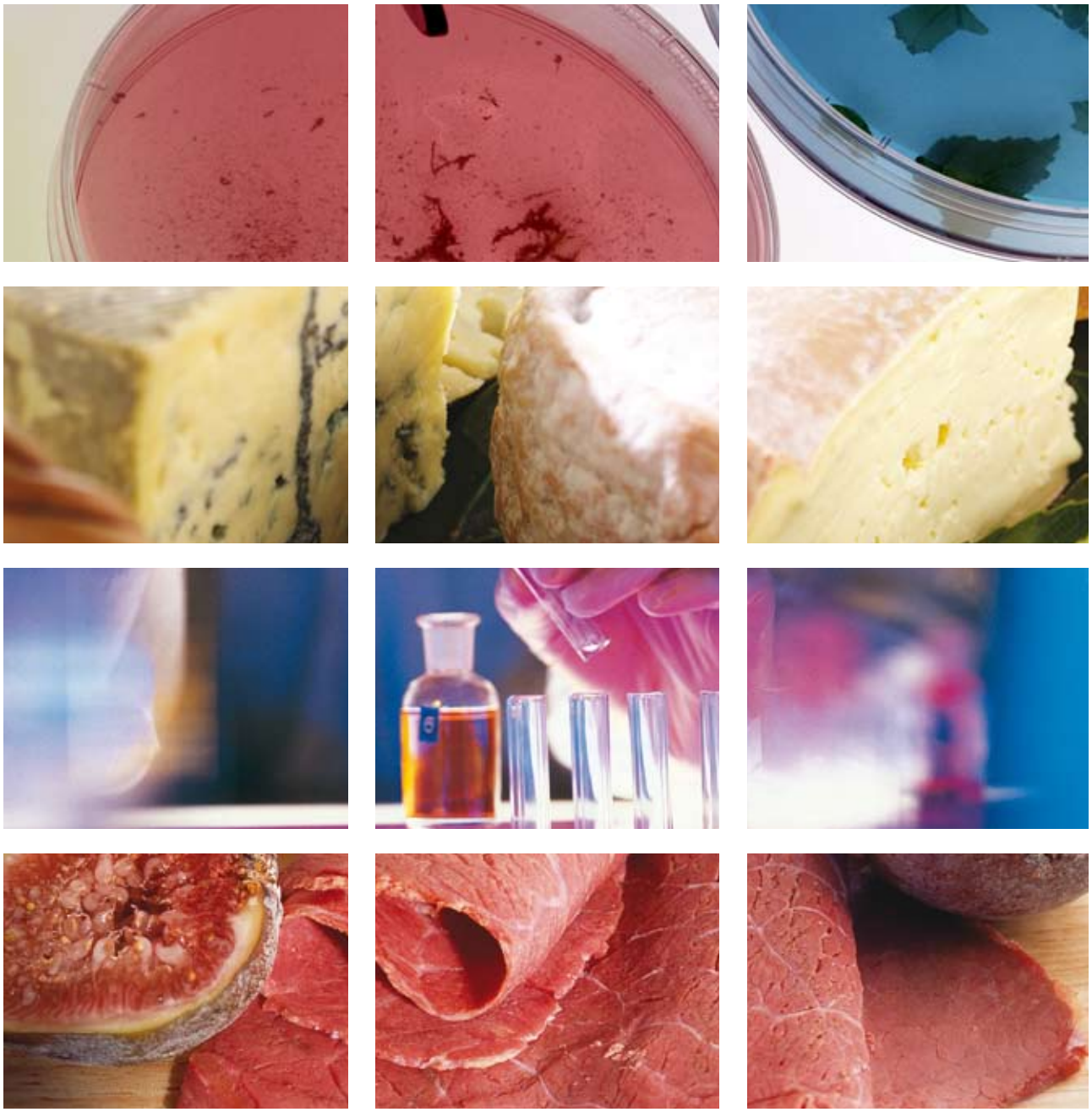
Quality Food founded on Science

FIRM 2006 Research Achievements



THE DEPARTMENT OF
AGRICULTURE & FOOD
AN ROINN TALMHAÍOCHTA AGUS BIA

Contents

Brollach

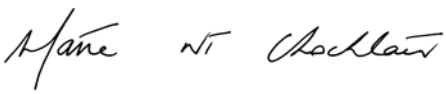
Is cúis áthais dom é roinnt d'éachtaí na dtionscadal taighde bia, maoinithe ag mo Roinn faoin gclár FIRM, a fheiceáil aibhsithe sa bhfoilseachán seo.

Bíonn fís, am, agus tiomantas do bharr feabhais de dhíth le bonn taighde a thógáil. Marcálann An Beart um Taighde Institiúideach Bia (FIRM), arna mhaoiniú faoin bPlean Forbartha Náisiúnta 2000 – 2006, isteach is amach ar deich mbliana de mhaoiniú tugtha ag mo Roinn do thaighde bia in Institiúidí Triú Leibhéal.

Tá ionaid barr agus taighdeoirí bia ag leibhéal an Dochtúra agus an Iar-Dhochtúra cothaithe ag FIRM. Baineann na tionscadal sa bhfoilseachán seo go príomha le bianna don tomhaltóir agus le sábháilteacht bhia, ag teacht le luas na n-athraithe ar fud an domhain. Tá tomhaltóirí ag lorg luach ar airgid níos fearr, sábháilteacht, áisiúlacht, inrianacht agus folláine agus tá a stíleanna beatha ag athrú faoi luas.

Agus mé ag seoladh 'An Plean Gníomhaíochta Fís Thalmhaíochta 2015' níos túisce sa bhliain, leag mé béim ar seo, gur tosaíochtaí iad an bonn eolais agus nuálaíocht do thionscal iomaíoch, nuálaíoch bhia na hÉireann. Aithníonn an 'Straitéis Náisiúnta um Eolaíocht, Teicneolaíocht agus Nuálaíocht 2006-2013' an tábhacht a bhaineann le hearnáil inbhuanaithe agri-bia agus aithníonn sé fresin an tábhacht a bhaineann le taighde a dhéanamh ar Chaighdeán Bhia, Sábháilteacht agus Cothú chomh maith le Bia don Sláinte agus Nuálaíocht Tháirgí. D'aibhsigh glao FIRM 2006, a d'eascair as comhchomhairle le lucht tionsclaíochta agus lucht acadúil na téamaí seo agus deonófar €30 milliún, an méid is mó go núige seo.

Mar chríoch, is mian liom mar chonclúid, ardmholadh a thabhairt do na taighdeoirí anseo agus dóibh siúd atá ag tabhairt faoi tionscadail faoi scáth FIRM. I gcomhar leis na hinstitiúidí taighde ag obair le chéile tá sé ar a gcumas a léiriú cé chomh spreagúil is ar féidir le sochaí eolasbhunaithe a bheith.



Máire ní Chochláin TD
Aire Talmhaíochta agus Bia

28 Samhain 2006

Foreword

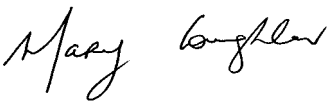
I am delighted to see some of the achievements of the food research projects funded by my Department under the FIRM programme highlighted in this publication.

It takes vision, time and a commitment to excellence to build a research base. The Food Institutional Research Measure (FIRM), which is funded under the National Development Plan 2000-2006, marks nearly a decade of funding of food research in third level research institutions by my Department.

FIRM has promoted centres of excellence and food researchers at doctorate and post-doctorate level. The projects in this publication deal mainly with consumer foods and food safety, reflecting a pace of change worldwide. Consumers are seeking even more value, safety, convenience, traceability and wellness and their lifestyles are rapidly evolving.

