DAFM FIRM 2015 Call Project Abstracts

DAFM Reference	Project Title	Lead(Collaborating)Institution	Award
15F602	Novel Technological Approaches for the developmenT of low FodMap food products. (TalentFood)	UCC (Teagasc, CIT)	€1,072,198
Project Coordinator: Prof Elke Arendt			
Project Abstract			
Irritable bowel syndrome (IBS) is the most common functional gastrointestinal disorder and has an estimated global prevalence of 10-20% of the general population and constitutes the most common cause of gastroenterology referral. IBS symptoms are triggered by the consumption of the poorly absorbed fermentable oligo-, di-, monosaccharides and polyols (FODMAPs) and insoluble fibre. On reaching the distal small intestine and colon, FODMAPS and insoluble fibre increase the osmotic pressure in the large-intestinal lumen and provide substrates for bacterial fermentation, with consequent gas production, abdominal distension and abdominal pain or discomfort. This condition reduces considerably the patients' quality of life. Sixty-two percent of IBS patients either limited or excluded certain food items from their daily diet and of these 12% were at risk of long-term nutritional deficiencies. In patients with IBS, a diet low in-FODMAPs effectively reduced functional gastrointestinal symptoms. This high-quality evidence supports its use as a first-line therapy. FODMAPs occur in a wide range of foods, including wheat/rye, and people in numerous countries (including Ireland) rely on bread and wheat products (e.g. bread and pasta), for a substantial part of their diet. Nowadays, in Ireland, there are no low-FODMAP food products available on the market and IBS sufferers are forced to follow FODMAP elimination diet by excluding a wide range of foods form their diet. Low-FODMAP diet should not limit IBS suffers' life, it should limit their pain and discomfort, such that they can lead a normal (pain-free) life. TALENT project will develop cereal-based low-FODMAP food products by providing effective technological solutions using enzymatic/malting and fermentation processes with remarkable reductions on FODMAPs and with a concomitant improvement of their nutritional qualities. A strong participation of food industry partners and support associations in this project will help contribute to the social feasibility and economic viability of the strategies developed.			

DAFM Reference	Project Title	Lead(Collaborating)Institution	Award
15F604	Thermal Or Membrane processing for Infant formula (TOMI)	Teagasc (CIT)	€590,964
Project Coordinator: Dr Linda Giblin			
Project Abstract			
TOMI will produce infant milk formula (IMF) by cascade membrane filtration (CMF) as an alternative to thermal processing. This next generation IMF will be safe with enhanced bioaccessibility, bioavailability and digestion of proteins, peptides and fats. At present IMF undergoes rigid heat treatment to ensure microbiological safety and long shelf life. As a consequence of the special composition and the heat regimen, IMF is more prone to thermally induced degradation reactions than regular milk products. At the same time, regulations (Commission Directive 2006/141/EC) specify that IMF composition is able to satisfy (1) normal physical growth and (2) is of sufficient biological quality (adequate amounts of protein and in a form that can be utilized by infants). There is scope to improve the nutritional quality of IMF by reducing the thermal load. However this must be accomplished with a clear quantification of the benefits and without compromising safety. The objective of this project is to formulate IMF with reduced levels of thermal treatment using CMF. The process and product will be evaluated to ensure safety is not compromised. TOMI will map the fate of CMF IMF during gastro-intestinal digestion using pioneering intestinal models to investigate bioaccessibility and bioavailability of proteins, peptides and fats and compare results to thermally processed IMF. A real strength of TOMI is the use of piglets in a 28 day feeding trial to mimic the infant gut. IMF represents a particularly important food category to the Irish food sector with approximately 10% of the entire global exports of IMF manufactured in Ireland. This project addresses a primary concern of the IMF industry and has the potential to radically improve the quality of IMF produced in Ireland.			

DAFM FIRM 2015 Call Project Abstracts

DAFM Reference	Project Title	Lead(Collaborating)Institution	Award
15F610	Novel Clean label Strategies for the Nutritional and Sensory Optimisation of Reduced Salt and Fat Processed Meat Products (NAPRIPOT)	UCC (Teagasc)	€871,796

Project Coordinator: Dr Maurice O' Sullivan

Project Abstract

NATRIOPT optimises processed meats through the reduction and or replacement of salt and fat using novel ingredients as replacers (eg. **edible seaweeds)**. Potential therapeutic benefits of seaweed consumption have been reported in the management of body weight, obesity and cardiovascular diseases thus offsetting negative effects of salt and fat. There is also considerable evidence that heterogeneity of distribution of salt content (eg, two batters with different salt contents unevenly mixed or encapsulation) in processed products enhances sensory perception of salt flavour intensity. Additionally inclusions of aromas that suggest saltiness and fat/creaminess can offset the sensory disadvantages of salt- and fat-reduced products and is termed Odour-induced saltiness enhancement (OISE). These will be explored along with the effects of matrix changes on flavour chemistry systems utilising advanced GC (Gas Chromatography) techniques. Salt and fat reduction has a major impact on flavour perception due to changes in the ratios of polar and non-polar flavour molecules. To date this has not been comprehensively undertaken and adds a unique dimension to the proposed project. This data, captured from state of the art GC techniques as well as sensory and consumer data will be mined using chemometrics. Thus this deep understanding of the inherent flavour chemistry systems involved in salt and fat reduction/replacement combined with affective (hedonic) sensory data will allow for the development of optimised products from both a nutritional and sensory perspective. To date UCC and AFRC have obtained very extensive experience in nutritionally optimising processed meats (PROSSLOW, MEATMATRIX) and are uniquely aligned in progressing the state of the art in this field. This is very timely considering recent negative scientific reports and media attention concerning processed meats. By building on existing knowledge and utilising novel natural replacers, products which are more appealing to consumers can be developed.

