

Food Research Programme



Teagasc

Teagasc is a Development Agency of the Department of Agriculture, Food and the Marine. The primary function of Teagasc is to support science-based innovation in the Agri-food sector and the broader bio-economy.

Animal and Grassland
Research and
Innovation Programme

Crop, Environment and
Land Use Programme

Food
Programme

Rural Economy
and Development
Programme

Teagasc Programmes

Teagasc is the leading organisation in the fields of agriculture and food research in Ireland, undertaking innovative research within the 4 programmes that make up the organisation's research and knowledge transfer capability.

Teagasc Food Programme

The Food Programme is conducted and delivered from two substantial research locations in Dublin and Cork and covers a wide range of topics in the agriculture/food arena.

Research, development and innovation initiatives supporting meat and dairy processing, cereals and marine food sectors, are the core activities within the Food Programme, delivered across four departments:

1. Food Biosciences
2. Food Chemistry and Technology
3. Food Safety
4. Food Industry Development

All departments work closely with each other and with the Teagasc Technology Transfer Office to implement the Teagasc Food Technology and Knowledge Transfer Strategy.

Food Programme Linkages

The Food Programme is closely linked to the Animal & Grassland Research and Innovation Programme (AGRIP; located on the same campus). The AGRIP Programme operates its own dairy and beef cattle, sheep and pig production units which are available to the Food Programme for large-animal feeding trials, milk and animals for processing and quality determination.

There are also close links to the Teagasc Crop Environment & Land Use Programme (CELUP) and the Teagasc Rural Economy & Development Programme (REDP) which provide access to crops for processing and market analysis respectively.

Together with University College Cork, Teagasc have formed the Food Innovation Alliance, which secures a longstanding vibrant collaboration. The Alliance involves joint strategic planning for food research, a joint approach to supporting key stakeholders, the co-development and sharing of technology platforms and a common approach to securing funding for the joint Food Research Programme in order to underpin industry profitability, competitiveness and sustainability.



Teagasc Food Research Centre campus at Moorepark



Teagasc Food Programme Mission

The scientific pipeline of the Teagasc Food Research Programme drives science-based innovations and solutions for the Irish Food Industry, through targeted project planning, a focus on technology transfer, industry training and collaboration.



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Teagasc Vision for Food

The Vision for the Teagasc Food Research Programme is to provide sustainable science-based innovations and solutions for the Irish Food Industry, to ensure economic development and profitability.

Teagasc Food Research Centres

The Teagasc Food Programme encompasses many aspects of food science and technology including: Food Structure and Functionality, Food Safety, Food Quality, Food for Health, Food Fermentation, Meat and Meat products, Dairy Foods and Ingredients, Plant based Food and Ingredients, Marine based Foods and Ingredients and Prepared Consumer Foods.

The Food Programme focuses on quality and safety and food product innovation and is performed in collaboration with universities and research institutes in Ireland, the European Union, the United States of America, Asia and New Zealand groups.

The research programme is underpinned by targeted studies of markets and consumer-led developments, as well as the need for rigorous adherence to national and international (European Food Safety Authority) regulations. The Programme is run from Teagasc Food Research Centres at Ashtown (Dublin 15) and Moorepark (Fermoy, Co. Cork). Both are internationally recognised sites of excellence.

The primary focus of the Teagasc Food Research Centre at Moorepark is dairy research and Food for Health research. It has a proud history in the development of microbial cultures, new dairy ingredients and hybrid cheese varieties for dairy companies.

The Teagasc Food Research Centre at Ashtown has an excellent research track record in microbiological and chemical food safety, meat and meat products, cereal and bakery products and in the field of nutraceuticals.

Teagasc Moorepark is located on a 110 hectare site in North Cork, with a dedicated Food Research Centre, an extensive Animal and Grassland Research Facility, a Pig Production Development Facility and the pilot plant; Moorepark Technology Limited. Teagasc Ashtown is located near Castleknock on the outskirts of Dublin. The site extends to 30 hectares which includes a category 3 food safety facility, a pilot-scale abattoir, meat processing plant, product development plant, a sensory analysis suite and a nutraceutical facility. Horticultural research is also undertaken at this location.



Nutraceutical Research Facility at Teagasc Food Research Centre, Ashtown

Funding and Collaborations

Teagasc implements its research programmes in close collaboration with national and international partners and possesses a portfolio of strong international contacts and networks.

The organisation is funded by way of direct State Grant and from national and international competitive funding sources. These include the EU Framework and Horizon 2020 Programmes, Enterprise Ireland, the Food Institutional Research Measure (FIRM) Programme of the Department of Agriculture, Food and the Marine, Science Foundation Ireland and Dairy Levy funding. The Teagasc Food Programme also generates income by conducting client funded contract research.

