseBoard 2015 partners are available to carry out contract or collaborative research with companies in the aforementioned areas. A range of testing services and consultancy is also offered.

### Background

'CheeseBoard 2015' was adopted as the masthead for a Teagasc-led cheese research proposal in collaboration with University College Cork (UCC), University of Limerick (UL), University College Dublin (UCD) and Agri-Food and Biosciences Institute, Northern Ireland (AFBI) that was successfully submitted to a FIRM 2010 Call launched by the Department of Agriculture, Food & Marine. The research call came on foot of the major food policy document – 'Food Harvest 2020' which forecasts a substantial expansion in Irish cheese production based on increased milk production following the lifting of EU Milk Quota restrictions in 2015.

### Benefits to Industry

CheeseBoard 2015 addresses through research a number of key questions impacting on industry e.g. to adapt cheese manufacturing processes to reduce fat and salt without compromising cheese quality; to assess the health benefits of vitamin D fortified, reduced fat cheddar cheese, to use next generation sequencing to study cheese microbiota and the bacteria that cause defects, and to rapidly detect trans fatty acids.

### Areas of Expertise

- Cheese for health (Teagasc)
- Cheese science & technology (Teagasc)
- Cheese diversification strategies (Teagasc)
- Consumer & market studies (Teagasc)
- Cheese culture – comparative genomic analysis (UCC)
- Cheese culture enzymology (UL)
- Microbiota of cheese defects (Teagasc)



### Facilities/Equipment

- Cheese making equipment.
- Flavour Chemistry laboratory (Teagasc Moorepark)
- Flow cytometry (University of Limerick)
- Spectroscopic analyses and chemometrics (Teagasc Ashtown)

### Range of solutions

Companies can engage via Teagasc and other CheeseBoard 2015 partners to avail of services.

### Of interest to

- Cheese manufacturers.
- Food Ingredient applications developers

### 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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## Centre for Membrane Applications Testing

With the recent extension of its membrane separation test facilities to span the range from laboratory to large scale pilot plant units, Teagasc researchers can make preliminary assessments of the potential for separation or enrichment of targeted compounds and molecules of interest from a diverse range of feedstocks. The accumulated experience of 45 years of membrane separations research at Moorepark in dairy can be brought to bear when deciding on applicability, membrane type, operating conditions, performance characterisation, specialised support analysis and process integration.

### Background

The installation of a SEPA CF II crossflow membrane test cell at Moorepark for laboratory scale separation of diverse feedstocks complements the Centre's existing pilot plant facilities and provides fast and accurate performance data based on the use of minimal amounts of membrane and product before up-scaling. The SEPA CF II test cell is capable of testing any flat sheet membrane using crossflow velocities comparable with industrial plants. The unit is also capable of operating at the high pressures typically used in nanofiltration – thus extending its capability for selective ion and other low molecular weight separation. In addition, laboratory scale ultrafiltration charged membrane cassettes (Sartorius; Novasep) are also available to support protein fractionation and peptide separations.

### Benefits to Industry

Membrane separation processes are now mainstream within dairy manufacture e.g. nanofiltration (NF) for the partial demineralisation and pre-concentration of whey, ultrafiltration (UF) for production of whey protein concentrates and isolates, and microfiltration (MF) for defatting of whey and native casein separation. Membrane technology is currently playing a key process role in the manufacture of performance and recovery-based nutrition products derived from whey.

More and more opportunities are opening up for application of membrane-based separations. This is increasingly the case as membrane technology plays a central role in re-engineering traditional manufacturing processes to accomplish improved nutritional quality and sustainability.

### Areas of Expertise

- Knowledge of potential fields of application.
- Collaboration with membrane developers and suppliers.



### Facilities/Equipment

- Laboratory scale SEPA II crossflow test cell for testing of flat sheet membranes.
- GEA multi-membrane pilot scale.
- Membrain electro dialysis (ED) – laboratory and pilot scale units.

### Range of Solutions

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

### Of interest to

- Dairy and Food Industry.
- Food Ingredient Manufacturers

### How to Proceed

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## Cheese Technology

Teagasc, through its resources at its Food Research Centre, Moorepark has extensive knowledge on the science and technology of a range of cheese types including Cheddar, Mozzarella and novel hybrid varieties. This knowledge, combined with an active ongoing research programme, offers the cheese industry a range of leading edge technologies to support the innovation of cheese products and optimisation of cheese making efficiency.

### Background

The fundamental knowledge on the critical factors affecting the composition, yield, biochemistry, rheology, and cooking properties of natural cheeses and processed cheese products are well understood. Teagasc has been engaged in this research for many years with food research institutes and universities on national and international platforms.

### Benefits to Industry

Engagement of cheese manufacturers with Teagasc gives access to state of the art facilities and an extensive research expertise in all aspects of cheese science and technology. This facilitates the innovation of new cheese products and optimisation of manufacturing efficiency.

### Areas of Expertise

- Texture and functionality of natural cheese and processed-/analogue-cheese.
- Manufacturing efficiency and component recoveries.
- Cheese flavour control and diversification.
- Development, scale-up and diversification of a range of cheese types: brine salted, dry salted, reduced-fat variants.
- Advanced methodologies for assaying cheese texture and functionality.
- Range of analytical capabilities for composition, biochemistry, microbiology, rheology, and functionality.
- Ripening rooms, mixers, culture production unit for specialised starter blends.
- Filtration and dehydration equipment for manufacture of ingredients for use in cheese products.



### Range of Solutions

Teagasc can provide a range of solutions through consultancy services, contract research and collaborative arrangements with industry, including:

- Identification and selection of micro-organisms with potential to influence flavour development.
- Development and scale-up of different cheese types.
- Increasing cheese making efficiency.

### Facilities/Equipment

- Pilot plant facilities for milk standardisation equipment, pilot scale cheese vats 500-3000L.
- Cookers for processed-/analogue-cheeses.

### How to Proceed

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## Development of Ingredients Using Spray Drying

Teagasc through its resources at Moorepark combines considerable 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 spray drying technology. This extends from powders for food service applications to nutritional formulations and tailored ingredients.

### Background

Ongoing adaptation of the spray drying process is extending beyond milk to the wider food ingredient sector. Through extensive research, the know-how and facilities are available at Teagasc to address most client demands in spray drying for the purpose of ingredients development.

### Benefits to Industry

Through engaging with Teagasc, access to state-of-the-art facilities and extensive expertise in ingredient evaluation and development is available to offer companies a range of innovative processing solutions, including powders for food service applications, nutritional formulations and tailored ingredients.

### Areas of Expertise

#### (a) Powders for Food Service Applications

- Coffee-stable powders, imitation creamers.

#### (b) Powders for Nutritional Applications

- Evaluate ingredient behaviour on end-product stability.
- Intermediate ingredient pre-mixes with defined performance.
- Stabilised mineral fortified powders.
- High protein ingredients for sports nutrition use.
- Protein hydrolysates.

#### (c) Business-to-Business tailored ingredients

- High fat & microencapsulated fat-containing powders.
- High free fat powders for chocolate applications.
- Yogurt and other fermented powders.
- Powders customised to client needs.

### Facilities/Equipment

- Pilot processing facilities.
- Moorepark Technology Ltd.
- Tall-form spray drying-Niro TFD-20 pilot scale drier to industrial specifications.



- Reconstruction processor, separation processor, evaporator and heating systems.
- Analytical facilities for analysis of powders.

### Range of Solutions

Teagasc can provide a range of solutions including

- Evaluation of scale-up considerations during drying of new ingredients.
- Provision of innovative milk powder ingredients for evaluation.
- Evaluation and diagnosis of ingredient performances in spray dried formulations.
- Optimisation of pre-processing treatments.
- Analysis of powders.
- Advice on quality and food safety issues.

