TResearch

Volume 20: Number 1: Spring 2025
ISSN 1649-8917

SIDESTREAM VALORISATION
The hidden potential of animal waste

PEAS OF MIND
Irish-grown flour alternatives for baked goods

NOT ADDING UP?
Examing sensory evaluation of nitrite-free meats

Powder to the people

Improving processes in the production of dairy powders plays a key role in upholding Ireland's status as a food exporter

BACK IN TIME: Reflecting on the industry contributions of Teagasc's Food Programme, p16.

Teagasc
Agriculture and Food Development Authority

Welcome

Advances in innovation across the food sector play a key role in maintaining Ireland's status as a food exporter, explains Mark Fenelon, Head of Teagasc's Food Programme at Ashtown and Moorepark, in this issue's Look Ahead column (p38).

Among the many valuable outputs of the meat-processing sector, animal blood has emerged as a promising yet underutilised resource, with potential for high-value applications across the food, nutraceutical and pharmaceutical sectors. Find out more in an article by Soudabeh Ghalamara and colleagues on p12.

Irish dried dairy exports exceeded €3 billion in 2023. Ireland produces an array of powders for international markets, from dairy ingredients like skim milk powder and whey protein isolate to specialised nutrition products such as infant formula. We interviewed Eoin Murphy about his research in this area (p14).

Our Back in Time feature celebrates Teagasc's Food Programme. This special feature on p16 highlights the programme's lasting impact on the evolution of the agri-food sector, covering everything from fermented foods to flavour profiling of whiskey.

A research team from Teagasc Ashtown is exploring new, food-focused applications of Irish-grown peas to formulate bread products. By using locally grown produce, this work holds potential benefits for the environment, local economy and consumer health. Mariana Maçãs and colleagues tell us more on p24.

Sinead McCarthy and collaborators, including a consortium of over 100 scientists as part of the EU-funded DOMINO project, are currently investigating how fermented food consumption influences the gut microbiome and provides health benefits to consumers, which you can read more about on p28.

Lastly, on p30, research at Teagasc Ashtown is investigating the role of food additives - such as nitrites - in cured meats, and whether these can be reduced without negatively impacting consumers' sensory perception and purchasing intentions.

Catriona Boyle
Editor, *TResearch* magazine, Teagasc

Tá dul chun cinn sa nuálaíocht á dhéanamh i ngach réimse d'earnáil an bhia agus tá sé sin an-tábhachtach chun stádas na hÉireann mar easpórtálaí bia a choimeád, a mhíníonn Mark Fenelon, Ceannasaí Chlár Bia Teagasc i mBaile an Ásaigh agus sa Chloch Liath, sa cholún dar teideal Look Ahead (lch 38) den eagrán seo.

Cuireann earnáil na próiseála feola an-chuid táirgí luachmhara ar an margadh, ach i measc na bhfotháirgí dá cuid tá fuil ainmhíoch tar éis teacht chun cinn le déanaí mar acmhainn thearcúsáidte a bhfuil gealladh fúithi, mar acmhainn nár baineadh leas ceart aisti go dtí seo agus mar acmhainn a bhféadfadh an-chuid úsáidí ardluacha a bheith léi in earnáil an bhia, san earnáil nútraiceodach agus in earnáil na cógaisíochta trí chéile. Faigh tuilleadh eolais faoin ábhar seo san alt le Soudabeh Ghalamara agus comhghleacaithe atá fáil ar lch 12.

B'fhiú níos mó ná €3 bhilliún na táirgí déiríochta triomaithe a easpórtáladh as Éirinn sa bhliain 2023. Táirgtear réimse leathan púdar in Éirinn agus díoltar ar mhargaí idirnáisiúnta iad. Áirítear comhábhair atá déanta as bainne amhail púdar bainne bhearrtha agus próitéin ón meadhg chomh maith le saintáirgí speisialaithe amhail bainne foirmle do naíonáin i measc na bpúdar sin. Chuireamar agallamh ar Eoin Murphy faoina chuid taighde sa réimse seo (lch 14).

Déantar ceiliúradh ar Chlár Bia Teagasc inár ngné-alt sa cholún Back in Time. Léirítear sa ghné-alt speisialta seo ar lch 16 an tionchar buan a bhí ag an gclár seo ar an bhforbairt atá déanta san earnáil agraibhia, agus clúdaítear ábhair éagsúla ann amhail bianna coipthe agus próifiliú blais uisce beatha.

Tá foireann taighde ag Teagasc i mBaile an Ásaigh ag déanamh taighde ar phiseanna a fhásann in Éirinn. Tá siad ag iniúchadh slite nua atá dírithe ar bhia chun iad a úsáid i dtáirgí aráin. Agus toisc go n-úsáidtear táirgí a fhásann go háitiúil, tá gach seans ann go mbeadh buntáistí ag baint leis an obair seo don timpeallacht, don gheilleagar áitiúil agus do shláinte na dtomhaltóirí. Insíonn Mariana Maçãs agus comhghleacaithe níos mó dúinn faoin ábhar seo ar lch 24.

Catriona Boyle
Eagarthóir, iris *TResearch*, Teagasc

TResearch is an official science publication of Teagasc. It aims to disseminate the results of the organisation's research to a broad audience. The opinions expressed in the magazine are, however, those of the authors and cannot be construed as reflecting Teagasc's views. The Editor reserves the right to edit all copy submitted to the publication.

www.teagasc.ie

EDITOR
Catriona Boyle
catriona.boyle@teagasc.ie

ADMINISTRATOR
Ann Kane
ann.kane@teagasc.ie

EDITORIAL STEERING GROUP
Catriona Boyle, Philip Creighton, Karen Daly, Eric Donald, Muireann Egan, Niall Farrelly, Mark Fenelon, Helen Grogan, Richard Hackett, Anne Kinsella, Brian McCarthy, Sinéad McCarthy, Edward O'Riordan, Ridhdhi Rathore Brijesh Tiwari, Declan Troy, Miriam Walsh

Reference to any commercial product or service is made with the understanding that no discrimination is intended and no endorsement by Teagasc is implied.

Published on behalf of Teagasc
Artful Dog Publishing
artfuldogcreative.com

Design: *Ross Behenna; Asami Matsufuji*
Editorial: *Theo Wilson*

Cover image: Fergal O'Gorman (main image); MediaProduction/istockphoto.com (Sidestream valorisation); Teagasc (Peas of mind); lensmen/istockphoto.com (Not adding up?).

Main image shows Senior Research Officer Eoin Murphy in the labs at Teagasc Moorepark's Food Research Centre.

Contents

Throughout TResearch, *we include icons alongside articles where there is a clear link to the urgent actions in our Climate Action Strategy. These actions are: Reduce Nitrogen Emissions, Reduce Methane Emissions, Increase Carbon Capture, Enhance Biodiversity, Increase Diversification, Enhance Adaptation, Circular Food System, and Supporting Policy. Teagasc's four research programmes, frequently referred to by their acronyms, are: Animal and Grassland Research & Innovation (AGRIP); Crops, Environment and Land-Use (CELUP); Food (FOOD); and Rural Economy and Development (REDP).*

Driving innovation, sustainability and performance

Teagasc launched a new report recently: 'Advancing Innovation, Sustainability and Technical Performance of the Agri-Food Sector in 2024'.

In climate, the report showed that greenhouse gas emissions from agriculture decreased by 4.6% in 2023. Meanwhile, 2024 saw significant advances in relation to the adoption of measures to reduce greenhouse gas emissions. For example, nitrogen (N) fertiliser use was close to the target set for 2030, while protected urea made up 26.4% of straight N use, with a target for 2030 of 95%.

The report highlighted that research produced through the Teagasc Climate Centre is driving innovations in nutrient management, carbon sequestration and methane reduction. For example, the Signpost Advisory programme saw 15,000 farmers enrol - driven by Teagasc Climate Advisors who develop farm-specific plans with each farmer, using the AgNav digital platform.

Regarding water quality, the EPA report for 2016 to 2021 shows that 54% of Irish surface waters are in 'good' ecological status or better. The Water Framework Directive requires all EU Member States to achieve at least 'good' status in all water bodies by 2027. Recent EPA data indicates that nitrogen concentration in 20 selected rivers has declined in the first six months of 2024 relative to 2023, which is welcome. In 2024, Teagasc launched the 'Better Farming for Water: 8-Actions for Change' campaign, which will build on existing programmes.

The Irish farming population is ageing, and the proportion of young farmers has been in decline over recent decades. Data from the Teagasc National Farm Survey reports that 33% of Irish farmers are aged over 65, with an average age of 58 years. Teagasc activities contribute strongly to capacity building for the sector. Over 3,600 students participate in Teagasc education programmes, and surveys undertaken five years after graduation consistently show over 90% are involved in farming. The Walsh Scholars Programme and other post-graduate programmes also play a key role by providing highly trained graduates for the sector.

Science-driven innovation in the food industry complements good technical performance at farm level in terms of overall performance of the agri-food sector.

In 2024, Teagasc research and innovation delivered significant advancements to the food industry to enhance safety, quality and sustainability, along with supporting a range of new products and processes through knowledge transfer. Over 150 companies utilised the state-of-the-art pilot plant facilities in Teagasc's National Prepared Consumer Food Centre and Moorepark Technology Ltd., while 410 entrepreneurs from across Ireland benefited from training and support to scale their businesses through the Food Works and Bia Innovator programmes.

Pictured at the launch were (L-R) Frank O'Mara, Teagasc Director; Stan Lalor, Director of Knowledge Transfer; Siobhán Jordan, Head of Technology Transfer and Commercialisation; Pat Dillon, Head of Research; and Emma Dillon, Teagasc Economist

John Ohle.

Dried dairy: a key Irish industry

Ireland produces an array of powders for international markets, from dairy ingredients like skim milk powder and whey protein isolate, to specialised nutrition products such as infant formula.

9
medium to large companies manufacturing dairy ingredients

3-10
tonnes per hour
Typical dryer production

3
of the world's largest infant formula companies have operations in Ireland

Product quality
is one of the most important factors for customers

Improving energy efficiency
is a top priority for the industry

Grounds for celebration

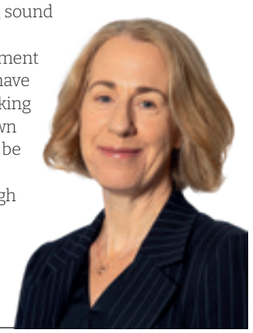
Well done to Karen Daly, who was recently appointed as Head of the Environment, Soils and Land Use (ESLU) Research Department at Teagasc Johnstown Castle. Karen holds a BA, Masters and PhD from Trinity College, and recently obtained a Graduate Certificate in Strategic Leadership from DCU.

Karen (pictured) brings to the role over 24 years' experience in leading research projects and teams, focussing on topics such as soil health, soil phosphorus and water quality, catchment and farm-scale water quality risk assessment and farm-scale mitigation measures for water quality protection. More recently, she has been advancing the research and innovation in spectroscopy and proximal sensing for environmental samples.

Karen is internationally recognised for her expertise and has 95 peer-reviewed scientific publications and has mentored 17 students to the award stage of PhD, and her work is trusted for providing sound scientific advice for policy and practice on-farm.

John Spink, Head of the Teagasc Crops, Environment and Land Use Programme, said: "I'm delighted to have Karen as part of the team and look forward to working with her. The ESLU Research programme has grown significantly in recent years and her expertise will be invaluable in managing the team."

Karen added: "It's a privilege to work with the high performance team here in Johnstown Castle, and I look forward to leading the department in developing innovative solutions to support the agri-food sector."



EAAP Young Scientist Award

Teagasc congratulates Kate Keogh on receiving the European Federation of Animal Science (EAAP) Young Scientist Award in 2024. This prestigious award, presented annually, recognises outstanding contributions to the field of animal science by early-career researchers across Europe.

Kate (pictured), a postdoctoral researcher based at the Animal & Grassland Research and Innovation Centre at Teagasc Grange, has distinguished herself through her innovative research in sustainable animal production systems. Her work focuses on developing strategies to enhance the efficiency and environmental sustainability of livestock farming, aligning with Teagasc's mission to support the agriculture and food sectors in producing safe, high-quality food while protecting the environment.

"I am deeply honoured to receive the EAAP Young Scientist Award," Kate said. "This recognition is a reflection of the hard work and dedication of the entire research team at Teagasc. I am excited to continue advancing research that supports sustainable animal production systems."

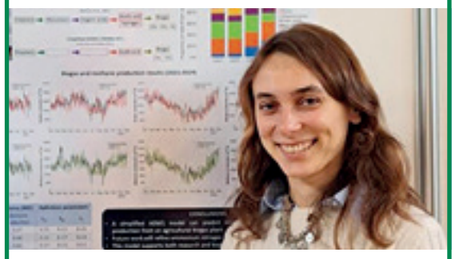
Kate's project is part of the prestigious Research Leaders 2025 Postdoctoral Fellowship programme, a Marie Skłodowska-Curie Actions co-funded initiative that supports the career development of high-potential researchers.

Commenting on this milestone, Raymond Kelly, coordinator of Research Leaders 2025, said: "We are incredibly proud of Kate's achievement in receiving the EAAP Young Scientist Award. Her success is a testament to her expertise and commitment, and it shows that the Research Leaders 2025 programme is achieving its aim of nurturing the next generation of scientific leaders. We look forward to seeing her continue to contribute groundbreaking research to the field."

News in brief

Women and girls in science

The International Day of Women and Girls in Science celebrated ten years on 11 February. Implemented by UNESCO and UN-Women in collaboration with institutions and civil society partners, it aims aim to promote women and girls in science. This day is an opportunity to promote full and equal access to, and participation in, science for women and girls. Gender equality is a global priority for UNESCO, and the support of young girls, their education and their full ability to make their ideas heard are levers for development and peace. Teagasc celebrated the day by running a social media campaign featuring women working in science across various roles - to show the diversity of careers available to women in science at Teagasc.



Turning waste into watts

Through the Teagasc International Training Awards, Sofia Tisocco, a Walsh Scholar based at Teagasc Grange and University of Galway, spent ten weeks at Aarhus University, Denmark, in the Department of Biological and Chemical Engineering. Aarhus University uses a diverse range of feedstocks, including cattle manure, deep litter, grass silage and maize silage, to produce biogas, which is then used in a combined heat and power plant. During her research stay, Sofia (pictured) collected four years of continuous operational data from the anaerobic digestion (AD) plant, including biogas, methane and digestate production and feedstock characterisation. Sofia is using this data to predict the biogas and methane production based on feedstock properties and operating conditions, which can be used to refine models and predict AD outputs in Ireland.

Increase Carbon Capture

Diversification

Rooting innovation: shaping Ireland's apple future

A research initiative at Teagasc Oak Park aims to boost apple production in Ireland by exploring innovative training systems and rootstocks. The project focuses on improving yield efficiency, enhancing fruit quality, and cutting labour costs, offering Irish growers strategies tailored to the local climate.