The Food Programme has enjoyed a seamless collaborative relationship with University College Cork for decades which has culminated in the formation of the Food Innovation Alliance. This was established to cement the mutual Teagasc and University College Cork Food Research activities, within a joint strategic approach. The objectives of the Food Innovation Alliance are to achieve critical mass and greater scientific depth in the areas of Food Science and Technology, Food and Health and Food and the Consumer. In addition the Alliance makes possible a “one stop shop” for Industry interaction with the research institutions.

ONE FOOD PROGRAMME

across two research centres





People, Science & Technology

People

Teagasc is a knowledge intense organisation which relies on its expertise, innovative capacity and research infrastructure for success. In total there are almost 300 staff involved in the Food Research Programme, comprising 40 permanent scientists, 14 permanent technical staff, 80 contract scientists and 100 post graduate students.

The quality of the science is reflected in the publication output for the programme, with an average of 180 peer reviewed publications per annum in addition to staff participation in editorships, memberships on national and international expert/advisory committees and working groups, and recognition in the form of both national and international awards. Food Programme staff actively engage with the food industry and are involved in collaborative and contract research with many national and international companies.

Teagasc Students

Annually, postgraduate fellowships are awarded under the Teagasc Walsh Fellowship Postgraduate Programme (mainly to Ph.D. level). The training of Walsh Fellows is aligned with Teagasc's mission to promote innovation in the Agri-Food sector. These young scientists will become the future drivers of Ireland's growing Agri-Food industry.



Teagasc Post-doctorates

Teagasc operates a Post-Doctoral Development Programme, to provide professional development opportunities for post-doctoral researchers. The programme is aimed at developing the performance of post-doctoral researchers while in Teagasc, while also equipping them with the necessary skills for the next stage of their career.

Technology

The Teagasc Food Programme spans the entire Agri-Food chain from farm production to food processing and innovation. It is supported by excellent infrastructure and extensive, modern and well equipped research and processing facilities. A number of unique facilities and specialist equipment underpins the Teagasc Food Programme including:

- **Specialised laboratory facilities** including dedicated level 2 and level 3 pathogen containment laboratories, an extensive cell culture facility, a small-animal feed testing facility, an analytical facility which includes UPLC-MS/MS, 2D Nano LC-MALDI-QTOF and Biacore instrumentation and fully equipped microbiology and biotechnology laboratories.
- **The Teagasc Sequencing Centre** contains a range of sequencers to cover genomic and metagenomic studies. These include Illumina NextSeq, Illumina MiSeq, ION Proton, ION PGM and Oxford Nanopore MinIon platforms.
- **The National Food Imaging Centre** which provides state of the art microscopes and an associated image management system to support analysis of food microstructure.
- **The Bio-Functional Food Engineering Facility** supports the development of dairy based ingredients and is specifically designed to support R&D associated with the Infant Milk Formula industry.
- **The Bioactive Protein Discovery Unit**, a world class facility with a proven track record in the purification of antimicrobial peptides. The unit is used for peptide purification, identification, analysis and generation via Ion Exchange, Reverse Phase and Size Exclusion chromatography, mass spectrometry, peptide synthesis and amino acid analysis.

- **Bioactive evaluation;** a broad series of bioassays are available for bioactive evaluation including antimicrobial assays, anti-infective assays, antithrombotic assays, anti-proliferative assays, anti-hypertensive assays, prebiotic/bifidogenic activity, pro-satiety assays, anti-obesity assays and immunomodulatory assays.
- **Bioactive bioengineering;** Researchers in Moorepark are world leaders in the use of bioengineering to carry out structure function analysis of bioactives and the generation of food-grade derivatives of existing bioactives with a view to enhancing activity and stability.
- **The Flavour Chemistry Facility** contains state of the art GCMS equipment and a range of automated discrimination techniques (TD/SPME/ITEX). This facility and research expertise are available to support industry in product development, flavour/aroma characterisation, product matching, and identification of off-flavours (aromas) or taints.
- **The Nutraceutical Research Facility** has expertise in extracting and purifying biologically active components from natural resources, quantifying potential and chemically characterising components via state of the art instrumentation including a High Resolution NMR Suite and Quadrapole Time of Flight Mass Spectrometer.
- **The NMR suite** consists of a 500 Mhz NMR spectrometer with both liquid and HR-MAS probes, which enables semi-solid samples to be analysed. It also contains an LC-NMR facility which allows the rapid determination of the structure of molecules from mixtures of compounds.
- **Cereal Chemistry Laboratory and Test Bakery Facilities** include a mill room, test bakery and dough rheology laboratory that support industry-led research into the use of a range of flours and novel formulations for baked goods and extruded snacks.
- **The Meat Industry Development Unit** encompasses a pilot scale meat facility incorporating a licensed abattoir (cattle, sheep, pigs and poultry); production units for processing and packaging of meat under controlled refrigeration systems and a cooked meats facility (curing, cooking, smoking). Process technologies include Tenderbound TM (hot boning and PiVac), electrical stimulation.