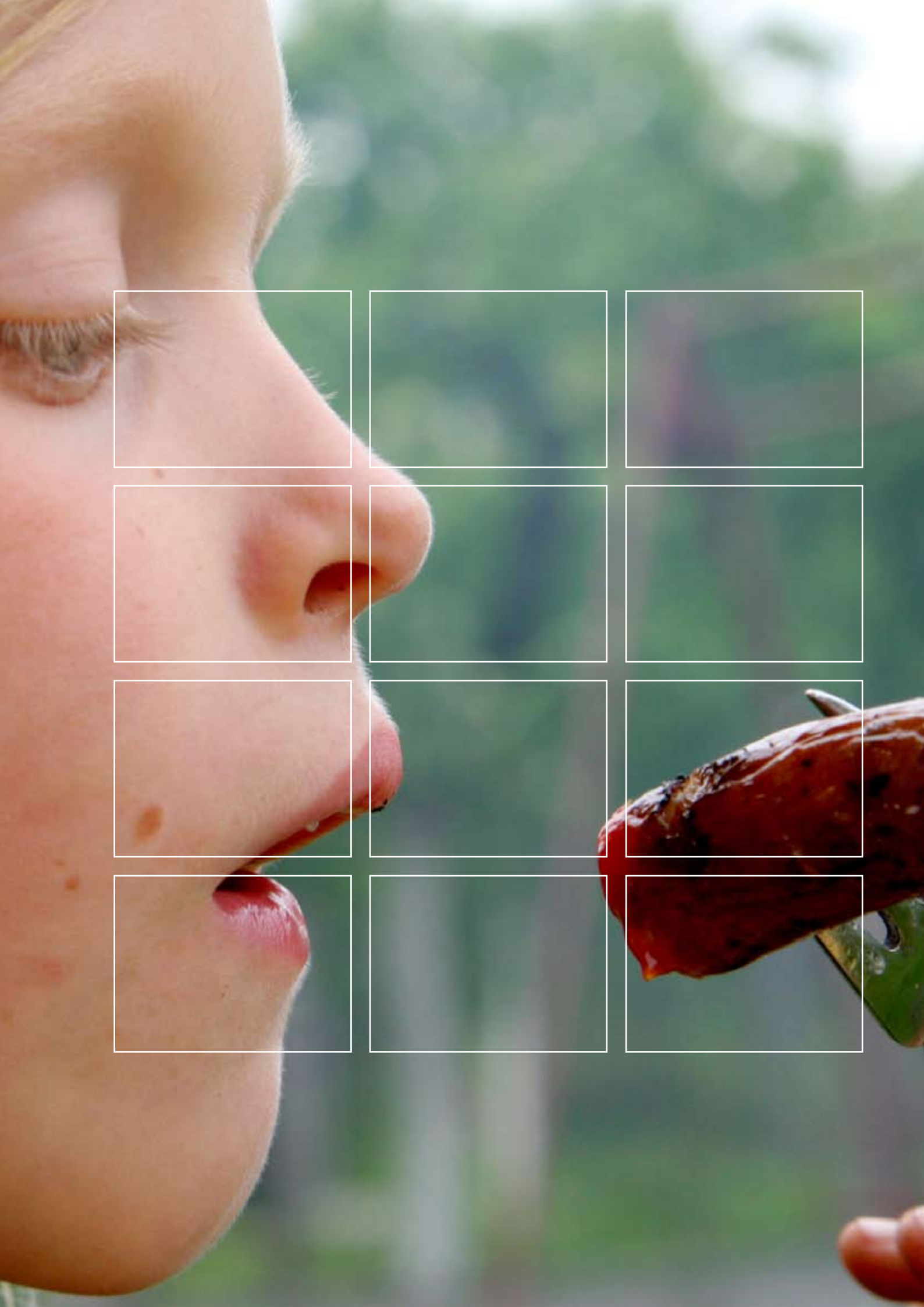
On launching the Agri Vision 2015 Plan of Action earlier this year I stressed that building the knowledge base and innovation were priorities for a competitive and innovative Irish food industry. The National "Strategy for Science, Technology and Innovation 2006-2013" acknowledges the importance of a sustainable agri-food sector and of research into food quality, safety and nutrition as well as food for health and product innovation. The 2006 FIRM call, which followed consultation with industry as well as academia, highlighted these themes and a record €30m will be awarded.

In concluding I wish to pay tribute to the researchers featured here and to those currently undertaking projects under FIRM. Together with the research institutes they show how exciting the knowledge society can be.

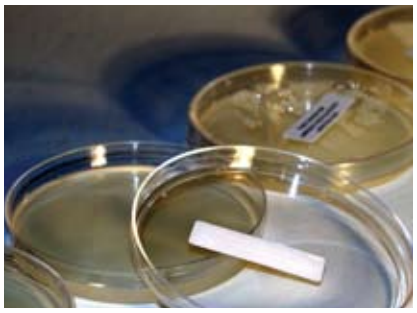


Mary Coughlan TD
Minister for Agriculture and Food

28 November 2006



Introduction



This brochure features the main outcomes of research projects completed in the past year under FIRM, the Food Institutional Research Measure of the Department of Agriculture and Food.

FIRM is the primary national funding mechanism for food research in third level collages and research institutes. Funding is awarded on the basis of open competition.

FIRM and its predecessor has been funding research through National Development Plans since 1994. The total funding for FIRM under the National Development Plan 2000-2006 was €70m.

How FIRM works

The research funded by FIRM is located at 18 participating research institutions throughout the country. The projects are usually carried out by multi-disciplinary teams from two or more institutions; some are linked directly with food manufacturers. The research outputs are communicated to industry by a dedicated dissemination team known as RELAY.

Creating a base of knowledge

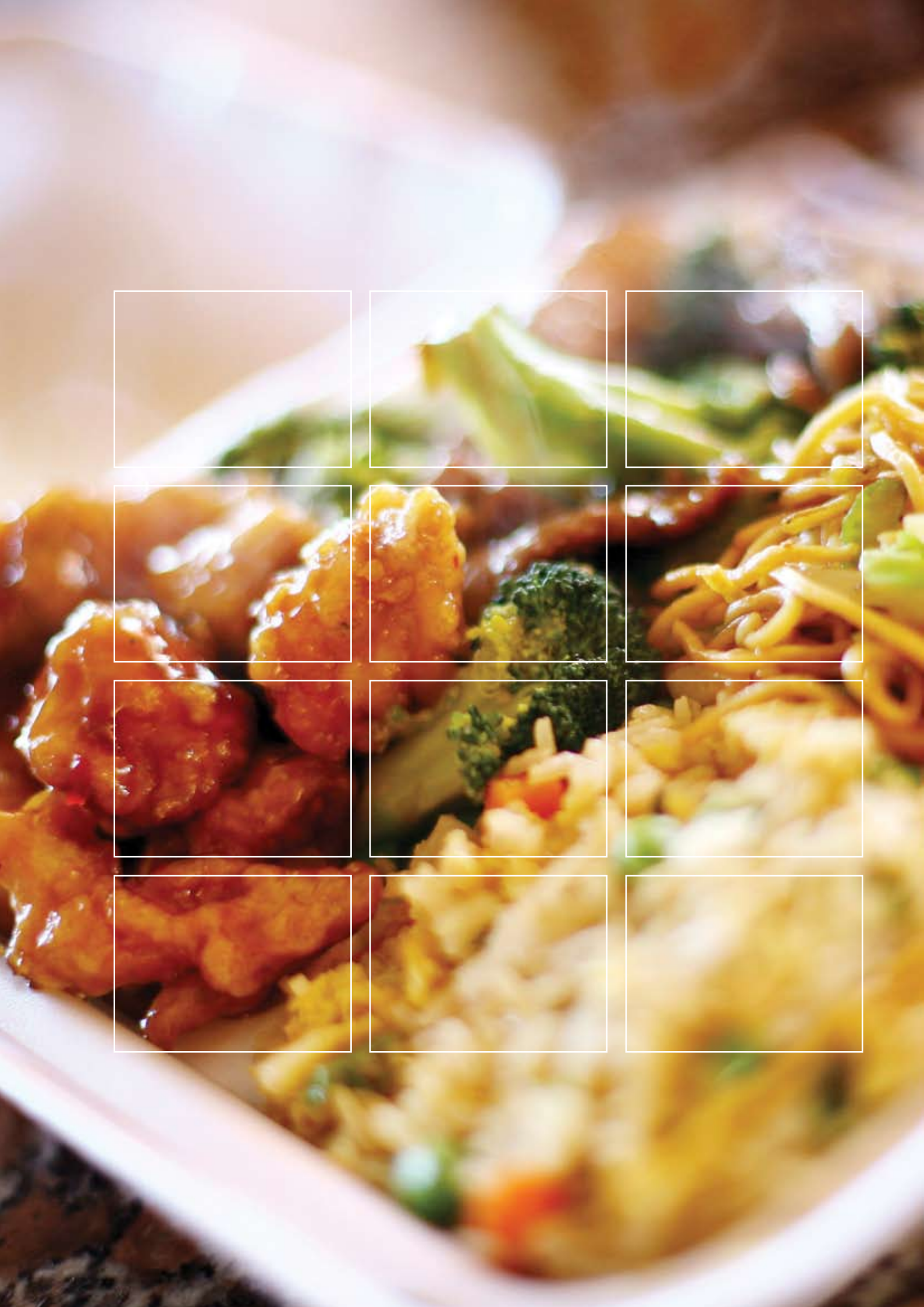
FIRM is concerned with developing the technologies that underpin a competitive, innovative and sustainable food manufacturing and marketing sector. It is creating a base of knowledge and expertise in generic technologies that can support a modern, consumer-focused industry. It strives to increase the level of collaboration between Irish institutions and to build up their capacity for research. A key output of FIRM is highly trained young researchers at PhD and postdoctoral level, with specialist skills that are particularly relevant to the Irish food sector.

The projects featured here fall into the areas of prepared consumer foods and food safety, two key priorities in the overall programme. These research achievements demonstrate the high quality of scientific expertise that is available in our institutions. This has been greatly strengthened over the past decade due, in considerable part, to the resources and motivation provided by FIRM and the Framework research programme of the European Union.