Research initiatives by Teagasc are set to revitalise the dessert apple sector in Ireland. Despite a domestic market valued at €131 million, the majority of apples are imported, highlighting a significant opportunity for local growers. Ireland's favourable climate, access to modern apple varieties, advanced technologies, and growing consumer preference for locally grown, plant-based foods all contribute to this opportunity. Furthermore, the environmental benefits of local apple production, such as carbon sequestration, make it a sustainable option.

The Efficient Orchard 2024 project marks a pivotal advance for the apple industry in Ireland, explains Teagasc Research Officer Alberto Ramos Luz.

"This initiative focuses on boosting production efficiency, improving fruit quality, and cutting labour costs by testing different training systems and rootstocks. The project's main goal is to identify the best combinations for high-yield efficiency and top-quality fruit, specifically tailored to the Irish climate."

Establishing efficiency

The Efficient Orchard 2024 project is being conducted at the Oak Park Research Centre in Carlow from 2024 to 2029, led by Alberto in collaboration with Syed Bilal Hussain of UCD's School of Agriculture and Food Science.

The project aims to evaluate the agronomic performance of 48 apple genotypes, including Alpigala, Story Inored, Inobi, Gala Buckeye, Elstar Red Flame, Elstar Elshof, and Wilton's Star Red Jonaprince Select.

In Oak Park's research orchard, these genotypes are grafted onto a variety of rootstocks – the below-ground root networks used for propagation – including M9, M200 and the Geneva series.

These genotypes and rootstocks will be examined in conjunction with different training systems, such as Tall Spindle (high planting density, minimal pruning), V-Trellis (improved light exposure) and innovative two-dimensional training systems.

Understanding behaviour

A key objective is to gather preliminary data on the vegetative, reproductive, and physiological behaviour of apple trees under Irish conditions, explains Alberto.

"The study will closely monitor phenological development, vegetative growth such as the trunk cross-sectional area, reproductive performance – e.g. yield and yield efficiency – and fruit quality properties like size, weight, firmness, soluble solids, acidity and colour."

He notes that although a full evaluation of the training systems would require at least 10 years to fully map out, the project aims to generate essential insights that will provide a starting point for guiding future research and orchard management strategies.

Understanding the behaviour of different apple genotypes under various training systems and rootstocks is essential for advancing apple production in Ireland. This research will provide key foundational data to guide the selection of varieties and systems with strong market potential, specifically adapted to Irish conditions, Alberto adds.

"This project's research outcomes will support the implementation of new orchard practices, informing future research to maximise yield efficiency and fruit quality. Ultimately, this will make apple production more attractive to Irish farmers by enhancing profitability and offering higher-quality fruit to consumers."

Boosting production

This research addresses economic, environmental and social issues, aligning with Teagasc's strategic objectives. It supports rural development, reduces greenhouse gas emissions, aids climate change adaptation, promotes biodiversity, improves human health and nutrition, and ensures sustainable farming.

"By boosting the production of high-quality Irish apples, we can decrease reliance on imports, enhancing both sustainability and food security," Alberto points out.

"In this broader context, apples serve as a pilot initiative, paving the way for further advancements in Irish fruit growing. By 2029, we anticipate having gained vital insights into the optimal combinations of apple genotypes, rootstocks and training systems best suited for Irish conditions. This knowledge will empower apple growers to diversify their production strategies with confidence, achieving high-yield efficiency and improved fruit quality."

The research findings will enable growers to enhance profitability by adopting the most effective practices identified, significantly reducing the risks traditionally associated with establishing new orchards. T

> The project's main goal is to identify the best combinations for high-yield efficiency and top-quality fruit, specifically tailored to the Irish climate.

Teagasc

FUNDING

This project is internally funded by Teagasc.

CONTRIBUTORS

Alberto Ramos Luz
Fruit Research Officer
Horticulture Development Department, Teagasc Oak Park.
alberto.ramosluz@teagasc.ie

Ahmad Hassan Chaudhry
Walsh Scholar (Efficient Orchard project)
Horticulture Development Department, Teagasc Oak Park/School of Agriculture and Food Science, University College Dublin.

Syed Bilal Hussain
Lecturer and Assistant Professor
School of Agriculture and Food Science, University College Dublin.

Supporting Policy

Going viral

Research at the Horticulture Development Department at Teagasc Ashtown is exploring the potential use of viruses to combat pathogens in commercial mushroom cultivation.

Typical symptoms of dry bubble disease on a mushroom crop

Mushroom cultivation is a significant horticultural enterprise in many countries. In Ireland, commercial mushroom production is the largest horticultural sector, accounting for around 26% of total production.

There are various factors that can substantially reduce mushroom yield, including dry bubble disease, which must be controlled to prevent economic loss. However, as the number of chemical pesticides approved for use dwindles, more attention is given to investigating novel, alternative methods for effective pest management.

Viruses are widespread in nature and are associated with all groups of living creatures such as bacteria, fungi (including mushrooms), plants, animals and humans. Contrary to general perception, most viruses are benign, with no apparent impact on their host organisms. Interestingly, some even provide their hosts with beneficial features, such as drought or cold tolerance conferred by plant viruses in crops such as rice, cucumber, tomato and beetroot. Nevertheless, others can cause severe, even fatal, diseases.

Combatting pathogens

Lorant Hatvani is a research fellow at Teagasc Ashtown's Food Research Centre. He received a Research Leaders 2025 Fellowship for his project, *Leca*-VIR, which examined the potential role of viruses in the development of dry bubble disease of mushrooms caused by the fungus *Lecanicillium fungicola*.

Mycoviruses are viruses that infect fungi and most of them are symptomless, causing no obvious macroscopic alterations in their hosts, Lorant explains.

"However, of great interest to the crop protection research community, several mycoviruses have been found to significantly affect various plant pathogenic fungi, with some viruses reducing the ability of pathogens to cause disease – what's known as hypovirulence."

A mycovirus causing hypovirulence in the plant pathogenic fungus *Cryphonectria parasitica* was successfully applied in the field, where it naturally disseminated and controlled blight disease of sweet chestnut trees. Further promising mycoviruses with potential biological control activity have since been discovered.

> **Several mycoviruses have been found to significantly affect various plant pathogenic fungi, with some viruses reducing the ability of pathogens to cause disease.**

The objectives of Lorant's *Leca*-VIR project were twofold: examine fungal viruses in the causal agents of dry bubble disease, and investigate the possibility that some viruses might be of interest for biological disease control in mushroom cultivation. The work was done in collaboration with the fungal virology group at the Institute of Plant Science and Resources (IPSR), Okayama University (Japan) and the Genome Evolution Laboratory at Maynooth University, with the purpose of knowledge transfer between the participants.

Teagasc

Identifying viruses

During the Outgoing Phase of the project spent at IPSR, the researchers examined a collection of 57 fungal cultures, obtained from dry-bubble-affected mushroom crops in several countries, Lorant explains.

"Virus screening by cellulose column chromatography revealed the presence of ten putative viral elements, which were subsequently identified by next-generation sequencing. A further three mycoviruses were also found during the identification process, which resulted in the discovery of potential novel species."

To examine the potential impact of these viruses on their hosts, they were eliminated from the fungal cultures (virus-curing) using different techniques such as cultivation under adverse conditions (nutrient limitation and drought stress) or by the application of different antiviral drugs. Comparison of the growth and spore production of the original, virus-containing cultures and their virus-cured counterparts revealed virus-cured cultures with substantially increased spore production (2-5x) following the removal of a partitivirus.

"No remarkable differences were observed in any other cultures," Lorant notes. "This finding suggests that the partitivirus may negatively affect the production of spores, which are essential for the spreading of dry bubble disease. Therefore, it may be a potential tool for biological disease control."

The virus was successfully introduced into two originally virus-free *L. fungicola* isolates obtained from industry, by allowing them to interact and fuse with the virus-carrying "donor" culture.

Promising results

The Return Phase of the project was undertaken in the Mushroom Research Unit at Teagasc Ashtown. Using partitivirus-carrying cultures and their virus-cured derivatives, the researchers examined the potential impact of the discovered partitivirus on dry bubble disease development in mushroom crops. Lorant explains: "In crop trials, less disease occurred following infection with the virus-containing pathogen, while significantly increased symptom development was observed when the virus was absent. This confirmed the hypothesised negative effect of the virus on the performance of the pathogenic fungus."

Lorant Hatvani examining mushroom crop trials at Teagasc Food Research Centre, Ashtown

In proteomic studies performed in collaboration with Maynooth University, proteins associated with the production of membrane components were detected in higher abundance in the virus-cured culture, compared to the virus-containing culture, suggesting that the partitivirus might have a negative effect on cell membrane integrity and function.

"Unfortunately, according to the results of additional crop trials, the experimental introduction of the partitivirus into two originally virus-free fungal cultures did not lead to reduced virulence of the pathogen," Lorant notes. "This suggests that the observed negative effects attributed to this virus may be strain-specific, rather than universal.

"Although the partitivirus examined in this study does not seem to provide a solution for the control of dry bubble disease, the findings of the *Leca*-VIR project have contributed to the discovery of potential new viral species as well as to our understanding of the biological role of viruses in fungal pathogens that affect the production of agricultural crops." T

ACKNOWLEDGEMENTS

The authors greatly acknowledge valuable contributions of Brian McGuinness and Antonia Santos (Teagasc); Hideki Kondo, Sakae Hisano, Paul Telengech, Savitri Shahi, Sarah Ibiang and Kazuyuki Maruyama (Okayama University); and Kevin Kavanagh, Joy Clarke and Aaron Curtis (Maynooth University).

FUNDING

Lorant Hatvani has received funding from the Research Leaders 2025 programme co-funded by Teagasc and the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement number 754380.

CONTRIBUTORS

Lorant Hatvani
Research Leaders 2025 Fellow
Horticulture Development Department, Teagasc Ashtown.

Nobuhiro Suzuki
Full Professor
IPSR, Okayama University, Japan.

David Fitzpatrick
Associate Professor
Department of Biology, Maynooth University.

Helen Grogan
Senior Research Officer
Horticulture Development Department, Teagasc Ashtown.
helen.grogan@teagasc.ie

Cultivating safety: sowing the seeds of safer farming

How do farming experience and social influences shape safety awareness among young farmers? This research explores the behavioural drivers of farm injury risk perception.

Although farm safety is governed by legislation, it is strongly influenced by individual behaviours. These behaviours are shaped by personal experience and the social context within which farming practices are shared.

A key factor for farm safety is increasing Farm Injury Risk Perception (FIRP). Farmers are more likely to avoid risks when they perceive a higher chance of injury associated with a given practice, situation or behaviour.

FIRP and risk tolerance are strongly shaped by individuals' experience and social influences, explains Mohammad Mohammadrezaei, a Research Officer at Teagasc Ashtown.

"These influences include the attitudes of family, friends and peers, and the expected behaviours within this context. This is especially the case in countries predominantly with family farm systems, such as Ireland. Within these systems, young adults are one of the groups most vulnerable to farm injury. These workers are highly influenced by their parents, friends and other farmers in decision-making related to at-risk behaviours on the farm."

To improve farm safety amongst young farmers, it is necessary to develop a better understanding of current levels of risk perception and assess the impact of experience and social influences.

Splitting the difference

This study surveyed 417 agricultural science students in Ireland, evenly split between first- and second-year undergraduates (53% female, 47% male). The research was conducted before the students completed a health and safety module, ensuring their responses reflected prior experiences rather than course influences. The median age of participants was 19.

A significant portion of students had direct exposure to farm-related risks. One in four reported experiencing a near-miss or close call in the previous year. Additionally, almost 14% of respondents had suffered a farm-related injury severe enough to disrupt their education or work for more than one day.

When asked about their key social influences, students most frequently cited farmers, family and friends as the most impactful figures shaping their farm safety perceptions.

Interestingly, nearly half of the participants (45%) were classified as "risk optimistic", meaning they underestimated the likelihood of injury or harm, while 41% were "risk averse", perceiving a higher chance of injury. The remaining 14% fell into a neutral category. Factors such as age, gender, stage of education, and farming experience showed no significant impact on whether students were risk optimistic or risk averse. This finding raises an important question: what drives differences in FIRP among students with otherwise similar characteristics?

The source of risk perception

The study identified two key factors influencing risk perception of young farmers: experience or knowledge of a serious injury, and social influences.

Students with experience of a farm work-related injury, having a near miss or close call, or knowledge of a farm-related death or injury reported significantly greater FIRP and were more likely to be "risk averse". Notably, 34.5% of participants had a personal connection to someone who died while 56.4% knew someone who was moderately or severely injured as a consequence of a farm-related incident. This is indicative of a relatively high level of farm work-related incidents among family farms.

Study participants identified farmers (38.6%), family and friends (33.6%), and support organisations (13.7%) as their main social influences in relation to FIRP. There was a statistically significant association between respondents who reported family and friends or farmers as key social influences and the level of FIRP.

The research found that students who are influenced by their family and friends or farmers are more likely to underestimate FIRP and are consequently "risk optimistic". This finding fits with a growing body of literature that highlights how young farmers gain credibility as "authentic farmers" by modelling their behaviours on older or more experienced farmers. The latter finding highlights the importance of taking a systematic approach to increasing FIRP.

Whilst it is crucial to provide students with education and training in relation to hazard identification and risk management, it is as important that education and training initiatives are targeted at farmers and farm families, highlighting their influence on younger farmers, Mohammad notes.

"The findings around direct experience of injuries and fatalities underline the importance of knowledge sharing and peer learning. Those with direct experience of such situations can better encourage and engage with young farmers to share and reflect around their perceptions of potential at-risk behaviours and their implications."

A considered approach

Taking this approach needs to be very carefully considered; there is a need for the development of guidance for educators and trainers that take into consideration the associated ethical issues, Mohammad adds.

"Related to developing further learning and guidance materials, there is potential to use existing resources. Such resources notably include testimony from farmers who speak about injuries they have experienced and the impact these have had on them, their families and their business."

A number of these accounts have been filmed and are available in the HSA 'Survivor Stories' series. These accounts provide a valuable resource to the sector to promote farm safety, assuming use of such resources is approached with suitable sensitivity.

"Despite the potential challenges associated with peer learning on the topic of farm safety, this research highlights the need for educational tools focusing on real-life experiences and showing the real consequences of risky actions, rather than just pointing out dangers," Mohammad concludes.

"By using practical examples and positive social influences from trusted individuals, we can challenge harmful farming traditions and shift the mindset in farming communities. This can help create a safety-first culture where avoiding risks is seen as a key part of farming culture."

For younger adults in farming systems, risk perception is strongly influenced by the behaviours and attitudes of peers

SolStock / istockphoto.com

ACKNOWLEDGEMENTS

This work is funded by the Department of Agriculture, Food and the Marine's BeSafe Grant (Grant number 17S269). The authors would like to acknowledge the students who participated in this study and Jim Kinsella of UCD, co-author of the paper on which this article is based.

CONTRIBUTORS

Mohammad Mohammadrezaei
Research Officer, Rural Economy and Development, Teagasc Ashtown.
mohammad.mohammadrezaei@teagasc.ie

David Meredith
Senior Research Officer, Rural Economy and Development, Teagasc Ashtown.