DAFM Reference	Project Title	Lead(Collaborating)Institution	Award
15F629	Surveillance of Verocytotoxigenic E. coli in Ireland: A One Health Approach (Vtec One for Health)	Teagasc (UCD, HSE)	€1,249,332

Project Coordinator: Dr Geraldine Duffy

Project Abstract

Ireland has the highest rate of human clinical cases of verocytotoxigenic *E. coli* (VTEC) in the EU, at around 15 cases per 100,000 population, compared to an EU average of 1 case per 100,000. Globally, the profile of VTEC strains causing human illness is continuing to change, and a diversity of serogroups outside the top six (O157, O26, O103, O111, O145, O104), with a variety of virulence profiles, now account for a substantial proportion of VTEC human clinical illness cases (~ 30% in EU in 2013, EFSA, 2015). It is not currently possible to fully define markers for human pathogenic VTEC or the factors that absolutely predict potential to cause human disease (EFSA, 2013). Nonetheless EU DG SANCO and the MS Competent Authorities are taking the view that 'unknown risk' does not mean 'no risk' and that a risk assessment is required if VTEC is recovered in a food product. This illustrates the continuing emergence and challenges posed by this diverse group on pathogens for the consumer, regulators and food business operators (FBOs). This project proposes a One Health approach to surveillance of VTEC in Ireland, with cross-sectoral collaborations across the environment, agri-food chain, veterinary and human public health. Value will be added, by linking the proposed project with other externally funded research and activities on this pathogen. The project will address key data gaps in Ireland on the prevalence and types of VTEC circulating in the agri-food chain and assessment of their human risk potential. The scientific platform to be exploited will be whole genome sequencing of Irish VTEC strains from the environment (wild-life, water, waste), food producing animals (cattle and sheep), food (raw milk cheese, sprouted seeds and fresh produce, meat), and human illness facilitating a national comprehensive comparative analysis of strains from across the total chain, in line with approaches currently being taken in other countries. The metadata on all isolates will be combined with phylogenetic information from the WGS to investigate geographical and temporal linkages and for source attribution of human VTEC isolates.

DAFM FIRM 2015 Call Project Abstracts

DAFM Reference	Project Title	Lead(Collaborating)Institution	Award
15F635	Generation of Functional Foods to Promote the Growth of Newly Identified Health Associated Microbes in the Gut (NIHAM Foods)	Teagasc (ITT, UCC)	€603,909

Project Coordinator: Dr Paul Cotter

Project Abstract

Irish researchers have established themselves as global leaders in the gut microbiota field. **It is critical that we do not now miss the opportunity to take advantage of the ever greater understanding of the composition of the human gut microbiota and its contribution to health and disease to develop new functional foods that enhance health through targeted programming of the microbiota (Thematic Research Area B.3.1)**. Until now, **prebiotics** (nondigestible food ingredients used by beneficial bacteria) were employed with a view to enhancing the growth of the classical, health promoting gut microbes (or **probiotics**), *Lactobacillus* and *Bifidobacterium*, only. However, the application of new DNA sequencing techniques have **revealed the next generation of health associated gut microbes**. These include *Akkermansia muciniphila* (anti-obesity), *Faecalibacterium prausnitzii* (anti-inflammatory), *Eubacterium rectale*, *Ruminococcus bromii* and *Roseburia* sp. (all butyrate producers*) across a number of **cohorts of the population with specific nutritional needs, including infants, young children, adolescents, obese individuals and older people**.

Species	Associated with	Representative (of many) Refs
A. muciniphila	Lean phenotype, Good metabolic health	Dao et al., 2015. Le Barz et al., 2015.
F. prausnitzii	Decreased inflammation, Butyrate production, General gut health	Miquel et al., 2013 Quévrain et al., 2015
E. rectale	Butyrate production (including maintaining gut barrier integrity, reduced artherosclerosis, lower heart attack risk as well as anti-obesity/anti-diabetes benefits)	Ohashi, et al., 2015.
R. bromii	Butyrate production (including maintaining gut barrier integrity, reduced artherosclerosis, lower heart attack risk as well as anti-obesity/anti-diabetes benefits)	Zhong et al., 2015.
Roseburia sp.	Butyrate production (including maintaining gut barrier integrity, reduced artherosclerosis, lower heart attack risk as well as anti-obesity/anti-diabetes benefits)	Dostal et al., 2015 Zhong et al., 2015.

While it is relatively difficult to grow these microorganisms sufficiently well to facilitate their direct use as probiotics, it is possible to instead **develop bioactives and growth substrates that can be incorporated into functional foods to encourage the growth of these microbes already naturally present (but at sub-optimal levels) in the human gut. If we do not take advantage of this knowledge immediately, we will miss an 'once-in-a-generation' opportunity to provide Irish industry with a key advantage in the functional food/gut health space.**

During the course of 'NIHAM-Food' (Foods for **N**ewly**I**dentifed**H**ealth**A**ssociated**M**icrobes), bioinformatic analysis of the metabolic pathways present within these microbes (using genome sequence information that is already available) and high-throughput growth assays will be employed to identify the functional food components that will encourage their growth in the laboratory and, ultimately, within the gut. Food processing technologies will be employed to optimise the extraction and application of these nutrients and *in vivo* and *in vitro* studies will be employed to demonstrate the extent to which the components enhance the growth of these highly-desirable microbes. Ultimately, the project will lead to the development of new, value-added functional foods that enhance health and wellness throughout the lifecourse. **Given that increases in proportions of *A. muciniphila*, *F. prausnitzii*, *Eubacterium rectale*, *Ruminococcus bromii* and *Roseburia* sp. would all benefit obese individuals, there will be a particular focus on this cohort when it comes to the human intervention Task within this project. However, it is anticipated that the functional foods developed would positively impact on the gut health on a large proportion of consumers.**