### 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**



## 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 1µg/kg (ppb) for 38 residues, 2 µg/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

#### For further information contact:

Mary Moloney  
 Tel: +353 (0)1 8059919  
 Email: [mary.moloney@teagasc.ie](mailto:mary.moloney@teagasc.ie)

## Bioactive Peptide Discovery Unit

The Bioactive Peptide Discovery Unit at Teagasc Food Research Centre, Moorepark 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 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

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.

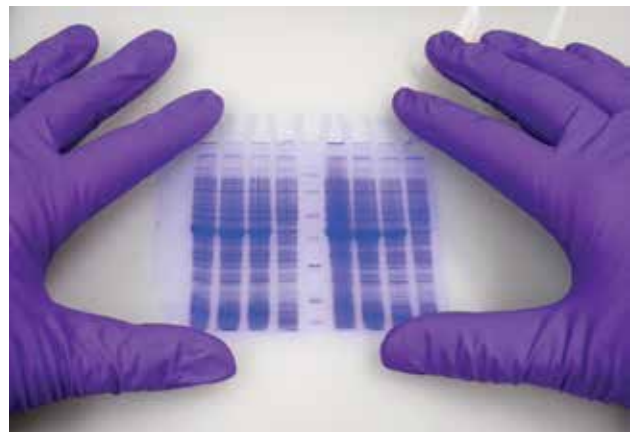
### Facility and Service Details

The unit is equipped with:

- Nano, analytical and semi prep HPLCs.
- MALDI TOF mass spectrometer.
- Peptide synthesiser.
- Amino acid analyser.
- DIGE and 2D electrophoresis units.

### Areas of Expertise Include

- Reverse phase, ion exchange, hydrophobic interaction and gel filtration chromatography.
- Molecular mass determination of peptides, and proteins, protein identification via peptide mass fingerprinting and peptide sequence confirmation via MS/MS using MALDI TOF mass spectrometry.
- Microwave Fmoc synthesis of peptides 6–50 amino acids long at 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.

### Service Interest to

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

### How to Proceed

#### For further information contact:

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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

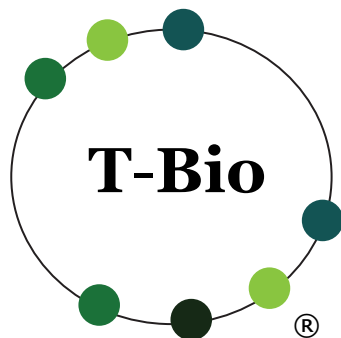
Blown pack spoilage occurs in correctly chilled batches (0 to 2°C) of vacuum packaged beef after 4 to 6 weeks and is caused by *Clostridium estertheticum* and *Clostridium gasigenes*. This type of spoilage is characterised by the production of large volumes of gas (carbon dioxide), a putrid smell and 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

**For further information contact:**

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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

**For further information contact:**

Mary Moloney  
 Tel: +353 (0)1 8059919  
 Email: [mary.moloney@teagasc.ie](mailto:mary.moloney@teagasc.ie)

## 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

#### For further information contact:

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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. This includes the capability to analyse 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 stand alone 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.

### Equipment

- Extraction.
- Thermal Desorption.
- Olfactory Analysis.
- Solid Phase Micro-Extraction.
- Purge & Trap.
- Steam Distillation.



### Service Details

- Advanced chromatography mass spectrometry.
- Extraction Techniques (TD, SPME, ITEX, SE and Purge & Trap).
- Sniffing ports.

### Of Interest to

Industry and academia involved in food and beverages, from production to packaging.

### How to Proceed

#### For further information contact:

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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

**For further information contact:**

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Tel: +353 (0)1 8059530  
Email: karen.hussey@teagasc.ie

## 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 di 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:

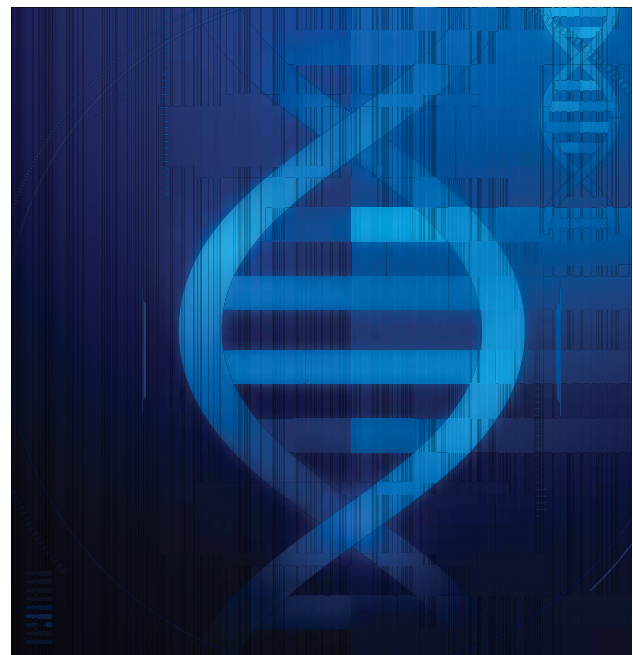
- Whole genome sequencing.
- Targeted resequencing.
- 16S/ITS amplicon sequencing.
- Shotgun metagenomics.
- (Meta)transcriptome sequencing.

### Competitive Advantage 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

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

**For further information contact:**

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Tel: +353 (0)25 42694

## 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

#### For further information contact:

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Carol Griffin  
Email: [carol.griffin@teagasc.ie](mailto:carol.griffin@teagasc.ie)

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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.

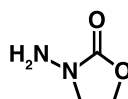
### Benefits to Clients

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.

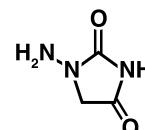
By using this test you can be satisfied that you are in compliance with EU legislation and customer specifications.

### Testing Details

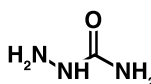
The Nitrofurans test has been validated in liver, muscle, fish, plasma, egg and honey samples according to the 2002/657/EC guidelines. The method is very sensitive and has a limit of detection of <0.10 µg/kg for all four residues in most matrices. The method has been accredited by the Irish National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



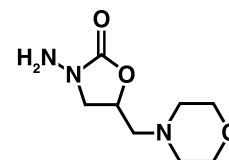
3-Amino-2-oxazolidinone (AOZ)



1-Aminohydantoin (AHD)



Semicarbazide (SEM)



3-Amino-5-morpholinomett  
2-oxazolidinone



**Figure 1:** Analyst placing sample extracts for injection into liquid chromatograph for LC-MS/MS analysis

### How to Proceed

**For further information contact:**

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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

#### For further information contact:

Carol Griffin or Carmel Farrell  
Phone: + 353 (0)1 8059592/8059572  
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[carmel.farrell@teagasc.ie](mailto:carmel.farrell@teagasc.ie)



## 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

#### For further information contact:

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 Tel: +353 (0)1 8059520  
 Email: [margaret.hennessy@teagasc.ie](mailto:margaret.hennessy@teagasc.ie)  
 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

**For further information contact:**

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Tel: +353 (0)1 8059572  
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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.