John McNamara
Senior Health and Safety Specialist, Teagasc Kildalton College.

Sinéad Flannery
Assistant Professor, School of Agriculture and Food Science, University College Dublin.

Animal blood is a nutrient-rich by-product offering sustainable solutions. Innovative processes transform it into valuable products, turning waste into wealth and advancing a circular economy.

Turning waste into wealth: the hidden potential of animal blood proteins

Ireland has established itself as a leader in sustainable practices within the meat processing industry. Among the many valuable outputs of this sector, animal blood has emerged as a promising yet underutilised resource. Recent advancements have highlighted its potential in creating high-value applications across the food, nutraceutical and pharmaceutical sectors, offering innovative pathways to sustainability and economic growth.

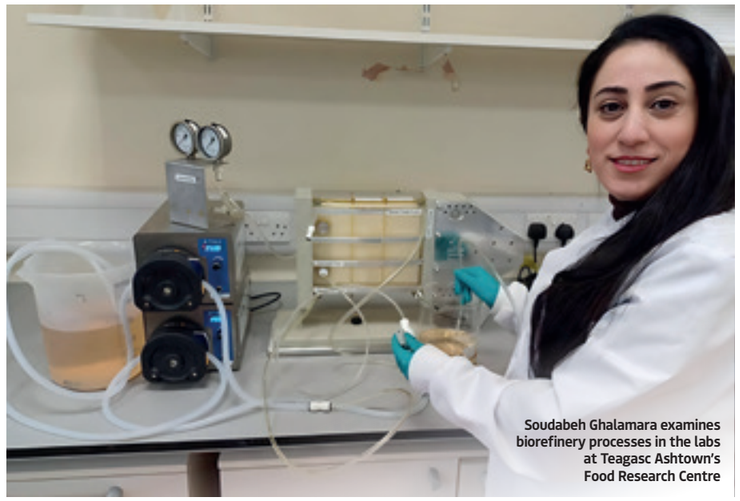
Animal blood as a sustainable resource

"Animal blood is a unique resource with immense potential," explains Soudabeh Ghalamara, Postdoctoral Researcher at Teagasc Food Research Centre. "It is not only nutrient-rich but also aligns perfectly with circular economy principles, turning what was once considered waste into valuable high-end products."

Environmental concerns demand greater resource optimisation in the meat industry. With global consumption of animal proteins expected to double by 2050, there is an urgent need for sustainable alternatives. Unlike traditional protein sources that require significant water, land and fertilisers, animal blood is an efficient, ready-made by-product.

"This approach enables the industry to support local economies while reducing reliance on synthetic additives," adds Shay Hannon, National Prepared Consumer Food Centre Manager. By leveraging advanced processing technologies, the untapped potential of animal blood can be harnessed to produce bioactive peptides with applications in food and pharmaceuticals.

MediaProduction /istockphoto.com



Teagasc

Soudabeh Ghalamara examines biorefinery processes in the labs at Teagasc Ashtown's Food Research Centre

From slaughterhouse to sustainability

The meat processing industry generates substantial volumes of by-products, including animal blood, which has long been underutilised despite its immense potential. "Blood is often treated as waste, but it's actually one of the most nutrient-dense outputs of meat processing," explains Brijesh K. Tiwari, Principal Research Officer. "Bovine blood, for example, contains up to 18% protein in its raw state, and these proteins have exceptional functional and bioactive properties."

The composition of blood includes key proteins like albumin, globulins, and hemoglobin, which make it an ideal candidate for high-value applications in the food, nutraceutical, and cosmetic industries. However, its highly perishable nature and complex composition present challenges for recovery and utilisation. Additionally, with blood consisting of approximately 80% water, sustainable water management becomes a critical consideration in processing.

To address these challenges, researchers at Teagasc developed an innovative biorefinery approach to valorise bovine blood. This process begins with enzymatic hydrolysis, a method that uses enzymes to break down proteins into smaller, more functional peptides.

"A degree of hydrolysis (DH) measures the extent to which proteins are broken down into smaller peptide chains - and this process achieved a DH of 45%," explains Soudabeh. "A higher DH is significant for generating bioactive peptides, which possess enhanced functional properties like antioxidant and antimicrobial activity."

Following hydrolysis, the peptide-rich fractions undergo membrane filtration, incorporating both microfiltration and ultrafiltration. This dual approach separates proteins and peptides based on molecular weight, producing fractions enriched with bioactive compounds.

"The resulting fractions exhibit antioxidant, antimicrobial and ACE-inhibitory activities, alongside exceptional functional properties such as solubility, water- and fat-binding capacities, and emulsifying abilities," adds Soudabeh.

These fractions hold practical potential across various industries, from protein-enriched foods and bakery products to encapsulates for bioactives and cosmetics. By unlocking the hidden value of this by-product, the meat industry can significantly reduce waste, increase resource efficiency, and open new avenues for sustainability.

Towards a zero-waste biorefinery

"Creating a zero-waste biorefinery is the next big step for the meat industry," says Brijesh. Solid by-products from blood can be used to make valuable products like iron supplements for nutrition or natural food colourants. Meanwhile, the liquid waste, which still contains nutrients, can be used in fermentation processes to produce useful items such as enzymes, bioactive compounds, and organic fertilisers.

"This step-by-step approach ensures that nothing goes to waste, and turns every part of bovine blood into something useful," Shay notes.

By adopting these innovative methods, the meat industry can reduce waste, protect the environment, and lead the way towards a more sustainable and efficient future. T

FUNDING

Department of Agriculture, Food, and the Marine (DAFM) and CirCoVal Project.

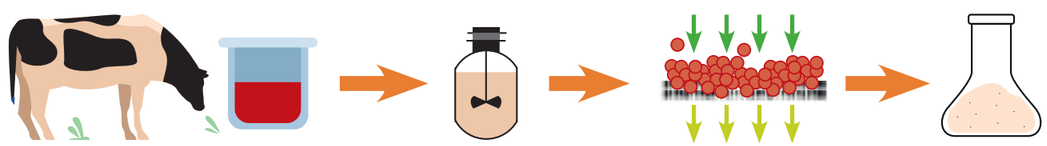
CONTRIBUTORS

Soudabeh Ghalamara
Postdoctoral Researcher
Teagasc Food Research Centre,
Ashtown, Dublin.

Shay Hannon
National Prepared Consumer Food Centre Manager
Teagasc Food Research Centre,
Ashtown, Dublin.

Brijesh K. Tiwari
Principal Research Officer
Teagasc Food Research Centre,
Ashtown, Dublin.
brijesh.tiwari@teagasc.ie

Figure 1. Advanced techniques for protein recovery from bovine blood



A Senior Research Officer at Teagasc Moorepark's Food Research Centre, Eoin Murphy is focused on improving drying processes and associated energy usage in the dairy industry. An upcoming symposium in Cork will be examining this sector's challenges and opportunities.

Photography: Fergal O'Gorman

Not for lack of drying

Eoin Murphy currently works as a Senior Research Officer in Teagasc's Food Chemistry & Technology department, using his background in process engineering and food science to work on academic and industrial drying projects supporting the agri-food industry, especially dairy. His current research focuses on dairy powders: their manufacture, drying processes and end properties.

"Spray-drying is near-ubiquitous for powder production in the dairy industry," he explains.

"Recently, there's been focus on reducing associated energy usage, given the large-scale pressure around energy costs."

Eoin is also interested in other drying technologies applicable to dairy and food that can provide solutions to current challenges and anticipate future concerns. Besides drying, he's interested in the design and engineering aspects of food processing operations. Drying generally sits at the end of complicated process flows; this allows collaboration with experts in other areas, which is one of his favourite parts of the job.

Can you put your research into context for us?

My research is engaged with dehydration processes and powder manufacture. Drying is inherently about preserving food for long shelf-life: reducing its weight and volume, turning a fresh product into something shelf-stable and transportable.

A figure we see a lot: for every ten litres of milk produced in Ireland, nine of those are exported – either as cheese or butter or dairy powders. So even when making cheeses, you're making whey, which is widely converted into powder. Hence the value of dried dairy is important to our national economy. In 2023, Bord Bia valued dairy exports at just over €3 billion.

It's an important sector in Ireland, built around farmer-owned cooperatives and ultimately supporting local business and providing employment in rural Ireland.

How has this field developed over time?

Drying itself is a prehistoric means of preservation. When talking about dried food in a contemporary sense, particularly dried dairy, the typical technology is spray-drying. In this process, milk is first pre-concentrated using an evaporator or filtration process. It's then sprayed in droplets into an air-drier at temperatures of 180-200°C, quickly extracting water. This type of technology has been in place at large scale since the mid-20th century. It's improving constantly in terms of hygienic quality, energy usage and design.

A study in France some years ago estimated that a quarter of its national dairy sector's energy usage came from dehydration – those final steps of concentration and spray-drying. This gives you an idea of the importance of energy reduction – more so in recent years as energy costs are rising globally, alongside the environmental and sustainability concerns underpinning the focus on energy reduction.

This work is balanced against awareness that you're producing commodity or consumer products. Quality aspects are vital, these products have to perform to expectations. This is part of the focus of our upcoming symposium, which our department is organising on behalf of the International Dairy Federation. The symposium will look at production and use of dairy powders, and striking the balance between producing materials that perform as expected, versus optimising the processes, technologies and efficiencies involved in that production. Spray-drying is the biggest process in this, but beyond improving the existing process we're always interested in potential new processes.

What are the challenges surrounding this topic?

You can make lots of different things from milk – regular, recombined or isolated products. The challenges will vary for each product. Drying typically sits at the end of a long production chain, so all those upstream processes influence it. You can't necessarily optimise a single process in isolation, you have to consider it within that chain.

Thus, our research is collaborative, with lots of work between colleagues across our department and with other universities and Research Performing Organisations (RPOs) in our pilot-scale facilities here. So, while it's a challenging area, its enjoyable and rewarding because we get to work at pilot-scale and look ahead to industry-scale and think about real-world applications.

What research have you been doing in this field?

It's broadly split into two different categories. First, supporting prevailing production set-ups: working to improve energy efficiency and product quality associated with spray-drying processes. Second, setting up our novel drying platform: looking at new drying methods and the effects on product quality and process efficiency. More recently we have also been working on drying other food types, for example, plant and cereal extracts.

In terms of supporting the prevailing infrastructure, Teagasc's Food Chemistry & Technology Department is engaged in a number of research collaborations with industry. We are also part of the Dairy Processing Technology Centre (DPTC) consortium – working with industry partners and other RPOs to demonstrate at pilot and industrial scale how energy efficiency can be improved in powder manufacture.

As part of that project, I've worked closely with my colleague Norah O'Shea to increase data capture in the drying process, upgrading facilities to better understand energy usage there. We examined this data with our colleagues John Tobin and Jonathan Magan at pilot scale; we then took this to industrial scale and demonstrated, at scale, an energy reduction of 5%.

For our novel drying platform, we're working in-house on three different technologies. We recently concluded an innovation partnership with Enterprise Ireland and six dairy companies, looking at lower-energy alternatives to spray-drying for lower-value dairy products. We have a PhD student examining technology for higher-end products, looking at consumer benefits such as solubility, appearance and nutritional benefits. Lastly, we're investigating technology for producing dried dairy snacks.

What has the industry response been?

We have lots of positive engagement. On campus we have Moorepark Technology, Ltd., which is a significant pilot plant used by the Irish and international dairy industry. One of the challenges is translating pilot scale to industry scale, so it's good to get constructive feedback on how to adapt processes to different scales.

Where next for this research?

Our research requires us to be responsive to our industry and the geopolitical climate. We need to move in tandem with the Irish dairy industry to help it overcome its challenges. Energy use is a vital issue, unlikely to change; we need to continue to adapt to the industry's energy needs. This includes ongoing examination of alternative technologies and improving production processes.

The IDF Joint Symposium on Dairy Drying Technology & Recombined Milk Products will be taking place in Cork across 13-15 May.

Eoin Murphy's research at Moorepark's Food Research Centre seeks to future proof dairy powder production methods

> **Energy use is a vital issue, unlikely to change; we need to continue to adapt to the industry's energy needs.**

Up close and personal

What's your favourite animal? My five-year-old son's a big fan of the "toughest animal in the world" – the honey badger – so I'd have to go with that.

If you hadn't ended up in research, what other job would you have wanted to give a go? The word "wanted" is doing a lot of heavy lifting there; I would've "wanted" to be a striker for Man Utd – if I could've is another question!

What are you most proud of professionally? We're at the interface between academia and industry, supervising lots of PhDs/MScs. It's hugely rewarding to see former students come full circle and be your future collaborators in either space.

Celebrating Teagasc's Food Programme

Highlighting the Food Programme's lasting impact on the evolution of the agri-food sector.

Teagasc's Food Programme focuses on research, development and innovation across key sectors such as meat, dairy, cereals, prepared consumer foods and marine food.

The programme also emphasises training and technology transfer, ensuring knowledge and expertise are shared effectively.

In November 2024, the Food Programme showcased 11 case studies as part of its peer review process to illustrate its work and impact. These case studies, some dating back to the early 2000s and others more recent, provide valuable insights into how Food Programme research, technology transfer and industry engagement have supported food companies, farmers, industry partners and policymakers. They also highlight the potential for even greater future impacts through the programme's evolving relationships with its networks.

Each case study reflects contributions to one or more of three key impact pathways: technology development and adoption, capacity building, and policy influencing. This demonstrates that the programme not only produces high-quality research and technologies, but also supports mechanisms to make this knowledge accessible and usable by end users.

These pathways, outlined in Teagasc's Statement of Strategy, "Teagasc Together", provide a clear framework for how the Food Programme drives developmental impact in the agri-food sector.

ReValueProtein collaborators attending a workshop event at Teagasc Ashtown

Teagasc

ReValueProtein

Collaborative efforts between Teagasc researchers, meat industry partners and academic collaborators have led to the development of specialised processes for recovering high-quality proteins and peptides from meat industry side streams and co-products. These advancements have created new revenue opportunities, supported applications in food, nutraceuticals, and biomedicine and encouraged more sustainable practices within the meat processing sector.

Teagasc's primary role involved leading research on extraction and purification techniques, characterising the functional and biological properties of recovered proteins and scaling up processes to a 100L proof-of-concept stage.

