51st Annual Food Science and Technology Conference

Food Systems in a Changing World- the Science, Challenges and Opportunities

December 6-7th,
Teagasc Food Research Centre,
Ashtown, Dublin

IFSTI
Institute of Food Science &Technology of Ireland

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Agriculture and Food Development Authority

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December 6th-7th, 2023
Teagasc, Ashtown

WELCOME MESSAGE FROM THE IFSTI PRESIDENT

On behalf of the Institute of Food Science and Technology of Ireland (IFSTI) I am delighted to welcome you to Teagasc, Ashtown for the 51st Annual Food Science and Technology Conference. This programme book contains over 80 abstracts and I would like to thank you all for the time taken to prepare and present your work. The conference promises to be an exciting two days of new findings from a broad range of scientific disciplines within food research, with a particular focus this year on food systems and sustainability. It has become very clear in recent years that evidence-based scientific knowledge greatly contributes to our society home and abroad. Given the pressures on countries to contribute to meeting the UN Sustainable Development Goals, it is vital that Ireland plays a pivotal role in this regard. Developing sustainable food systems in a changing world presents challenges, requires excellent science and also offers business opportunities. Exploitation of our bioeconomy through circular pathways and models poses real gains, not only for our wider economy and society but also for our producers and food companies alike.

The conference is also an excellent opportunity to network with your colleagues in the field of food science and to prepare for your future career in food science and technology.

I would like to welcome and thank our guest presenters; your participation is very much appreciated.

Finally, I appreciate and welcome the support of the International Union of Food Science and Technology (IUFoST), and the generosity of our sponsors, *safe*food, Teagasc and the Society of Chemical Industry.

I wish you an enjoyable and productive conference, full of learning, networking and inspiration.

If you would like to join IFSTI please contact ifsti@hotmail.com

Best regards,

Declan J. Troy,
President, Institute of Food Science and Technology of Ireland.
Assistant Director of Research,
Director of Food Technology Transfer,
Teagasc Food Research Centre,
Ashtown, Dublin 15.
Ph. +353 1 8059500
Mobile: +353 87 8530556
Email: declan.troy@teagasc.ie, ifsti@hotmail.com

Programme

Day 1: WEDNESDAY DECEMBER 6th, 2023	
08.45-09.30	**Registration and coffee**
9.30-9.45	**Welcome Address and Opening Remarks** **Mr Declan Troy** **Assistant Director of Research, Teagasc and President of IFSTI**
Session 1: Safe, healthy and sustainable food innovation Chair: Dr Emily Crofton, Teagasc	
09.45-10.05	**KEYNOTE PRESENTATION** ***Safe, healthy and sustainable food innovation*** **Dr Kari Tronsmo, President, EIT Food's Protein Diversification Think Tank; Open Innovation leader, Danone**
10.05-10.20	The impacts of a multispecies sward grazing system upon cheddar cheese manufacturing efficiency and quality **Richard Page, Teagasc**
10.20-10.35	Enhancing the techno-functional properties of lentil protein isolate dispersions using high pressure homogenisation for use in plant protein based young child formula **Nicolas Malterre, University College Cork**
10.35-10.50	Extracts from *Onopordum platylepis* flowers: novel vegetable coagulants for cheesemaking with ovine milk **Giorgia Rampanti, Università Politecnica delle Marche (UNIVPM), Italy**
10.50-11.05	Evaluation of the effect of sweeteners on bacterial quorum sensing: Implications for gut microbiome dynamics **Mindani Watawana, University of Limerick**
11.05-11.30	**COFFEE AND POSTER VIEWING**
Session 2: Safe, healthy and sustainable food innovation Chair: Dr. Róisín Burke, Technological University Dublin	
11.30-11.45	Antioxidant capacity of β-glucan from mushrooms using ultrasound-assisted extraction **Bárbara Biduski, Teagasc**
11.45-12.00	What does it take for novel food authorisation in the European Union? Insights from risk assessment to market authorisation **Maame Ekua Manful, Technological University Dublin**
12.00-12.15	Impact of porcine red blood cells (RBC) feeding on the proximate composition of yellow mealworm (*Tenebrio molitor*) and house cricket (*Acheta domesticus*) **Eduarda M. Cabral, Teagasc**
12.15-12.30	Study of the polyphenol retention in distilled gin spent botanicals, its antioxidant capacity, and economic importance **Ekene Umego, Technological University Dublin**
12.30-12.45	A new food application of Irish-grown peas: Milling, dough rheology, bread profiling and NIR spectroscopy **Mariana Macas, Teagasc**

12.45-13.00	Impact of different light conditions on nitrogen, colour and amino acid profiles of cultured *Palmaria palmata* and technofunctional properties of protein rich ingredients **Anthony T. Idowu, University of Limerick**
13.00-14.00	**LUNCH AND POSTER VIEWING**
Session 3: Zero waste approaches to address food loss and waste Chair: Dr Lael Walsh, Teagasc	
14.00-14.20	**KEYNOTE PRESENTATION** *Sustainability at O'Brien Fine Foods* **Mr Nicholas Reynolds, Sustainability Manager, O'Brien Fine Foods**
14.20-14.35	The application of plant extraction waste in horticulture: A proof-of-concept zero-waste research study **Sridevi Bindiganavile Ranganath, Technological University Dublin**
14.35-14.50	An integrative model of multiple quality responses to assess the effect of different food packaging solutions for kale, spinach, mushroom, and strawberry on food waste production **Francesco Saverio Giordano, Technological University Dublin**
14.50-15.05	Exploring the efficacy of food waste as a potential source of antibacterial agents and antibiotic adjuvants against MRSA and MSSA isolates **James Blee, Atlantic Technological University**
15.05-15.20	Combination effects on the longevity improvements of *Agaricus bisporus* using silicon bio-stimulants and sustainable packaging alternatives **Andrew Reynolds, Technological University Dublin**
15.20-15.45	**COFFEE AND POSTER VIEWING**
Session 4: Engaging the consumer and society Chair: Dr Sinéad McCarthy, Teagasc	
15.45-16.05	**KEYNOTE PRESENTATION** *The role of the consumer and society in delivering a sustainable food system* **Prof Maeve Henchion, Teagasc**
16.05-16.20	Fatty acids analysis for verifying the production system of commercially sourced Irish grass-fed beef **Sherif Shaheen, University College Dublin**
16.20-16.35	EFSA Focal Point: connecting Ireland with the European Food Safety Authority **Gráinne Redmond, Food Safety Authority of Ireland**
16.35-16.50	Antibacterial properties of macroalgae against community and clinical acquired MRSA strains **Peter O'Hara, Atlantic Technological University**
19.30-22.00	**Conference networking event** **Venue: The Church Café Bar, Jervis Street, Dublin 1 D01 YX64.**