* butyrate production has been associated with a number of beneficial effects including maintaining gut barrier integrity, reduced artherosclerosis, lower heart attack risk as well as anti-obesity/anti-diabetes benefits

DAFM FIRM 2015 Call Project Abstracts

DAFM Reference	Project Title	Lead(Collaborating)Institution	Award
15F641	Clean Broilers through Enhanced Farm Biosecurity, Processing Prerequisites and HACCP Based Interventions (Clean Broilers)	Teagasc (UCD, CIT)	€1,117,171

Project Coordinator: Dr Declan Bolton

Project Abstract

Campylobacter is the commonest bacterial cause of gastroenteritis in Ireland and Europe. In 2013 (the last year for which there is data available) there were an estimated 68,705 cases of infection in the Republic of Ireland (HPSC, 2015, EFSA, 2010a). Data from the European Centre for Disease Prevention and Control (ECDC) suggests that approximately 43% of confirmed cases are hospitalised. Moreover, although specific data is not available for Ireland, the economic burden of campylobacteriosis is reported to be in the region of £900m for the UK and €2.4bn in the EU, per annum. The handling, preparation and consumption of broiler meat accounts for approximately 20% to 30% of human campylobacteriosis cases, while 50% to 80% may be attributed to the chicken reservoir as a whole (EFSA, 2011). A public health risk reduction of at least 50% would be achieved if all broiler batches complied with microbiological criteria setting a critical limit of <1,000 (103) CFU/g neck skin (EFSA, 2011). Thus, the European Commission recently published draft legislation amending Regulation (EC) No 2073/2005 and proposing processing hygiene criteria (PHC) for the poultry sector. It is proposed that 15 birds will be randomly selected per flock, 10g of neck flap shall be taken and pooled to give 5 x 25g final samples. Within a moving window of 50 samples, no more than 5 may exceed the limit of 103 cfu/g. It is planned that this legislation be in place by September 2016. The EC are currently discussing intervention options to assist processors in achieving this target. To date EFSA have considered the use of trisodium phosphate, acidified sodium chlorite, chlorine dioxide or peroxyacid solutions. All are considered to be 'safe' for use and effective in achieving the Campylobacter reductions required (EFSA, 2011).

The specific objective of this project is to ensure that the maximum number of birds at retail are as clean as possible thus facilitating compliance with the proposed EC Campylobacter PHC. This will be achieved by reducing neck skin Campylobacter counts on all first thin broiler batches to <103 CFU/g through the development, validation and transfer of improved biosecurity on broiler farms and more effective prerequisites (GHP) and HACCP interventions in the processing plant. The commercial cost (cost-benefit analysis) of changes in practices (eg. feeding regimes & removing thinning) and interventions (eg. freezing) to treat noncompliant birds (carcass Campylobacter counts in excess of 103 cfu/g) will also be assessed.

In addition to protecting public health, our research will assist our poultry industry stakeholders in achieving compliance with the new EC Campylobacter process hygiene criterion, including preventative measures and corrective actions for FBOs if the microbiological criteria are not achieved. The project will also deliver a 'demonstration farm' to assist in the training of broiler farmers and a virtual Campylobacter data centre (VCDC) to manage (collate, store and analyse) the Campylobacter broiler testing data generated by the private laboratories for the 3 major poultry processors in the Republic of Ireland. The information generated, in combination with the baseline data obtained in this project, will be important in better understanding and monitoring/assessing improvement in the broiler Campylobacter issue. Finally, the research approach and outputs are specifically designed to complement and integrate into the antimicrobial susceptibility testing (AST) programme (undertaken at DAFM Backweston) required under new legislation in 2016 and beyond.

DAFM FIRM 2015 Call Project Abstracts

DAFM Reference	Project Title	Lead(Collaborating)Institution	Award
15F647	Incorporation of novel brewers' spent grain (BSG)-derived protein hydrolysates and blended ingredient in functional foods for older adults and assessment of health benefits in vivo. (BSG-NIVO)	UL (UCC, CIT)	€683,937

Project Coordinator: Prof R.J. Fitzgerald

Project Abstract

Brewer's Spent Grain (BSG) represents a substantial waste product of the Agri-Food sector. Previous and ongoing research in our laboratories has isolated protein and polyphenolic co-fractions, which have demonstrated *in vitro* antioxidant and anti-inflammatory effects. The proposed research aims to build on this knowledge by optimising the extraction of BSG protein, phenolics, carbohydrate and lipid by methods including enzymatic extraction, solvent extraction and isoelectric precipitation. All fractions will be fully characterised by advanced chromatographic methodologies including reverse-phase high-performance liquid chromatography and ultra-performance liquid chromatography. It is proposed that producing a novel blended ingredient incorporating each isolated fraction would result in synergistic bioactive effects and yield an ingredient with more potent and complete health-promoting properties. All fractions produced will be initially screened for bioactivities of interest *in vitro;* antioxidant, immunomodulatory, anti-hypertensive, effect on adipocyte metabolism and satiety signals. This initial screening process will inform the production of a novel blended ingredient and allow the selection of samples with greatest bio-efficacy for incorporation into food formulations. These food products will be specifically tailored for the older adult cohort, being informed by national dietary databases and allowing for physiological changes occurring with aging and needs and preferences of older adults. A range of formulated foods will be analysed for their sensory acceptability using sensory trials and will evaluate texture, flavour, aroma, appearance and overall acceptability. The functional food with greatest acceptability will be selected for a human interventional trial in older adults. This randomised double-blind placebo-controlled trial will measure the effect of the functional food with BSG-derived ingredient(s) on biochemical and functional markers including blood lipids, glucose, inflammatory markers, serum glutathione, weight, body mass index, waist circumference, blood pressure and muscle strength. In the final phase of the project, *in vivo* findings will be further validated *in vitro* and mechanisms of action identified.