Pathways: **Technology development and adoption**
Teagasc researchers: **Carlos Alvarez and Anne Maria Mullen**

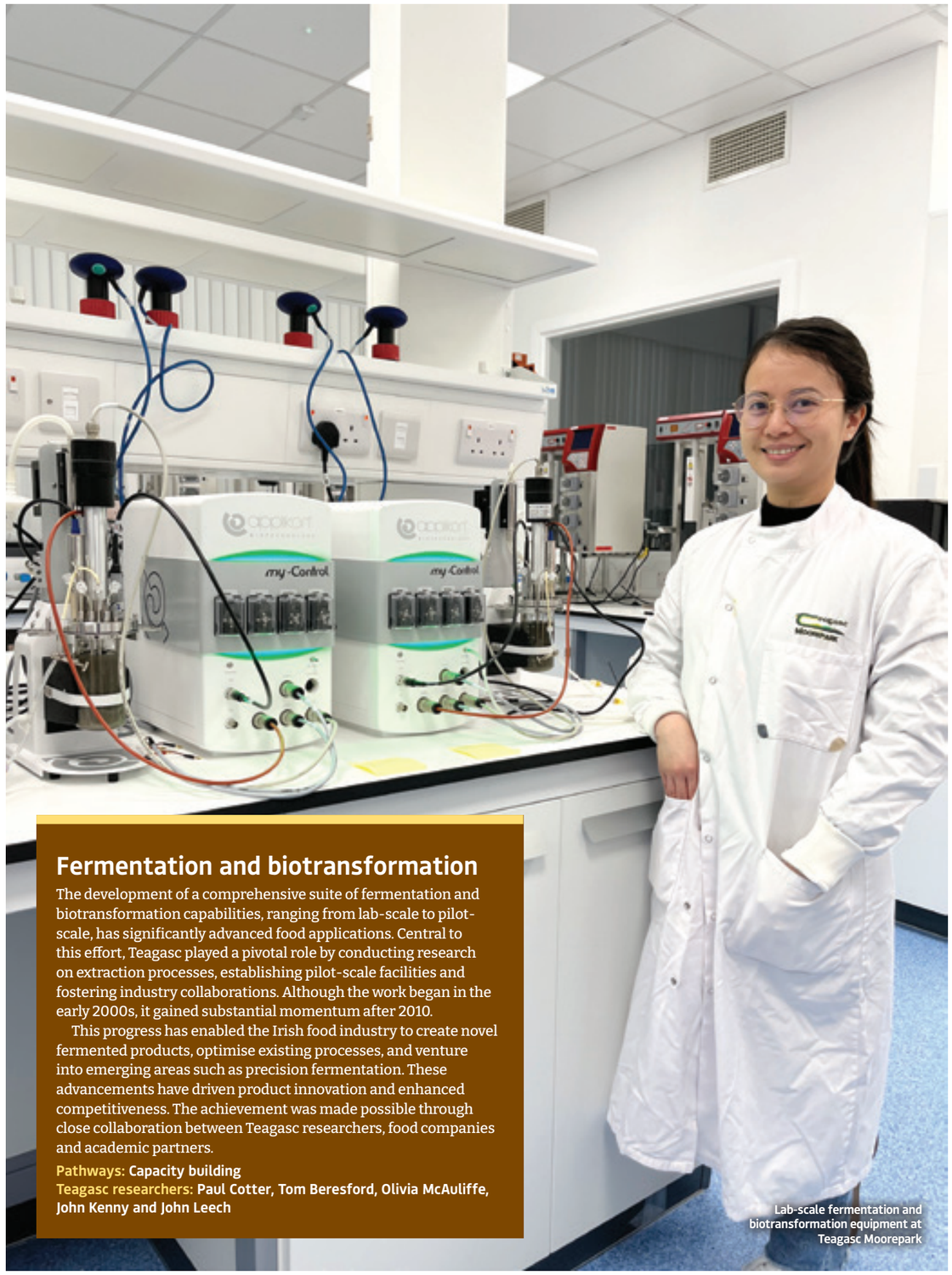
ValentynVolkov/istockphoto.com

Fava bean protein

Through collaboration between Teagasc researchers, industry partners and academic collaborators, this initiative has supported the growth of plant-based protein alternatives in Ireland. The research indicates that fava bean protein production is compatible with current farming systems, offering the potential to establish a new enterprise within the Irish agri-food sector.

Teagasc's primary contributions included optimising wet extraction methods for fava bean proteins, adapting dairy processing technologies for plant protein stabilisation and evaluating the nutritional quality and functionality of these proteins for various food applications.

Pathways: **Technology development and adoption, policy influencing**
Teagasc researcher: **Eoin Murphy**



Lab-scale fermentation and biotransformation equipment at Teagasc Moorepark

Teagasc

Fermentation and biotransformation

The development of a comprehensive suite of fermentation and biotransformation capabilities, ranging from lab-scale to pilot-scale, has significantly advanced food applications. Central to this effort, Teagasc played a pivotal role by conducting research on extraction processes, establishing pilot-scale facilities and fostering industry collaborations. Although the work began in the early 2000s, it gained substantial momentum after 2010.

This progress has enabled the Irish food industry to create novel fermented products, optimise existing processes, and venture into emerging areas such as precision fermentation. These advancements have driven product innovation and enhanced competitiveness. The achievement was made possible through close collaboration between Teagasc researchers, food companies and academic partners.

Pathways: **Capacity building**
Teagasc researchers: **Paul Cotter, Tom Beresford, Olivia McAuliffe, John Kenny and John Leech**

Food Works programme

This case study presents the establishment of a successful tri-agency food start-up accelerator programme that has become a cornerstone of food entrepreneurship support in Ireland.

A partnership involving Teagasc, Bord Bia and Enterprise Ireland established the Food Works programme in 2021. The programme has since supported over 120 food and drink start-ups, resulting in the creation of 496 jobs, achieving a combined turnover of €60 million and attracting over €6.5 million in investment funding.

Teagasc's critical contribution has been to provide technical expertise, access to research facilities and pilot plant equipment and to support product development and process optimisation for participating businesses.

Pathways: Capacity building, policy influencing
Teagasc researchers: Ciara McDonagh, Ita White and Carol Griffin

The Food Works programme has helped establish over 120 food and drink start-ups

Teagasc

INFOGEST digestion method

A standardised *in vitro* digestion method has been developed and globally adopted, enabling consistent and comparable food digestion studies across laboratories worldwide. Since 2011, Teagasc researchers, in collaboration with the international INFOGEST network, have worked to establish this method as the global standard for *in vitro* digestion research. It has been cited over 7,500 times, supporting more reliable studies on food digestion, nutrient bioavailability and the creation of functional foods.

Teagasc played a leading role in the development, validation and dissemination of the INFOGEST method. This involved coordinating international efforts and publishing highly influential papers detailing the protocol, cementing its status as a critical tool for advancing food science research globally.

Pathways: Technology development and adoption, policy influencing
Teagasc researchers: André Brodkorb, Linda Giblin and Laura Mascaraque

Tijana87/istockphoto.com

Chlorate reduction

This case study highlights a new research area on chlorates in dairy and horticulture that began in 2016. Teagasc's main contribution was to develop rapid, high-throughput testing methods for chlorate residues, provide testing services to the dairy industry and support the implementation of chlorate reduction strategies.

The impact of this case study was to protect export markets for Irish dairy products, ensure food safety, and provide companies with a competitive advantage by demonstrating low chlorate levels. This was achieved by Teagasc researchers, dairy industry partners, the horticulture industry, commercial laboratories and regulatory agencies working together.

Pathways: Technology development and adoption, policy influencing
Teagasc researchers: Martin Danaher and Kaye Burgess

Food Programme "wraparound" approach

Over the past 5 to 10 years, a comprehensive, industry-focused research and innovation support system has been established for the Irish food industry, underpinned by significant infrastructure investments. This initiative has boosted innovation and competitiveness across the sector, enabling product development from concept to pilot scale and attracting international food companies to set up R&D operations in Ireland. Teagasc played a pivotal role by investing over €37 million in new food research infrastructure, aligning research capabilities with industry needs, and creating flexible models for industry collaboration.

Pathways: Capacity building
Teagasc researchers: Mark Fenelon and Ciara McDonagh

The BIA Innovator Campus at Teagasc Athenry is one of several centres benefiting from Teagasc investment

Teagasc

stephankerkhofs/ istockphoto.com

Fish by-product valorisation

Since 2018, Teagasc researchers, fishing industry partners and funding agencies have collaborated on developing patented technology to convert fish processing by-products into high-value ingredients with demonstrated anti-inflammatory and anti-hypertensive properties. This has created potential new revenue streams for the fishing industry, demonstrated feasibility at a pilot scale (100L), and attracted industry interest for commercialisation, supporting sustainability in the sector.

Teagasc's contribution included leading research on extraction methods, characterisation of bioactive compounds and *in vitro* and animal studies to demonstrate efficacy and development of scalable processes.

Pathways: Technology development and adoption, policy influencing
Teagasc researchers: Eoin Murphy, Brijesh K. Tiwari, John Tobin, Noel McCarthy, Laura Mascaraque, Maria Hayes and Dilip Rai

DNA sequencing centre

Beginning in 2009, a world-class DNA sequencing facility was established at Teagasc Moorepark to perform high-throughput metagenomic and genomic analyses for food-related applications. A key aspect of this initiative was Teagasc's role in developing advanced expertise in DNA sequencing technologies. This included building a robust infrastructure and designing bioinformatics pipelines specifically for food microbiome research. These capabilities have allowed food companies to characterise and optimise microbial communities in fermented foods, develop innovative probiotics and generate vital data for food safety and quality control. Additionally, the facility has fostered research into the effects of foods and food ingredients on the human gut microbiome and overall health, driving innovation within the Irish food sector. This achievement was realised through collaboration among Teagasc researchers, APC Microbiome Ireland and industry partners.

Pathways: Technology development and adoption, capacity building
Teagasc researchers: Paul Cotter, Fiona Crispie, Orla O'Sullivan, Catherine Stanton and John Kenny

Teagasc's DNA sequencing centre at Moorepark plays a pivotal role in developing microbial food research

Teagasc

Campylobacter reduction

Research by Teagasc Food Safety has focused on approaches to significantly reduce *Campylobacter* on Irish poultry carcasses. There has been sustained collaboration among Teagasc researchers, University College Dublin, the Department of Agriculture, Food and the Marine – Central Veterinary Research Laboratory, the Food Safety Authority of Ireland and the poultry sector. These efforts have significantly enhanced food safety in the poultry industry, protected public health and ensured continued market access for Irish poultry products.

Teagasc's main contribution was to lead research on sources and dissemination routes of *Campylobacter*, develop improved biosecurity measures and cleaning protocols on farms, in addition to processing and post-processing control interventions, which were delivered to farmers and processors in training courses.

Pathways: Technology development and adoption, capacity building, policy influencing
Teagasc researcher: Declan Bolton

Whiskey flavour profiling

Since 2018, Teagasc researchers, whiskey distilleries and academic partners have generated the scientific proof of the terroir concept in whiskey production and the development of advanced analytical capabilities for whiskey flavour profiling.

Terroir, traditionally associated with wine, refers to how environmental factors like soil, climate, and local practices influence a product's characteristics, with whiskey showcasing this through the impact of barley origin and local conditions on its unique flavour profile.

The outputs from this case study have provided scientific backing for marketing claims, supported product development and quality control in the Irish whiskey industry and contributed to the industry's rapid growth and export success.

Teagasc's main involvement was to develop and apply advanced flavour chemistry techniques to characterise whiskey congeners, create databases of volatile compounds in Irish whiskeys and publish the first scientific paper proving terroir in whiskey.

Pathways: Technology development and adoption, capacity building, policy influencing
Teagasc Researchers: Kieran Kilcawley and David Mannion

CS0523183 / istockphoto.com

CONTRIBUTORS

Kevin Heanue
Senior Evaluation Officer,
Teagasc, Athenry and Oak Park.
kevin.heanue@teagasc.ie

Boru Braithwaite
Director, Selkie Consulting,
Westport, Co. Mayo.

Udder perfection

Based at Teagasc Moorepark, the mastitis research team is equipping farmers with evidence-based solutions to enhance udder health and reduce reliance on antibiotics. Their research explores key areas such as the risk factors driving clinical and heifer mastitis and the variables influencing the success of non-antibiotic dry cow therapy.

Photography: Fergal O'Gorman

(L-R) Research Officer Pablo Silva Boloña, Lab Manager Jim Flynn and Walsh Scholars Rachael Millar and Natasha Harding are at the forefront of mastitis research at Teagasc Moorepark

The goal of the mastitis research team is to position Teagasc as a leading source for industry guidelines, offering practical tools to help farmers tackle mastitis effectively. This work is timely, given recent legislation emphasising the need to shift away from the preventive use of antibiotics. The team currently comprises Research Officer Pablo Silva Boloña, Milk Quality Laboratory Manager Jim Flynn and Walsh Scholars Rachael Millar and Natasha Harding.

Can you explain the history of this team within Teagasc?

Pablo: The mastitis research team has been continuously evolving and growing over the last few years. I started as a Research Officer in 2019, which involved only one project with one PhD student under my supervision. Now, there are three projects related to mastitis with three PhD students, a technologist, Jim managing the lab and a post-doctoral researcher to join soon.

What specific projects are you currently working on?

Rachael: I am investigating clinical mastitis levels across a cohort of Irish dairy farms. My research examines what bacteria most commonly cause mastitis, and how mastitis occurrences are influenced by management interventions and hygiene practices on farms.

Natasha: I am currently working on a study assessing different somatic cell count (SCC) thresholds, an indicator of mammary gland inflammation to determine cows' eligibility for non-antibiotic dry therapy and understand its impact on SCC and intramammary infections in the following lactation.

What are your core priorities and objectives?

Pablo: The overall objective of the mastitis programme is to help farmers, through research, to prevent and control mastitis, improve cow health and welfare, and reduce the use of antibiotics associated with this disease.

Natasha: My project's core focus is exploring the management practices during dry-off and the dry period to support the implementation of non-antibiotic dry cow therapy. The overall aim is to align with EU regulations to effectively reduce antibiotic use across dairy farms, without compromising herd health.

Jim: Part of the objectives of the milk quality lab is to provide technical support for the mastitis research programme in microbiology and cytology, by analysing a large volume of milk samples entering the laboratory.

We analyse quarter milk samples for milk composition, SCC and microbiological analysis for the identification of pathogens causing mastitis.

How does your research achieve these objectives?

Pablo: Our work generates knowledge and evidence to tackle mastitis issues, helping to inform the development of guidelines such as the national mastitis control programme, CellCheck. We disseminate our research at national conferences, farm discussion groups, and advisor and veterinary training, among other initiatives.

Rachael: We aim to reflect what farmers are doing at ground level in terms of mastitis management and intend to present results to them and to the wider dairy industry. To make my work applicable to most farmers in Ireland, a cohort of 82 randomly selected dairy farmers across the country were chosen to participate in my study. There are farms from each province in the country – 69.5% from Munster, 14.6% from Leinster and 15.9% from Ulster and Connacht.

Natasha: My research emphasises farmer collaboration for designing the studies, allowing their perspective to help shape approaches. We aim to develop guidelines for non-antibiotic dry cow therapy that are practical and can be tailored to the needs of individual herds.

> **"Identifying cows affected with mastitis and the main bacteria causing intramammary infections... is key to determining what management factors might be causing a problem."**

Jim: Our work contributes to identifying cows affected with mastitis and the main bacteria causing intramammary infections. This is key information to determine what management factors might be causing a problem and how to control it.

What are the key techniques and tools you use to achieve this work?