Commercialisation is encouraged

FIRM research is pre-commercial and, if appropriate, may transfer directly into a company. Commercialisation is encouraged and supported by Enterprise Ireland by bringing together companies and institutions to work on specific research projects.

Many of the research outputs reported here have commercial potential and some have already been adopted in the food sector.



Research on Prepared Consumer Foods

Changing lifestyles and demographics are influencing trends in consumer behaviour and this is reflected in changing retail trends.

Consumers now have less time to prepare food and many buy convenience foods such as prepared meals, takeaway meals and food to eat on the go. Health and well-being are dominant issues affecting consumer behaviour at present.

As a consequence, the manufacture of prepared consumer foods has become the fastest growing sector of the Irish food industry.

Continuous innovation based on research is directly contributing to this growth, and Irish food companies are investing in new research facilities to drive the development of innovative consumer products.

An essential part of the knowledge infrastructure needed to sustain industrial innovation is a flow of technology, ideas and skills from the research community to business start-ups and established industry players. Commercialisation opportunities for industry arise from publicly funded research in the institutions.

The outputs of the following four projects create opportunities for manufacturers, or are the basis for further research leading to such opportunities.

Natural enzyme found to improve bread quality

Researchers in Ireland have developed a naturally occurring enzyme preparation for baking. This increases loaf volume and crumb softness while also extending shelf life by three days.

"The enzymes, called hemicellulases, work on compounds found in wheat that inhibit the optimal development of dough," say researchers at Teagasc and scientists at the National University of Ireland, Galway - *Bakery and Snacks News,October 2005.*

Freshness of baked goods

Consumers value freshness in baked goods and prefer natural ingredients. A way to increase the freshness of baked goods using natural enzymes was found. The enzymes are produced by microbes grown on rye and white and wholemeal flours, as a result they are able to break down these raw materials.

The hemicellulase enzymes break up hemicelluloses, found naturally in the layers of bran. Hemicelluloses are large molecules that interfere physically with dough formation when water is added to flour. This occurs because they are mainly insoluble and are also capable of binding many times their weight of water.
In this way, hemicelluloses reduce the elasticity of the dough, so the bread rises less well during baking.

The researchers produced enzymes that break down hemicellulose molecules to optimum lengths for gluten development during breadmaking - if the fragments are too short they release too much water, resulting in slack dough.

Dr Maria Touhy produced the enzymes at the National University of Ireland, Galway, while Dr Gerry Downey and Ms Emily Green at Ashtown Food Research Centre studied the functional effects of the enzymes on dough elasticity.

Novel enzymes make superior bread

Dr Downey says their preparations had far superior results in bread making compared to commercial additives. Results with white bread loaves and rolls, wholemeal and rye bread, showed a bread volume increase of up to 21 per cent and a crumb softness increase of up to 128 per cent.

"In some cases, bread made with the enzymes was softer after three days than untreated bread was on the day of baking," said Gerry Downey.

"What is absolutely crucial for the commercial exploitation of this enzyme development is for it to work with a variety of wheats from different sources, as the amount of natural inhibitors varies in different wheat types," said Stanley Cauvain of BakeTran, a UK bakery consultancy firm.

"Provided that is achieved, then this really is a breakthrough for a naturally occurring enzyme," he added.

Commercialisation

The enzyme preparations are still experimental but it is possible that they could be taken up by an ingredients company and marketed in the near future.

Many enzymes for bakery applications are derived from genetically modified (GM) microorganisms. An effective naturally occurring enzyme would generally have more appeal than a GM-derived one.

According to the scientists, the next step in their research will be to find a way to increase the amount of dietary fibre in bread while retaining crumb softness. Further assessment will also be carried out on evidence that the hemicellulases may release substances with antioxidant or probiotic activity.

Gerry Downey

Project (01/R&D/TN/154)
Hemicellulase treatment of flour: a route to innovative bakery products.

Researchers:
Dr Gerry Downey, Ashtown Food Research Centre, Teagasc, Ashtown, Dublin 15.

Dr Maria Tuohy, The National University of Ireland, Galway.

(For more info visit http://relayresearch.ie)

Drink to your health

Increasing consumer demand for healthful foods and beverages, coupled with discovery of ingredients that can produce specific physiological effects, have led to the development of functional foods and beverages.

These products move beyond fortified foods or products marketed as healthy because they are low in fat or sugar. Instead, functional foods and beverages contain specific ingredients that enhance our physical or mental well-being.

Included in the ever-growing functional beverages category are the so-called 'meal-replacement' beverages, that help to slip in the proteins, vitamins, minerals and other nutrients needed to help keep up with a busy lifestyle. Nutritious and versatile functional drinks, from yoghurts to smoothies and juices, are an excellent way of grabbing a quick meal.

Consumers' emotions

Drs Jorge Oliveira and Joe Bogue at UCC designed new beverages with consumers' preferences in mind. They applied a new Japanese method, known as kansei engineering, which analyses consumers' response at an emotional rather than a rational level. This helped them to develop an emotional description of the proposed new drink, and design its composition according to the emotional response triggered.

Drinkable meals

A 'breakfast replacement' drink with the nutritional profile of a typical breakfast was developed by Prof Brian McKenna and Drs Jim Lyng, Des Morgan, JC Jacquier and Amalia Scannell at UCD, working closely with the UCC team.

Also developed was a meal 'pal' in the form of a drink to accompany high-fat, high-cholesterol meals. The drink contains ingredients to prevent fat uptake.

Breakfast replacement drinks

Three breakfast replacement drinks were developed, each with the nutritional profile and micronutrient content of a typical cereal based breakfast. The researchers developed several fortified drinks with different flavours and textures. They studied how the processing conditions influenced the quality of these drinks and adjusted the formulations to optimise their shelf-life.

The researchers found that it was the volume of a beverage, more than its calories or viscosity, that gave the feeling of fullness. In addition, drinks with more ingredients were more satiating than simple beverages.

The new drinks proved very successful when compared, in 'blind trials' by panels of consumers, to similar commercially available drinks. The use of a mix of natural products, such as rice, fruit juice, egg and milk proteins, was central to the success, as it stimulated a positive emotional response compensating for the 'guilty' feeling of not having a proper breakfast.

A fast-food accompaniment

The second innovation was a soft drink to complement a fast-food meal. The drink contains bioactive compounds that block fat uptake. It offers a healthier alternative to the ordinary soft drinks that usually accompany high-fat, high-cholesterol meals. Blind trials with consumer panels indicated that the taste of the new drinks was less appreciated than the typical soft drink, implying that the health benefits would play an essential role in the marketing strategy for this type of product.

Reasearch achievemnets

Functional drinks are the fastest growing market segment in the beverages industry and drinkable meals, such as these, can benefit companies looking for opportunities for new healthful products.

Jim Lyng

Project (01/R&D/D/176)
Consumer-oriented development of new functional drinks: meal replacements and supplements.

Researchers:
Dr Jim Lyng and Prof Brian McKenna, Agriculture and Food Science Centre, University College Dublin.

Dr Jorge Oliveira, Dept of Process and Chemical Engineering, and Dr Joe Bogue, Food Business and Development, University College Cork.

(For more info visit http://relayresearch.ie)

Healthy snacks

Food manufacturers have identified a market opportunity for an innovative tasty cheese snack. Until now, attempts to make such a product have been hindered because natural cheeses are unsuitable for making a breaded and heated cheese snack.

High fibre, low fat cheese snacks

Researchers at University College Dublin used imitation cheese to create a hand-held snack that can be eaten warm or cold. Prof Dolores O'Riordan and postgraduate students Nessa Noronha, Clara Montesinos and Paul Hennelly transformed the imitation cheese beyond recognition by adding fibre to make it more nutritious, flavours to enhance its taste and a coating of breadcrumbs to enhance its appearance.

When heated the cheese melts, giving an attractive mouth-feel. The cheese snack is ideal to eat 'on-the-go' and it is also nutritious because it is high in protein and fibre and low in fat.

Health benefits of fibre

The benefits of eating high fibre foods include a healthier colon, bulkier faeces and controlled energy release from the gut. Adults are advised to consume about 18g of fibre a day. However, two-thirds of Irish adults and children do not eat enough fibre. Natural cheese contains no fibre, so adding it to a cheese snack is an innovative way of increasing fibre intake.

The added fibre behaves as a fat substitute, so the more fibre added to the imitation cheese the lower its fat content. Using 'resistant starches' as fibre, the researchers were able to incorporate 10% in the finished product. They also used inulin, a polymer of the sugar fructose, as added fibre. Inulin stimulates growth of probiotic bacteria, such as bifidobacteria, in the human gut and the amount used (3.5%) would justify a health claim.