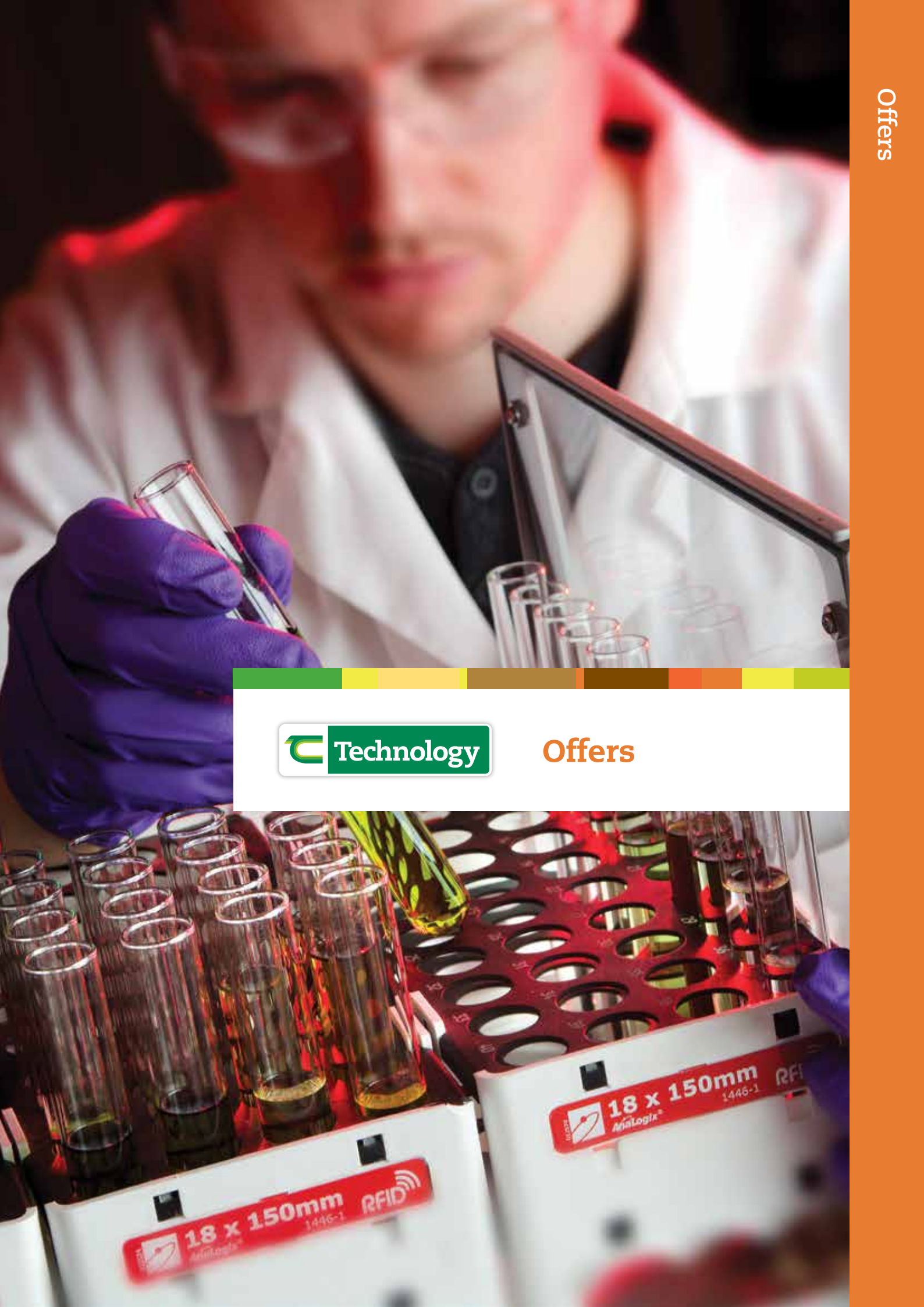
### Of Interest to

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

**For further information contact:**

Mary Moloney  
 Phone: +353 (0)1 8059919  
 Email: [mary.moloney@teagasc.ie](mailto:mary.moloney@teagasc.ie)



Offers

18 x 150mm  
1446-1 RFID

18 x 150mm  
1446-1 RFI

## 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

#### For further information contact:

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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



### 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

#### For further information contact:

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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 Yoghurt

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 yoghurt. 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 yoghurt 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 yoghurt 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 yoghurt with improved textural and rheological qualities compared to other yoghurts.
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 yoghurt, 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

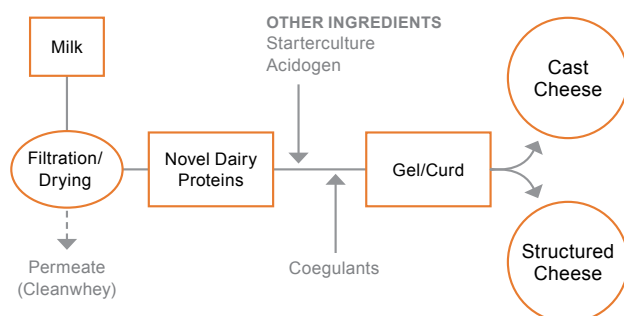
The rapidly growing market for ingredient cheese is currently being served by sourcing traditionally-manufactured table cheeses. Teagasc has developed a dedicated 2-step process for direct manufacture of ingredient cheese tailored to customer requirements. Without the need for whey expulsion it lends 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.
3. Tsitsilonis, O.E, Stoeva, S., Echner, H., Balafas, A., Margomenou, L., Katsoulas, H.L., Troy, D.J., Voelter, W., Papamichail, M. and Lymberi, P. (2002) A skeletal muscle troponin –t ELISA based on the use of an antibody against the soluble troponin T (16–31) fragment. *Journal of Immunological Methods* 268 (2), 141–148.
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

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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.





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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

2013–Present: 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

My 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. I am 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 my current research relates to the investigation of green and sustainable solutions to food industry challenges. In addition, I am 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. Paul Allen

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### Education

B.Sc. Biological Sciences, University of Exeter.

M.Sc. Applied Genetics University of Birmingham.

Ph.D. Faculty of Agriculture, NUI University College Dublin.

Certified Diploma in Accounting and Finance, ACCA.

### Career

1977–1978: Genetics Advisor, Meat and Livestock Commission, UK.

October 1978–Present: Member of the Research Staff at Teagasc Food Research Centre Ashtown in the Food Chemistry and Technology Department, specialising in meat research.

### Expertise

- Automated and non-invasive methods of carcass grading and evaluation.
- Factors affecting meat quality.
- Meat packaging.
- Meat processing.
- Healthier meats.
- Imaging methods to predict eating quality.
- Novel processing.

### Selected Publications

1. Jackman, P., Sun, D.-W., Allen, P., Brandon, K. and White, A. (2010). Correlation of consumer assessment of *longissimus dorsi* beef palatability with image colour, marbling and surface texture features. *Meat Science*, 84, 564–568.
2. Hayes, J., Stepanyan, V., Allen, P., O'Grady, M.N. and Kerry, J.P. (2010). Effect of lutein, sesamol, elagic acid and olive leaf extract on the quality and shelf-life stability of packaged raw minced beef patties. *Meat Science* 84, 613–620.
3. Romvari, R., Dobrowolski, A., Repa, I., Allen, P., Olsen, E., Szabo, A. and Horn, P. (2006). Development of a computed tomographic calibration method for the determination of lean meat content in pig carcasses. *Acta Veterinaria Hungarica*, 2006, 54, 1–10.
4. Beggan, M., Allen, P. and Butler, F., (2006). Effect of oxygen concentrations on blooming ability of aged beef *longissimus lumborum* steaks following ultralow oxygen and vacuum storage. *Journal of Muscle Foods*, 2006,17, 267–276.
5. Sorenson, D., Henchion, M., Marcos, B., Ward, P., Mullen, A.M. and Allen, P. (2011). Consumer acceptance of high pressure processed beef-based chilled ready meals: The mediating role of food-related lifestyle factors. *Meat Science* 87, 81–87.



## Dr. Carlos Álvarez

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### Education

B.Sc. University of Oviedo, Spain. 2004

Master's degree, University of Oviedo, 2006

Ph.D. University of Oviedo, Spain. 2012

### Career

2012–2013: Researcher in “Bloodin” project. University of Oviedo, Spain.