DAFM FIRM 2015 Call Project Abstracts

DAFM Reference	Project Title	Lead(Collaborating)Institution	Award
15F670	Development of biofortification approaches for enhanced vitamin K content of foods: proof of stability, efficacy and sensory appeal (BioKfoods)	UCC (Teagasc)	€533,403

Project Coordinator: Prof Kevin Cashman

Project Abstract

Vitamin K has important physiological functions which relate to blood coagulation (its classical role), but also bone turnover and strength, inhibition of arterial calcification, amongst others. Inadequacy of vitamin K intake is common in all age groups within the population, and this translates into under-carboxylation of key Gla-proteins, respresenting sub-clinical vitamin K deficiency – also common in the population. Clearly, there is an urgent need for food-based strategies for increased vitamin K intake so as to minimise risk of sub-clinical vitamin K deficiency. There are, however, some important hurdles which point towards the need for more creative food-based solutions. For example, vegetables and vegetable dishes are key food contributors to vitamin K intake. Promoting greater vegetable consumption in the population, across all age groups, has been a mainstay of dietary guidelines over several decades, but adherence and uptake of this advise has been challenging. Biofortification of foods with vitamin K is an important potential complementary food-based approach to addressing low vitamin K intakes in the overall population, young and old. Eggs have been shown to be an ideal vehicle for biofortication with vitamin D and cultured/farmed fish likewise. The same approach can be adopted for vitamin K, with scope to potentially increase the content of phylloquinone (vitamin K1) and/or menaquinine (vitamin K2) in eggs and cultured fish. These two foods are being used as exemplars in this project, but there are numerous foods which could be used likewise. The biofortification approach needs to be evidence-based, and this project will bring together a multidisciplinary team of human and public health nutritionists, analytical chemists, food technologists, sensory scientists, and animal nutrition and feed, poultry and culture fish specialists. This research will contribute to the development of functional food products capable of enhancing nutritional status of the consumer while assuring consumer/sensory acceptance.

DAFM Reference	Project Title	Lead(Collaborating)Institution	Award
15F673	National Children's Food Consumption Survey II. (NCFS II)	UCC (UCD, DIT)	€1,242,170

Project Coordinator: Prof. Albert Flynn

Project Abstract

The overall objective of this project is to establish for the Republic of Ireland (ROI) a nationally representative database of food consumption in children aged 5-12 years to update 2003-04 data for this group and to complement more recent data on preschool children and adults. The survey will be comparable with existing survey data in ROI and with surveys in UK (GB & NI). The ROI database will be designed to address both nutrition and food safety issues of relevance to the development and implementation of public health policy, food safety risk assessment and to the needs of the food industry.

In addition to detailed data on food consumption, data will be also be collected on body weight, lifestyle, including physical activity, determinants of food choice, urine, and composition of foods and food recipes. Food composition databases will be updated and restructured to facilitate future analyses of food ingredients, packaging materials, residues, contaminants, allergens, bioactives and microorganisms. Urine samples will be stored to facilitate future analyses nutrition and metabolic indicators, markers of food intake and for estimating exposure to food chemicals.

Data will be analysed to estimate intakes of foods and nutrients and compliance with dietary recommendations, to establish the prevalence of overweight and obesity, to investigate physical activity patterns and compliance with guidelines, to identify psychological, social and attitudinal determinants of food choice and eating behaviour. Salt intake will be estimated from urine excretion. Findings will be disseminated to relevant stakeholders.

The project will be carried out by a multi-disciplinary research team with strong linkages to related on-going research in food and health sciences.

DAFM FIRM 2015 Call Project Abstracts

DAFM Reference	Project Title	Lead(Collaborating)Institution	Award
15F679	Developing the next generation of protein-enriched spray dried dairy powders with enhanced hydration properties (DAIRYDRY)	Teagasc (CIT, UCC, UU, WIT)	€2,557,837*

Project Coordinator: Dr Mark Auty

Project Abstract

There is a growing market for high protein powdered dairy ingredients. These powders are often poorly soluble, causing major problems both in manufacturing and the end-user. There is a need to develop high protein powdered ingredients optimized for quality and ease of dispersion. Little is known of the mechanism of dairy powder hydration, and new methods and data are needed to understand the key factors controlling powder hydration. New process technology will be developed to efficiently hydrate primary ingredients before spray drying. Poor hydration of high protein powders is a generic problem frequently manifested as high sediment, surface free fat/flecks and fouling of process pipelines. The standard industry-accepted test for powder solubility is based on crude sedimentation. Little is known about how powder formulation/processing affects rehydration at the molecular and particularly the nano/microstructural scales due to the complexity of powder constituents, shear forces and speed of hydration. This project is an innovative major collaboration bringing together Ireland's leading research centres in the areas of dairy science, ingredient and process dehydration technology, photonics, and imaging expertise. New protein-enriched dairy powders will be formulated and processed using pilot-scale liquid processing and spray drying facilities. A new Industry Advisory Board, comprising Irish dairy processors will ensure industry relevance. Physico-chemical properties will be characterized at the molecular, nano- and microscales in real time using advanced spectroscopy, microscopy and high speed imaging. Prototype photonics-based sensor devices including off-line flow cells and in-line infra-red sensors will be developed to measure the pattern of dispersion and dissolution of specific constituents such as lactose, proteins and milk salts using infra-red and Raman spectroscopy. New tools will thus be developed to characterise and measure hydration of individual powder particles for the first time. Results will be used to reverse engineer new base powders optimised for rehydration.