Day 2: THURSDAY DECEMBER 7th, 2023	
Session 5: Data and digitalisation advances in food systems **Chair: Prof Jesus Frias, Technological University Dublin**	
09.30-09.50	**KEYNOTE PRESENTATION** *Global food systems – A digital journey towards a sustainable future* **Dr Ultan McCarthy, Lecturer, Department of Land Management at South East Technological University (SETU), IEEE CRFID Distinguished Lecturer**
09.50-10.05	A digital technology-based framework for preventing fraud in agri-food supply chains **Zhijun Wang, University College Dublin**
10.05-10.20	Optimization of high capacity sorptive extraction thermal desorption for the volatile profiling of raw and cooked beef by gas chromatography mass spectrometry **Fathi Morsli, Teagasc**
10.20-10.35	Kinetic study for cooking optimization of chicken breast meat in professional oven **Giulia Romano, Teagasc**
10.35-10.50	Mathematical modelling of sauerkraut acidification and lactic acid production through fermentation **Victoria Caballero, Technological University Dublin**
10.50-11.05	From olives to oil: food fraud vulnerability assessments in Greek olive oil supply chain **Zhijun Wang, University College Dublin**
11.05-11.30	**COFFEE AND POSTER VIEWING**
Session 6: Addressing climate challenges in agri-food production **Chair: Dr Dilip Rai, Teagasc**	
11.30-11.45	Enhancing the bioactive fat composition and microbial stability of bovine milk using multispecies swards **Samuel Rapisarda, Technological University Dublin**
11.45-12.00	Exploring the potential suitability in Ireland for the current cultivation of high protein output crops and forecasted utilising three Shared Socioeconomic Pathways (SSPs) 245, 370 and 585 **Talia Huffe, Teagasc**
12.00-12.15	Evaluating the microbial quality of roof-harvested rainwater as a sustainable irrigation alternative **Michael Arthur, Teagasc**
12.15-12.30	The potential of edible insects as a palatable, safe and sustainable food source **Ann Conway, Technological University Dublin**

12.30-12.45	'Raising the Pulse': systems analysis of the environmental, nutritional and health benefits of pulse-enhanced foods **Donal O'Sullivan, University of Reading, UK**
12.45-13.30	**LUNCH AND POSTER VIEWING**
Session 7: Bio-based solutions for food production and processing Chair: Prof Jim Lyng	
13.30-13.50	**KEYNOTE PRESENTATION** **Dr Ian Noble, VP R&D – Research and Analytical Sciences, Mondelēz International**
13.50-14.05	An empirical analysis on smallholder diets in Ethiopia: examining the joint interplay between farm production diversity and market access **Tsegay Balcha, University College Cork**
14.05-14.20	Recovery of humic substances from digestate using advanced technologies for sustainable agriculture production **Shon Shiju, Munster Technological University**
14.20-14.35	Quantitative microbial risk assessment modular framework for waste-pathogen combinations from land-spreading in Ireland **Jennifer McCarthy, Technological University Dublin**
14.35-14.50	Ultrasound homogenization and its effects on certain rheological and physical properties of rich-polyphenol dairy-based beverage **Gontorn Putsakum, Teagasc**
14.50-15.05	Comparison of trypsin and chymotrypsin inhibition in different fava bean (*Vicia faba*) varieties **Luthando Gcaza, University of Limerick**
15.05-15.20	Monitoring the effect of consumption temperature of whole fat milk on in vitro gastric digestion using magnetic resonance imaging **Conor Fitzpatrick, Teagasc**
15.20-15.40	General discussion, prize giving for best poster and oral presentations **Mr. Declan Troy**, President, IFSTI and Assistant Director of Research, Teagasc

Oral Presentations- Abstracts

The impacts of a multispecies sward grazing system upon Cheddar cheese manufacturing efficiency and quality

Author information

Richard M. Page[1], Tom F. O'Callaghan [2] and Prabin Lamichhane [1]

[1]Teagasc Food Research Centre, Moorepark, Fermoy, Co. Cork
[2]School of Food and Nutritional Sciences, University College Cork

Abstract

In Ireland, dairy herds are typically managed in seasonal pasture-based systems, and outdoor grazing has been associated with more nutritious dairy products, improved environmental sustainability and better animal health. Despite numerous benefits, current grazing systems generally utilise perennial ryegrass (GRS) monocultures and the approach requires extensive use of nitrogen fertilisers, resulting in high financial and environmental costs. Consequently, interest in alternative pastures, like multispecies swards (MSS) comprising grasses, herbs and legumes, has increased. These pastures can increase biodiversity and reduce costly chemical inputs through natural nitrogen fixation. The impacts of MSS grazing systems on the nutritional composition and quality characteristics of milk and dairy food products, including cheese, are still under-represented in the literature. This research investigated the effects of a MSS grazing system on Cheddar cheese properties over 180 days of ripening, with triplicate cheese manufacturing trials completed at both mid- and late-lactation. The milk obtained from a MSS grazing system had a significantly higher protein content and a significantly lower somatic cell count ($P < 0.05$). The MSS diet resulted in significantly higher cheese yield (Ya) ($P < 0.05$); Ya was 6.10% and 4.53% higher at mid-lactation and late-lactation respectively. However, the overall macro-composition of cheese obtained from the MSS grazing system was within the range of previously reported results for Cheddar, and only minimal differences were observed in sensory characteristics. This suggests consumers should be willing to accept cheese manufactured from a MSS grazing system. Overall, adopting a MSS grazing system may be beneficial from a cheesemaking efficiency perspective without adversely affecting the nutritional composition and the quality characteristics of the final cheese.

Enhancing the techno-functional properties of lentil protein isolate dispersions using high pressure homogenisation for use in plant protein based young child formula

Author information

Nicolas Malterre[1], Francesca Bot[2], Emilie Lerda[1], Elke K. Arendt[1,3], Emanuele Zannini[1,4] and James A. O'Mahony[1]

[1]School of Food and Nutritional Sciences, University College Cork, Ireland
[2]Department of Food and Drug, University of Parma, 43124 Parma, Italy
[3]APC Microbiome Institute Ireland, University College Cork, Cork, Ireland
[4]Department of Environmental Biology, "Sapienza" University of Rome, 00185 Rome, Italy

Abstract

Lentil protein is a good alternative to animal protein due to their high protein content, essential amino acid profile and good techno-functional properties. However, their limited solubility may be a hindrance to their use in food matrices. This study aimed to evaluate the impact of high-pressure homogenisation in the range 0 to 180 MPa on the techno-functional properties of lentil protein isolate dispersions. The solubility of the lentil protein dispersions significantly ($p<0.05$) increased from 62.8 to 86.5% with 15 MPa HPH treatment, and further increased in pressure up to 180 MPa resulted in a solubility of 95.3%. The weighted mean volume diameter decreased from 10.7 ± 1.1 µm (control dispersion) to 0.27 ± 0.01 µm for the dispersion treated at 150 MPa. This reduction in particle size was attributed to the intense mechanical forces, cavitation, shear, and turbulence induced during the homogenisation process, leading to the dissociation of insoluble protein aggregates. The surface hydrophobicity of the lentil protein dispersion increased from 614 to 1312 as HPH increases, due to the exposure of buried hydrophobic groups. The physical stability of the protein dispersions was improved with increased pressure as indicated by the reduced height of sediments from 4.31 mm to 1.41 mm and separation rate from 8.55 %/h to 4.92%/h, respectively for the control and the HPH treated sample at 180 MPa. This study indicates that high pressure homogenisation is a promising processing strategy for the development of colloidally stable lentil protein dispersions with enhanced solubility and improved techno-functional properties. These findings have significant implications for the further use of lentil proteins ingredients in sustainable food products.