Adding flavour to cheese snacks

Mediterranean-style flavours were preferred by a trained panel. Some traditional flavours such as Cheddar cheese, ham and onion also rated highly. The cheesy flavour was provided by adding enzyme modified cheeses to the low-fat imitation cheese. For a full flavour, it is essential that the enzyme modified cheeses should contain small amounts of 'short chain' fatty acids and be added as late as possible in the imitation cheese-making process.

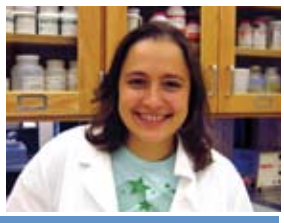
Shaping and coating the cheese snacks

The best size for ease of production, uniformity and satiety was a 14g snack in a cylindrical roll measuring 70mm in length and 15mm in width.

Very coarse, toasted breadcrumbs were preferred as coating. The product was flash fried at 180°C for 30 seconds and chilled or frozen stored. The ingredients were manipulated to get the hot cheese snacks to melt to the desired texture while ensuring they don't burst through the coating during high temperature cooking.

Benefits of the research

Dolores O'Riordan says "the high fibre and low fat content of the cheese snacks are ideal for imparting healthfulness and the addition of flavours makes it a tasty snack". This product is aimed at the lunch box and healthy snack sectors.



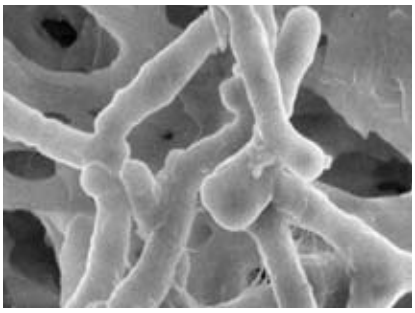
Nessa Noronha

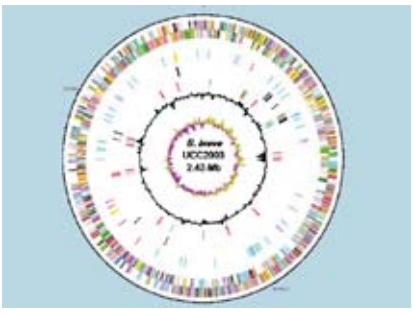
Project (00/R&D/D/126)
Development of ingredient technology for a 'healthy', convenient, flavoursome snack food.

Researcher:
Prof Dolores O'Riordan, Agriculture and Food Science Centre, University College Dublin.

(For more info visit http://relayresearch.ie)

Beneficial bacteria in the diet





Above is the view under the microscope of the new probiotic and a diagram of its gene map.

One way of maintaining a balance between the beneficial and harmful bacteria in the gut is to consume a source of beneficial bacteria in the diet. Probiotics are beneficial bacteria that can be introduced into the digestive system through food.

Most commercially produced fermented milk products with probiotic properties contain strains of Lactobacillus bacteria or Bifidobacteria. They are also naturally present in the human gut.

Most live bacteria that are ingested die when they reach the acid conditions of the stomach. For beneficial bacteria to be classified as probiotic, they must be resistant to gastric, bile and pancreatic juices, so as to reach the lower parts of the gut alive. There, the probiotics attach to the wall of the gut where they increase the number of beneficial bacteria and fight against harmful bacteria.

A new probiotic with novel properties

The gene map of a 'good-for-you' bacterium was deciphered by Dr Douwe van Sinderen and Prof Gerald Fitzgerald at UCC and Prof Paul Ross and Dr Catherine Stanton at Teagasc Moorepark. Post-graduate students Moritz Knobel, Marcus Claesson and Cian O'Mahony also worked on the project. The team went on to identify the essential conditions for survival and growth of the new probiotic, which they named *Bifidobacterium breve* UCC2003.

The gene map contains 1,850 genes, several of which are believed to be responsible for probiotic attributes. This knowledge will help the researchers to predict how well the bacteria can grow under stress. This is important as bacteria encounter stress during food manufacture, as in freezing or spray drying, and again in the gut when exposed to gastric acid and bile salts. To be effective, probiotic bacteria must be active and in high numbers when delivered in the human gut.

The scientists discovered that glucose is not necessarily the best sugar source for the new strain of Bifidobacteria, which has the ability to grow on large glucose-containing sugar polymers such as amylopectin and pullulan. This is unusual for Bifidobacteria and the researchers believe that it could confer a competitive advantage on strain UCC2003 over other gut bacteria.

Nutrients for probiotic bacteria

Amylopectin and pullulan are examples of prebiotics. These are nutrients for probiotic bacteria. Prebiotics are not digested by humans but pass straight to our gut, stimulating the growth of the beneficial bacteria. The combination of pre- and probiotics has a dual benefit in a food product, in that it contains both the live bacteria and nutrients for their growth.

The most versatile method of adding probiotic bacterial cells to foods is as a dried powder. However, making a powder by spray-drying can damage the bacterial cells. The research showed that encapsulating the bacteria in gum acacia improves their survival during spray drying and powder storage.

Genes that may be important for the attachment of the new probiotic to the human gut were also identified. The type of sugars used to grow the new probiotic bacteria affects its ability to secrete a capsule, which in turn is believed to play a role in attaching it to the gut wall.

Research achievement

Information about the growth and storage of a new probiotic is relevant to the functional food industry. The skills developed in bioinformatics are a valuable resource.

Catherine Stanton and Amaia Sangrador, part of the team who worked on the project.

Project (01/R&D/C/159)
Optibiotics.

Researchers:
Dr Douwe van Sinderen and Prof Gerald Fitzgerald, Department of Microbiology, Biosciences Institute, University College Cork.

Prof Paul Ross and Dr Catherine Stanton, Moorepark Food Research Centre, Teagasc, Fermoy, Co. Cork.

(For more info visit http://relayresearch.ie)

Research on Food Safety

Food poisoning microbes continually evolve, and can re-emerge as new threats as soon as they are able to bypass existing food safety controls.

Food safety research is a high priority and is likely to remain so for several reasons:

- food poisoning microbes continually evolve, and can re-emerge as new threats as soon as they are able to bypass existing food safety controls;
- there is now better surveillance and reporting of food borne illness, and food scares are now more newsworthy than in the past;
- there is a growing number of prohibited substances, giving greater scope for breaches of the law. Also, better analysis is leading to higher detection rates.

EU food policy has food safety as its top objective and places primary legal responsibility with the food business operator. Nevertheless, food safety research, particularly at a fundamental level, is beyond the scale of most food companies. Since the beneficiary is society as a whole, such research is seen as the prime responsibility of public funded institutions.

Thus, FIRM places strong emphasis on the development of scientific knowledge to underpin effective food safety practices at all stages in the food chain.

The following sections illustrate some of the research issues in food safety. For example, development of sophisticated analytical tools is essential to detect emerging infectious viruses, prions and bacteria. Better analysis is also needed to detect the residues of chemicals used in farming and environmental contaminants, and biological toxins.

Research on the factory floor has helped to elucidate the technical and operating procedures that enable industry to comply with the new food regulation.

Safety of Irish beef

From 1 January 2006, new food hygiene legislation has applied throughout the EU. The new package modernises, consolidates and simplifies the previous law.

The new legislation emphasises every food business operators' responsibility to produce food safely. It obliges food businesses to apply good hygienic practices and also food safety management procedures based on the principles of 'hazard analysis and critical control point'.

To enable the beef industry to implement the new rules, research was needed to work out the microbial criteria and sampling techniques required.

A valid measure of carcass hygiene

The new law required that carcasses are sampled by excision of a small piece of meat with a knife unless another sampling technique was shown to be as effective. Excision is destructive, difficult to undertake and dangerous for the operator.

Dr Declan Bolton and his colleagues Anabel Tergny, Rachel Pearce and Brendan Howlett at Ashtown Food Research Centre, Teagasc, validated an alternative sampling procedure using a sponge swab in place of the knife. The swabbing is non-invasive, easy to use and does not pose a safety risk for the operators. As a result of this work, the Department of Agriculture and Food permits swabbing instead of excision for microbial sampling and it is now the preferred method of sampling for the Irish beef industry.

Carcass contamination down by half

The researchers then evaluated a computer-based monitoring system for use as a food hygiene tool during beef slaughter. The system detects and records visible faecal contamination on beef carcasses and identifies the cause.

The Irish on-line monitor is based on an American system that was first used in a pork factory in Philadelphia. It has seven indicator buttons representing the most frequently contaminated parts of the carcass. The idea behind the monitor is when an inspector sees contamination at any of the seven sites, the relevant button is pressed alerting the responsible worker who then takes corrective action.

The new monitoring system was tested in two factories. The number of carcasses visibly contaminated as a consequence of removal of the hide fell from 54% to 28%, and contamination at evisceration dropped from 33% to 14%. As would be expected, the number of bacteria on the carcasses also decreased. Dr Bolton believes that this system has the potential to be used routinely by industry because it can monitor, record and reduce contamination.

Costs

The industry needs to know the cost of complying with the new law. It was estimated that the annual cost of implementing the required 'hazard analysis and critical control point' procedure in an Irish beef plant averaged €161,000. The plants do not receive grants or financial aid towards this cost.