2013–2014: Technical Advisor in Chemical Engineering Department, University of Oviedo, Spain.

2014–Present: Post-Doctoral Research at Teagasc, project NutraMara

2014-to date: Research Officer on ReValue Protein project, Teagasc

### Expertise

Carlos Álvarez obtained his doctorate in the University of Oviedo (Spain) in 2012. His research work focused on the characterisation of isolated proteins from porcine blood, based on their functional and antioxidant properties.

Through this project he has collaborated with several companies aiming to develop new food products containing blood purified proteins. He then joined NutraMara project as a Post-doctoral student. Within this project new techniques were developed aiming to recover proteins, peptides, amino acids, minerals and fatty acid from several fisheries wastes (frames, guts, heads, shells or mollusc flesh). Currently he is a Research Officer on the FIRM funded project ReValue Protein, focusing on the recovery and re-valorisation of molecules of high-added value from waste and by-products of the meat industry such as blood, lungs, heart and other offal. As a researcher, his main interest is in developing and applying new methodologies such as ultrasound, isoelectric solubilisation-precipitation, enzymatic assisted extraction and tailored processes for specific raw materials to increase the value of meat industry by-products.

### Selected Publications

1. A. M. Mullen and C. Álvarez, Offal: Types and Composition, In Encyclopedia of Food and Health, edited by Benjamin Caballero, Paul M. Finglas and Fidel Toldrá, Academic Press, Oxford, 2016, Pages 152–157.
2. 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.
3. Marcet, I., Álvarez, C., Paredes, B., & Díaz, M. (2016). The use of sub-critical water hydrolysis for the recovery of peptides and free amino acids from food processing wastes. Review of sources and main parameters. *Waste Management*, 49, 364–371.
4. Álvarez, C., Tiwari, B. K., Rendueles, M., & Díaz, M. (2016). Use of response surface methodology to describe the effect of time and temperature on the production of decoloured, antioxidant and functional peptides from porcine haemoglobin by sub-critical water hydrolysis. *LWT-Food Science and Technology*.
5. Anne Maria Mullen, Carlos Álvarez, Milica Pojić, Tamara Dapčević Hadnadev and Maria Papageorgiou, Chapter 2 – Classification and target compounds, In Food Waste Recovery, edited by Charis M. Galanakis, Academic Press, San Diego, 2015, Pages 25–57.



## 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 39 peer reviewed scientific articles and generated > €2m in research funding.

1985–1996: Senior Scientist at Leatherhead Food International.

### Expertise

Dr. Auty is a food structure expert with over 25 years' experience in applying microstructural and rheological analysis to understanding food functionality. Particular research interests include food nanotechnology and relating the microstructure of food ingredients and products to processing and consumption. Mark 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 industry. With a strong international reputation, he gives many invited and keynote presentations in Europe, the US and China.

### Selected Publications

1. Ciron, C.I.E., Kelly, A.L. and Auty, M.A.E. (2012). Modifying the microstructure of low-fat yoghurt by microfluidization of milk under different pressures to enhance rheological and sensory properties. *Food Chemistry*, 130: 510–519.
2. 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).
3. Oboroceanu, D., Wang, L., Kroes-Nijboer, A., Brodkorb, A., Venema, P., Magner, E. & Auty, M.A.E. (2011). The effect of high pressure microfluidization on the structure and length distribution of whey protein fibrils. *International Dairy Journal*, 21: 823–830.
4. 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 yoghurt. *Food Hydrocolloids*, 25: 1470–1476.
5. Oboroceanu, D., Wang, L., Brodkorb, A., Magner, E., Auty, M.A.E. (2010). Characterization of  $\beta$ -lactoglobulin fibrillar assembly using atomic force microscopy, polyacrylamide gel electrophoresis and *in situ* Fourier transform infrared spectroscopy. *Journal of Agricultural and Food Chemistry*, 58: 3667–3673. (Top 20 cited article in past 3 years).



## 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: Principle Research Officer.

2005–Present: Senior Principle Research Officer  
Teagasc Food Research Centre, Moorepark.

### Management Experience

2000–2004: Acting Head, Cheese Department.

2004–2009: Head, Food Cultures & Safety Department.

2009–Present: Head, Food Biosciences Department.

### Expertise

My 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 my current research relates to the potential of bacterial exopolysaccharide to impact on both the techno – and bio-functionality of dairy products. In addition, I am interested in microbial fermentation with particular reference to the capacity of a range of bacteria to release bioactive peptides from protein molecules. I also undertake 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. 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, *T Research*, Volume 5, Number 1, Spring 2010 Pages 20–21 (ISSN 1649–8917).
4. Barry (2012) Shelf-life of Food, *T Research*, Volume, Number 1, Spring 2012 Pages 20–21 (ISSN 1649–8917).



## 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 TReseach.
2. Brennan, K.A. (2012) Quality assurance and microbiological criteria regulations, Teagasc TReseach.
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 Libré 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.

### Selected Publications

1. Minekus, M., Alminger, 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.
2. O'Loughlin, I. B., Murray, B. A., FitzGerald, R. J., Brodkorb, A., & Kelly, P. M. (2014). Pilot-scale production of hydrolysates with altered bio-functionalities based on thermally-denatured whey protein isolate. *International Dairy Journal*, 34, 146–152.
3. 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.
4. O'Loughlin, I. B., Murray, B. A., Kelly, P. M., FitzGerald, R. J., & Brodkorb, A. (2012). Enzymatic hydrolysis of heat-induced aggregates of whey protein isolate. *Journal of Agricultural and Food Chemistry*, 60(19), 4895–4904.
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 gastro-intestinal 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

Sept 2005–Present: Research Officer, Teagasc Food Research Centre Ashtown

June 2005–Aug 2005: Postdoctoral researcher, Department of Microbiology, University College Cork

### Expertise

My 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. I am 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. I am 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. I am also a work package leader on the EU COST Action BacFoodNet which is focused on bacterial colonisation of foods and food contact surfaces. 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.

### 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. McCabe E.M., Burgess C.M., O'Regan E., McGuinness S., Barry T., Fanning S., Duffy G. (2011) Development and evaluation of DNA and RNA real-time assays for food analysis using the *hilA* gene of *Salmonella enterica* subspecies *enterica*. *Food Microbiol.* 28(3):447–56.
7. Dolan, A., Burgess C.M., Fanning S. & G. Duffy, (2010) Application of quantitative reverse-transcription PCR (qRT-PCR) for the determination of the total viable count (TVC) on meat samples. *J Appl Microbiol* 109: 91–98.



## 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

My scientific background is essential to my position within the Teagasc Technology Transfer Office (TTO). In my role in the TTO I assist and provide support to the Head of the Intellectual Property (IP) Management unit and facilitate 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.

I am 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. I am 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 I actively participate 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. 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

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
2. Clarke, S.F., E.F. Murphy, O. O'Sullivan, A.J. Lucey, M. Humphreys, A. Hogan, P. Hayes, M. O'Reilly, I.B. Jeffery, R. Wood-Martin, D.M. Kerins, E. Quigley, R.P. Ross, P.W. O'Toole, M.P. Molloy, E. Falvey, F. Shanahan and P.D. Cotter. 2014. Exercise and associated dietary extremes impact on gut microbial diversity. *Gut*. 63:1913–20
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. 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–Present: Senior Post-Doctoral Researcher, Next Generation Sequencing Platform, APC (Teagasc).

### 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.
7. 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

Ph.D. in Sensory and Consumer Science, University College Dublin (2009–2013).

Postgraduate Diploma in Education (PGDE), NUI Maynooth (2007–2008).

B.Sc. in Food Science, University College Dublin (2003–2007).