Extracts from *Onopordum platylepis* flowers: novel vegetable coagulants for cheesemaking with ovine milk

Author information

Giorgia Rampanti[1], Cindy Bande-De Leon[2], Roberta Foligni[1], Ilario Ferrocino[3], Lucia Aquilanti[1]

[1]Department of Agricultural, Food, and Environmental Sciences (D3A), Università Politecnica delle Marche (UNIVPM), via Brecce Bianche, 60131, Ancona, Italy
[2]Department of Human Nutrition and Food Technology, Universidad Católica de Murcia (UCAM), Campus de los Jerónimos, Guadalupe, 30107, Spain
[3]Department of Agricultural, Forest, and Food Science, University of Turin (UNITO), Largo Paolo Braccini 2, 10095 Grugliasco, Italy

Abstract

Since ancient Roman times, extracts from thistle flowers have been utilized as milk coagulants. This longstanding tradition persists in Mediterranean countries, resulting in the production of various traditional thistle-curdled cheeses, particularly with ewe's milk, some of which have received PDO recognition. Beyond their unique organoleptic characteristics, these cheeses find favor among vegetarian consumers. However, a significant challenge in these productions lies in the availability of extracts, often sourced from wild thistles. In addition to the commonly used *Cynara cardunculus L*, other species, such as *Cynara humilis L*. and *Onopordum tauricum* Willd., have been recognized as valuable sources of vegetable rennet. Furthermore, cultivation trials have yielded promising results in both agronomic and technological aspects.

Notably, the milk-clotting activity of *Onopordum platylepis* Murb., a thistle species native to Tunisia, has been recently discovered. This study marks the first use of extracts from flowers of both spontaneous and cultivated *O. platylepis* in the production of traditional ewe's milk cheese. The initial evaluation involved chemical-physical analyses (pH, titratable acidity, aw, proximate composition), microbiological assessments (viable counting and Illumina sequencing), and volatile organic compounds (VOCs) analyses on ripened cheeses. Experimental cheeses were compared with control cheeses produced using a commercial rennet obtained from *C. cardunculus*. While no statistically significant differences were observed in chemical-physical parameters, except for titratable acidity, slight variations in the loads of presumptive lactococci, coliforms, and eumycetes between experimental and control samples were revealed. The metataxonomic analysis showed no significant differences in microbiota and mycobiota composition. Among VOCs, acids, ketones, esters, and alcohols were the primary components in all samples, with differences noted in specific compounds such as butanoic acid, ethanol, 3-hydroxybutan-2-one, and isobutyl acetate. The comprehensive results obtained demonstrate the suitability of *O. platylepis* as a novel source of vegetable rennet to produce Mediterranean ovine cheeses.

Evaluation of the Effect of Sweeteners on Bacterial Quorum Sensing: Implications for Gut Microbiome Dynamics

Author Information

M.I. Watawana[1], E.M.F. Lima[2], B.X.V. Quecan[2], U.M. Pinto[2], A. Schmalenberger1, D. Granato1 and F.A.H. Sarda[1]

[1]Department of Biological Sciences, Faculty of Science and Engineering, University of Limerick, Limerick, Ireland.
[2]Department of Food and Experimental Nutrition, USP Faculty of Pharmaceutical Sciences, University of São Paulo, São Paulo, Brazil.

Abstract

Quorum sensing (QS) is a pivotal communication mechanism employed by various microorganisms, enabling them to coordinate collective behaviours in response to changes in population density. Emerging evidence suggests that certain food substances possess the potential to disrupt QS and thereby affect the stability of the gut microbiome. Natural Sweeteners are generally considered safe, but available reliable scientific data remains limited. This study aimed to assess the effect of three selected natural sweeteners, Allulose, Tagatose, and Rebaudioside-A (Reb-A), on model bacteria's QS pathways, *Chromobacterium violaceum* and *Pseudomonas aeruginosa*. Violacein production by *Chromobacterium violaceum* ATCC12472 and Swarming and Swimming Motility by *P.aeruginosa* PAO1 were used for evaluation of the effect of sweeteners on bacterial QS. Test concentrations were established, considering each sweetener's daily maximum allowable dosage and the maximum and minimum gut volumes. The results demonstrated that Allulose inhibited the violacein notably at 56 and 113 mg/ml concentrations, while Tagatose partially inhibited production at 32 mg/ml. In contrast, Reb-A did not exhibit any inhibitory effects on violacein production in this model organism. Swarming motility assays demonstrated that Allulose, Tagatose and Reb-A did not significantly affect QS. Swimming motility tests are negative for the lower concentrations tested of the 3 sweeteners, but higher concentrations have shown to impair partial inhibition. The results of this experiment highlight the potential impact of sweeteners on microbial behaviour through quorum sensing modulation and thereby may have unintended consequences on microbial communities in the gut.

Antioxidant capacity of β-glucan from mushrooms using ultrasound-assisted extraction

Author Information

Barbara Biduski[1], Mélanie Huet[2], Xianglu Zhu[1], Mariana Macas[1,3,] Brijesh Tiwari[1] and Eimear Gallagher[1]

[1]Teagasc, Food Research Centre, Ashtown, Dublin, Ireland
[2]Université de la Réunion, Reunion Island, France.
[3]Department of Food and Nutritional Sciences, University College Cork

Abstract

The selection of β-glucan extraction methods can be a challenge, considering that the procedure significantly influences the molecular weight and, consequently, its functional behaviour. Conventional extraction uses hot water for a long period resulting in low yield and time-consuming processes that require high amounts of energy, both heating and stirring. Innovative technologies such as ultrasound-assisted extraction (UAE) are increasingly applied for green extraction. This study aims to assess the impact of ultrasound-assisted extraction on the antioxidant capacity of β-glucan from Irish mushrooms. Freshly harvested white mushroom by-products were manually washed with tap water, sliced (2 mm thick) and dried at 50 ℃ for 24. The resulting powder was dispersed in distilled water (1:20 ratio, w/v) and subjected to ultrasound (1000 W) for 10 min. Following filtration with muslin cloth and centrifuged at 10,000g for 20 min, the supernatant was nanofiltered using a 10 kDa membrane. The total phenolic compounds (TPC) was assessed by Folin-Ciocalteu method and the antioxidant capacity by DPPH and FRAP assays. There was an increase in the antioxidant capacity between the mushroom powder and the extracted samples. A reduction in the FRAP assay was observed with UAE. However, no significant difference was noted between conventional and UAE methods for both DPPH and TPC. The application of novel, eco-friendly technologies such as ultrasound demonstrated a significant reduction in extraction time from 16 hours to a mere 10 minutes, without compromising the functionality of β-glucan extracts. This study underscores the potential of ultrasound-assisted extraction as an efficient and sustainable approach for enhancing the extraction process of β-glucan with improved functional properties.