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Moorepark Technology Limited

A key feature of the Technology Transfer activity of the Food Programme is Moorepark Technology limited, a modern pilot plant facility containing the most up-to-date and versatile pilot scale processing equipment, offering services which include: Pilot plant rental, Contract research and development, Pre-commercial manufacture and Technical assistance/advice/support for food producers.



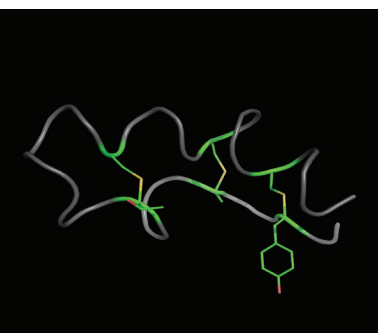
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**Teagasc Food Programme
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1. Food Biosciences

Introduction

The core objective of the Food Biosciences Department is to engage in advanced research and technology development in support of the Irish Agri-Food industry sector. Activities are organised into three research areas: an extensive Food for Health sub-programme; a food Microbiology and Biochemistry sub-programme and a Milk and Product Quality sub-programme.

The Food Biosciences Department is a partner in the Alimentary Pharmabiotic Research Centre (www.ucc.ie/research/apc) and Food for Health Ireland (www.fhi.ie).

The objectives are:

- To extract and/or modify food components and provide bio-functional molecules, as food solutions to address key societal diet related health concerns including gut health, cardiovascular disease, obesity, diabetes and infant nutrition.
- To exploit micro-organisms, microbial metabolites and bacteriophage as agents to control deleterious or pathogenic organisms in food systems or the gastrointestinal tract.
- To focus on the application of micro-organisms and their enzymes to impact on the sensory, textural, techno-functional properties and health benefits of a range of foods, with particular emphasis on cheese.

Food for Health: Research on the key societal diet related health concerns focuses on:

- Extraction and isolation of bioactive components from a range of food grade biological sources (milk, meat and marine origin).
- Extraction of phytochemicals from fruits, vegetables and cereals.
- Application of high throughput bioassays to screen for putative bioactive compounds
- Identification and structural characterisation of bioactives.
- Elucidation of the physiological mechanism(s) of action of bioactive molecules.
- Assessment of bioavailability

- Understanding the relationship between gut microflora and health status, and the potential of food to programme a healthy gut microflora.
- Biocontrol agents (bacteriocins and bacteriophage) for spoilage/pathogen control.

Cultures and flavour analysis: Research focuses on the:

- Application of micro-organisms and enzymes to the manufacture and ripening of cheese.
- Selection, identification and production of novel starter cultures of commercial interest.
- Investigating approaches to control and modulate the key sensory properties of cheese.
- Demonstration of the natural health benefits of cheese and application of novel approaches to enhance such benefits.
- Microbial-biotransformation; production of active metabolites by industrially important organisms

Milk Quality: While milk produced in Ireland is highly regarded there is an ongoing need to ensure that quality standards are maintained. Milk quality research is a cross departmental activity in the Food Programme and performed in association with AGRIP and focuses on:

- The microbial quality of raw milk.
- The growth of spore forming bacteria in milk processing streams.
- The mapping of milk factory flora via sequencing technologies

2. Food Chemistry and Technology

Introduction

The Food Chemistry & Technology Department is located at both the Teagasc Food Research Centres, with dairy science carried out primarily in Teagasc Moorepark and meat and cereals research at Teagasc Ashtown.

Dairy research focuses on cheese, infant formula and dairy-based ingredients. Meat research focuses on quality, whole chain management and recovering value from meat processing streams. Cereals research is focused on product quality and innovation in the bakery industry.

The objectives are:

- To understand proteins, minerals and other ingredient interactions in food systems.
- To understand the impact of ingredient composition, processing and storage conditions on micro- and macro-structural properties, and how this impacts the quality of dairy, meat and cereal products.
- To facilitate product modification and process optimisation through intelligent process design.
- To extract value from meat processing waste streams and by-products.
- To add value to an expanding milk pool.