### Career

2014–Present: Manager – Sensory Food Network Ireland, Teagasc Research Centre, Ashtown, Dublin 15.

Sep–Dec 2014: Online Tutor for the Principles of Sensory Science module as part of the M.Sc. 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. Crofton's expertise lies in the area of sensory and consumer science. Her Ph.D. was part of a large FIRM-funded project, in which her research focused on the consumer-led development of healthy snack foods containing brewers spent grain for the Irish market. 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. She also has a wide range of teaching experiences 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 the product development process. She also has a keen interest in understanding how interactions between the human senses impact our eating and drinking experiences. Dr. Crofton joined Teagasc in 2014 where is she responsible for co-ordinating the development of Sensory Food Network Ireland.

### 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): 384–390.



## Pat Daly

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### Education

Honours Degree in Chemistry and M.Sc., Food Science.

### Career

He is a Principal Research Officer and Head of Food Industry Development at Teagasc, the Irish Agriculture and Food Development Authority.

### Expertise

He has worked with Teagasc since 1988 where he leads the Teagasc Food Industry Development programme. He leads a team of scientists and technologists providing technology development support for the food processing sector through product development supports, training programmes, scientific seminars, consultancy services, food market research and technical information service. The work programme operates from two Teagasc Food Research Centres, Ashtown, Dublin and Moorepark, Co. Cork. The team also support food research knowledge and technology transfer to industry through training courses, seminars, consultancy work and R&D supports. A wide range of expertise, pilot scale processing facilities and product testing services are available to industry for business start-up, new product development and innovation supports. A focus of the work programme is

supporting small and medium sized (SME) enterprises and start-up food businesses. This work is carried out in conjunction with Enterprise Ireland and other national and regional food development agencies. Previously he worked as a technical consultant and trainer in the food industry and other sectors with the Irish Institute for Industrial Research and Standards. He has over twenty years experience working with the food processing sector as a trainer and consultant, specialising in the area of food safety and quality management systems. During this time he worked with a large number of leading international food manufacturing companies with production operations in Ireland and also with the many SMEs throughout the country. He has also carried out several projects for Government Departments and other state agencies. He has participated in EU food research projects, international assignments and study visits in relation to the food processing sector. He has represented Teagasc on many national food technical committees and contributed to the development of a number of national policy documents and standards for the food sector.



## 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.





## Mr. 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. Liana Drummond

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### Education

B.Sc. University of Rio de Janeiro, Brazil. 1991

M.Sc. South Bank University, London, UK. 1997

Ph.D. University College Dublin, Ireland. 2008

### Career

1991–1992: Project Engineer, Rio de Janeiro, Brazil

2001–2002: Research Assistant – Delft University of Technology, The Netherlands

2010–2012: Post Doctoral Research Scientist, FP7 – COOLMEAT Project, University College Dublin

2012–2014: Post Doctoral Research Scientist, FP7 – MILDDRY Project, University College Dublin

2014–Present: Research Officer, Food Chemistry and Technology Department

### Expertise

My research interests relate to food processing in general and meat products in particular. I hold a B.Sc. in Chemical Engineering and an M.Sc. Food Safety and Control. Previous research work included the development of a rapid cooling technology for cooked meat products and the applications of microwave-vacuum drying to heat sensitive food ingredients. Currently a Project Manager for ReValueProtein project which aims to establish and optimise protocols to extract, characterise and test proteins and peptides from beef and pork fifth quarter products. The project brings together a multidisciplinary team to generate technical know-how, develop and optimize processing conditions for protein extraction, followed by isolation, characterisation and investigation of various applications in food, beverage, health and biomedical engineering.

### Selected Publications

1. Drummond, L., Mullen, A.M., Garcia, C., and Lynch, S. (2015) Adding value to meat processing. *TResearch Magazine*, Spring 2015, (2015): 30–31.
2. Drummond, L., Meinert, L., Koch, A.G., Wurtz J., Zhang, Z. and Sun, D.-W. (2015) Safety and quality evaluation of large meat joints cooled by a pre-commercial immersion vacuum cooling prototype. *International Journal of Food Science & Technology* 50(9), 2066–2073.
3. Zhang, Z., Drummond, L. and Sun, D.-W. (2013). Vacuum cooling in bulk of beef pieces of different sizes and shape – Evaluation and comparison to conventional cooling methods. *Journal of Food Engineering* 116 (2) 581–587.
4. Drummond, L. and Sun, D.-W. (2012) Evaluation of the immersion vacuum cooling of cooked beef joints – mathematical simulation of variations in beef size and porosity and pressure reduction rates. *Innovative Food Science and Emerging Technologies* 16, 205–210.
5. Drummond, L., Sun, D.-W., Vila, C.T. and Scannell, A.G.M. (2009). Application of immersion vacuum cooling to water-cooked beef joints – quality and safety assessment. *LWT – Food Science and Technology* 42(1), 332–337.
6. Drummond, L. and Sun, D.-W. (2008). Temperature evolution and mass losses during immersion vacuum cooling of cooked beef joints – a finite difference model. *Meat Science* 80(3), 885–891.



## 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. Michael Gaffney

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### Education

B.Sc. National University of Ireland, Maynooth, 2002

Ph.D. University College Dublin, Ireland. 2012

### Career

2002–2006: Ph.D. Candidate, Department of Environmental Resource Management, UCD

2006: Research Assistant, Department of Biological Sciences, University of Wales, Swansea, Wales

2006–2013: Protected Crops Specialist, Horticulture Development Department, Teagasc

2013–2016: Research Officer, Horticulture Development Department, Crops, Env & Land Use Programme, Teagasc

2016–Present: Senior Research Officer, Horticulture Development Department, Crops, Environment & Land Use Programme, Teagasc

### Expertise

My primary research interests relate to aspects of vegetable and fruit agronomy, in particular, the influence and impact of agronomic practices on the phytochemical content and quality of edible crops, including the impact of variety selection, fertilisation strategy and crop protection inputs. Phytochemical content can vary greatly depending on variety selection alone, as we have demonstrated for Broccoli, Onion, Carrot, Strawberry and Rocket among others to date. The value and reuse of fruit and vegetable processing waste, either as a food additive or extraction material is also an interest of mine as is the fate of phytochemical's through the food production process. I am also interested in the impact phytochemical's have on insect pests and if increasing the concentration of phytochemical's in a plant, either by variety selection or application of bio stimulants, can suppress the damaging impact of crop pests. A particular focus of my work has been the use of such plant extracts

as plant protection products, including the use of plant extracts to suppress insect pest populations. In addition, I am interested in most aspects of horticultural food production.

### Selected Publications

1. Reilly, K., Valverde, J., Finn, L., Gaffney, M., Rai, D & Brunton, N. (2015) A note of the feasibility of selenium supplementation of Irish grown Allium crops. *Irish Journal of Agricultural and Food Research*. 53(1): 91–99
2. Valcarel, J., Reilly, K., Gaffney, M & O'Brien, N (2015) Total carotenoids and ascorbic acid content in sixty varieties of potato (*Solanum tuberosum* L.) grown in Ireland. *Potato Research*. DOI:10.1007/s11540–014–9270–4
3. Valverde, J., Reilly, K., Villacreses, S., Gaffney, M., Grant, J & Brunton, N. (2014) Variation in bioactive content in broccoli (*Brassica oleracea* var. *italica*) grown under conventional and organic production systems. *Journal of the Science of Food and Agriculture*. DOI: 10.1002/jsfa.6804
4. Tiwari, U., Sheehy, E., Rai, D., Gaffney, M., Evans, E. & Cummins, E. (2015) Quantitative human exposure model to assess the level of glucosinolates upon thermal processing of cruciferous vegetables. *Food Science and Technology* Vol 63, p253–261.
5. Lola-Luz, T., Hennequart, F. & Gaffney, M.T. (2013) Enhancement of phenolic and flavonoid compounds in cabbage (*Brassica oleracea*) following application of commercial seaweed extracts of the brown seaweed (*Ascophyllum nodosum*) *Agricultural and Food Science* Vol 22, p288–295.
6. Reilly, K., Valverde, J., Finn, L., Brunton, N., Sorensen, J., Sorensen, H., Grant, J., and Gaffney, M. (2013) Potential of cultivar and crop management to optimise phytochemical content in winter-grown sprouting broccoli (*Brassica oleracea* L. var. *italica*). *Journal of the Science of Food and Agriculture*.