What Does it take for Novel Food Authorisation in the European Union? Insights from Risk Assessment to Market Authorisation

Author Information

Manful M E[1,2], Ahmed L[1,2], Barry-Ryan C[1,2]

[1]School of Food Science and Environmental Health, Technological University Dublin - City Campus, Dublin 7, Ireland.
[2]Environmental Sustainability and Health Institute, Technological University Dublin - City Campus, Dublin 7, Ireland.

Abstract

Novel foods are foods that have not been consumed to a significant degree by humans in the European Union (EU) prior to 15th May 1997 and require market authorisation before they are commercialised. The growing demand for natural, functional, innovative, and more sustainable foods has led to the rise of innovative and alternative feedstocks and products derived through unconventional sources, novel processing technologies, and traditional foods from third countries, aiming to address current consumer needs. The study presents insights from the case study of novel foods derived from side streams in the corn and olive processing industries in the form of Xylo-oligosaccharides (XOS). XOS is a functional ingredient whose prebiotic, gut modulation, and antioxidant properties have been documented. The market approval procedures for the novel food authorised corn by-product XOS are reviewed, and the implications for the authorisation of olive by-product XOS are assessed. Various legislative documents published by the European Commission were consulted, including European Food Safety Authority (EFSA) scientific opinions and guidance documents for the preparation and submission of a novel food dossier. The case study found that the risk assessment procedures by EFSA played a pivotal role in the novel food authorisation process. Furthermore, detailed description of the primary production practises, postharvest handling, manufacturing, through to the consumer table, compositional properties, hazard identification and characterisation, proposed uses, nutrition, and toxicology are foundational to the risk assessment and the subsequent novel food status. The study provides insights into the regulatory landscape of novel foods in the European Union and highlights the importance of scientific evaluation and regulatory compliance in bringing innovative and novel foods to the market.

Impact of porcine red blood cells (RBC) feeding on the proximate composition of yellow mealworm (*Tenebrio molitor*) and house cricket *(Acheta domesticus*)

Author information

Eduarda M. Cabral[1], Carlos Alvarez[1], and Tiffany Lau[2]

[1] Teagasc Ashtown Food Research Centre, Department of Food Quality and Sensory Science, Dublin, Ireland

[2] IBERS, Aberystwyth University, Aberystwyth, United Kingdom

Abstract

The need for alternative protein sources that requires less use of natural resources is growing in today's society due to rising population levels and sustainability issues worldwide. Insects have proven to be able to convert low-nutrient biomass into nutrient-rich body mass, making them nutritionally interesting for applications such as food, feed and technical applications. The aim of this study was to provide more insight on the potential of valorising a meat co-product (RBC) as feed ingredient for the rearing of yellow mealworm (*Tenebrio molitor*) and house cricket (*Acheta domesticus*), and its impact on the final biomass composition. Different levels of RBC inclusion from porcine blood (CTRL, 5%, 10%, 15% and 20% w/w) were used as feed source. Main results showed that when feeding mealworms with increased concentration of RBC (higher protein intake) higher content of dry mass was observed, being this value of 26% (dry basis) for control diets and 34% for the diets containing 20% of red cells as feeding, no impact was observed for crickets. When describing the impact on the fat content of mealworms and crickets different patterns were identified. For crickets, no differences were observed in fat content, regardless the amount of red cell included in the diet. Mealworms fed with increasing concentration of RBC had increasing amounts of fat on their body composition (dry weight), moving from 13% using a control diet up to 22% when adding 20% of red cells to the substrate. No significant differences regarding the amino acid composition in mealworms was observed, however, there is a very strong correlation between the amounts of protein provided in the diet and the amount of total amino acids found in the dry mass for both species. Finally, increasing RBC content in the diet led to an increment in the iron content in both species.

Study of the Polyphenol Retention in Distilled Gin Spent Botanicals, its Antioxidant Capacity, and Economic Importance

Author Information

Ekene Umego and Catherine Barry-Ryan

School of Food Science and Environmental Health and Environmental Sustainability and Health Institute, City Campus, Technological University Dublin, Grangegorman, Dublin 7, Dublin, Ireland.

Abstract

Polyphenols are chemical compounds found naturally in plants with reported bioactivities ranging from antioxidant and anti-inflammatory properties. Gin distillation involves steeping of botanicals mix in grain neutral spirit (GNS) for flavour extraction and development. Distilled gin spent botanicals is the by-product from the process. Fresh gin botanicals mix (FGBM) and DGSB were studied to understand the intensity of the gin distillation process and evaluate the polyphenol retention rate of DGSB and its economic importance. Samples of FGBM and DGSB were collected from an Irish gin distillery. The samples were prepared for polyphenol extraction and evaluation using optimised parameters from a previous study and standard assay methods, respectively. The economic importance of DGSB was studied using data and information obtained from different industry reports and market research tools. Results from the study showed that the DGSB samples retained at least 45% of their polyphenol content and antioxidant activity post distillation. The market research study showed that the market for polyphenol and its products was valued at USD 1.68 billion in 2022 with an estimated CAGR of 7.4% per annum. Notable trends such as dietary trends, product launches, functional foods initiatives, clean labels, cosmetics, and research and development were found to be the key drivers of the market. The study also showed that the market may be hampered by limited supply of raw materials. Natural and potent polyphenol sources are in demand and based on the results of this study, DGSB has shown potential that it can be exploited as a valuable polyphenol source.

A new food application of Irish-grown peas: Milling, dough rheology, bread profiling and NIR spectroscopy

Author Information

Mariana Macas[1,2], Alessandro Ferragina[1], Barbara Biduski[1], Karen Hussey[1], Elke K. Arendt[2] and Eimear Gallagher[1]

[1]Food Quality and Sensory Science Department, Teagasc Food Research Centre, Ashtown, Dublin 15.
[2]Department of Food and Nutritional Sciences, University College Cork.