Total Award (denotes projects co-funded by DAERA)

DAFM FIRM 2015 Call Project Abstracts

DAFM Reference	Project Title	Lead(Collaborating)Institution	Award
15F683	Future proofing the Irish cheese-whey industry – a step change process to move Irish dairy commodities up the value chain. (SETUP)	Teagasc (UCC)	€599,000

Project Coordinator: Dr John Tobin

Project Abstract

Dairy processors in Ireland must future proof their operations against price volatilities in dairy commodities, particularly based on the outlook for the 2016 production season. This project targets novel valorisation technologies, such as new fractionation designs, which fit existing production platforms, for future investment. The creation of high added value in existing product portfolios, particularly cheese and whey, will help buffer the Irish dairy industry against international market volatilities.

The STEPUP project aims to revolutionise cheese and whey processing technologies in the Irish dairy industry by reversing the cheese to whey relationship in both Cheddar and Swiss type commercial processes. As such this project will develop, low temperature, scalable, cascade ceramic/organic microfiltration (MF) and ultrafiltration (UF) processes to create whey depleted recombined milks suitable for cheese making.

The soluble proteins (whey/β-casein) removed prior to cheese making will provide processors with an ideal whey source which is extremely desirable for sports/nutritional products and in particular to infant formula manufacturers due to improved nutritional quality. The absorption of the whey depleted milks in custom cheeses suitable for manufacture in typical Cheddar/Swiss type plant designs, creates options for cost effective stabilisation of caseins in low operational cost (as compared to spray drying), long shelf life products (i.e. cheese). Additionally Irish cheese manufacturers will benefit from the new cheese varieties of Cheddar, Swiss and Quark style cheeses created by the STEPUP project, which will be specifically targeted for export markets, which already absorb ~172,000 tonnes of cheddar type cheese and 35,000 tonnes of speciality cheeses from Irish processors per annum.

Finally removal of whey proteins before cheese manufacture will mean that subsequent whey streams will contain little or no whey proteins. However, the protein composition of whey produced by the STEPUP project will be dominated by Glycomacropeptide (GMP), which will provide Irish dairy processors with a high value, highly functional glycoprotein stream for use in staged nutritional/medical products.

DAFM FIRM 2015 Call Project Abstracts

DAFM Reference	Project Title	Lead(Collaborating)Institution	Award
15F685	Functional foods for Optimal nutrition for healthier Ageing (OPTI-AGE)	UCD (UU)	€598,615*

Project Coordinator: Dr Michelle Clarke

Project Abstract

Osteoporosis is a major public health problem among older adults. Given the significant healthcare costs of treating osteoporosis and its consequences, new strategies to maintain better bone health in older age are urgently needed. Vitamin D and calcium have well established preventive roles against osteoporosis, but other nutritional factors are emerging, with recent evidence suggesting important protective roles for folate and the metabolically related B vitamins. We hypothesise that the beneficial effects of B-vitamins will be observed in older adults at-risk of sub-optimal B-vitamin status (either because of low dietary intakes or a genetic variant in metabolism). The aim will be to develop and test a new functional food product designed to enhance bone health in older Irish adults.

We will draw on the Trinity Ulster Department of Agriculture 'TUDA' study, the largest database of its kind in Europe, providing comprehensive data on 5200 older Irish adults recruited from both North and South of Ireland (as part of a previous FIRM initiative with co-funding from DEL NI). We will build on our recent TUDA findings showing that those with low B-vitamin intakes (or genetic variation in folate metabolism) were at significantly higher risk of osteoporosis. In parallel studies at UCD and Ulster, we will conduct a 2-year randomised controlled trial (RCT) to demonstrate the benefit on bone health of combined low-dose B vitamins (folic acid and vitamins B12, B6 and B2) in 'at-risk' older people (n=228). Concurrently, in collaboration with our industrial partners, we will develop a new B-vitamin fortified drink and conduct a 4-month controlled intervention study (n=80) to test its effectiveness in optimising B-vitamin status in the target group.

The research outputs anticipated from this project will benefit the Irish Agri-Food Sector via development of a new functional food with proven health benefits in meeting the specific needs of older adults.

Total Award (denotes projects co-funded by DAERA)

DAFM Reference	Project Title	Lead(Collaborating)Institution	Award
15F690	Research supporting the unpasteurised milk and associated cheesemaking industry from a food safety perspective (Raw Milk Cheese)	Teagasc	€149,627

Project Coordinator: Dr Kieran Jordan

Project Abstract

Ireland's agri-food sector accounts for approximately €24 billion of the Irish economy and the dairy industry is one of the most important, indigenous industry sectors. The abolition of milk quotas in 2015 presents the opportunity to significantly increase Ireland's production of milk and associated added value products, for example, cheese. Ireland has an international reputation for the quality and variety of its artisan food products, including cheese made from unpasteurised milk. It is important for the entire dairy industry that this reputation is not damaged. Therefore, there is an urgent need to develop advanced analytical methodologies and risk tools to analyse the risks associated with unpasteurised milk cheese. The aim of this project is to assess microbiological (general microbiological quality and foodborne pathogens), toxicological (mycotoxins) and residue (anthelmintic drug residues) risks associated with unpasteurised milk used for cheesemaking. Exposure to such contaminants will be assessed, and appropriate advice will be given to the cheese producers in order to give research support to the industry and protect consumer health. During the project, 400 samples of unpasteurised milk and associated cheese (from at least 10 unpasteurised milk cheesemakers) will be assessed for microbiological, toxicological and residue risks.