Ingredient development and Infant formula/nutritional beverage research focuses on:

- The design of 'SMART' protein based ingredients in dehydrated form suitable for export via understanding of protein chemistry and the effects of thermal processing.
- Investigating the control of protein aggregation, mainly by understanding self aggregation of whey proteins and interaction with casein.
- Studying the interactions of proteins, carbohydrates and minerals in concentrated colloidal systems through optimisation of formulation and processing conditions.

Cheese research focuses on:

- Developing non-cheddar table cheeses and cheeses/cheese ingredient products for food service.

- Investigation of structure/function relationships and physical properties (e.g. macrostructure, rheology, functionality, opacity) by controlling protein-protein interactions, protein-mineral interactions, and product structure via alteration of milk composition, milk treatments, process modifications, type/level of added ingredients, and/or storage conditions.
- The development of 'SMART' processes for cheesemaking.
- Cheesemaking efficiency/component recovery and influence of stage of lactation and manufacturing process.

Meat research focuses on:

- Meat quality from a whole-chain meat management perspective.
- The application of genomic, proteomic, metabolomic and imaging technologies to elucidate underlying post-mortem molecular mechanisms and structural characteristics involved in regulating meat quality and the identification of biological markers of quality.
- Investigating food matrix properties, for the generation of targeted food systems which deliver consistency in product quality.
- Identifying physico-chemical parameters which influence sensory performance and technological functionality of processed meats.
- Strategies for recovery of value through generation of higher value functional products from the meat processing chain.

Cereals research focuses on:

- The development and transfer of enabling science and technology to support the bakery industry's needs and requirements for product quality and innovation.
- Fundamental and applied research on the links between food/ingredient structure and functionality.



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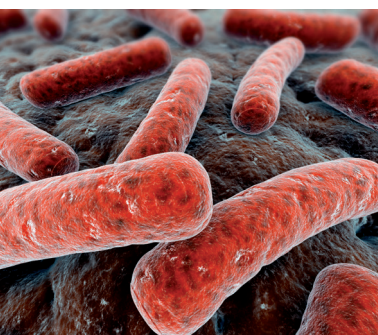




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3. Food Safety

Introduction

The safety and the integrity of food is fundamental to the sustainability and continued development of the Irish Agri-food sector and a 'risk based total chain approach' to food safety management is essential to reduce level of food borne illness.

The objective of the Food Safety programme is to provide the science to underpin a total chain risk based approach to food safety focusing on microbial and chemical contaminants in the "farm to fork" food chain.

The objectives are:

- To understand the transmission, behaviour, virulence potential of key and emergent microbial pathogens and to a lesser extent, spoilage organisms in Irish food.
- To develop predictive microbial models and quantitative risk models which can be used to assess and manage microbial risk.
- To develop novel controls for microbial pathogens and spoilage organisms.
- To develop state of art methods to detect and monitor for chemical contaminants including residues from veterinary drugs, environmental contaminants and natural toxins in the food supply.
- To develop quantitative risk models and exposure models for key chemical contaminants in the Irish food supply.

The Microbiology Programme addresses key food bacterial pathogens and specific food spoilage issues along the complete "farm to fork" chain with the main focus on zoonotic pathogens. The research areas addressed include:

- Pathogen transmission and tracking using molecular epidemiological tools.
- Pathogen behaviour and survival in the food chain including adaptation to stresses and resistance to antibiotics and biocides.
- Pathogenicity, virulence and its molecular basis.

- Development of predictive modelling and quantitative risk assessment models.
- Development of novel interventions, strategies, particularly biocontrols.
- Specific issues related to microbial spoilage (packaged meat) and quality (milk) that are of concern to the Irish food industry.
- Some of the main issues being addressed are verocytotoxigenic *E. coli* in meat and dairy sectors; *Salmonella* in pigs and pork, *Listeria monocytogenes* in dairy and ready to eat foods, *Campylobacter* in poultry, and pathogen resistance to antibiotics and biocides.

Chemical contaminants: The research on chemical contaminants focuses in particular on veterinary drug residues, and includes research on environmental contaminants and natural toxins in the food supply. The research includes:

- Development of state of art methods to detect chemical contaminants using mass spectroscopy and biosensor technologies.
- Investigation of the fate of residues during processing.
- Application of the technologies as part of the national residue monitoring plan.
- The data and technologies underpin a quantitative risk based approach to the control and management of chemical residues in the food.

4. Food Industry Development

Introduction

Irish food businesses face constant challenges to be competitive, sustain existing and new markets and comply with a demanding regulatory environment. Teagasc, working in conjunction with other national development agencies, provides a comprehensive support service for the food processing industry with a particular focus on supporting Small and Medium sized Enterprises (SME) and start up food businesses.