Rachael: I am collecting data by visiting the 82 farms three times throughout the lactation, a first in Ireland. During visits, I assess farm facilities, milking routines and the hygiene of the cows and the environment. Also, I conduct a questionnaire with the farmer to understand general farm management, mastitis management and treatment protocols. All farmers have agreed to, and been trained on, taking aseptic quarter milk samples of clinical mastitis cases for us to learn what bacteria are causing it.

Natasha: I am using a controlled study across research herds to evaluate SCC thresholds and alternative selection methods for assigning cows' non-antibiotic therapy at dry-off. The approach allows for the validation, in a research setting, of on-farm practical tools to effectively and safely dry-off cows. This also helps provide tools for farmers that may not record milk samples – and therefore don't have SCC data – to make the right decisions around non-antibiotic dry cow therapy.

Jim: From six Teagasc research farms, we analyse approximately 98,000 milk samples annually for milk composition and SCC using the CombiFoss instrument. For our ▶

microbiology tests, we usually analyse thousands of quarter samples each year by plating the milk on blood agar (non-selective agar with 7% sheep blood), whilst also conducting confirmatory tests using selective agars such as Baird Parker, Edwards and McConkey.

Can you explain the importance of your work in the context of Irish farming and agriculture?

Rachael: Clinical mastitis is a common disease in dairy cattle and results in huge economic loss. By investigating farm management, facilities and farm hygiene, and analysing mastitis milk samples to determine pathogens present on each farm, this research provides valuable insights to enhance control and prevention of clinical mastitis.

Natasha: Exploring and identifying key tests to identify infected cows at the end of lactation and support the assignment of cows to non-antibiotic dry cow therapy will contribute to farmers' confidence in the practice while maintaining udder health.

The project supports sustainable practices that align with EU policies while emphasising the importance of maintaining herd health, milk quality and animal welfare, and safeguarding Ireland's reputation in the dairy industry.

Jim: We provide accurate real-time data, enabling farmers and farm managers to monitor individual cow SCC and researchers to monitor milk quality on the different trials ongoing in commercial and Teagasc research farms.

We also identify the pathogens causing high SCC, helping identify cows that should be treated accordingly.

I've been working in the milk quality laboratory since 1990 and have been involved in numerous different trials including the development of alternative mastitis treatments, non-antibiotic dry cow therapy and effectiveness of disinfectants in reducing mastitis, among others.

What results have you seen so far?

Pablo: The work is recent and continues to be carried out. However, we have seen an increase in the uptake of non-antibiotic dry cow therapy – from almost every cow being treated with antibiotic at dry-off, to close to 80% being treated with antibiotic in 2023, an almost 20% reduction in antibiotic use.

We're seeing greater awareness by dairy farmers and the industry of the importance of milk recording and an increasing knowledge of things that work and do not work around mastitis management and the implementation of non-antibiotic dry cow therapy.

20%

In 2023, the dairy industry saw a 20% reduction in antibiotic use.

How does your team's work sit within the wider Teagasc organisation?

Pablo: We contribute to Teagasc by publishing research results in the top scientific journals in the field, increasing the organisation's research status, and developing new project proposals to bring in external funding.

Engaging with farmers and the wider industry helps keep Teagasc relevant to key stakeholders and heightens the work's impact. We strive to deliver research that is of excellent quality, is relevant to dairy farmers and the industry and improves the health of dairy cows. Keeping these values in mind helps us contribute positively to the dairy industry in Ireland. T

Meet the team

What are you proudest of as a member of the team?

Rachael: I am proud of the work that I have carried out so far, with the organisational challenges involved in planning each farm visit and with over 500 samples analysed in the lab so far. I would like to acknowledge the 82 farmers for their endless efforts and interest in every aspect of the trial, without whom none of this would be possible.

Natasha: As a new member, I'm proud to be part of a team focused on sustainable farming. While I'm just starting, I look forward to contributing to impactful research in the near future.

Jim: The volume of samples that I and other members of the laboratory team have analysed in the different trials – some submitting over 8,000 samples for analysis in a very short time. I am also proud of having set up the method to measure trichloromethane (TCM) in milk for the dairy industry and to have been able to significantly reduce its levels in butter in a short space of time.

Pablo: I'm proud to be delivering evidence-based work to control mastitis in Ireland. I'm excited with how the programme and team have developed and look forward to our continued evolution.

Improving understanding of the underlying causes behind mastitis is a vital step towards reducing antibiotic use

Reduce Methane Emissions

Enhance Adaptation

Agriculture forms a key part of Ireland's economy, but the sector must improve its use of renewable energy to withstand rising economic and sustainability challenges.

Could the grass be greener?

The agricultural sector is a cornerstone of the Irish economy, contributing significantly to exports, rural employment and national food security. Renowned for its dairy, beef and crop production, Irish agriculture ensures a reliable supply of high-quality produce while maintaining Ireland's reputation for agricultural excellence.

However, the sector faces rising economic pressures, including the high cost of fossil fuel-based electricity, which ranks among the highest in Europe. These escalating energy costs increase production expenses, posing challenges to profitability and sustainability.

Renewable energy technologies, such as solar photovoltaics, wind turbines and biogas systems, offer a sustainable solution. By generating clean energy on-site, farmers can significantly reduce operational costs, strengthen energy security and contribute to Ireland's climate goals. To promote the adoption of renewable energy within the farming sector, the Irish government has implemented a variety of supportive measures.

Taking the initiative

Key initiatives include financial support schemes, streamlined regulations and targeted training programmes for farmers. Among the most attractive support schemes are the Targeted Agricultural Modernisation Scheme, Small-Scale Renewable Electricity Support Scheme and Non-Domestic Microgen Grant.

These programmes provide financial assistance for installing and operating renewable energy systems. Additionally, under export tariff schemes, farmers can generate income by selling surplus energy back to the national grid.

Researchers at Teagasc and Maynooth University are currently evaluating the engagement levels of the farming sector in renewable energy and other bioeconomy projects. This collaborative project is funded by the Sustainable Energy Authority of Ireland and is expected to yield results by the end of 2025.

Preliminary findings from interviews conducted with farmers highlight that they often deem the capital investment required for such projects as large and prohibitive, thereby contributing to low levels of engagement. Muhammad Paend Bakht, a Postdoctoral Researcher at Teagasc working on this project, suggests that this is a common misconception.

"We should emphasise the importance of considering these systems in terms of lifecycle assessment. This would take into account expenses and energy generation over their entire operational lifespan, rather than focusing on the initial capital investment."

Lifecycle assessment

Through a comprehensive lifecycle assessment, this research project aims to determine the per-unit cost of electricity generated by renewables for Irish farms, Muhammad continues.

"Our findings will provide a more accurate and comprehensive financial comparison of renewable energy systems with traditional electricity sources. This research will help address misconceptions among farmers, which will lead to increased engagement by the farming community in renewable energy projects."

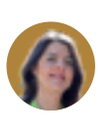
To maximise the benefits of renewable energy, solutions should be tailored to meet the specific energy needs of different types of farms, Muhammad concludes.

"For example, dairy farms can benefit from solar photovoltaic systems for heating water and refrigeration, while pig and poultry farms might utilize anaerobic digesters to manage waste and generate energy. Crop farms can convert crop residues into biomass energy, and livestock farms may rely on wind turbines or solar systems to meet their high energy demands. Customising renewable energy strategies will ensure that all farms can leverage renewable energy while reducing operational costs." T

CONTRIBUTORS

Muhammad Paend Bakht
Postdoctoral Researcher
Agricultural Economics and Farm Surveys Department,
Teagasc Athenry.
muhammadpaend.bakht@teagasc.ie

Anne Kinsella
Senior Research Economist
Rural Economy and Development Programme, Teagasc Athenry.



Michael Hayden
Assistant Professor of Accounting
Maynooth University, Kildare.

FUNDING

This research is funded by the Sustainable Energy Authority of Ireland (SEAI) under their 2023 Research, Development and Demonstration Funding Programme - grant agreement number 23/RDD/920.

aluxum / istockphoto.com

Circular Food System

Using Irish-grown peas as a bread ingredient may improve product quality, while also providing economic and sustainability boosts

Innovative research at Teagasc Ashtown's Food Quality and Sensory Science department is examining how Irish-grown peas can help promote new, sustainable food solutions.

Peas of mind

Increasing consumer demand for high-protein, plant-based foods has sparked innovation in the bakery sector, driven by health and sustainability trends. Incorporating alternative plant sources has been shown to enhance the nutritional profile of baked products. However, it is also crucial for any new foods to balance nutritional benefits with consumer acceptability.

Peas are an excellent source of protein, fibre and micronutrients. A research team from Teagasc Ashtown is exploring new, food-focused applications of Irish-grown peas to formulate bread products that are technologically optimised and health-enhanced. By using locally grown produce, this innovative work holds potential benefits for the environment, local economy and consumer health.

From field to flour

Research began by evaluating the pea milling process, explains Mariana Maçãs, a Walsh Scholar at Teagasc Ashtown.

"The milling process is a critical step in pea flour production, influencing the quality of both the resulting flour and the final product. We evaluated three milling processes – roller, hammer and cutting – each of which produced unique flour characteristics."

- **The hammer mill** produced flour with a high content of fibre and protein, and achieved a flour yield of 93.9%.
- **The roller mill** delivered flour with a higher starch content and lower content of insoluble dietary fibre. These differences in composition are due to the fractionation system of the roller miller. The larger milling fraction was discarded, resulting in a yield of 55.64%.
- **The cutting mill** created flour with a similar composition to that of hammer-milled flour. However, this flour had a higher proportion of damaged starch, as well as the lowest yield at 39.15%.

In addition to traditional analytical methods, near-infrared (NIR) spectroscopy was used to evaluate flour quality at the compositional and structural level. NIR is a rapid and non-destructive technique used to analyse the properties of materials such as flour and bread, by using near-infrared light on a sample and measuring how the light interacts with it. This interaction provides information about the sample's composition, including protein, moisture and fibre.

"NIR obtains a 'fingerprint' of the material, allowing for analysis without destroying the sample," Mariana explains. "In this study, NIR spectroscopy provided results that aligned with the proximate composition analysis. It also proved an effective tool for distinguishing between different flour types and identifying the milling techniques used for peas."

Teagasc

Hammer-milling was found to be the most suitable process for milling peas for onward bread applications as this flour showed the highest yield, fibre and protein content. Further research was then undertaken to study the influence of the pea milling process on bread-making performance, crumb texture, microstructure and shelf-life.

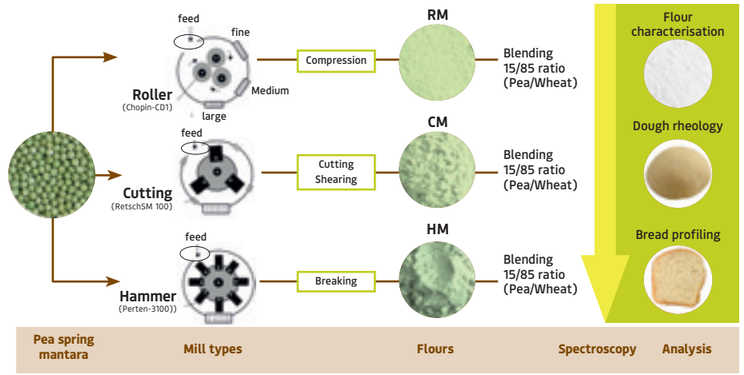
Finding the balance

Milled Irish pea flour was blended with wheat flour at a 15:85 pea to wheat ratio, and the resulting dough rheology, bread crumb texture, crumb microstructure and nutritional aspects were studied, showing promising results, Mariana notes.

"Incorporating pea flour improved the nutritional profile of bread, particularly its protein and fibre content. The hammer-milling process produced flour with the most favourable quality markers for bread production, including volume and texture, with these breads also showing the slowest rate of crumb staling."

NIR spectroscopy effectively differentiated between wheat and non-wheat formulations, identified storage time across breads, and predicted flour quality, highlighting again its potential for rapid, non-destructive analysis.

Methodology: studying the influence of the milling process



However, there are some points of caution, Mariana adds.

"Incorporating low levels of pea flour into bread formulations was shown to yield a product with good baking characteristics and slightly elevated nutritional properties. Increasing the incorporation levels to further boost the nutrition will likely compromise the flavour characteristics – due to indigenous bitter compounds in peas – and lead to undesirable physical properties."

Trust the process

Research has continued and has most recently focused on non-thermal and thermal processing technologies for the hammer-milled pea flours – exploring the possibility of including higher levels of pea flour without compromising the end product, while at the same time enhancing its nutritional profile.

Hammer-milled pea flours were processed by roasting, microwave and ultrasound treatments, individually and in combination. Roasting can enhance overall bread quality by improving the development of volatile compounds that contribute to a richer flavour and aroma profile. Emerging techniques such as microwave and ultrasound offer innovative approaches with the potential to improve processing efficiency, Mariana says.

"These methods have enabled us to include up to 35% pea flour in bread formulations as a substitution for wheat flour. Initial results demonstrate that these treatments positively impact the structure and sensory properties of the resulting breads. Specifically, the treated flours improved loaf-specific volume, reduced crumb hardness, and slowed the crumb staling kinetics. Preliminary studies also show positive effects on taste and aroma."

Bridging the gap

A significant aspect of the research involves evaluating the digestion characteristics of pea-enriched bread using dynamic *in vitro* models that closely simulate human digestion. This innovative approach assesses factors such as starch and protein hydrolysis during digestion, providing valuable insights into the physiological benefits of incorporating pea flour, notes Mariana.

"When comparing wheat bread to pea-enriched bread, we observed a lower glycemic index for the latter. These initial results are very promising, as they demonstrate the ability to improve the acceptability of bread while simultaneously enhancing its nutritional and digestive benefits."

The findings from the research team have broad implications for academia, the food and crops industries, and consumers," Mariana concludes.

"By optimising milling techniques and applying innovative processing technologies, the potential of Irish-grown peas has been demonstrated as a viable step forward in sustainable food innovation, bridging the gap between health and acceptability." T

FUNDING

This work was funded by Teagasc under the Walsh Scholarship Programme. Project Acronym: HighPBreads. Project reference: 2021044.

CONTRIBUTORS

Mariana Maçãs
Walsh Scholar, Teagasc Food Quality & Sensory Science Department, Ashtown.

Eimear Gallagher
Principal Research Officer, Teagasc Food Quality & Sensory Science Department, Ashtown.
eimear.gallagher@teagasc.ie

Barbara Biduski
Research Officer, Teagasc Food Quality & Sensory Science Department, Ashtown.

Enhance Adaptation

Reduce Methane Emissions

Enteric methane: generating new baselines

Improving enteric methane emission estimates from ruminant livestock is an important step towards more informed decision-making on appropriate mitigation strategies.

Agriculture is the largest contributor to Ireland's greenhouse gas (GHG) emissions profile, with enteric methane from ruminant livestock accounting for approximately 63% of all agricultural GHG emissions. Various strategies offer potential to reduce enteric methane emissions, such as optimising diets and animal breeding. Accurately quantifying these emissions is important for the agricultural sector, as it enables more informed decision-making on mitigation strategies at a national level.