## 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

2000–Present: 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.



## Dr. Linda Giblin

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### Education

1989 B.Sc. Biotechnology, Dublin City University, Dublin, Ireland

1995 Ph.D. Microbiology Dept., University College Cork, Cork, Ireland

### Career

2002–Present: Senior Researcher Teagasc Food Research Centre, Moorepark, Fermoy, Cork, Ireland.

1999–2002: Research/Senior Scientist R&D, XANTHON Inc. (start-up biotech company), Research Triangle Park, North Carolina, U.S.A.

1997–1999: Post-doctoral Scientist, Institute of Molecular BioSciences, Massey University, New Zealand.

1994–1997: Wellcome Post-doctoral Research Scientist, Biochemistry Dept., U.C.C, Cork, Ireland.

### Expertise

- Life stage Nutrition: Designing foods for pregnant women and their child.
- Foods for weight management.
- Food Bioavailability & Bioaccessibility.
- Food Bioactives.
- Genotype-phenotype interactions.
- Large animal trials: Bovine mammary challenge studies, Porcine post-prandial studies, Porcine models for Infant programming.
- Bovine DNA depository.

### Selected Publications

1. Giblin, L., C. Darimont, P. Leone, L.B. McNamara, F. Blancher, D. Berry, E. Castaneda-Gutierrez, and P.G. Lawlor. 2015. Offspring subcutaneous adipose markers are sensitive to the timing of maternal gestational weight gain. *Reprod Biol Endocrinol.* 13(1):16.
2. O'Sullivan, D.J., P.D. Cotter, O. O'Sullivan, L. Giblin, P.L. McSweeney, J.J. Sheehan. 2015. Temporal and spatial differences in microbial composition during the manufacture of a continental-type cheese. *Appl Environ Microbiol.*;81(7):2525–33.
3. H. Schellekens, P.N. De Francesco, D. Kandil, W.F. Theeuwes, T. McCarthy, W.E. van Oeffelen, M. Perello, L. Giblin, T. G. Dinan and J. F. Cryan. 2015 (in press). Ghrelin's Orexigenic Effect Is Modulated via a Serotonin 2C Receptor Interaction. *ACS Chem Neurosci.* 2015.
4. Amdi,C., L. Giblin, T. Ryan, N.C. Stickland and P.G. Lawlor, 2014. Maternal backfat depth in gestating sows has a greater influence on offspring growth and carcass lean yield than maternal feed allocation during gestation. *Animal* 8(2):236–44.
5. Le Maux, S., A. Brodkorb, T. Croguennec, A. A. Hennessy, S. Bouhallab, and L. Giblin. 2013. beta-Lactoglobulin-linoleate complexes: In vitro digestion and the role of protein in fatty acid uptake. *J Dairy Sci* 96:4258–68.
6. Hand, K. V., C. M. Bruen, F. O'Halloran, H. Panwar, D. Calderwood, L. Giblin, and B. D. Green. 2013. Examining acute and chronic effects of short – and long-chain fatty acids on peptide YY (PYY) gene expression, cellular storage and secretion in STC-1 cells. *Eur J Nutr* 52:1303–13.
7. Beecher, C., M. Daly, R. P. Ross, J. Flynn, T. V. McCarthy, and L. Giblin. 2012. Characterization of the bovine innate immune response in milk somatic cells following intramammary infection with *Streptococcus dysgalactiae* subspecies *dysgalactiae*. *J Dairy Sci* 95:5720–9.



## 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

1. 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.
2. 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.
3. 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.
4. 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.
5. 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.
6. 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.
7. 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.
8. 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.



## 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.





## 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

My 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. My research programme is collaborative and nationally (FIRM/RSF) and European (FP7/COST) funded and I have also worked on confidential industry projects. I am currently a collaborator on a number of active projects in the healthier meat products area (e.g. Prosslow) and I am 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 I 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. Maeve Henchion

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### Education

B.Agr.Sc. (Hons, 2.1) 1991, University College Dublin (Awarding Body: NUI).

M.Agr.Sc. (Hons, 1H) 1993, University College Dublin (Awarding Body: NUI).

Ph.D., 1996, University College Dublin (Awarding Body: NUI).

Post Graduate Certificate in Leadership Development (2014) IMI/UCC

### Career

Maeve started her research career as a research assistant in University College Dublin during which time she was awarded a Ph.D. for her work on the performance of the Irish beef industry. She took up employment with Teagasc in 1996 on a nationally funded collaborative project that looked at logistics and supply chain management. Since then she has been awarded funding in excess of €3 million from national and EU sources to pursue a range of research interests. These research interests span the supply chain and usually operate at the interface between social science and technical science. They include food innovation, sustainable food production and consumption, consumer and industry acceptance of novel food technologies, food quality and strategic food marketing.

Maeve has published in a wide range of journals given her involvement in many multi-disciplinary projects and she has acted as a referee for *Meat Science*, *Appetite*, *British Food Journal*, *Journal of the Science of Food and Agriculture*, *International Journal of Food Science and Technology*, *Journal of Risk Research* and *Irish Geography*. She was appointed Associate Editor to the editorial board of *Nutrition and Food Science* in April 2016.

She has developed her leadership and management experience over the years also through appointments within Teagasc, membership of project steering/ advisory committees and formal training. She is currently head of the Department of Agrifood Business and Spatial Analysis which comprises 9 permanent research staff along with associated post-doctoral researchers and post-graduate students.

### Expertise

Maeve has significant experience of conducting strategic market research at various points in the chain from farmers through to consumers. She uses qualitative (e.g. focus groups) as well as quantitative (e.g. surveys) research approaches. She has an understanding of food science and supply chain issues and hence can relate research findings to real world contexts. Based on her expertise she can provide advice on strategic marketing, consumer behaviour, innovation management, new product development, market development and food policy.

### Selected Publications

1. Henchion, M., McCarthy, M., Resconi, V., Berry, D., and S. McParland (2016) Stakeholder involvement in establishing a milk quality sub-index in dairy cow breeding goals: A Delphi approach, *Animal*, pp1–14. pii: DOI: 10.1017/S1751731115002165. 10 (5), pp.878–891
2. Handford, C., Dean, M., Henchion, M., Spence, M., Elliott, C. & Campbell, K. (2014). Implications of nanotechnology for the agri-food industry: Opportunities, Benefits and Risks. *Trends in Food Science and Technology*. Vol. 40, No. 2, 12.2014, p. 226–241
3. Henchion, M., McCarthy, M., Resconi, V. and D. Troy (2014). Meat Consumption: Trends and Quality Matters, *Meat Science*, 98 (2014), pp. 561–568 DOI information: 10.1016/j.meatsci.2014.06.007
4. Greehy, G. M., McCarthy, M.B., Henchion, M.M., Dillon, E.J, and McCarthy, S.N. (2013). Complexity and conundrums. Citizens' evaluations of potentially contentious novel food technologies using a deliberative discourse approach. *Appetite* Volume 70, 1 November 2013, pp 37–46
5. Sorenson, D. and Henchion, M. (2011). Understanding consumers' cognitive structures with regard to high pressure processing: a means-end chain application to the chilled ready meals category, *Food Quality and Preference* Vol. 22(3), Pages 271–280



## 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

- Food oligosaccharides – extraction, enrichment, fractionation and structural analysis for nutraceutical applications.
- Development of bioassays for investigating the bioactive properties of glycans isolated from food sources.
- Manager of tissue culture facilities at Moorepark.
- Electrophoresis including 1D and 2D SDS-PAGE, Western Blotting, protein overproduction, concentration and renaturation.
- Chromatography – Size-exclusion, Affinity and Ion Exchange Chromatography.
- Microbial molecular biology techniques.