The objectives are:

- To provide technology development and problem solving supports for the food SME sector, food start up businesses and related stakeholders, through specialist technical training courses and seminars, company specific consultancy, product development and testing, and a technical information service.
- To support research knowledge and technology transfer to industry and other stakeholders, through specific research dissemination activities, and interactions with industry in training, consultancy, product development and technical information.

Technical Training Courses and Seminars

Specialist technical training courses and seminars are provided in key areas of emerging technologies, legislation, and outputs from the food research programmes. Topics encompass food safety, quality management systems, food processing, ingredient and packaging innovations.

Product Development Supports

- This includes technical advice, access to modern food processing plant and product testing in microbiological, chemical, physical and sensory analysis.

Consultancy, Food Assurance Standards

- Provides support, usually in-company, in the development, implementation and maintenance of industry and regulatory food assurance standards.

Pilot Plant facilities

- A wide range of modern food processing facilities and equipment are available to food businesses at both Teagasc Ashtown and

Teagasc Moorepark. An ultra modern pilot plant, Moorepark Technology Ltd., containing the most up-to-date and versatile pilot scale processing equipment exists on the Moorepark campus. MTL has a wide range of capabilities in general food and food ingredient development and is arranged in a modular structure of self-contained processing areas which guarantees single client access and total confidentiality.

- At Teagasc Ashtown a pilot production scale facility is available which includes incubation units and a range of processing and test equipment. These include an abattoir, cooked meats plant, bakery, prepared foods plant, product development and sensory test kitchens.

Technical Information Service

- This service is provided for food businesses relating to problem solving or requests for information on new product development, commercial or regulatory requirements for food production.

Food Market Research Unit

- This unit located on the Teagasc Ashtown campus is part of the Teagasc Rural Economy and Development Programme. In addition to undertaking strategic research to understand key drivers of consumer behaviour, market developments and innovation processes, it underpins the activities of the Food Programme. Specifically, it collaborates on many projects within the Food Programme to ensure that technical outputs are market-oriented and developed based on an understanding of consumer requirements.



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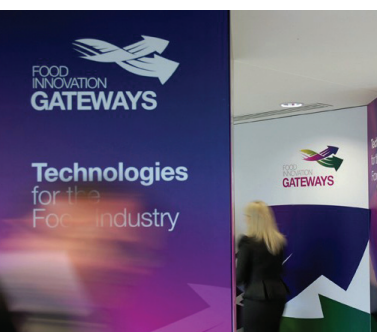




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Food Technology and Knowledge Transfer

Introduction

Innovation is one of the keys to accelerating economic recovery. The Teagasc Technology and Knowledge Transfer Strategy underpins the implementation of a systematic, effective and flexible technology transfer process which promotes science based innovation in the Agri-Food Sector.

A 'culture' of technology transfer and an environment in which it can flourish exists within the Food Research Programme. Teagasc food researchers demonstrate leadership, flexibility, entrepreneurial and other skills in order to deliver an effective technology transfer function in their area. The newly established Teagasc Technology Transfer Office assists researchers and their teams to build collaborations with industry.

Technology and Knowledge Transfer mechanisms take many forms within the Food Programme and include industry collaborations, contract research, services to large public/private contractors, agreements or licensing, acquisition of technologies, in addition to commercial service arrangements (incorporating training courses, consultancy provision and other services).

Central to these mechanisms are mutual trust, credibility, confidentiality, clear business objectives and high quality customer relationship management. Teagasc values its extensive industry interactions and has stringent policies regarding IP management, contract agreements and confidentiality.

The objectives are:

- To develop best practice in technology transfer.
- To develop a Technology Marketing Portfolio which ensures our technologies, capabilities and expertise are widely accessible (at www.teagasc.ie) and describes:
  - *Technology Offers* that can be marketed for exploitation by potential users.
  - *Technology Updates* which summarise the main findings of Teagasc research projects and describe technologies which can be further developed in partnership with external clients.
  - *Specialised Services* which are offered from the Ashtown and Moorepark sites.
  - *Technology Expertise* which gives an overview of our advanced technical equipment and pilot plant facilities.
  - *Experts* which profiles our key contact research and development staff.
- To foster key collaborations and strategic partnerships with industry and state agencies by proactively engaging with external stakeholders to align our technologies and capabilities to solution focused programmes and projects.

Our TTO staff are ready to assist in facilitating, enhancing and supporting the transfer of IP resources and information to the food industry and other stakeholders.

For further information view our Food Portfolio at <http://www.teagasc.ie/research/collaboration/>



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