Localised data

Models of varying complexity are used to estimate enteric methane emissions from ruminant livestock within different jurisdictions. In Ireland, the agricultural sector makes its estimations using tier-two empirical prediction models from the Intergovernmental Panel on Climate Change (IPCC), explains Ben Lahart, Research Officer at Teagasc Moorepark.

"These models calculate animal gross energy intake based on energetic needs for growth, milk production, pregnancy and maintenance. This estimated feed intake is then multiplied by a methane conversion factor to estimate daily methane emissions for different categories of ruminant livestock."

8%

The methane conversion factor for grazing Irish dairy cows is circa 8% lower than the recommended international value

For dairy and beef cattle grazing on pasture, enteric methane emissions are calculated using an international methane conversion factor recommended by the IPCC. When cattle are housed and fed a silage-based diet, the inventory uses an equation from historic research data to calculate the methane conversion factor. For sheep, emissions are estimated using international methane conversion factors for both grazing and housed conditions.

"However, the IPCC states that it's good practice to utilise country-specific data where possible," Ben notes. "Therefore, further research is required to determine methane conversion factors specific to Irish ruminants under grass-based systems."

Country-specific methane conversion factors improve the accuracy of estimates by accounting for localised factors such as diet, livestock type and management practices. This reduces uncertainty and improves the reliability of national GHG inventories, enabling the development of targeted emission mitigation strategies.

Dairy cows using a GreenFeed unit for methane measurement at Teagasc Moorepark

Teagasc

Seasonal variation

To evaluate enteric methane emissions under Irish conditions, Teagasc uses GreenFeed units, Ben explains.

"Animals are enticed to visit these units roughly three times per day by offering a small portion of concentrate feed. When an animal enters the machine, an air sample is obtained from the animal, which is then measured for methane content."

Direct measures of methane output within localised conditions can also reveal new insights into the dynamics of methane output. Recent research conducted by Teagasc and VistaMilk has revealed significant variation in methane emissions from dairy cows within spring-calving pasture-based systems. Notably, lower methane emissions are observed in the spring, when cows are at peak milk production.

As the grazing season progresses, methane output increases while milk solids production declines, coinciding with deteriorating pasture quality and advancing lactation. In contrast, methane emissions were previously estimated to follow the same profile as feed intake, peaking in early lactation during the spring period.

Substantial differences can occur when comparing measured methane output values in Irish conditions against values calculated using international default methane conversion factors, particularly during the spring grazing period, Ben points out.

"Furthermore, when all data is collated from grazing dairy cows under Irish conditions, the methane conversion factor for Irish dairy cows is approximately 8% lower than the international value recommended by the IPCC. However, it is important to note that further data is needed for other ruminant livestock categories such as beef and sheep, to ensure that methane conversion factors are accurately estimated across all species."

Improving accuracy

In 2023, the Department of Agriculture, Food and the Marine and the Department of Agriculture, Environment and Rural Affairs funded the Rumenventory project to develop more accurate methane conversion factors for ruminant livestock under Irish conditions.

"These experiments will quantify methane output under different nutritional regimes and growth stages, providing essential data for national inventories."

Led by Teagasc in collaboration with University College Dublin, the Irish Cattle Breeding Federation and the Agri-Food and Biosciences Institute, the project aims to advance research on enteric methane emissions in Ireland.

The project will evaluate methane emissions across dairy, beef and sheep systems using GreenFeed technology. Field experiments will take place at Teagasc research centres in Moorepark, Grange, and Athenry, along with University College Dublin's Lyons Research Farm, explains Ben.

"These experiments will quantify methane output under different nutritional regimes and growth stages, providing essential data for national inventories. Additionally, the Agri-Food and Biosciences Institute will assess the accuracy of GreenFeed technology by comparing its results with those from the gold-standard respiration chamber method."

Advancing models

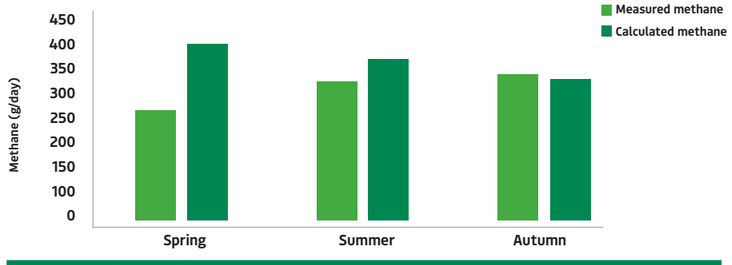
Another important aspect of the project is evaluating the impact of improved genetic merit on methane emissions. Specifically, it will focus on the Economic Breeding Index for dairy cattle and the EuroStar indexes for beef and sheep. This will help determine if genetic selection for traits that improve livestock productivity and efficiency could also reduce methane emissions, and whether current inventory models need to be revised to account for such genetic effects.

In the latter stages of the project, data will be compiled by the Irish Cattle Breeding Federation to create Ireland's first large-scale enteric methane database. This database will capture the variation in methane emissions across different production systems, allowing for more accurate methane conversion factors to be generated for ruminant livestock in Ireland.

"The data will also support the development of advanced IPCC tier-three prediction models that account for the effects of diet and genetics, improving the accuracy of methane emission estimates and reducing uncertainty in national inventories," Ben concludes.

"Ultimately, this will lead to more precise predictions of enteric methane emissions in Ireland, enabling the agricultural sector and national inventory to make better-informed decisions on methane mitigation strategies." T

Measured and calculated methane of grazing dairy cows



FUNDING

The dairy research results in this article were funded by Tirlan, Kerry, Carbery, Ornua, Dairygold and Nutribio through VistaMilk (Research Ireland). The Rumenventory project was funded by the Department of Agriculture, Food and Marine and the Department of Agriculture, Environment and Rural Affairs.

ACKNOWLEDGEMENTS

Noirin McHugh, Hazel Costigan and Eoin Dunne are gratefully acknowledged for their contributions to the research.This works forms part of the Teagasc Climate Centre.

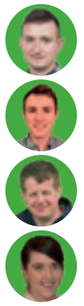
CONTRIBUTORS

Ben Lahart
Research Officer
Teagasc Moorepark, Fermoy.
ben.lahart@teagasc.ie

Jonathan Herron
Research Officer
Teagasc Moorepark, Fermoy.

Peter Doyle
Research Officer
Teagasc Grange, Dunsany.

Fiona McGovern
Research Officer
Teagasc, Mellows Campus, Athenry.



Fermented foods, an ancient dietary staple, are making a comeback. With new innovations and growing demand, researchers are uncovering what makes these foods a hit with modern consumers.

More than a gut feeling

New research reveals six key factors that influence consumer acceptance of fermented foods, shedding light on how taste, health benefits and sustainability drive the growing popularity of these ancient products.

In fact, fermented foods have been part of the human diet for more than 10,000 years, dating back to early civilisations. "Fermentation was one of the earliest methods of food preservation, and its use has evolved alongside our diets," explains Sinéad McCarthy, Senior Research Officer at Ashtown Food Research Centre.

Recently, fermented foods have seen a significant resurgence in popularity, fuelled by growing evidence of their health benefits, particularly their positive impact on gut health. "The connection between gut health and overall wellbeing has gained a lot of attention and fermented foods are now recognised as a key contributor to this area," says Sinéad.

This increased awareness of gut health, combined with a strong body of emerging scientific evidence, has driven rapid growth in the fermented foods market, which is now valued at more than US$50 billion globally.

Health claims and scientific research

Despite the growing popularity of fermented foods and related health benefits, only one formal health claim has been approved by the European Food Safety Authority (EFSA) in relation to live yogurt and lactose digestion. Although applications for health claims on probiotics have been submitted for evaluation to the EFSA, none has received a positive opinion and authorisation, due in part to a lack of data or rigorous studies supporting the claims.

Therefore, a consortium of over 100 scientists is currently investigating how fermented food consumption influences the gut microbiome and provides health benefits to consumers as part of the DOMINO EU-funded project. Within this project, six novel plant-based fermented foods are being developed. In addition, one product will be consumed as part of an intervention trial across Europe to identify the health benefits of these foods and the role of microorganisms in generating health properties associated with the fermented foods.

Exploring consumer perspectives: six key themes

A qualitative approach was used to gather consumer responses to six novel plant-based fermented products: kefir, legumes, olives, cereals, pulses, and apple pomace. This research was completed through a series of living labs across five European countries. The transcripts from the Irish and French living labs were analysed to identify themes across the two countries regarding the acceptance of novel fermented foods.

Using this approach, six different themes were identified that were similar for both French and Irish consumers as outlined below.

1. Sensory aspects were especially important for French and Irish consumers. Irish consumers expressed their willingness to accept the new fermented products on the condition that it "tastes nice enough", while the French sought foods that were appetising and expressed concerns regarding the taste and smell of the fermented products.
2. Health aspects also resonated with the consumers, with one French consumer purporting the benefits of probiotics and colonic health while an Irish consumer recognised the marketing opportunity for promoting the health benefits of a water kefir.
3. This was followed by knowledge, claims and beliefs. Some French consumers had low levels of knowledge with uncertainty surrounding orange juice and whether it was a fermented product or not. Others displayed a very high knowledge, confidently claiming: "Kefir is rich in ferments, so it contributes to intestinal function with bacteria in the gut microbiota."
4. Cultural familiarity was of significant importance with yoghurt being a familiar fermented product consumed for a long time in Ireland, while one French consumer preferred to "stick to my traditional fermented milk" rather than changing to a new kefir.
5. The homemade aspect of fermented foods resonated with many consumers. Irish consumers referenced a culture of sharing homemade produce like kombucha and starter cultures with friends. French consumers highlighted the naturalness of producing a food with no preservatives using an ancient method.
6. Environmental characteristics also appealed to French and Irish consumers, with concerns including generating excess waste with new products on supermarket shelves and the production of natural products that do not pollute.

Using these consumer co-design approaches across more European countries can help enhance the likelihood of product success by understanding what traits consumers desire, alongside knowing undesirable characteristics.

"Increasing plant-based fermented food consumption can have many co-benefits from food waste prevention due to the preservation properties of fermentation, to helping increase plant-based food consumption, which is frequently recommended for personal and planetary health reasons," explains Sinéad.

However, ultimate acceptance and consumption of plant-based fermented foods will only be successful if sensory properties are satisfied. For incorporating novel plant-based fermented foods into the habitual diet, fermented food producers need to ensure that this sustainable and healthy food choice is not only the easy one but also the tasty and acceptable choice for consumers. T

French consumers	Themes	Irish consumers
It has to be appetising. What worries me is the taste and also the smell.	Sensory	If it tastes nice enough, and it's actually good for you.
Probiotics apparently are good for the colon, so I use them more for that.	Knowledge	If it's a healthy drink and it's a refreshing, sparkling drink, it would increase its marketability.
Kefir is rich in ferments, so it contributes to intestinal function.	Health	Are these vitamins in the olives before they are fermented?
I would stick to my traditional fermented milk.	Cultural Familiarity	Yoghurt, it's the oldest product there, maybe that's why people were aware of it in Ireland.
You can do them yourself, no preservatives, more natural, existed since the dawn of time.	Home Made	I like making kombucha and kefir at home, I make extra and I give it to my friends.
I'm in favour of a product that's natural, that doesn't pollute.	Environment	The kind of wellness, what that's done, it's just created so much more waste.

Daniel_Dash/shutterstock.com

FUNDING

The DOMINO project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101060218. www.domino-euproject.eu

ACKNOWLEDGEMENTS

[1]John Kenny, Moorepark Food Research Centre has co-authored this research and manuscript. The authors would like to acknowledge Anne Van Deer Geest and Camilla Bodewes, Vrije Universiteit Amsterdam, for the design of the focus group script. Data collection and contributions from the French team at INRAE: Stephane Chaillou, Marie-Christine Champommier-Vergès, Christele Humblot, Bastien Renard, Anne Saint-Eve, Pascal Bonnarme, and all the WP5 and DOMINO project members.

CONTRIBUTORS[1]

Sinéad McCarthy
Senior Research Officer, Food Research Centre, Teagasc Ashtown.
sinead.mccarthy@teagasc.ie

Anik Khan
Walsh Scholar,
Food Research Centre,
Teagasc Moorepark.

Lucia Espinosa-Brisset
Research Scientist,
INRAE Paris.

Ayite Adama
PhD Research Student,
INRAE Paris.

Not adding up?

Nitrites in cured meat play a key role in developing sensory characteristics that are important to consumer perception and purchase intent. Research at Teagasc Ashtown is investigating whether nitrites can be reduced without compromising the sensory experience.

Cured meats, such as cooked ham, bacon and sausages, have long been an integral part of the cuisine of various cultures around the world. They form a quintessential element of the traditional fry-up in Ireland and the UK, and are considered the flagship of traditional cuisine in countries such as Italy, Germany and Spain.

While global demand for cured meats remains strong, the market is undergoing significant changes as consumers become more aware of health concerns influencing their purchasing decisions.

Nitrite is an authorised food additive and one of the most widely used curing ingredients for meat within the EU, commonly added to product formulations during the development of cured meat products. Stergios Melios, a Walsh Scholar at Teagasc Ashtown's department of Food Quality and Sensory Science, explains further.

"Nitrites help prevent the growth of harmful microorganisms and plays a critical role in the development of the pinkish colour and distinct savoury flavour which consumers associate with cured meats. However, there are increasing health concerns associated with long-term consumption of cured meats. Evidence suggests that added nitrites can produce potentially cancer-causing chemicals, such as N-nitrosamines, through interactions with naturally occurring secondary amines in meat."

A complex challenge

In 2015, the International Agency for Research on Cancer classified processed meat as carcinogenic, and in October 2023, a new European Commission regulation reduced the maximum allowable levels of added nitrites in cured meats, granting the meat industry a two-year period to adapt current practices.

"Nevertheless," Stergios continues, "the sensory profile of cured meats – appearance, odour, taste, flavour and texture – remains one of the most important factors driving consumers' purchasing decisions. Colour and flavour, in particular, play a significant role in consumers' willingness to buy cured meat products."

Since nitrites are added to develop these important sensory characteristics in cured meat, reformulating recipes without nitrites is a complex challenge for the meat industry. Consequently, meat manufacturers in Ireland and elsewhere are working to develop technological solutions to reduce or completely replace nitrites in cured meat, with a range of nitrite-free meat products recently emerging onto supermarket shelves across Europe.

Researchers at Teagasc Ashtown have conducted a series of studies to evaluate whether nitrite-free products can compete with their conventional counterparts in terms of sensory characteristics. They aim to understand how consumers in Ireland perceive nitrite-free products and whether their perceptions change when informed about the health benefits of these formulations.

Getting a sense of it

In an initial study, a highly trained sensory panel evaluated the sensory profiles of various conventional and nitrite-free cooked ham products and bacon rashers commercially available on the Irish market.

The results showed that for bacon rashers, the type of curing method – dry *vs.* brine curing – significantly influenced the flavour profile of the products, while the removal of nitrites had no substantial impact. Nitrite-free bacon had a similar sensory profile to their conventionally cured counterparts.