DAFM FIRM 2015 Call Project Abstracts

DAFM Reference	Project Title	Lead(Collaborating)Institution	Award
15F698	Seaweed-Microbe Interactions to enhance bioactive yields for food applications (SMO-BIO)	NUIG (UCC, Teagasc)	€824,992

Project Coordinator: Dr Dagmar Stengel

Project Abstract

Irish seaweeds are recognised as an important source of valuable bioactives with, e.g., antioxidant, anticancer, anti-inflammatory, antidiabetic potential for food applications. However, their chemical composition is highly variable, and fluctuates according to environmental influences. More recently, the impacts of biotic (including microbiome) impacts on algal chemical composition and associated bioactivity have been demonstrated but the implications of these impacts on algae used for food applications remain poorly understood. Additionally, storage and processing methodologies influence both directly (e.g. degradation/oxidation processes) and indirectly (through microbe-mediated processes) the food value of algal biomass. This project will assess the role of seaweed-associated bacteria in bioactive production, and potential degradation, and investigate the scope to apply naturally produced enzymes to increase bioactive yields.

Project objectives are to 1) perform for the first-time a characterisation and isolation of bacteria associated with natural Irish seaweeds of food value, 2) evaluate the role of epiphytic bacteria in bioactive production by seaweeds and induced enhancement of bioactive yields, 3) assess the impact of storage and processing conditions on high value compounds in seaweed food species, and 4) assess microbial enzymatic activity with potential applications in bioactive recovery by enzyme-assistant extraction.

This project combines established expertise in seaweed biology (NUI Galway; Stengel), microbial biotechnology (UCC: Dobson; NUI Galway: Fleming) and food science and chemistry (Teagasc Ashtown: Rai). It builds on existing capacity developed under the Marine Beaufort Biodiscovery Discovery Programme (http://www.qub.ac.uk/research-centres/MarineBiodiscovery/) (and NutraMara, (http://www.nutramara.ie/) as well as recent FIRM-funded projects and a recently funded ERA-net project (Marine Biotechnology) NEPTUNA (http://www.marinebiotech.eu/sites/marinebiotech.eu/files/public/NEPTUNA%20Project%20description%20ERA-MBT%20Call%201.pdf). A link between bacterial colonisation, diversity and seaweed functionality, and biochemical composition and related bioactivity will be established for selected seaweed species with recognised value to the Irish seaweed/food industry. Expected project outputs include characterisation of novel seaweed bioactives; processes to enhance bioactive levels and composition, and reduce algal biomass degradation by selecting appropriate storage methodologies; and the development of new applications in bioactive extraction technologies.

DAFM FIRM 2015 Call Project Abstracts

DAFM Reference	Project Title	Lead(Collaborating)Institution	Award
15F702	Campylobacter – Control On-farm via Prevention and Exclusion (Campclean)	NUIG (Teagasc)	€599,284

Project Coordinator: Dr Cyril Carroll

Project Abstract

Campylobacter infections are the leading cause of gastroenteritis worldwide with poultry meat identified as the primary vector due to carcass contamination from intestinal pathogens. An estimated 2 log10 reduction of intestinal C. jejuni counts would yield a 30-fold decrease of human cases of campylobacteriosis. Extensive ongoing research to reduce flock contamination, including bio-security, vaccination, phage therapy and competitive exclusion using probiotic feed additives containing naturally occurring bacteria with bacteriocin activity, have had little impact to date. The aim of the Campyclean project is to provide poultry producers and processors with novel, safe natural biocides and cleaning treatments to reduce the prevalence and level of Campylobacter in poultry flocks.

This project will capitalise on prior research projects at NUI Galway and Oilean Glas Teoranta, which identified GRAS, polysaccharide-based bioactives from seaweed with the ability to achieve a Campylobcter-limiting effect, giving a 1-3 log reduction in Campylobacter colonisation in broilers. Research with Necon Ireland Ltd. has validated the antimicrobial properties of copper/silver ionised water for the control of pathogens in hospital water systems, food-related process lines and on surfaces. The interventions proposed will address prevention (ionised water) and reduction (plant bioactives) of Campylobacter colonisation. This collaborative, inter-disciplinary and multi-sectorial proposal will translate laboratory research on these novel natural anti-microbials and water treatments to on-farm application, establish their mechanism of action, and develop effective feed and implementation methods that will add commercial and marketing value to Irish Poultry Sector, assist with EFSA, FAO and WHO targets and increase the RDI capability of two Irish SMEs.

DAFM FIRM 2015 Call Project Abstracts

DAFM Reference	Project Title	Lead(Collaborating)Institution	Award
15F703	Analysis of diet and eating behaviours in infants and young children as determinants of weight status and health outcomes for innovative product development. (BASELINE-DIET)	UCC	€69,759

Project Coordinator: Dr Áine Hennessy

Project Abstract

Irish consumers are increasingly aware of the relationship between food and health, and are embracing the concept of foods that are wholesome, clean and enhance health and wellness. Parents are particularly concerned with providing healthy foods that foster good eating habits and behaviours in early childhood, a time of rapid growth and development, which will continue into later life. The Cork BASELINE Birth Cohort study is Ireland's first prospective cohort study which is following 1500 children from 15 weeks gestation throughout childhood. Data collected from birth onwards include biological samples, early infant feeding and nutrition and a unique longitudinal dataset, the largest to date in the world, of eating behaviours in infants and young children. Our study currently holds Ireland's largest food consumption dataset of 2-year old children and includes biomarkers of nutrient status, prospective validated health outcome variables as well as detailed information on linear growth and body weight status. Currently, the 5-year follow-up assessments are ongoing, for completion in September 2016. The exploitation of these resources will support innovative development of foods and food ingredients to enhance the health and wellness of infants and young children and aid in the development of public health policy.

The overall objective of this study is to examine diet and eating behaviours in early childhood and together with the 2-year and 5-year follow up data, investigate associations with dietary quality, nutritional intakes and nutritional status, including growth outcomes, throughout early childhood.