Abstract

Peas contain valuable macronutrients, such as protein and dietary fibre. The use of locally grown peas for food innovation could benefit the environment and the local economy. However, the pea milling process and subsequent R&D activities, e.g. applying peas in baking formulations must be carefully monitored, as blending pea flour (PF) with wheat flour (WF) can interfere with the gluten network, resulting in a weakened dough structure and deterioration in bread quality. Limited information is available on the milling process to produce flours for specific food applications. This study assessed different milling technologies for Irish-grown peas, to achieve optimal pea flour for bread applications. Three mills were used to produce pea flour: roller mill (RM), hammer mill (HM) and cutting mill (CM). The PFs were assessed and were blended in a 15/85 (PF/WF) ratio. Proximate composition, starch pasting properties, dough rheology, bread profiling and NIR spectroscopy were assessed. The different milling methods yielded distinct flours, with RM exhibiting higher significant differences with regards to gel hardness and crumb hardness ($p<0.05$) in comparison to WF. The divergent performance of RM can be attributed to variations in proximate composition and particle size. The 3 PFs, compared to WF, showed a starch breakdown decrease and an increased protein weakening following mechanical work, most likely due to the high amylose content and weakening of protein matrix. Regarding bread profiling, there were no differences ($p>0.05$) among samples for wall thickness, cells area and holes number, indicating similar internal crumb structure and mouthfeel in breads. Although there are differences ($p<0.05$) in some bread colour parameters among samples, these are not evident to naked eye, thus contributing to bread acceptance. This research suggests that the hammer mill is the most effective for producing pea flour and is well-suited for applications in bread-making.

Impact of different light conditions on nitrogen, colour and amino acid profiles of cultured *Palmaria palmata* and technofunctional properties of protein rich ingredients

Author Information

Anthony Temitope Idowu[1], Miryam Amigo-Benavent[1,2] and Richard J. FitzGerald[1,2]

[1]Department of Biological Sciences, Faculty of Science and Engineering, University of Limerick, Limerick.
[2]Health Research Institute, University of Limerick, Limerick.

Abstract

The red macroalgae *Palmaria palmata* (Dulse) has been consumed for centuries and may be a good source of alternative protein. Its protein content varies between 8 to 20% on a dry weight (dw) basis depending on season, location and culture method. This study assessed the impact of different light conditions: white (1 and 2), red, blue and green, during 12-day culture on the nitrogen, protein, colour, total phenolic content (TPC) and amino acid profile of *P. palmata* biomass. Moreover, the technofunctional properties of a P. palmata protein concentrate (PPPC, 47% (w/w) protein) were investigated at pH 3.0, 5.0, 7.0 and 9.0 and were compared with whey protein concentrate (WPC, 56% (w/w) protein), as a reference protein ingredient. Culture under blue light for 12 days resulted in a significant increase ($p < 0.05$) in protein content for the *P. palmata* samples, i.e., from 15.0 (day 0) to 16.7 % (w/w) (day 12) increase. This represents an 11.2 % increase in protein content for P. palmata grown under blue light for 12 days. Electrophoretic profile showed light-related changes in protein composition following culture under different light conditions. Furthermore, culture under blue light for 12 days enhanced the essential amino acid content of *P. palmata* sample. The technofunctional (solubility, emulsification, foaming, viscosity, heat stability) properties varied as a function of pH and the protein used, PPPC or WPC.

Careful selection of lighting regime during culture may allow targeted production of sustainable high-quality proteins from *P. palmata*. The results also provide information of relevance to the technofunctional applications of the *P. palmata* protein-enriched material when considering its valorisation and sustainable utilisation as an alternative protein-rich food ingredient.

The application of plant extraction waste in horticulture: A proof-of-concept zero-waste research study

Author Information

Sridevi Bindiganavile Ranganath[1,2], Tao Zhang[1,2], Christine O'Connor[1,2]

[1]School of Food Science and Environmental Health, Technological University Dublin, Grangegorman, Dublin 7, Ireland.
[2]Environmental Sustainability and Health Institute, Technological University Dublin, Dublin 7, Ireland

Abstract

Circular economy, a system aimed at reducing waste and environmental burden while regenerating nature, is very important in a sustainable approach towards research. The waste products of core studies in research labs can be utilised for horticultural benefits, provided there is no involvement of hazardous chemical and biological substances. The aim of this study was to achieve a zero-waste design utilising the waste generated from the mainstream project to fuel smaller studies that could prove beneficial to the society and the environment. Plant extractions were performed on *Curcuma longa, Triticum aestivum* and *Phyllanthus niruri* using water, ethanol and a combination of cellulose-pectinase enzymes, for further chemical and biological analyses. The waste from the extracted plants was dried and tested for horticultural benefits, using ISTA-approved blotter seed test and soil germination test. Alfalfa, barley, rocket and wheat seeds, soaked overnight in respective samples, were examined using the Blotter method while barley and basil were analysed further using the soil germination method. On an average, 60% of barley seeds soaked in water-extract waste of the three plants sprouted to produce leaves in 15 days. It was observed that 95.53% of the barley seeds sowed in soil mixed with *Curcuma longa* waste germinated compared to the 73.33% germination of seeds growing in soil alone. Basil seeds growing in soil mixed with *Curcuma longa* plant waste exhibited faster and abundant growth compared to the other plant wastes and a commercial fertiliser. It is evident that these plant extraction wastes produced after Green chemical extraction act as natural fertilisers which result in enhanced crop growth, increase the overall health of the soil causing no significant damage to the soil microbiota. The large-scale application of these wastes, after industrial extraction of the plants, could potentially prevent tonnes of chemical fertilisers from entering the food chain at source.

An integrative model of multiple quality responses to assess the effect of different food packaging solutions for kale, spinach, mushroom, and strawberry on food waste production.

Author information

Francesco Saverio Giordano[1], Andrew Reynolds[1], Rukmini Brahmachari[1], Lorraine Folley[1], Kaye Burgess[2], Jesus Frias Celayeta[1]

[1] Environmental Sustainability and Health Institute, Technological University Dublin, Ireland.
[2] Teagasc Ashtown Food Research Centre, Dublin, Ireland.

Abstract

The transition from traditional food packaging for horticultural products to more sustainable solutions is a challenging task to accomplish.

This research proposes to employ mathematical modelling to assess how changes in packaging material affect multiple quality criteria in horticultural products. The model considered the influence of the respiration rate on the quality parameters using a relative respiration rate effect, and relative first-order rates of quality degradation. The assessment of those criteria influences how much of this product will end up as waste.

The model was built using data from agricultural experiments on spinach, kale, strawberries, and mushrooms, followed by simulation of the distribution and retail storage conditions of the horticultural products. Kale and spinach were packaged in polypropylene (OPP) and polylactic acid (PLA) MAP films. Strawberries and mushrooms were packaged in polyethylene terephthalate (PET) packaging and stored both in non-MAP and MAP conditions. The model parameters were estimated using nonlinear mixed effect model regression, allowing for random variation in the production batch.

The food waste production was assessed with the use of food technology thresholds of the product's critical properties under uncertainty. The sub-population of response forecast outside the critical thresholds would represent the out-of-specification product (i.e. waste).