In terms of appearance, dry-cured bacon and smoked nitrite-free bacon exhibited darker reddish colours with less marbling and white fat around the edges. By contrast, brine-cured bacon and unsmoked nitrite-free bacon appeared lighter in colour and thinner, with more fat and marbling. Smoked nitrite-free bacon was noted for having a brownish smoky appearance.

For cooked ham, the nitrite-free product was similar to conventionally cooked ham products in both appearance and flavour but had a slightly more rubbery texture during the initial few moments of chewing.

"Nonetheless, the overall similarity in sensory profiles indicates progress in achieving comparable sensory characteristics in nitrite-free cooked hams, which is promising given the market demand for clean labels," Stergios points out.

Notably, the distinction between whole-muscle and sectioned-and-formed cooked hams emerged as a significant factor influencing sensory profiles. Added water, meat percentage and fat content were also crucial in shaping the sensory profile of cooked ham.

> **"Curing methods significantly influenced the flavour profile of the products, while the removal of nitrites had no substantial impact."**

Improving information

Building on these findings, a consumer sensory study was conducted with 120 participants to determine sensory and emotional responses to a selection of cooked ham products. The aim was to understand the extent to which consumer response is influenced by information regarding the potential health impacts associated with the consumption of cured meats containing nitrites.

"Results showed that irrespective of the information provided, the nitrite-free cooked ham was the most liked product. What's more, health benefit information significantly increased consumers' overall liking and purchase intent for the nitrite-free cooked ham," Stergios notes.

"Interestingly, after receiving information, consumers rated the conventional cooked ham product as significantly saltier, while the nitrite-free ham was associated with more 'happy' and fewer 'disgusted' emotions."

The similarity of nitrite-free meat products to their conventional counterparts and the high level of consumer liking demonstrates that the development of similar cured meat products is feasible without the addition of nitrites. Moreover, the results provide evidence that cured meat products of high sensory quality can benefit from the provision of health benefit information, increasing both overall liking and purchase intent.

"These results highlight the importance of informative packaging for nitrite-free products. This can create new opportunities for manufacturers of healthier cured meats to stand out in the market and motivate companies to invest in developing such nitrite-free solutions," Stergios concludes.

"Finally, the findings support innovation for the development of cured meats that offer benefit in terms of health, driving opportunities for future consumer engagement within the processed meat industry." T

FUNDING

This research was funded by the Department of Agriculture, Food and the Marine, Republic of Ireland, under the No-2-Nitrates (2021R426) project.

CONTRIBUTORS

Stergios Melios
Walsh Scholar, Food Quality and Sensory Science Department, Teagasc Ashtown.

Declan Bolton
Principal Research Officer, Food Safety Department, Teagasc Ashtown.

Emily Crofton
Senior Research Officer, Food Quality and Sensory Science Department, Teagasc Ashtown.
emily.crofton@teagasc.ie

Modelling seasonality of beef finishing systems

Researchers at Teagasc Grange are exploring how seasonality impacts beef prices and farm profitability, using bioeconomic models to examine Irish beef production systems and the potential of altering slaughter dates.

Seasonality affects beef prices, with significant implications for farm profitability. Teagasc researchers used bioeconomic models to study how seasonality impacts Irish beef production systems.

Irish grass-fed beef is produced in systems involving spring-born calves fed diets of 80–90% grass and conserved forage. Grazing for up to ten months a year provides high animal welfare credentials, valued by consumers nationally and internationally. Grass-based systems offer a competitive advantage by minimising purchased feed. Additionally, they enhance sustainability through carbon sequestration, biodiversity and minimal competition with human-edible food production.

Profitability: a key challenge

Despite these advantages, profitability at the farm level continues to be low. Average beef farm incomes in 2023 stood at €7,425 (cattle rearing) and €14,735 (other cattle) with farm incomes in some cases supplemented with off-farm income. A key lever to improve farm profitability is maximising beef prices for animal sales.

Denis Meehan, a Meat Technology Ireland (MTI)-funded postdoctoral researcher at Teagasc Grange explains.

"We know that beef prices typically follow the law of supply and demand, with peak factory slaughtering in autumn coinciding with the lowest carcass prices when beef farmers sell their stock as grass supply tightens.

"This trend is reversed in the spring when cattle supplies fall and prices respond accordingly, illustrating the effect of seasonality on beef price trends," he adds. Thus, there are opportunities to affect beef prices by altering the sale date; consequences for feed costs and carcass traits must be considered. Results from a study on these factors were presented at the British Society of Animal Science (BSAS) conference in Belfast in 2024.

The basics of modelling

The approach followed was to use historic Bord Bia-published weekly beef prices from 2015 to 2024 to tabulate monthly beef price ratios (i.e. monthly price as a proportion of average yearly price) for all carcass conformation and fat scores. Applying these data to bioeconomic systems models developed at Teagasc Grange, four beef finishing systems were simulated, differing in slaughter age and month and weight at purchase. Price ratios relating to the respective slaughter months were applied within these models to determine the respective beef systems' profitability levels (as average margin, €/head/year).

Bioeconomic models are a widely used approach applied in animal production systems research, explains Denis.

"Such models quantify all physical inputs and farm-level interactions occurring in beef cattle production from birth to finish. 'Partial' systems e.g. yearling to finish, as operated on many farms, can be extracted from these systems as required. Key outputs are produced relating to the financial, physical and environmental characteristics of the system modelled."

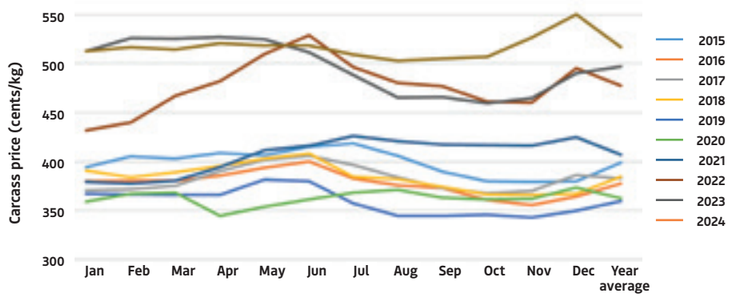
The four beef systems analysed in this present study involved March-born late maturing crossbred steers purchased in September as either 'heavy' (580kg) or 'light' (480kg) animals. Heavy animals were finished at pasture (P) at 20 months (HP, October slaughter) or indoors (I) at 22 months (HI, January slaughter) with the light animals finished indoors at 25 months (LI, April slaughter) or pasture at 28 months (LP, June slaughter).

The effects of seasonality

Pronounced intra- and inter-year fluctuations in beef prices were observed over the period 2015-2024 with the historically high beef prices in 2024 (R3-graded steers presented in Figure 1) yielding a year average price 43% greater than the corresponding price for 2019 (516 vs. 359 c/kg carcass), the lowest year average price over the ten-year study period.

Average monthly price ratios over the ten years showed a general increasing trend from the beginning of the year until June. Beyond this, they reverted towards the year-end (R3 carcass data presented in Figure 2) before registering a further increase in December on the back of rising Christmas demand. A similar trend was seen for all other carcass categories. Large differences in margins (€/head) were seen in the profitability of the systems between years with the highest margins ranging from €247 to €467/head seen with LP (Figure 3).

Figure 1: Average monthly and yearly R3 steer carcass prices over the period 2015 to 2024



Beef production systems maximising the use of grazed grass have potential for greater profitability

Teagasc

"This arises because this system had the greatest numbers of days at grass (at 165 days), greatest grass and forage proportion in the diet (94%) and greatest carcass weight (395kg), while also having the least concentrate input (200kg), while its June slaughter date coincided with peak carcass prices and price ratios," notes Denis.

The second most profitable system, the LI, had the highest concentrate input (one tonne) despite producing a lower carcass weight (385kg), illustrating the extent to which seasonality can offset the added costs associated with higher concentrate inputs.

Re-ranking profitability

The yearly impact of price seasonality over the ten-year period also led to some re-ranking in the profitability of the remaining three systems. These data relate to profit per head; a key issue to consider in this regard is that the longer on-farm period for the LP system (ten months) compared to the other systems reduces the number of animals that can be accommodated on farm. This has implications for profitability per hectare. In this present analysis, despite reducing the advantage of LP, the ranking was unchanged on a per-hectare basis.

"One can never predict the future, but systems modelling can help beef farmers make more informed decisions when there are a large number of farm system variables and output metrics to consider," concludes Paul Crosson, Grange's Beef Enterprise Leader and Lead Researcher on this project. Future research is aimed at examining the relationship between environmental sustainability (as carbon footprint) and economic sustainability of beef finishing systems.

Figure 2: Average R3 steer carcass price ratios over the period 2015 to 2024*

*Bars signify maximum and minimum price ratios

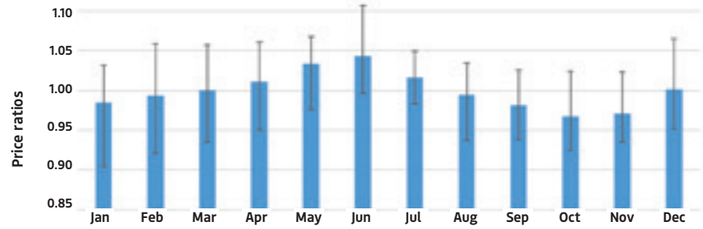
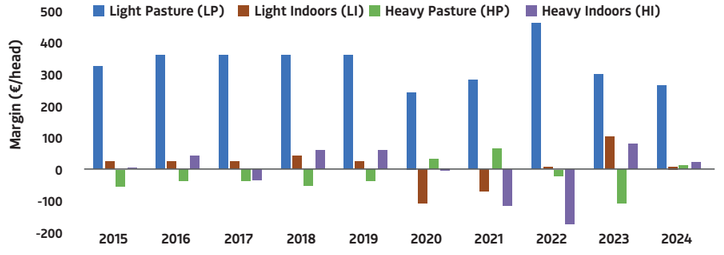


Figure 3: Profitability of beef finishing systems differing in slaughter date over the period 2015 to 2024



FUNDING

This research was funded through the support of Meat Technology Ireland Phase 2 (Ref PN 1647 & DAFM/28/2016/PR.EFP).

Take home message

Beef production systems that maximise the use of grazed grass are more profitable than those requiring more prolonged indoor feeding periods, and based on the current seasonality of cattle supplies, prices are highest in summer. Therefore, production systems which finish cattle at this time of year are most profitable. T

CONTRIBUTORS

Denis Meehan
MTI Postdoctoral Researcher, Teagasc Grange.
denis.meehan@teagasc.ie

Edward O'Riordan
Beef Systems Researcher, Teagasc Grange.

Paul Crosson
Lead Researcher and Beef Enterprise Leader, Teagasc Grange.

Diversification

FAST-IP: driving innovation in agri-food sustainability

Discover how the FAST-IP programme is transforming Ireland's agri-food sector with innovative solutions, immersive learning and a sustainable future focus.

The Food and Agriculture Sustainable Technology Innovation Programme (FAST-IP), launched in March 2024, addresses the need for innovation in Ireland's food and agriculture sector.

The agri-food sector is a cornerstone of the Irish economy, contributing €8 billion annually and employing over 160,000 people. Aligning with Ireland's national Agri-Food strategy, 'Food Vision 2030', FAST-IP aims to establish Ireland as a leader in sustainable food systems by balancing climate-smart agriculture, environmental and economic sustainability, and innovation, explains Siobhán Jordan, Teagasc's Head of Technology Transfer and Commercialisation.

"By addressing key challenges such as climate change, food security, productivity and economic diversification, FAST-IP positions Ireland as a global innovator in AgTech and food systems."

Supported by a €7 million funding package over six years under the Innovators' Initiative Programme co-funded by the Government of Ireland and the European Union through the Southern, Eastern & Midland Regional Programme 2021-2027, this programme aims to equip mid-career professionals with the skills to identify and address unmet needs through needs-led innovation.

"The ultimate goal is to foster the creation of high-potential start-ups, scalable businesses and sustainable solutions that contribute to the long-term economic and environmental resilience of Ireland's agri-food sector," says Siobhán.

A collaborative effort

FAST-IP is a partnership between University College Dublin (UCD) and Teagasc, leveraging their combined expertise in sustainable food systems, agriculture and food science. The participants are hosted at the AgTechUCD Innovation Centre at Lyons Farm, Co. Kildare, a hub dedicated to nurturing early-stage start-ups and small-to-medium enterprises. Both organisations bring extensive networks and a proven track record in supporting innovation and entrepreneurship.

FAST-IP's inaugural cohort of 14 participants, selected from nearly 200 applicants, demonstrates the programme's strong appeal and relevance. By providing a €38,000 tax-free stipend, the programme ensures participants can fully commit to their entrepreneurial journey along with completing a Graduate Diploma in Agricultural Innovation and Entrepreneurship. The participants, drawn from diverse professional backgrounds including ICT and marketing, commenced the programme in September 2024.

The programme's innovative approach combines immersive experiences with practical, design-thinking methodologies, Siobhán notes. "Teagasc researchers have played a pivotal role in shaping the journey of the FAST-IP participants, supporting the immersive learning experience that integrates scientific expertise, industry insights, and practical applications."

A key aspect of the first semester was immersion in agri-food systems including farms and food processing facilities.

Participants visit

The participants engaged in site visits to Teagasc's leading research centres, including the Animal & Grassland Research Centres at Grange and Moorepark, the Food Research Centres at Ashtown and Moorepark, and the Crops Research Centre at Oak Park. Participants explored state-of-the-art facilities, such as the National Prepared Consumer Foods Centre and the anaerobic digestion facility at Grange, gaining practical insights into real-world applications.

These hands-on sessions empowered participants to connect theoretical knowledge with the challenges and opportunities across the entire agri-food sector from farm to fork.

In addition to research centre visits, the participants benefited from the insights of Signpost farmers who demonstrate climate-smart farming across Ireland as part of the Teagasc-led Signpost Programme. The collaborative and mentorship approaches of Teagasc researchers and engagement with Signpost farmers not only enhanced participants' understanding of Ireland's agri-food landscape, but also inspired innovative thinking in response to unmet needs in sustainability, production, processing and mechanisation. This guidance was instrumental in equipping the cohort with the insights to consider industry challenges, paving the way for sustainable and impactful entrepreneurial ventures in the food and agriculture sectors.

Glossary box

Needs-led innovation:
Innovation based on identifying specific gaps or challenges that require solutions.

AgTech:
Agricultural technology, referring to innovations that improve efficiency, productivity and sustainability in agriculture.

Circular food system:
A sustainable model of food production and consumption that minimises waste and maximises resource reuse.

Climate-smart agriculture:
Farming practices that increase productivity while reducing greenhouse gas emissions and adapting to climate change.

Design-thinking methodologies:
A problem-solving approach focused on understanding user needs, brainstorming solutions, and testing them iteratively.

Signpost Programme:
A Teagasc-led initiative that supports climate-smart farming practices by showcasing best practices across Ireland.

A look ahead

The next few months will be busy across the collaboration as the participants progress to develop compelling solutions to the identified primary unmet needs.