Specifically, this project aims to:

Investigate the use of follow-on and growing-up milk products and their effect on diet, nutrient intake (with a particular focus on nutrients of concern previously identified in this population subgroup, e.g. vitamin D and iron) and status as well as validated health outcomes, such as body weight in an extensively characterised paediatric cohort

Identify dietary patterns and key food groups that support healthy body weight and growth and development

Investigate longitudinal changes in eating behaviour and evaluate the impact of eating behaviour on weight status from 6 months of age up to 5 years.

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15F707	Opportunities for functional and bioactive protein ingredients derived from co-products of the Irish meat industry – Desk Study (BioOpps)	Teagasc	€90,818

Project Coordinator: Dr Anna Marie Mullan

Project Abstract

Recovery of high value protein-rich bioactive/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. Several previous FIRM funded projects, and other international research efforts, have focused on developing methods for generating and extracting these compounds from natural sources, including high value-added co-products derived from meat sources. Examples of products generated include extracts with techno-functional (emulsifiers etc) or biological (heart health) properties. While clear opportunities for recovery of high value functional and bioactive co-products from these streams have been identified, one of the main challenges for technology transfer and commercialisation of these products is the lack of a robust analysis of the market and product specifications etc for such products from an Irish industry perspective. The current project proposes a comprehensive study of the opportunities for selected bioactives derived from co-products of the Irish meat industry, including an overview of the global market and its main producers, global trends, key market drivers, opportunities for small/new players, the supply chain, the competitive landscape, quality, safety and cost requirements (product specifications), available methodologies for production (processes and technologies), regulatory environment, return on investment and a SWOT analysis. As well as guiding research, knowledge generated will be critical in feeding into decisions taken at an industry or national level in how to best exploit these outcomes

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15F721	The relation between the Human Milk Microbiome, Composition and Infant Nutrition (INFAMILK)	UCC (Teagasc)	€600,308

Project Coordinator: Prof Alan Kelly

Project Abstract

Human breast milk (HM) is the Gold Standard feeding regime for newborn infants and represents a baseline for the functional performance of infant formulae. While many milk constituents – for example oligosaccharides, immune cells, and microbes – have been studied for decades, new analytical approaches, research findings, and paradigm shifts are rapidly providing new insights as to how they might impact both maternal and infant health. Moreover, interdisciplinary work is beginning to shed light on how these factors might be interacting in both the mammary gland and the infant's gastrointestinal tract, and influencing the development of the gut microbiota. Establishment of the intestinal microbiota commences at birth and it plays a major role in maturation of the immune system, protection against pathogens, and the long-term metabolic welfare of the infant. In terms of infant health, it is imperative to understand how early infant nutrition influences the development of a healthy gut microbiota. This project will investigate milk compositional analysis of a large number of lactating mothers from initiation of lactation following giving birth to end of lactation (6 weeks minimum) and will include proteomics, metabolomics and the HM microbiome and will involve computational approaches to understand its complexity, effectors, and functions, as well as the analysis and role of host cells (immune and otherwise) in HM. The relationship between milk constituents and infant health will also be explored, as will the emerging area of milk genomics. Interestingly, no studies have yet been reported to reveal the evolving composition and functionality of HM over lactation, coupled with infant health and development including gut microbiota in infants exclusively fed breast milk, using next generation sequencing. The objective of this platform study is to define the composition, functional performance and microbiome of breast milk over time, using state-of-the-art analytical technology, and correlate findings with gut microbiota composition, using NGS in infants exclusively fed breast milk. The findings of this Platform Study will inform Infant Milk Formula manufacturers as to essential baseline composition, with which to compare and tailor different formulations and ingredients to mimic the biological effects of human breast milk. Thus, the project will provide new opportunities for optimisation of infant milk formula composition, with appropriate new bioactive ingredients such as milk fractions, probiotics and prebiotics to effectively programme the early infant gut microbiota in a manner resembling that of mother's milk. In addition, the work will directly benefit Irish companies producing next-generation ingredients for IMF applications.

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DAFM Reference	Project Title	Lead(Collaborating)Institution	Award
15F724	Foodborne Viruses in Ireland – farm to fork Investigation, Identifying Risk and mitigation Approaches for Hepatitis E Virus, Hepatitis A Virus, Norovirus & Sapovirus (FoVIRA)	UCD (MI)	€569,441

Project Coordinator: Prof Suzie Coughlan

Project Abstract

Foodborne viruses pose a risk to public health and are a threat to consumer confidence in the safety of Irish food. Recent developments in testing methodologies (including the publication of International Standards for the detection of viruses in food), growing public health, consumer and industry concerns make it feasible and moreover, essential to address current deficiencies in our knowledge about the risk from viral pathogens in the Irish food chain.

The aims of this project are to determine the prevalence and molecular epidemiology of Hepatitis E virus (HEV) in Irish pigs/ pig products and of Hepatitis E virus (HEV), Norovirus (NoV), Sapovirus (SoV and Hepatitis A Virus (HAV) in Irish berries and shellfish and to apply genetic sequencing techniques to investigate the association between viruses identified in the food-chain and those isolated from human infections. A HEV cell culture system will also be established to provide the foundation for future work on HEV inactivation and infectivity studies.

Data generated from this research will contribute to a risk exposure assessment and will be used to identify potential control points and risk mitigation measures for viral foodborne pathogens. This collaborative project also provides a unique opportunity to build national capability in the area of food testing within three leading Irish public laboratories, the National Virus Reference Laboratory, Marine Institute and the Central Veterinary Research Laboratory. This capability, and the network of expertise developed, will provide a sustainable foundation for future work to address the emerging threat to food safety and the food industry posed by these enteric viruses.