Implementing the research findings

Knowledge-based guidelines were prepared to enable the industry to implement the research findings. A team of researchers, trainers and auditors produced two manuals that give detailed guidance, both for the implementation of food safety assurance in beef abattoirs, and for the accompanying audit procedure.

Research achievement

The combined work of researchers, trainers and auditors transformed the Irish meat sector's capability in this area, providing the technical skills and operating procedures that are essential to comply with the new law.

Declan Bolton

Project (00/R&D/TN/13)

HACCP and hygiene auditing in Irish beef abattoirs.

Researcher:
Dr Declan Bolton, Ashtown Food Research Centre, Teagasc, Ashtown, Dublin 15.

(For more info visit http://relayresearch.ie)

How to lower acrylamide in food

Acrylamide is a chemical that is found in unexpectedly large amounts in starchy foods that have been cooked at high temperatures. As acrylamide has only recently been discovered in food at these levels, practically nothing is known about its effects on humans via the diet.

However, acrylamide is known to cause cancer in animals and certain doses are toxic to the nervous system of both animals and humans. Based upon this information, it has been labelled as a potential carcinogen and neurotoxin.

Acrylamide formation during cooking of potato products

Drs Ronan Gormley and Nigel Brunton at Teagasc, Ashtown teamed up with Dr Francis Butler at University College Dublin to study the formation of acrylamide in cooked potatoes and to estimate the human intake of acrylamide from potato products.

Even though acrylamide is found in cooked starchy foods, its formation is not directly related to starch. It is formed by a chemical reaction between an amino acid called asparagine and certain sugars, called 'reducing' sugars, in food. This reaction occurs during the high-temperature browning of foods, as with French fries or the baking of bread.

The researchers observed that storage of potatoes at 3°C compared with 8°C doubled the content of 'reducing' sugar, and crisps made from the potatoes stored at 3°C had twice as much acrylamide. Thus, before processing into crisps, potatoes should be stored at 8°C to lower the sugar content.

They also observed that the sugar content of potatoes increased during storage over the winter; the longer the potatoes were stored the higher the sugar content. French fries made from these potatoes were initially low in acrylamide but the content increased with length of storage of the raw potatoes.

The acrylamide content of French fries made from Rooster, Record and Oilean potatoes bought in supermarkets was high. This was related to high sugars, because the potatoes were not conditioned at 8°C, and were therefore unsuitable for frying or roasting.

In summary, potatoes with high sugars and low dry matter cooked at high temperatures are high in acrylamide.

Process to lower acrylamide

Soaking and blanching the chipped potatoes before cooking lowered the sugars, and thus the acrylamide in the fried product.

Soaking raw chipped potatoes in 2% citric acid for one hour lowered sugars more than soaking in water.

Blanching raw chipped potatoes in sunflower oil (150°C for 43 seconds) was better than blanching in water (85°C for three and half minutes).

The blanched chips were fried in sunflower oil at 150°C, 170°C or 190°C for six minutes. Those fried at the lower temperature, 150°C, had the lowest level of acrylamide.

The high temperature cooking process that produces the browning and flavour sensation in French fries is also responsible for the formation of acrylamide. The presence of acrylamide is, therefore, closely associated with the golden brown appearance and taste qualities sought and appreciated by the consumer.

How to lower acrylamide in food (continued)

We are tempted to over-fry potatoes to make them more golden and crispy. This should be avoided, as it increases the likelihood of acrylamide formation.

Daily intake of acrylamide

It is not known how much acrylamide is consumed daily. Health experts recommend the maximum daily intake should not exceed 1 microgram of acrylamide per kilogram of body weight. Dr Enda Cummins of University College Dublin conducted a risk assessment study on the human intake of acrylamide from fried potatoes.

Enda Cummins calculated that the intake of acrylamide from French fries averaged 0.27 micrograms per kilogram of body weight per day for men and 0.20 for women.

Intake of acrylamide from crisps in Irish men and women averaged 0.052 and 0.064 micrograms per kilogram of body weight per day. These average intakes are within the recommended limit.

Benefits of the research

The results will help health professionals to formulate recommendations for acrylamide for all sectors of the potato industry from growers, storers and processors to fast-food outlets and caterers.

Consumers should know that acrylamide appears to be formed in food by common cooking practices and so people are likely to have been exposed to acrylamide through this route for some considerable time. At present, conditioning the raw potatoes at 8°C and using lower frying temperatures/times are the only practical ways to lower acrylamide levels in French fries and crisps.

Nigel Brunton

Project (03/R&D/TN/204)
Research into factors influencing the formation of acrylamide in foods.

Researchers:
Dr Ronan Gormley, Ashtown Food Research Centre, Teagasc, Ashtown, Dublin 15.

Dr Francis Butler, School of Agriculture and Veterinary Science, University College Dublin.

(For more info visit http://relayresearch.ie)

Detecting antibiotics in milk

The concern about antibiotic residues in food stems from the possible medical impact of their use in farm animals. Some doctors worry that widespread use of antibiotics in agriculture may contribute to the development of resistant strains of infectious bacteria.

Resistant bacteria might then be passed from animals to people either in food or through direct contact with animals.

Antibiotics are often used to treat mastitis in cattle. Overuse of an antibiotic or insufficient withdrawal time after administration can lead to the presence of antibiotic residues in milk. Traces may still be present in milk up to 5 days after treatment, depending on the antibiotic used.

Antibiotic traces in milk are unacceptable on health grounds. Furthermore, they can interfere with the fermentation of milk during the manufacture of cheeses and yoghurts.

Milk must therefore be routinely tested to ensure that it is residue-free. However, some screening tests give variable results, creating the need for a rapid, versatile, reliable system that is capable of detecting traces of various antibiotics in food.

Linking biotechnology to sensor technology

Scientists at Dublin City University and University College Cork developed a miniature disposable biosensor that detects traces of antibiotics in milk.

Professors Richard O' Kennedy and Brian Mac Craith, and Dr Colette Mc Donagh, of DCU working with Dr Fred Sheehan, Sharon Stapleton, Dr Helen McEvoy and Dr Robert Blue combined the technologies of immunology, optics and software engineering to produce a biosensor that detects specific antibiotics in milk.

They began by engineering an antibody for each suspect antibiotic in milk. They then positioned each antibody on the surface 'platform' of a sensor. The sensor platform carries several antibodies; the function of each antibody is to bind to its target antibiotic.

They then incorporated a unique optical detection system that effectively captures fluorescence emitted when the sensor detects any of its target antibiotics.

The new sensor was validated for detecting several beta-lactam antibiotics found in milk by Dr Joe Kerry, UCC. Dr Kerry will also assess it for detecting antibiotic residues in beef.

Research achievement

The biosensor will provide dairy companies with a quick, reliable method to monitor antibiotic residues in milk from dairy farms. The platform and technology are versatile and can be applied to other contaminants in food simply by changing the antibody.

Sharon Stapleton

Project (01/R&D/DCU/184)
Rapid detection of antibiotic residues in milk using disposable bio-chip sensors.

Researchers:
Prof Richard O'Kennedy, Prof Brian Mac Craith and Dr Colette Mc Donagh, National Centre for Sensor Research and School of Biotechnology, Dublin City University.

Dr Joe Kerry, Department of Food Science and Technology, University College Cork.

(For more info visit http://relayresearch.ie)

Detecting toxins in food

A toxin that is produced by a fungus or a mould is called a mycotoxin. Mycotoxins are formed by a few species of mould that readily infect crops, either in the field or after harvest, and thus pose a threat to humans and animals that ingest food prepared from these crops.

Any crop that is stored for more than a few days is a target for mould growth; it is estimated that 20% of crops harvested in the EU are contaminated with mycotoxins.

The major crops affected are cereals, nuts, dried fruit, coffee, cocoa, spices, oil seeds, dried peas, beans, and fruit, particularly apples. Mycotoxins may also be found in beer and wine made from contaminated barley or grapes, and in meat, eggs, milk and cheese as a result of livestock eating contaminated feed. Most mycotoxins survive storage and processing even when cooked to quite high temperatures such as those reached during baking of bread or toasting of breakfast cereals.

Some of the most common mycotoxins can cause cancer or organ damage in humans and animals. The Food Safety Authority of Ireland called for comprehensive data on the presence of mycotoxins in food. This will allow an estimate of exposure of Irish consumers to mycotoxins. Because they are toxic in very low concentrations, sensitive and reliable methods are needed for their detection.

Mycotoxins in Irish foods

A team led by Dr Michael O'Keeffe at Ashtown Food Research Centre investigated mycotoxins produced during cool, damp seasons by the mould *Fusarium*. They bought cereal-based foods such as pastry, pasta, rice and beer, and dairy foods including milk, dairy products and baby foods, in shops throughout the country over a 12-month period. The foods were analysed for contamination with trichothecenes and zearalenone, toxic residues of the mould *Fusarium*.