In kale and spinach, the PLA packaging, affected by non-optimal water permeability, delivered a higher weight loss associated with food waste production. For strawberries and mushrooms, transition to PET proved to be feasible, delivering results in line with market packaging.

These results suggest that the benefits of a transition to different packaging material in food products could be nullified by the increasing of food waste production, and the use of mathematical modelling to estimate the effect of different solutions can serve as an instrument to assist the decision process for package migration.

Exploring the efficacy of food waste as a potential source of antibacterial agents and antibiotic adjuvants against MRSA and MSSA isolates

Author information

James Blee [1], Thomas J. Smyth [1] and Owen Kenny [1].

[1] Department of Health & Nutritional Sciences, Atlantic Technological University, Sligo Campus, Sligo, Ireland.

Abstract

The accelerated emergence of antimicrobial resistance (AMR) has surpassed that of antibiotic development, consequently limiting effective treatment options. *Staphylococcus aureus* is a leading cause of nosocomial and community acquired infections, with up to 50% of isolates exhibiting methicillin resistance. Methicillin-resistant *Staphylococcus aureus* (MRSA) infection is associated with longer hospital stays, increased healthcare costs and higher mortality rates, with over fifty thousand MRSA associated deaths reported in the WHO European region for 2019. Indicative of this, is resistance to first-line beta-lactam therapy, which necessitates the development of novel antimicrobial compounds. In this study, the antibacterial properties of solid-liquid crude extracts, derived from thirteen fruit and vegetable waste streams, were investigated against MRSA and MSSA isolates, using a broth microdilution assay. Of the 65 crude extracts tested, 11 were shown to have activity against both strains at minimum inhibitory concentrations (MICs) ≤ 1 mg/ mL. Ethyl acetate crude extracts from onion skins (0.4 mg/ mL), kiwi skins (0.8 mg/ mL) and broccoli stalks (0.8 mg/ mL) and pineapple skins (1 mg/ mL) demonstrated the greatest antibacterial activity. Furthermore, extracts were also evaluated for their efficacy as antibiotic adjuvants in conjunction with several beta-lactam antibiotics. The strongest antibacterial effect was shown from the combination of the onion skin ethyl acetate extract with ampicillin, which resulted in an eight-fold reduction of its MIC (31.25 µg/ mL) and a Fractional Inhibitory Concentration Index (FICI) of 0.375, thus definable as synergistic. Total phenolic content analysis of the onion skin ethyl acetate extract (1.2 mg GAE/ mg DW sample) suggest that these compounds may play a key role in its overall efficacy against MRSA and MSSA. Overall, the results of this study demonstrate the potential of food waste valorisation as a viable strategy for combatting the rise of AMR.

Combination Effects on the Longevity Improvements of Agaricus bisporus using Silicon Bio-stimulants and Sustainable Packaging Alternatives

Author Information

Andrew Reynolds[1], Francesco Giordano[1], Rukmini Brahmachari[1], José Galán[1], Lorraine Foley[2], Orla O'Halloran[3], Michael Gaffney[3], Shivani Pathania[4], Tigist Shonte[4], Mehraj Fatema[4] & Jesus Frias[1]

[1]Environmental Sustainability and Health Institute (ESHI), Grangegorman Campus, TUDublin, Dublin 7, Ireland
[2]Dept. of Horticulture, Technological University Dublin, Blanchardstown Campus, Blanchardstown, Dublin 15, Ireland
[3]Entomology & Horticulture, Teagasc, Ashtown, Dublin 15, Ireland
[4]Food Packaging, Food Research Centre, Teagasc, Ashtown, Dublin 15, Ireland

Abstract

Crops are reliant upon the use of fertilisers and pesticides to improve their yield and longevity, while these chemicals often have numerous adverse effects to the environment around them. The research conducted by our team attempted using a potential alternative agricultural bio-stimulant supplementation of mono-silicic acid and combined with novel packaging designs to discern potential impact on the post-harvest longevity on Agaricus bisporus (White mushrooms). Fresh A. bisporus were grown and packaged within Teagasc Ashtown utilising controlled growing conditions with treatments of water containing 0.5% silicic acid (Actisil) or left as control samples (standard watering). Samples were then packaged in three varieties of packaging, either standard polypropylene (PP) punnets with Polyvinylchloride (PVC) wrap, PP punnets with a Biaxially Oriented Polypropylene (BOPP) bag for better recyclable alternative packaging material, or a biodegradable Berigard punnet in compostable Polylactic-acid (PLA) plastic sealed bag for reduced environmental impact. Samples would then be shipped to ESHI and stored under retail conditions (4±1 °C, 80% RH), before undergoing a 14-day test battery at 5 interval periods across three "flushes". A variety of standard post-harvest shelf-life experiments including weight and density change, internal atmosphere change, colour change and electrolyte leakage were used to discern any mushroom longevity alterations from silicon treatments or the novel packaging.

Fatty acids analysis for verifying the production system of commercially sourced Irish grass-fed beef.

Author Information

Sherif Shaheen[1,2,3], Aidan P. Moloney[3], Raquel Cama-Moncunill[1], Simona Grasso[1], Peter G. Dunne[1] and Frank J. Monahan[1]

[1]UCD School of Agriculture and Food Science, University College Dublin, Belfield, Dublin 4, Ireland.
[2]Food Quality and Sensory Science Department, Teagasc Food Research Centre, Ashtown, Dublin 15, Ireland.
[3]Animal and Bioscience Research Department, Teagasc Animal and Grassland Research and Innovation Centre, Grange, Dunsany, County Meath, Ireland.

Abstract

Grass-based beef production systems have been regarded as more environmentally and animal welfare-friendly compared to other mainstream systems. There is increased focus on beef origin highlighting the need for reliable and robust methods to verify the provenance of beef and ensure product label claims are genuine. In this study, we investigated the potential of fatty acids of intra-muscular fat, using gas chromatography, to authenticate beef provenance. Irish commercial beef samples (n = 320) from grass (G), grass-concentrate (GC), silage-concentrate (SC), and concentrate-fed (C) production systems (80 samples per treatment), where diets were self-declared by farmers, were compared using a one-way ANOVA followed by a Tukey's multiple comparison test. Production system had a significant effect on C15:0, C18:3*n*6*c*, C20:2*n*6*c*11,14, C20:3*n*3*c*11,14,17, C22:5*n*3*c*7,10,13,16,19 (all $P < 0.05$), C18:2*n*6*c* ($P < 0.01$), and C18:3*n*3, C18:2*c*9*t*11, C18:2*t*10*c*12 and C22:2*n*6*c*,13,16 (all $P < 0.001$). For C18:2*n*6 and C18:3*n*3, respectively, G was significantly lower ($P < 0.05$) and higher ($P < 0.05$) than C but not different from GC or SC. For both C18:2*c*9*t*11 and C18:2*t*10*c*12 isomers, G was significantly higher ($P < 0.05$) than C and SC, but not different from GC. For both total *n*6 PUFA and *n*3 PUFA, G was significantly ($P < 0.05$) higher than C but not different from GC or SC. For the *n*6:*n*3 ratio G (1.97) was significantly ($P < 0.05$) lower than C (3.93) but not different from GC (2.05) or SC (2.26). Overall, the results suggest that the lipid profile of beef can be used to clearly distinguish self-declared extremes (G and C) of commercial beef, but are more equivocal when forage inclusion, in particular grass, is a feature of commercial diets.