### Selected Publications

1. Lane, J. A., Kavanaugh, D., Mariño, K., Rudd, P.M., Carrington, S.D., Naughton, J., Clyne, M. and Hickey, R.M. (2012) Anti-infective bovine colostrum oligosaccharides: *Campylobacter jejuni* as a case study. *International Journal of Food Microbiology* (In press).
2. Lane, J. A., Marino, K., Slattery, H., Carrington, S. D., Rudd, P. M., and Hickey, R.M. (2012) Methodologies for screening of bacteria-carbohydrate interactions: anti-adhesive milk oligosaccharides as a case study. *Journal of Microbiological Methods* (In press).
3. Hickey, R. (2012). The role of oligosaccharides from human milk and other sources in prevention of pathogen adhesion. *International Dairy Journal*, 22: 141–146.
4. Lane, J.A., Carrington, S.D., Mehra, R.K. and Hickey, R.M. (2011) Screening whole bacterial cell adherence to the human milk oligosaccharide, 2' – fucosyllactose using Surface Plasmon Resonance (SPR) technology. *Analytical Biochemistry*. 410, 200–205.
5. Lane, J.A., Mehra, R.K., Carrington, S.D. and Hickey, R.M. (2010). The Food Glycome: a source of protection against chronic infection in the gastrointestinal tract. *International Journal of Food Microbiology*, 142; 1–13.
6. Hickey, R. M. (2009). Harnessing Milk Oligosaccharides for nutraceutical applications. In: *Dairy-derived ingredients: food and nutraceutical uses*. Corredig, M (ed), p308–343.



## Dr. Mohammad B. Hossain

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### Education

M.Sc. Leibniz University of Hannover, Germany. 2006

Ph.D. Dublin Institute of Technology, Ireland. 2012

### Career

2010–January 2016: Department of Food Biosciences, Teagasc.

February 2016–Present: Department of Food Safety, Food Residue Lab, Teagasc.

### Expertise

My research focuses primarily on the extraction, enrichment and characterisation of antioxidant, antimicrobial, anti-inflammatory, anticarcinogenic and cholesterol-lowering phytochemicals from plant sources. My 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. My 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. Currently I am involved in methods development and validation for chlorates analysis in dairy products in a laboratory which functions in compliance with ISO 17025:2005 and accredited by Irish National Accreditation Board (INAB).

### Selected Publications

- 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.
- 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.
- 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.
- 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.
- 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.
- 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.
- 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

B.Sc. University of Westminster, UK. 1994

Ph.D. 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

My research interests are primarily focused on the impact of volatile compounds on sensory perception of foods and beverages. Most of my experience is directly related to biochemistry and enzymology of foods with a particular emphasis on cheese flavour. I am 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. I am also a member of the Sensory Food Network Ireland., International Dairy Federation, American Dairy Science Association and Irish Mass Spectrometry Society.

I also have extensive experience in gas chromatography and associated techniques.

I have published >40 peer review research articles and 10 book chapters. I am a member of the editorial board for Dairy Science & Technology (formerly Le Lait) and Journal of Dairy Research. I am a reviewer for a wide number of international peer reviewed journals.

I 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). I was a member of the scientific committee for the IDF Symposia on Cheese in 2016.

### Selected Publications

1. 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*, In press
2. 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.
3. 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. *Int. J. Dairy Tec*, 69, 38–50.
4. 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.
5. 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.
6. Nongonierma, A.B. Abrolova M, Fenelon, M.A, Kilcawley. K.N (2009). Evaluation of two food grade proliposomes to encapsulate an extract of a commercial enzyme preparation by microfluidization *J. Agri. and Food Chem*, 57, 3291–3297.
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. 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. Olivia McAuliffe

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### Education

Ph.D. Microbiology (1995–1999), University College Cork.

B.Sc. Microbiology (1991–1995), University College Cork.

### Career

2009–Present: Senior Research Officer, Teagasc Food Research Centre, Moorepark.

2003–2009: Research Officer, Teagasc Food Research Centre, Moorepark.

2000–2002: Post-Doctoral Research Fellow, Dept. of Food Science, North Carolina State University, Raleigh, USA.

1999–2000: Post-Doctoral Research Fellow, National Food Biotechnology Centre, University College Cork.

### Research Activities/interests

- Genetics and genomics of food cultures, including probiotics and fermentation starter cultures.
- Genomic analysis and characterisation of bacteriophage infecting food cultures and food pathogens.
- Evaluation of novel LAB for flavour diversification in dairy products.
- Genomic analysis and the study of persistence in *Listeria monocytogenes*.
- Development of therapeutic uses for bacteriophage against multi-drug resistant pathogens including MRSA, *E. coli* O157:H7, *Clostridium difficile* and *Pseudomonas aeruginosa*.
- Development of detection systems for foodborne pathogens based on phage-host interactions.

### Selected Publications

1. Cavanagh, D., G. F. Fitzgerald, O. McAuliffe. 2014. From field to fermentation: the origins of *Lactococcus lactis* and its domestication to the dairy environment. *Food Microbiol.* In press.
2. Cavanagh, D., K. Kilcawley, M. O'Sullivan, G. F. Fitzgerald, O. McAuliffe. 2014. Assessment of wild non-dairy lactococcal strains for flavour diversification in a mini Gouda type cheese model. *Food Res. Int.* 62: 432–440.
3. Cavanagh, D., C. M. Guinane, H. Neve, A. Coffey, R. P. Ross, G. F. Fitzgerald, O. McAuliffe. 2014. Phages of non-dairy lactococci: isolation and characterisation of  $\phi$ L47, a phage infecting the grass isolate *Lactococcus lactis* ssp. *lactis* DPC6860. *Front. Microbiol.* 4: 417.
4. Casey, A., E. M. Fox, S. Schmitz-Esser, A. Coffey, O. McAuliffe, K. Jordan. 2014. Transcriptome analysis of *Listeria monocytogenes* exposed to biocide stress reveals a multi-system response involving cell wall synthesis, sugar uptake and motility. *Front. Microbiol.* 5: 68.
5. Elbreki, M., R. P. Ross, C. Hill, J. O'Mahony, O. McAuliffe, A. Coffey. 2014. Bacteriophages and their derivatives as biotherapeutic agents in disease prevention and treatment. *J. Viruses.* Article ID 382539.



## 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.; Henschion, 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 Chemistry and Technology Department, Teagasc

2014–2016: Research Manager, AllinAll Ingredients

2013–2014: Technical Manager, Mark & Chappell

2013: Research Assistant, University College Dublin

### Expertise

The research interests of Dr. McDonnell include novel processing technologies, food ingredients and processed meat products. Previous research work has included the assessment of two novel processing technologies, power ultrasound and pulsed electric fields, to accelerate the processing and improve the quality of cured meat products. The FIRM-funded project involved experimental design, scale-up and analysis of various technological properties of meat. The project demonstrated the strong potential of power ultrasound as a process to accelerate meat curing without affecting meat quality. During previous roles, Dr. McDonnell has gained a strong knowledge of product development, legislation and quality issues related to processed meat products. She has strong skills regarding functional food ingredients and meat processing technologies for improved product quality. Dr. McDonnell recently joined Teagasc as a Meat Scientist and is interested in researching the effect of various processing technologies and novel healthy ingredients on the meat matrix.