About 70% of foods tested contained none, or less than 5 parts per billion, of zearalenone. The highest levels were in breakfast cereals, particularly those containing bran, the outer layer of the cereal grain. Of all the foods tested, only one contained zearalenone above the maximum permitted level of 50 parts per billion, that was a breakfast cereal with 64 parts per billion.

Concerning the trichothecenes, most foods tested negative or had only trace amounts. However, Dr O'Keeffe found a trichothecene called deoxynivalenol was present in flour, bread mixes and breads at up to 600 parts per billion. Pasta contained up to 500, biscuits and cakes up to 300 and breakfast cereals up to 250 parts per billion of deoxynivalenol.

Detecting toxins in food (continued)

The results will guide food manufacturers in sourcing their grain supplies.

With the exception of two breads, all of the foods tested were below the maximum permitted level of deoxynivalenol, which is 500 parts per billion. The non-compliant breads had 559 and 572 parts per billion, respectively.

Dr O'Keeffe said the results will guide food manufacturers in sourcing their grain supplies, and in drawing up specifications and tests to ensure the grain is free from *Fusarium* toxins.

Genes controlling toxins

Microbiologists at University College Cork led by Prof Alan Dobson used molecular tools to identify the fungal genes that control the production of two mycotoxins called ochratoxin A and patulin. Ochratoxin A occurs in cereals, while the most important source of patulin for humans is in apples that are affected by soft rot.

They successfully isolated the gene responsible for ochratoxin A in *Penicillium verrucosum* and then used it as a tool to detect the presence of ochratoxin A. Prof Dobson also isolated five genes from *Penicillium expansum* which appear to be excellent molecular markers for patulin growth. The study gives an insight into the way these two mycotoxins are synthesized in mould.

Research achievement

Knowledge of the incidence of *Fusarium* contamination in cereal-based food products is essential for food safety assurance by manufacturers. The analytical methods developed for the toxins, and knowledge of the genes controlling toxin production, will help to eliminate them from the food chain.

Michael O'Keeffe

Project (01/R&D/TN/196)
Mycotoxigenic fungi and mycotoxins in food.

Researchers:
Dr Michael O'Keeffe, Ashtown Food Research Centre, Teagasc, Dublin 15.

Prof Alan Dobson, Department of Microbiology, University College Cork.

(For more info visit http://relayresearch.ie)

Survey of children's food

Ireland has state-of-the-art records on nutrient intakes in Irish men and women *(visit www.iuna.net)*. However no such data exist for Irish children, until now. The Irish Universities Nutrition Alliance conducted a children's food survey on six hundred 5 to 12 year olds in 20 schools throughout Ireland.

In summary, the survey showed there is an increase in obesity in children, especially girls. Children who watch more TV are more likely to be obese. As would be expected, parents and the home environment have a considerable influence on body weight, and are critical in shaping the eating behavior, diet and physical activity habits of this age group.

Unbalanced diets

Dr Sinéad McCarthy and Professor Michael Gibney of Trinity College Dublin and Professor Albert Flynn and Dr Mairead Kiely of University College Cork observed that 15% of boys and 20% of girls between the ages of 5 and 12 are overweight.

Doctors recommend that energy intake from fat should not exceed 35% of total energy intake, however, four in ten Irish children exceed this limit. The sources of fat in the children's diets are milk and dairy products, confectionery, snacks, biscuits, meat and spreads. The survey also showed that:

- sixty-one percent of Irish children do not consume enough fibre,
- salt intake is too high; mainly from processed meats and bread,
- calcium, iron, vitamins A, C, D and folate are inadequate, especially in girls.

Children's exercise

The survey showed that 71% of children are either driven to school or use public transport; 21% walk and the remaining 9% use a combination of walk/car/cycle/public transport. Half of the children live within one mile of the school.

The more television watched the less recreational activity children engage in and the more likely they are to be overweight or obese. Thirty-six percent of children watch more than two hours TV per day during the week, this rises to 68% at the weekend.

Survey of children's food (continued)

Boys take more physical exercise than girls, with 82% playing hurling, football or rugby at least once a week. As would be expected, children spend more time on physical activities during the holiday period (25 hours per week) than during the school term (14.5 hours per week).

Parents' example

There are more overweight and obese children with mothers and fathers who are either overweight or obese; the influence of the mother is greater. Children follow parents' example in the amount of television watched per day.

The research examined why some children are fussy eaters and why others are not. Children who are continually offered new foods are less likely to be fussy eaters. Food fussiness is also linked to level of education, geography and social class.

Barriers to a healthy diet

The three most significant barriers to providing a healthy diet for children are child likes/dislikes, convenience and food advertising. Cost, availability and allergies have little influence.

Benefits

The electronic database compiled from the survey is one of the most comprehensive in Europe. It will be used by agencies concerned with public health policy and planning, and by the food industry.

Aine Hearty, Triona Joyce and Sarah Burke; part of the team who also worked on the project.

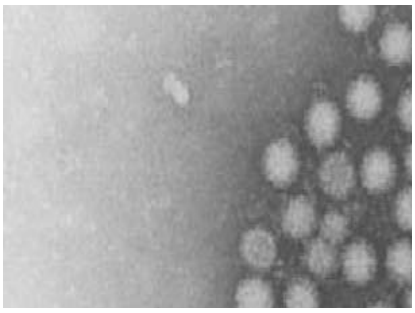
Project (01/R&D/TCD/150)
The development of a national food consumption database for children for risk assessment of food-borne chemicals and nutrient intakes.

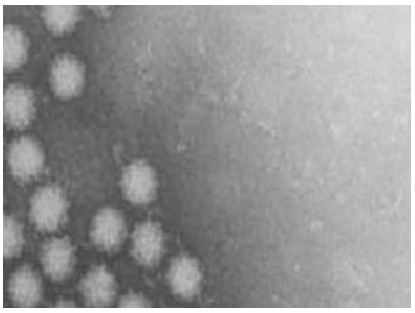
Researchers:
Dr Sinead McCarthy and Prof Michael Gibney, Trinity Centre for Health Sciences, St James' Hospital, Dublin 8.

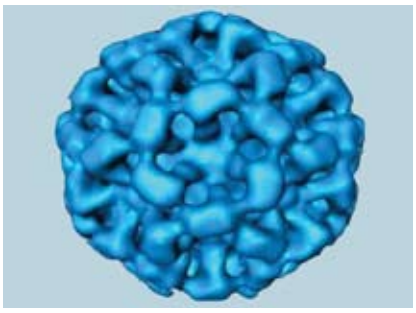
Prof Albert Flynn and Dr Mairead Kiely, Dept Food Science and Nutrition, University College Cork.

(For more info visit http://relayresearch.ie)

A common cause of food poisoning







A cluster of winter vomiting bugs is shown above left. The round blue structure on the right is a protein coat that surrounds the genetic material of the individual virus. It attaches to and injects its genetic material into our gut lining, reproducing itself and infecting more cells in the gut.

Norovirus, the 'winter vomiting bug', is a common cause of food poisoning. It is thought that at least 50% of all food borne outbreaks of gastroenteritis can be attributed to these viruses.

The virus is easily transmitted from one person to another. Anywhere that large numbers of people congregate for periods of several days provides an ideal environment for the spread of the infection, such as hospitals, schools, nursing homes and hotels.

Most people make a full recovery within 1-2 days, however, the very young or elderly may become dehydrated and require hospital treatment. Because there are many different strains of norovirus, and immunity is short-lived, outbreaks are common and widespread. There is no specific treatment for norovirus apart from letting the illness run its course.

Progress in diagnosing and controlling outbreaks of 'winter vomiting' has been hindered by the lack of methods to detect it. Since viruses cannot be grown in the laboratory as a means of detection, molecular assays were developed that are fast and accurate.

Developing an assay for winter vomiting bug

Scientists at University Colleges Cork and Dublin developed rapid assay methods to detect the virus in the faeces of infected people. The new assay is more efficient than those currently in use. The researchers used the new assay to identify the predominant strain of norovirus circulating in Ireland. In addition, they mapped the genetic code of the virus, providing the basis for the possible future development of a vaccine.

Gene sequences for rapid identification

Detection of the winter vomiting virus is based on the 'polymerase chain reaction' wherein short pieces or 'primers' of virus DNA 'pick up' corresponding gene sequences in samples infected by the virus. The method is somewhat limited by the fact that the winter vomiting virus is actually a large group of viruses, creating a need for multiple DNA primers.

For this reason, Dr John Morgan and his research team at UCC devised a 'catch-all' primer system. They designed primers to target a gene sequence that is similar in all of the winter vomiting viruses. The primers designed by Dr Morgan's team are more efficient at detecting norovirus than primers developed elsewhere.

A common cause of food poisoning (continued)

Norovirus, the 'winter vomiting bug', is a common cause of food poisoning. It is thought that at least 50% of all food borne outbreaks of gastroenteritis can be attributed to these viruses.