EFSA Focal Point: connecting Ireland with the European Food Safety Authority

Author Information

Gráinne Redmond[1] and Wayne Anderson[1]

[1]Food Safety Authority of Ireland

Abstract

Established in 2008, the Focal Point network acts as an interface between the European Food Safety Authority (EFSA) and national food safety authorities, research institutes and other stakeholders in all 27 EU Member States, Iceland, and Norway, as well as observers from Switzerland and pre-accession countries. The Food Safety Authority of Ireland is the EFSA Focal Point for Ireland. The main areas of activity of the Focal Point include knowledge exchange; collaboration and partnerships; capacity building; data and risk communication. The Focal Point offers a range of supports to national stakeholders to enable them to collaborate and participate with EFSA and organisations in other Member States. These include support and information on EFSA grants, partnership searches, training courses, fellowship programmes, career opportunities and available publishing tools. EFSAs remit covers food and feed safety, nutrition, animal health and welfare, plant protection and plant health and each year they launch Calls for Proposals (Grants) and Calls for Tender for projects/activities in these areas. EFSAs Grant and Procurement budget has increased significantly in recent years and is expected to stabilise at approximately €35 million per annum. Opportunity exists for Irish organisations to avail of this funding which will lead to increased collaboration and will contribute to building a common EU culture for Risk Assessment. Only organisations on EFSAs List of Competent Organisations (also known as Article 36 List) are eligible to receive grants. Organisations are considered competent organisations if they are active in fields within EFSA's mission; and fulfil a set of eligibility criteria, ensuring for example independence and scientific expertise. If you would like further information on how to become an Article 36 organisation, please contact focalpoint@fsai.ie.

Antibacterial properties of macroalgae against community and clinical acquired MRSA strains

Author Information

Peter O'Hara [1], James Blee [1], Thomas J. Smyth [1], Owen Kenny [1].

[1]Atlantic Technological University Sligo. Department of Health and Nutritional Science.

Abstract

Although antimicrobial resistance (AMR) is inevitable, the overuse and often misuse of antibiotics has further accelerated the issue. Consequently, the CDC has labelled AMR as an urgent public health threat, associated with prolonged hospital admissions, increased healthcare costs and, in some cases, even death. In particular, methicillin resistant *S. aureus* (MRSA) is of serious global concern and was attributable to over 100,000 deaths in 2019. The issue is further exasperated by dwindling reserves of effective antibiotics, leading to an increased onus on the research community to explore alternative sources of novel antibiotics and/ or effective treatments. In this study, the antibacterial properties of solid-liquid crude extracts, derived from thirteen seaweed species, were investigated against six community and seven hospital acquired MRSA isolates, using a broth microdilution assay. Of the 65 crude extracts tested, 22 were shown to have widespread activity at minimum inhibitory concentrations (MICs) ≤ 1mg/ml, with the strongest activities (MICs = 1000 – 31.25 µg / mL) reported in non-polar crude extracts compared to polar extracts. Overall, hexane extracts from Rhodophyta and Phaeophyceae genera seaweeds demonstrated greater activity (500 – 31.25 µg / mL) compared to the Chlorophyta genus seaweeds, respectively. In particular hexane extracts of *Alaria esculenta* (Phaeophyceae) and *Asparagopsis armata* (Rhodophyta) displayed the strongest antibacterial activity against all isolates (125 – 31.25 µg / mL). GC-MS analysis of these hexane extracts showed high concentrations of hexadecanoic acid (C16:0) and bromoform, suggesting that these compounds may be responsible for the demonstrated activity, though further bioactivity guided fractionation of these extracts to isolate the compound(s) of interest is still required. Nevertheless, the results of this study highlight the antibacterial potential of macroalgae, which may further support future industrial applications for this underutilised natural resource.

A Digital Technology-Based Framework For Preventing Fraud in Agri-Food Supply Chains

Author Information

Wang Zhijun[1], Nikolaos Panayiotou[2], Sotiris Gayialis[2], Evripidis Kechagias[2], Spyridon Evangelatos[3], Apostolos Apostolaras[4], Dimitrios Argyropoulos[1]

[1]School of Biosystems and Food Engineering, University College Dublin, Dublin, Ireland
[2]Industrial Engineering Lab, School of Mechanical Engineering, National Technical University of Athens, Athens, Greece
[3]Research & Innovation Development, Netcompany-Intrasoft S.A., Luxembourg, Luxembourg
[4] Electrical & Computer Engineering, University of Thessaly, Volos, Greece

Abstract

Food fraud poses significant risks to the integrity and safety of the agri-food supply chains, necessitating the adoption of digital technologies and systems for prevention. This paper aims to provide valuable insights for industry stakeholders, researchers, and policymakers striving to enhance the integrity and safety of the global food supply chain. This paper offers a comprehensive framework, part of an ongoing EU project (Watson), which integrates various digital technological solutions and can effectively be applied in multiple food chains to prevent fraud. The beginning of this paper is dedicated to giving an overview of the current state of food fraud prevention systems, especially the existing approaches and limitations. Then, the Watson project's primary objectives, key pillars, and emerging technologies are introduced. The main content of this paper is to analyse the framework's technological solutions, highlighting their interconnectedness and role in ensuring food products' traceability, authenticity, and safety throughout the supply chain. Multiple digital technologies and platforms, such as portable DNA-based devices, multi-sensor scanning devices, the IoT platform, the blockchain platform, mobile Apps, and the digital passport, will be involved at different supply chain stages to prevent food fraud. In addition, an early warning system based on robust and explainable AI will also be established in this food fraud prevention framework. The following steps are implementing the framework, emphasising the need to enhance fraud prevention systems further and validating the solutions in specific agri-food chains. This research also contributes to raising consumer awareness regarding food safety and value, ultimately leading to adopting healthier lifestyles and developing sustainable food ecosystems. By addressing the current condition in the food supply chain and continuously improving the presented framework, the integrity, authenticity, and safety of the global food supply chain can be collectively enhanced, ultimately protecting consumers and fostering trust in the food industry.