DAFM Reference	Project Title	Lead(Collaborating)Institution	Award
15F731	Isolation, characterisation and exploitation of natural anti-yeast agents and their application as consumer-friendly preservatives in food and beverages (ANTIYEAST)	CIT (UCC)	€421,200

Project Coordinator: Dr Aidan Coffey

Project Abstract

Yeast contamination is a problem in a wide range of food products. Yeast growth, leading to spoilage, is an important cause of economic losses in food industry. The sensorial changes that appear in spoiled food result in consumers' complaints. Vacuum-packed cheeses and other foods/beverages stored under similaranaerobic conditions are particularly susceptible. The overall objective of this project is to characterise the anti-yeast activity of compounds either produced by protective lactic acid bacteria (LAB) or plant-derived compounds identified as defensins. We have previously identified a strong anti-mould LAB strain and the strain has been patented and licensed to Industry. As yeast inhibition was not investigated previously, the proposed project aims to isolate and characterise potential anti-yeast compounds from LAB strains including those previously shown to have anti-mould traits. These anti-yeast compounds would be chemically synthesised to unravel their inhibitory concentrations against selected yeasts.

In parallel, antimicrobial peptides known as defensins would also be investigated. These are present in diverse organisms (plants, humans, insects etc). Some defensins in the scientific literature have already been shown to have inhibitory activity against yeast, and indeed one anti-yeast defensin has already been identified in our laboratory where it has been subjected to preliminary investigation against other microorganisms. Here, we propose to mainly focus here on plant defensins that can be easily extracted from seeds and or/chemically synthesised. The inhibitory activity of anti-yeast compounds from LAB and the plant defensins will be assessed both in vitro and in a range of food products (dairy, cereal products and beverages). In addition, the impact of these compounds on a wide range of product parameters will be measured. Special emphasis will be placed on product safety aspects. Challenge tests will be performed on the food products and cytotoxicity assays will be carried out as well. A comprehensive dissemination and product protection plan will be an integral part of the project.

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15F737	Innovative food structures to enhance the sensory experience, the nutrient profile and nutrient bioavailability for older people (NutriPlus)	UCD (WIT, Teagasc)	€599,950

Project Coordinator: Dr Graham O' Neill

Project Abstract

Nutriplus will grow Irish dairy capabilities to develop innovative products to target the global elderly population by developing foam and emulsion structures that are easy to chew, digest and promote nutrient bioavailability. Consumer intelligence underpinning the research will be supplied by the partner food companies.

One of the key functions of the gastrointestinal tract is the ingestion, digestion and absorption of nutrients. As people age several conditions develop that limit this capability, causing poor health. In the mouth weakened teeth/gums and muscle dysmotility make chewing unpleasant and unsuccessful. In the stomach/intestine decreased secretions (acid,pepsin) reduce digestive capability leading to immunocompromisation. The national adult nutrition survey (2011) highlighted that over 65's were below the estimated daily requirement by 85% for vitamin D, 37% for magnesium while the HSE (2008) reported that diseases of the digestive system cost the HSE 333,716 hospital bed-days.

This project focuses on food structure, developing microgel stabilised foams (enriched with vitamins) and nanoemulsion/microemulsions that are easily digested providing a readily available source of vitamin D. Foam/emulsion digestion will be examined in detail, facilitating manipulation of the digestion process to favour the formation of substructures that resolubilise vitamin D improving bioavailability. Sensory science will play an integral role; firstly a pilot study will be conducted to identify the attributes most desired by the older cohort in foams and emulsions. A technique called temporal dominance of sensations will be used to record the sequence of perception of several emulsion attributes by participants. Scale-up studies will ensure processing parameters (temperature, sheer) do not degrade the emulsions functionality/sensory appeal. Human intervention studies will determine the effectiveness of the optimised foam and emulsion structures on improving vitamin D bioavailability. The emulsions will improve general health among over 65's, the foams will target a much later lifestage who suffer from oral processing difficulties.

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DAFM Reference	Project Title	Lead(Collaborating)Institution	Award
15F747	Enzymes for efficient milk oligosaccharide production (EFFICIenz)	NUIG (Teagasc)	€98,877

Project Coordinator: Prof Lokesh Joshi

Project Abstract

This application builds upon an ongoing FIRM-funded project "Enzymatic generation of sialylated lactose from waste whey using marine-derived sialyltransferases" (SIALenz). Two strategies were proposed for the production of sialylated oligosaccharides for use in infant formula supplementation. One strand described in vitro reaction of sialic acid and lactose catalysed by novel animal sialyltransferases while the second strand described bacterial fermentation on lactose using a metabolically engineered Lactococcus strain. The enzymatic addition of sialic acid (Neu5Ac) to lactose cannot be achieved efficiently and with specificity by chemical synthesis. A number of studies have shown that the sialylated oligosaccharides, possess anti-adhesive effects against certain pathogens and pro-adhesive effects for beneficial commensal strains. Sialyllactoses are present in bovine milk but at much lower levels than in human making isolation from bovine milk an impractical option at present.

A commercial necessity for the production of sialyllactoses by the in vitro approach using novel purified CHO expressed sialyltransferases is an inexpensive supply of the substrate CMP-Neu5Ac (CMP-activated sialic acid). We propose to use purified CMP synthetase (CMAS) to convert Neu5Ac to CMP-Neu5Ac. Because CMP-Neu5Ac is relatively unstable, a secondary goal is to fuse CMAS with ST6Gal1 making a complex that transfers labile CMP-Neu5Ac directly from CMAS to ST6Gal1 thereby making 6'sialyllactose from lactose and sialic acid. In our second approach to HMO production, we propose to use the expertise gained in the SIALenz project to expand our repertoire of oligosaccharides to the production of fucosylated oligosaccharides. Fucosylated HMOs are important in shaping the infant gut microbiome and are associated with a lower risk of diarrhoea and respiratory disease. We are currently in the final stages of creating a metabolically engineered E. coli strain capable of producing 3' and 6'-sialyllactose. We will use a similar recombineering approach and enzymes derived from marine bacteria/non-human pathogen sources to produce 2'fucosyllactose.