Support from a range of partners, including Enterprise Ireland, and investors is essential as the participants progress their journeys to transform ideas into viable business propositions and ultimately impactful companies, addressing critical unmet needs in food and agriculture sectors worldwide. In parallel, FAST-IP is seeking the next cohort of participants who want to transform their career.

"A general call is open for those interested in embarking on a cutting-edge, immersive programme empowering mid-career professionals to create innovative, sustainable agri-food solutions with expert mentorship and entrepreneurial training at UCD and Teagasc," Siobhán concludes. "This partnership approach underpins Teagasc's commitment to fostering the next generation of innovators."

FAST-IP participants meeting Teagasc Director Frank O'Mara (holding sign) and James Healy, Engage@Teagasc (far left) at the National Ploughing Championships

Teagasc.

FUNDING

FAST-IP is supported under the Innovators' Initiative Programme, co-funded by the Government of Ireland and the European Union through the Southern, Eastern & Midland Regional Programme 2021-2027. #euinmyregion

CONTRIBUTORS

Siobhán Jordan
Head of Technology Transfer and Commercialisation, Teagasc Oak Park.
siobhan.jordan@teagasc.ie

James Healy
Industry Engagement Executive, Teagasc Moorepark.

Research Ireland Board members: Back row (left-right): Rebecca Braun, Eoin O'Sullivan, Godfrey Gaston, Leonard Hobbs; Front row (left-right): Lorraine Allen, Anne Vaughan, Patricia Quane

Research Ireland – a transformative reset

On 1 August, 2024, Ireland marked a significant milestone with the establishment of Taighde Éireann – Research Ireland, a new competitive research and innovation agency. This achievement fulfils a key action from Ireland's Research and Innovation Strategy, Impact 2030. By amalgamating the functions of the Irish Research Council (IRC) and Science Foundation Ireland (SFI), the new agency fundamentally resets Ireland's competitive public funding landscape.

For the first time, research in the arts, humanities, and social sciences is placed on a statutory footing. This integration creates an opportunity for Ireland to build a cohesive national research and innovation system, supporting a strong, sustainable and resilient economy and society.

Engaging stakeholders for transformation

The Research Ireland team is committed to establishing a high-performance organisation that reflects the successes of its predecessors while delivering the government's ambitions for the future. Central to this effort is a detailed stakeholder engagement exercise, running throughout the first half of 2025. This outreach will involve workshops, webinars, town halls and surveys, building on pre-establishment consultations. The insights gathered will inform the agency's ambitious strategy through 2030, setting clear goals and actionable objectives.

Ireland's new research and innovation agency, Research Ireland, sets the stage for a cohesive, interdisciplinary system that drives sustainability, excellence and impact across all disciplines.

Driving excellence and impact

Research Ireland's mission is to fund and champion excellent research and innovation that creates a better future. The agency is committed to managing its portfolio fairly and inclusively, addressing the needs of diverse stakeholders – including the research community, enterprises and government – while delivering societal, cultural, environmental and economic impact. Above all, Research Ireland prioritises value for money for Irish taxpayers.

Maintaining continuity of service to the academic community is essential during this formative period. All existing awards previously administered by SFI and IRC, such as DOROTHY, COALESCE, Laureate and Frontiers for the Future, will continue.

Large-scale Research Centre funding announced in mid-2024, such as for the VistaMilk Research Ireland Centre for Digitalising Dairy Production and Processing and the BiOrbic Research Ireland Centre for Bioeconomy, will also remain. These centres alone are supporting hundreds of highly skilled research positions across senior researcher, post-doctoral, PhD and MSc levels over the next five years.

In parallel, Research Ireland is reviewing its current programme calls to identify gaps, eliminate duplications and enhance efficiency.

A vision for the future

Outlining the agency's vision, Celine Fitzgerald, Interim CEO of Research Ireland, stated: "Our vision is for enhanced coordination of funding activities, an intensification of interdisciplinary research, and a more vibrant research base that showcases Ireland's global reputation as a research and innovation leader across all disciplines."

With a clear mandate and ambitious strategy, Research Ireland is poised to drive transformative innovation across Ireland's research and innovation landscape, ensuring a better future for all. T

Words by:
Carl Gibney, Communications & Marketing Manager, Research Ireland
carl.gibney@researchireland.ie

Research Ireland

A novel food emulsifier from a red seaweed hydrolysate

Technology value proposition:

- Teagasc researchers have developed a seaweed-derived emulsifying agent, using extracted protein hydrolysate.
- This allows for the production of vegan baked goods and food products, free from egg and dairy.
- Use of such a sustainable resource can overcome issues associated with some conventional emulsifiers, without impacting the quality of food products.

Unique selling propositions:

- **Source**: A red, cultivable, invasive seaweed species found in Europe consumed in different cultures prior to 1997 as a food.
- **Hydrolysate**: A protein-rich hydrolysate achieved with food-grade enzymes. Functionality of emulsifying ingredients like lecithin (soy).
- **Formulation**: Techno-functional properties comparable to egg-derived emulsifiers, and source of essential amino acids.

Development stage

- Protein extract developed using food-grade enzymes.
- *In vitro* trials confirming functional emulsification properties.
- Testing and analysis of baked goods formulation using baking trials.

Opportunity to collaborate

- This may be of interest to producers of baked goods and/or emulsifiers targeting non-egg/vegan baked goods market.
- We welcome engagement from companies to discuss collaborative and technology development opportunities.

Research funding

DAFM-funded U-Protein project: "*Unlocking protein resource opportunities to evolve Ireland's nutrition*" (WP2).

Teagasc leads

Maria Hayes & Dolly Bhati, Teagasc Food Research Centre, Ashtown.

For further opportunities to discuss, please contact Miriam Walsh: engage@teagasc.ie or miriam.walsh@teagasc.ie

Circular Food System

Food for the future

Advances in innovation across the food sector play a key role in maintaining Ireland's status as a food exporter, explains Mark Fenelon, Head of Teagasc's Food Programme at Ashtown and Moorepark.

Future innovation within our food system will undoubtedly involve new technologies, methodologies and science to drive transformation in food production, processing and consumption. Research will need to embrace advanced data analytics to drive efficiency, sustainability and resilience within our food sector. To achieve this, our focus is on maintaining core food science principles while facilitating the introduction of the latest developments in science and engineering.

The concept of sustainable food systems includes diversification, nutrition, sustainable packaging and processing efficiency across all food sectors. This is underpinned by food safety, sensory, quality and health benefits, which are integral to any food system.

The Teagasc Food Research Programme is uniquely positioned to look across the value chain from soil to ingredient and, ultimately, the finished food product. Since Ireland is an exporting country, it is highly relevant to our work that we understand consumer trends in global markets, and the nutritional and functional attributes of the ingredients or foods we produce.

Creating new value

Research has evolved to support diversification within our food system, creating new value streams and increasing bio-circularity by valorising crop-, animal-, and marine-based biomass into novel or renewable products.

> **"Alongside advances in molecular sciences, this knowledge and technology can be applied to the nutrition, functionality and safety of the food we consume."**

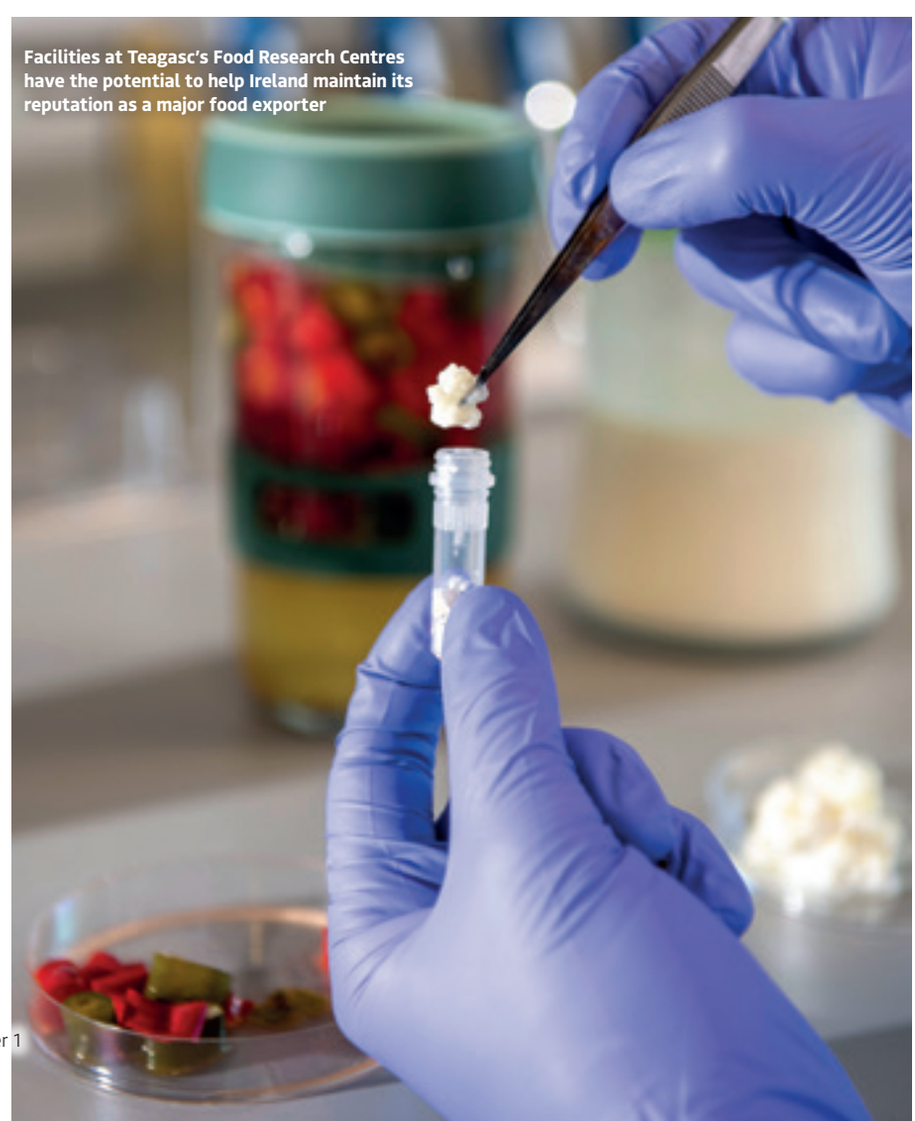
The conversion to biomaterials for food and non-food applications is made possible through molecular and processing techniques. New and existing processing strategies can be integrated for protein and residual biomass extraction, fractionation, concentration and drying. Coupled with the development of biobanks for microbiome and enzyme biotransformation, this will ultimately determine the extent of capability and thus circularity by creating new food value streams.

Moreover, to innovate in food product and process design, we need to be able to measure what we study. Advanced instrumentation and Artificial Intelligence analytical tools will continue to be a key focus of our research. The integration of digital solutions doesn't stop there; vision recognition, robotics, mixed reality, generative AI and advanced data analytics are applicable across the food programme.

The Industrial Internet of Things supports sensor development and edge computing and can transform manufacturing processes. It has the potential to re-engineer food manufacturing to better meet changing consumer demand.

A convergence of technologies is happening, generating a new understanding of complex food structures and behaviour during processing, storage and digestion. Alongside advances in molecular sciences, this knowledge and technology can be applied to the nutrition, functionality and safety of the food we consume.

The Teagasc food programme team will continue to collaborate extensively with the other Teagasc programmes and external collaborators to develop Ireland's natural food resources and, ultimately, its economic and nutritional needs. T



Facilities at Teagasc's Food Research Centres have the potential to help Ireland maintain its reputation as a major food exporter

Andrew Downes, xposure

Events: my take-home message

Teagasc's researchers attend many events throughout the year, sharing the findings from their research with national and international audiences. Here, we capture the take-home messages – key pieces of information that our researchers want people to remember – from recent events.

Targeted actions for water quality

Event: Farming Consultative Group Visit to the ACP, Co. Wexford
Date: 25 November 2024

European regulations have set out target objectives for water quality by 2027 under the Water Framework Directive, and the Environmental Protection Agency has reported agriculture as a significant pressure impacting water quality. Teagasc has gained a thorough understanding of the processes that influence water quality in an agricultural landscape through 16 years of research undertaken by the Agricultural Catchments Programme (ACP) at six strategically located and contrasting sites across the country.

Representation from all the major farm organisations gained an understanding of the different impacts that soil type, weather and farming practice have on the various aspects of water quality while visiting two ACP catchments in Co. Wexford. The reasons and options for targeted actions (mitigation measures) for nitrate and phosphorous were demonstrated.

Edward Burgess, Agricultural Catchment Specialist, explains: "It is well established that a 'one size fits all' approach of the Good Agricultural Practice regulations need support from a more targeted advisory service with incentives. This support is being delivered by the Agricultural Sustainability Support Advisory Service, jointly funded by the government and industry, with EU funding for extra on-farm actions available now through the Farming for Water EIP."

The group visits one of the ACP water-monitoring stations

Teagasc

Sustaining the future of tillage crops

Event: Teagasc National Tillage Conference 2025, Lyrath Hotel, Kilkenny
Date: 29 January 2025

The main theme of the 2025 Teagasc National Tillage conference was sustainable crop production. The latest results were presented on carbon stocks in tillage soils, along with discussion around the impact of reductions of pesticide use due to regulation. Richie Hackett, Crops Research Officer at Teagasc Oak Park, explains: "The soil carbon results showed higher than expected levels of soil carbon in tillage soils, comparable to some grassland enterprises, with higher levels associated with soils with a higher clay content. In terms of soil carbon stocks, differences between plough-based and minimum-tillage systems were reported to be small – as were differences in winter wheat yield, except following very wet autumns when the minimum tillage systems tended to have lower yields."

Delegates heard that work examining the effects of reductions in pesticide inputs showed that yield reductions were likely to occur. Two workshops on weed and disease control further highlighted the importance of retaining access to as wide a range as possible of pesticides in Ireland. Speakers strongly emphasised the importance of using alternative means of pest, weed and disease control as part of an integrated pest management regime.

Overall, the conference showed that crop production had good environmental sustainability credentials but highlighted that growers need to be aware of, and react to, a number of risk factors to maintain economic sustainability.

Speaker line-up for the National Tillage Conference 2025 in Kilkenny

Dylan Vaughan Photography

Don't miss Teagasc's upcoming events! Join us for the International Dairy Federation Joint Symposium on Dairy Drying Technology and Recombined Milk Products in Cork, Ireland, 13 to 15 May 2025. Visit our website for more information on this and all our upcoming events: www.teagasc.ie

Hydroponic sweet basil: cultivating flavour and sustainability

Circular Food System

Hydroponics is an innovative approach in precision agriculture, driving a more efficient, sustainable and scalable future. Hydroponic cultivation replaces conventional soil-based agriculture with nutrient-rich water solutions. Nutrient solutions are the lifeblood of plant growth, with plant roots submerged in a precisely controlled fertiliser regime that ensures optimal nutrient availability and sustainability, leading to nutrient-rich harvests.

Photo and description by:
Zoia Arshad Awan
Teagasc project:
Leaf No Waste
Funding:
Science Foundation Ireland