### Selected Publications

1. 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.
2. 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.
3. 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.
4. 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.
5. 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. Submitted to LWT- *Food Science and Technology*, 59, 1054-1060.



## 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. 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

I assist 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.

My expertise is primarily in the area of contaminant analysis, focussing on foods of animal origin. I have 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. I am currently working on multi-residue methods for antibiotics in aquaculture and pesticides in animal fat in particular the pyrethroid pesticides. I work primarily with UHPLC coupled to tandem mass spectrometry but also have 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. Kanishka N. Nilaweera

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### Education

Ph.D. Neuroscience, University of Aberdeen, UK. (2002).

B.Sc., University of Aberdeen, UK. (1998).

### Careers

2009–Present: Senior Research Officer, Teagasc, Moorepark Food Research Centre, Fermoy, County 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

My research aims to identify nutrients that reduce weight gain, so that these could be commercialised as Functional Food ingredients to tackle the obesity problem. This work involves animal feeding trials. Utilising this approach, we have shown that whey protein isolate (a by-product of cheese manufacture) reduces weight gain by decreasing the size of the gut. Moreover, bovine serum albumin, a constituent protein within the isolate, has a greater suppressive effect on weight gain.

### Selected Publications

1. 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;113; 372–379.
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;114; 654–662.
3. McManus BL, Korpela R, O'Connor P, Schellekens H, Cryan JF, Cotter PD, Nilaweera KN. Compared to casein, bovine lactoferrin reduces plasma leptin and corticosterone and affects hypothalamic gene expression without altering weight gain or fat mass in high fat diet fed C57/BL6J mice. *Nutrition & Metabolism* 2015, 12;53.
4. Finucane OM, Lyons CL, Murphy AM, Reynolds CM, Klinger R, Healy NP, Cooke A, Coll R, McAllan L, Nilaweera KN, O'Reilly M, Tierney AC, Morine MJ, Alcalá-Díaz JF, López-Miranda J, O'Connor DP, O'Neill L, McGillicuddy FC, and Roche HM. Monounsaturated fatty acid enriched high fat-diets impede adipose NLRP3 inflammasome mediated IL-1 $\beta$  secretion and insulin resistance despite obesity. *Diabetes* 2015;64:2116–28.
5. McAllan L, Skuse P, Cotter PD, O'Connor P, Cryan JF, Ross RP, Fitzgerald G, Roche HM, 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; 10;9(2):e88904.



## 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 C. 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: Senior Research Officer in the Biosciences Department, Teagasc Food Research Centre, Moorepark.

### 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. M.C. Rea, O. O'Sullivan, F. Shanahan, P.W. O'Toole, C. Stanton, R.P. Ross and C. Hill. (2012). *Clostridium difficile* carriage in elderly subjects and associated changes in the intestinal microbiota J. Clin. Microbiol., 50:867–875.
2. M.C. Rea, A. Dobson, O.O'Sullivan, F. Crispie, F. Fouhy, PC. Cotter, F. Shanahan, B. Kiely, C. Hill and RP. Ross (2011). Effect of broad – and narrow – spectrum antimicrobials on *Clostridium difficile* and microbial diversity in a model of the distal colon. Sackler Symposium Microbes and Health Proc. Natl. Acad. Sci. USA, 108 Suppl 1: 4639–4644.
3. K. Murphy, O'Sullivan O, Rea MC, Cotter PD, Ross RP, Hill C. (2011). Genome mining for radical SAM protein determinants reveals multiple sacitibiotic-like gene clusters. PLoS One 6:e20852. Epub 2011 Jul 8.
4. 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. 76:602–14.
5. Field, D., Quigley, L., O'Connor, P., M.C. Rea, Daly, K., Cotter, P., Hill, C. and Ross, R.P. (2010). Studies with Bioengineered Nisin peptides highlight the broad-spectrum potency of Nisin V. Microbial Biotechnology 3: 4, 473–486.
6. M.C. Rea, CS. Sit, E. Clayton, PM. O'Connor, RM. Whittal, J. Zheng, JC. Vederas, R P. Ross and C Hill (2010). Thuricin CD, a novel post-translationally modified bacteriocin with a narrow spectrum of activity against *Clostridium difficile*. Proc. Natl. Acad. Sci. USA, 107: 9352–9357.



## Dr. Diarmuid Sheehan

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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. 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

My 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.



## 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. 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

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

My primary research interests include the links between dairy science, process technology and process engineering. Process technology platforms I am involved in include thermal processing, evaporation, spray drying, homogenisation, high shear technologies and separation/fractionation technologies. In particular my 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. I am 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. My 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. 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, my 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.

We strive to facilitate the professional management of our research outputs through strategic management, by close alignment with our research and technology transfer strategic priorities and by evidence of impact on research community and related industry.

I manage 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. We 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 we use National IP protocol and template agreements to facilitate formalisation of such interactions, we 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, T-Research 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, *T Research* 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.



## Dr. Zhihang Zhang

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### Education

BSc. Shanghai Fisheris University, China. 1996

PhD. University College Dublin, Ireland. 2008

### Career

2008–2010: Post Doctoral Research Scientist,  
FP7 – MINICRYSTAL Project, University College Dublin

2010–2012: Post Doctoral Research Scientist,  
FP7 – COOLMEAT Project, University College Dublin

2012–2014: Post Doctoral Research Scientist,  
FP7 – MILDDRY Project, University College Dublin

2015–present: Research Officer, Food Bioscience  
Department

### Expertise

My research interests relate to food engineering and processing, in particular, heat and mass transfer, making use of novel technologies such as power ultrasound, microwave, vacuum and high pressure. Previous research work includes the development of a rapid freezing technology with assistance of power ultrasound; development of a rapid cooling technology for cooked meat products; the application of microwave-vacuum drying to heat sensitive food ingredients; and rapid curing of meat using power ultrasound. Currently working as a research officer, I play an important role in joint project WASTE2FUEL, which aims to valorise food waste by extracting valuable components from the waste. This research promotes novel and green, environmentally-friendly extraction methods to extract valuable components such as protein, anti-oxidants and pectin, etc., and optimise their extraction conditions for different types of waste.

### Selected Publications

1. Cheng, L., Sun, D.W.; Zhu, Z., Zhang, Z. Effects of High Pressure Freezing (HPF) on Denaturation of Natural Actomyosin Extracted from Prawn (*Metapenaeus Ensis*). *Journal of Agricultural and Food Chemistry*, In press.
2. Drummond, L., Meinert, L., Koch, A.G., Wurtz J., Zhang, Z. and Sun, D.-W. (2015) Safety and quality evaluation of large meat joints cooled by a pre-commercial immersion vacuum cooling prototype. *International Journal of Food Science & Technology* 50(9), 2066-2073.
3. Zhang, Z., Drummond, L. and Sun, D.-W. (2013). Vacuum cooling in bulk of beef pieces of different sizes and shape – Evaluation and comparison to conventional cooling methods. *Journal of Food Engineering* 116 (2) 581–587.
4. Kiani, H., Sun, Da-Wen, Zhang, Zhihang (2013). Effects of processing parameters on the convective heat transfer rate during ultrasound assisted low temperature immersion treatment of a stationary sphere. *Journal of Food Engineering*, 115(3), 384-390.
5. Zhang, Z., & Sun, Da-Wen. (2006). Effects of cooling methods on the cooling efficiency and quality of cooked rice. *Journal of Food Engineering*, 77 (2), 269-274.