The researchers then identified the predominant type of virus circulating in Ireland, called genogroup II, and mapped its genetic code. This is the first gene map of a winter vomiting virus isolated in Ireland. Knowledge of the genetic make-up of the virus brings scientists a step closer to developing a vaccine against it.

The researchers used the new primers to count the number of virus particles in samples from infected patients. The technique is fast, precise and can tell the level of infection in an individual. They found that viral numbers ranged from 2.6 million to 2.5 billion per gram of faeces.

The team then developed a 'line probe assay' which allows the rapid identification of the particular strain of winter vomiting virus that has infected a patient. To date, 19 probes have been designed to identify different strains of the virus.

Source of virus

Meanwhile, Dr Paul Whyte at UCD investigated the possibility that the winter vomiting bug circulating in humans may originate from animals. He tested meat and faecal samples from chicken, beef, pork and lamb using the primers developed at UCC. No viruses were detected. The researchers concluded that Irish farm animals are not a source of norovirus.

Research achievement

A more efficient assay is now available and was used to identify the most common strain of winter vomiting virus circulating in Ireland. Its genetic code was mapped, bringing scientists a step closer to developing a vaccine against norovirus.

John Morgan and PhD Student John Menton

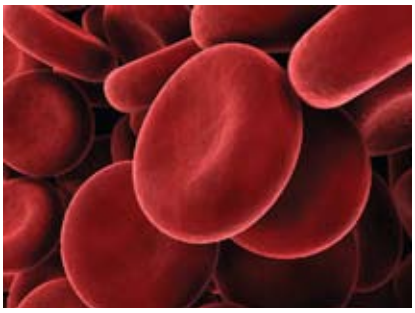
Project (01/R&D/C/195)
Development and evaluation of sensitive methods for the detection of human food borne viruses (NLVs and Astrovirus) in human and farm animal foods and faeces.

Researchers:
Dr John Morgan, Department of Microbiology, University College Cork.

Dr Paul Whyte, Department of Veterinary Medicine, University College Dublin.

(For more info visit http://relayresearch.ie)

Protecting the Food Chain from TSEs



Cattle, sheep and goats can be susceptible to a group of brain diseases known as TSEs, transmissible spongiform encephalopathies. TSEs get their name from the spongy appearance of the infected brain. The best known of these diseases is BSE (mad cow disease) in cattle. The disease in humans is known as CJD, Creutzfeldt-Jakob Disease, and scrapie in sheep and goats.

After BSE was first recognised in 1986, it developed as an epidemic with significant economic loss. It is transmitted to cattle through rendered meat-and-bone meal, if not heated to temperatures sufficient to kill any BSE contamination. The practice of feeding meat-and-bone meal to cattle and all other farm livestock is now banned.

TSE infections are caused by abnormal proteins called prions. Prions are found naturally in the membranes of normal cells. Infectious prions, for example the scrapie prion or the BSE prion, are abnormal disease-producing forms of the prion proteins.

BSE is linked to CJD in humans. Researchers concluded that the most likely origin of the new variant form of CJD, called vCJD, was human exposure to the BSE agent. Like BSE in cattle, vCJD is always fatal in people, making it vital that scientists understand the disease and have effective tests for it.

The incidence of BSE in cattle continues to decline. vCJD cases in humans appear to be stabilising. Although there is currently no diagnostic test for the pre-clinical disease in live animals, it is imperative that reliable, sensitive and specific tests are available to ensure that meat is free of this disease. Current BSE tests are limited in their sensitivity and are only usable post mortem.

The following three FIRM projects were aimed at developing better diagnostic tests for TSEs.

Testing for BSE in cattle

Researchers at University College Dublin led by Prof Mark Rogers developed a sensitive and specific laboratory test that detects BSE in cattle. They also gained an understanding of how the disease progresses in animals. This will help the meat industry to identify which parts of the carcass pose greatest risk to consumers.

The aim of this work was to develop tests to discriminate between normal prion proteins and the BSE prion and to gain a greater understanding of the pattern of infection in cattle which may facilitate detection of BSE in live animals.

The team developed a highly sensitive 'ELISA' system that uses an antibody to discriminate between the normal prion and the one causing BSE. The test was optimised using an antibody that is sensitive to the altered form of the BSE prion protein. The test successfully detected altered prions in tissues of mice and cattle that were clinically sick with BSE. The researchers are confident that this optimised, highly sensitive test can detect and measure the BSE prion in beef at an earlier stage than present tests.

The pattern of BSE infection

Mark Rogers then set up a tissue bank from cattle and mice that were experimentally infected with BSE. He used the tissue bank to establish the pattern of BSE spread in terms of time and space throughout the tissues and organs of infected animals. This information will allow the researchers to follow the route of BSE infection in animals, from consumption of infected feed to onset of clinical signs.

Research achievement

A test was produced that can detect the BSE prion earlier in infected cattle. Also, knowledge obtained of how BSE spreads in an infected animal may help industry to identify the carcass parts at greatest risk of infection, allowing them to be removed from the food chain.

Mark Rogers and David O'Connell, part of the team who worked on this project.

Project (01/R&D/D/160)
Temporal and spatial distribution of PrPBSE in BSE infected transgenic mice expressing bovine PrP and experimentally infected cattle and its potential for diagnosis.

Researcher:
Prof Mark Rogers Dept of Zoology and Conway Institute of Biomolecular and Biomedical Sciences, University College Dublin.

(For more info visit http://relayresearch.ie)

Rapid screening for scrapie and BSE

Unlike BSE, classical scrapie is not known to be linked to any human disease. Scrapie has been seen in sheep flocks for over 250 years, and while some of the symptoms of the disease are very similar to BSE – it attacks the nervous system of sheep and goats and causes death – studies have not shown any link between scrapie and human illness.

BSE has never been found in the sheep flock. However, some sheep ate the feed which is thought to have given cattle BSE. Also, laboratory research has shown that sheep can be artificially infected with BSE. There is, therefore, a possible risk that BSE is in sheep.

Because of these concerns, it is vital that screening is routinely carried out. Herein lies a problem. The only technique available for distinguishing between BSE and naturally-occurring scrapie in sheep was a bioassay on mice which took several months to do. Research was needed to develop a quicker screening technique that would discriminate between scrapie and BSE in sheep.

Differences at the molecular level

Dr Torres Sweeney and PhD student Caterine Thuring at the Faculty of Veterinary Medicine, University College Dublin together with Drs Máire McElroy and Ann Sharpe at the Central Veterinary Research Laboratory examined sheep with naturally-occurring scrapie and sheep that were experimentally infected with BSE. Although scrapie and BSE-infected sheep showed the same clinical symptoms, closer examination revealed significant differences at the molecular level in the distribution of the disease-causing prions in the brain and lymph tissues of both groups of sheep.

Tests now available to industry

The researchers developed tests that can discriminate between sheep with experimentally-induced BSE and scrapie. The tests are now available to industry through the national TSE testing centres in Europe, and can be performed in the Central Veterinary Laboratory at Backweston.

Are black faced mountain sheep resistant to scrapie?

The question arises as to whether genetic selection for resistance to scrapie could eliminate the scrapie prion in sheep. Black faced mountain, or BFM, sheep are dominant in the hills of Ireland. As there are no confirmed cases of scrapie in this breed, it was considered that they may be resistant to scrapie. The research showed that they are susceptible to scrapie, however, no natural cases have yet been found in BFM sheep in Ireland.

Research achievement

Tests that discriminate between scrapie and BSE in sheep are now available to the industry.

Torres Sweeney

Project (00/R&D/D/132)
Impact of sheep genotype and TSE strain type on development and diagnosis of TSE in sheep: will genetic selection for resistance eliminate PrPsc.

Researchers:
Dr Torres Sweeney, Faculty of Veterinary Medicine, University College Dublin.

Drs Maire McElroy and Ann Sharpe, Central Veterinary Research Laboratory, Backweston Lab Complex, Celbridge, Co. Kildare.

(For more info visit http://relayresearch.ie)

Using ultrasound to detect infectious prions

The tests currently in place to detect TSEs, or transmissible spongiform encephalopathies, are cumbersome and there is a requirement for rapid, highly specific tests. Dr Torres Sweeney's team at University College Dublin developed a high resolution ultrasound assay for TSEs, including BSE in cattle and scrapie in sheep.

Her aim was to provide the food industry with a rapid sensitive assay for detecting the infectious prions in animal feed and carcasses.

Current techniques for assaying BSE and scrapie prions require a minimum of four analytical steps and take 12 to 24 hours to get a result, and may not be sensitive enough to detect pre-clinical or early clinical cases.

Dr Sweeney investigated the potential of an ultrasonic immunoassay for rapid testing for TSEs on the killing line in meat factories. An advantage of ultrasonic assays is that they are neither invasive nor destructive, which is a major advantage in testing valuable meat.

Antibody binds to infectious prions

Immunoassays work by using an antibody to bind to an antigen, in this case the antigen is the prion that causes scrapie. The researchers found an antibody, called 15B3, that can differentiate between normal and scrapie prions. Finally, they found a way around using a slow protein digestion step by replacing it with a plasma protein called plasminogen which binds to the scrapie fibril in infected brain tissue.

Research achievement

A rapid, reliable test that can detect TSEs in meat was developed.

Torres Sweeney

Project (01/R&D/D/169)

Novel physical-chemical methodologies for the detection of transmissible spongiform encephalopathies.

Researchers:
Dr Torres Sweeney, Department of Animal Husbandry and Production, and Dr Vitaly Buckin, Department of Chemistry, University College Dublin.

(For more info visit http://relayresearch.ie)

RELAY

Derbhile Timon and Amanda Forde; RELAY Cork.

Breda Mulvihill and Ronan Gormley; RELAY Dublin.

RELAY is the dissemination project for FIRM research. It provides information to Irish food companies and to the rest of the food sector on research projects, scientists and institutions, free of charge.

It also disseminates information about other publicly funded research, so it has become a 'one-stop-shop' for all food research conducted at Irish institutes and universities.

Team members meet with companies

The dissemination team consists of Ms Derbhile Timon, Team Leader, based at Teagasc Moorepark, Dr Breda Mulvihill based at Teagasc Ashtown and Dr Amanda Forde based at UCC. Team members meet with companies, issue regular updates about on-going research and host workshops on the latest topics. They act as conduits for information transfer between companies and researchers.

Research results are relayed to industry

Over the past 5 years, RELAY has issued 230 updates of research projects, hosted 37 workshops and has made 525 company visits. Its database contains 1,515 companies and 326 researchers. The website www.relayresearch.ie has 2,100 registered members who, between them, have downloaded 49,500 research-related documents.

As companies receive vast amounts of information, RELAY uses targeted email alerts to ensure that companies receive only information relevant to their company.

Project (00/R&D/C/27)

Dissemination and exploitation of results from the 'Food Institutional Research Measure' to the Irish food industry.

Disseminators:
Dr Ronan Gormley and Dr Breda Mulvihill, RELAY, Ashtown Food Research Centre, Ashtown, Dublin 15.

Ms. Derbhile Timon, RELAY, Moorepark Food Research Centre, Moorepark, Fermoy, Co. Cork.

Dr. Amanda Forde, RELAY, Faculty of Food Science and Technology, University College Cork.

(For more info visit http://relayresearch.ie)

Summary of outputs of Research Projects

The following Tables contain the outputs of the 13 laboratory-based research projects that were completed in the FIRM 2006 programme.

Outputs of 13 Research Projects	Ph D degrees	M Sc degrees	Scientific papers	Workshops at which reports presented	Outcomes with commercial potential	Innovations adopted by industry
Consumer foods projects (4)	8	5	44	17	14	5
Food safety projects (6)	11	4	36	26	8	2
BSE & TSE projects (3)	3	1	9	2	2	2
Totals (13)	22	10	89	45	24	9

Per Project Averages	Ph D degrees	M Sc degrees	Scientific papers	Workshops at which reports presented	Outcomes with commercial potential	Innovations adopted by industry
Consumer foods projects	2.0	1.3	11.0	4.3	3.5	1.3
Food safety projects	1.8	0.7	6.0	4.3	1.3	0.3
BSE & TSE projects	1.0	0.3	3.0	0.7	0.7	0.7

In the pipeline

Research scheduled for completion over the next 24 months will further advance FIRM's twin objectives.

These are to:

- provide a base of scientific knowledge and expertise in generic technologies that will support innovation and product development in the Irish food industry; and to
- assist in assuring consumer protection and in ensuring that development is underpinned by attention to food safety and quality issues.

Projects nearing completion fall into areas not featured this year, including innovative ways to enhance the quality of cheese and meats, as well as further work in the areas of consumer foods and food safety.

Powerful proteins

Researchers at St Vincent's University Hospital in Dublin are studying small but powerful proteins from hen eggs that kill bacteria. These proteins might be active against common infections and, if so, could provide an alternative to antibiotic use. As some disease-causing bacteria are becoming resistant to antibiotics, these novel proteins may provide an alternative way to kill harmful bacteria.

Gene technology

Researchers in several laboratories are applying the sophisticated skills of gene technology, including the powerful techniques that were developed to decipher human genes, to detect and destroy newly-emerging microbes that cause infections or produce toxins.

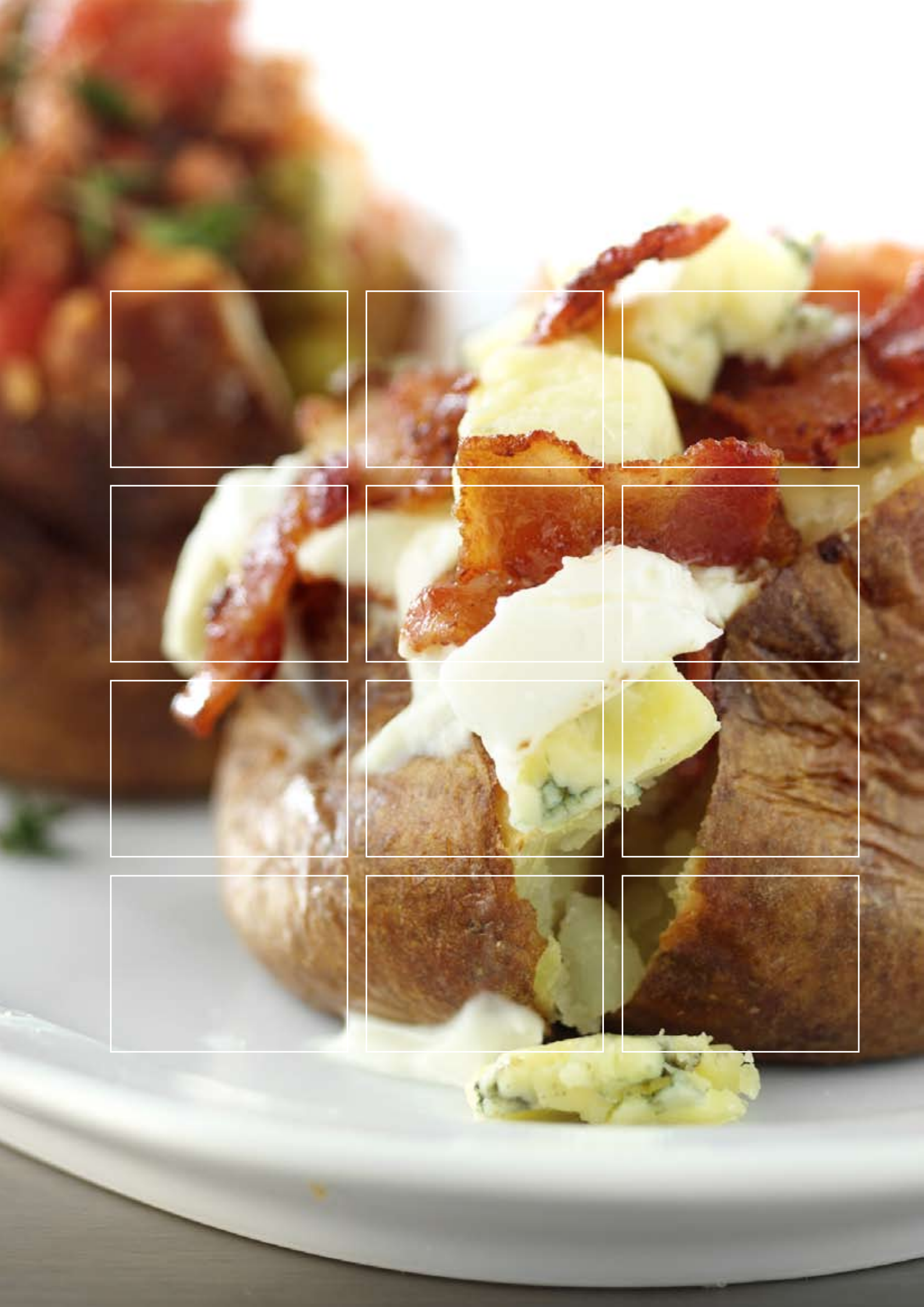
National food residue database

The goal of bringing the myriad of information that is now available on the status of Irish foods regarding chemical residues into one easily-accessible source, is being accomplished in a new National Food Residue Database. The database is already available to public access through the interactive website http://nfrd.teagasc.ie.

Quality of meat and diary products

The entire protein complement of milk, termed the milk 'proteome', is being analysed to understand its influence on the quality of dairy products. Likewise, meat researchers are analysing the beef 'proteome', and the genes that control it, to understand why the eating quality of beef from the same cut in like animals can be so variable.

These and other projects in the pipeline are establishing strength in science and technical development as a foundation stone of the Irish food sector.

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