Optimization of High Capacity Sorptive Extraction Thermal Desorption for the Volatile Profiling of Raw and Cooked beef by Gas Chromatography Mass Spectrometry

Author Information

Fathi Morsli[1,2], Aidan P Moloney[2,3], David T Mannion[1], Frank J Monahan[2], Kieran N Kilcawley[1,4]

[1]Food Quality and Sensory Science, Teagasc Food Research Centre, Moorepark, Fermoy, Co. Cork
[2]School of Agriculture and Food Science, University College Dublin, Belfield, Dublin 4
[3]Teagasc Animal and Grassland Research and Innovation Centre, Grange, Dunsany, Co. Meath.
[4]School of Food and Nutritional Studies, University College Cork

Abstract

There is a need to substantiate quality claims of Irish beef in relation to flavour associated with a grass diet. Flavour comprises of both taste and aroma, with aroma having a much greater impact as it is perceived both ortho- and retro-nasally. The focus of this initial study was to evaluate and optimize high capacity sorptive extraction (HiSorb) thermal desorption (TD) to profile aroma compounds in raw and cooked beef by gas chromatography mass spectrometry (GCMS). Different sample preparation conditions were appraised in order to maximize the number of volatile compounds identified. The parameters investigated included a) homogenization, b) sample amount/solvent (15 % methanol) ratio, c) different phase HiSorb probes (PDMS vs PDMS/CWR/DVB), and d) the effect of cooking vs raw meat. Optimal results were achieved using 2g of emulsified beef (prepared by homogenizing equal ratios of finely chopped beef with deionized water with an Ultra Turrex dispenser for 2 min in ice) in 13 mL of 15% MeOH, and extracted by direct immersion using a PDMS HiSorb probe at 40°C for 24 hr. The probes were desorbed pre GCMS analysis using a Centri automated sample extraction platform. Identification of volatiles was undertaken by mass spectral matching from libraries created from standards in association with linear retention indices. All analysis were carried out in triplicate. More than 100 volatile compounds were identified in the raw and cooked beef. The method also highlighted significant changes to the volatile profile of beef post cooking (medium rare) with a significant reduction in the percentage volume of esters and a concomitant increase in other chemical classes such as alcohols, aldehydes, alkanes, benzenes, furans. This method provides additional information on the volatile profile of raw and cooked beef that will aid in highlighting differences in the perception of beef from grass and concentrate diets.

Kinetic study for cooking optimization of chicken breast meat in professional oven

Author Information

Romano Giulia[1], Nicoli Maria Cristina[2], Bozzato Arianna[3] and Anese Monica[2]

[1]Teagasc Food Research Centre Ashtown, D15 DY05 Dublin, Ireland
[2]Department of Agricultural, Food, Environmental and Animal Sciences, University of Udine, via Sondrio 2/A, 33100 Udine, Italy
[3]Electrolux Professional S.p.A., viale Treviso 15, 33170 Pordenone, Italy

Abstract

The expanding food service market and increasing consumer concern about wellness are driving the optimization of professional cooking devices. At present, only temperature probes are used as cooking monitoring sensors in professional ovens to test safety requirements, but their accuracy is often compromised due to the error-prone positioning. Moreover, the control of food quality evolution during a cooking process has not been addressed by companies yet, since no cooking programs or innovative sensors capable of monitoring the sensory quality of food exist. In the present study, an innovative approach has been proposed in order to develop mathematical models predicting the optimal oven cooking time for chicken breast meat, considering both sensory quality and safety requirements. Evolution of the most representative quality indices of chicken breast meat (i.e. cooking loss, colour, texture) was monitored over three different oven cooking processes at three different temperatures (grill, T=240, 260, 280 °C; forced convection, T=150, 170, 190 °C; *sous vide*, T=80, 95, 120 °C, RH=100%). The respect for the safety requirements was also assessed. Quality indices evolution were elaborated according to data kinetic modelling and activation energies (*Ea*) were computed thanks to the Arrhenius model. Predictive models based on *Ea* of the most sensitive quality index (i.e. cooking loss) of chicken breast cooking were developed and validated. Optimal cooking time was predicted as a function of cooking loss evolution and process temperature. Kinetic modelling allowed to develop a cooking prediction model based on a reliable quality indicator as an alternative to temperature monitoring. The obtained predictive model could be considered a powerful tool to be integrated inside an oven as an automatic program and by monitoring in real-time cooking loss, e.g. with a balance. The approach may open the way to innovative sensor development aimed at the cooking optimization of different foodstuffs and cooking machines.

Mathematical modelling of Sauerkraut acidification and lactic acid production through fermentation

Author Information

M. Victoria Caballero[1], Leon Maughan[2], Declan Bolton[2] and Jesus Frias[1]

[1]Environmental Sustainability and Health Institute, Technological University Dublin, Grangegorman, Dublin 7, Ireland

[2]Food Safety Department, Teagasc Food Research Centre, Ashtown, Dublin 15, Ireland.

Abstract

Sauerkraut is a fermented product made from fresh cabbage fermentation. Sauerkraut fermentation can be spontaneous, relying on a very small population of LAB which are naturally present in fresh vegetables; or carried out through starter cultures for shortening fermentation times. During this fermentation acetic and lactic acids are produced and the pH of the product drops. Fermentation is a means for preventing cabbage deterioration and extending its shelf life, since the organic acids released by LAB inhibit the growth of undesirable microorganisms. It is also considered to be healthy, since it contains, a high amounts of vitamins and minerals and high levels of glucosinolate hydrolysis products (Peñas, E. et al. 2010).

A mathematical model presented by Vereecken K. et al. (2002) to describe the cell growth and production of lactic acid in fermented food was adapted to Sauerkraut fermentation. Concentrations of undissociated lactic acid [LaH] and decreasing pH in the environment were described and simulated. In order to achieve this, parameters describing the media and the starter culture were fitted through non-linear regression based on data on LAB growth, total lactic acid produced, and pH decrease during fermentation.

Results indicate significance on the parameters describing the undissociated lactic acid on the media considering the buffer capacity of the system (α=1.0322±0.15, p<1e-10; β=0.06±0.009, p<1e-10; γ=0.056±0.006, p<2e-16). Same parameters for that indicates the relationship between pH and undissociated lactic acid during the fermentation (α_1=67.93±2.26, p<2e-16; β_1=1.19±0.14, p<2e-16; γ_1=0.002±0.001, p<2e-16). Simulations also indicate that for natural fermentation, pH drops below 5 after three days. The ability of the model to predict the pH drop and undissociated lactic acid concentration can later be use to estimate the growth and survival of potential pathogenic bacteria through secondary models.

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From olives to oil: food fraud vulnerability assessments in Greek olive oil supply chain

Abstract Information

Zhijun Wang[1], Sarah Nolan[1], Stilianos Arhondakis[2], Styliani Moraiti[2], Dimitrios Argyropoulos[1]

[1] School of Biosystems and Food Engineering, University College Dublin, Stillorgan Rd, Belfield, Dublin 4, Ireland
[2] BioCoS P.C., 73100 Chania, Crete, Greece

Abstract

Since 2021, olive oil production has decreased significantly in the main producing regions of Spain, Italy, and Greece, leading to an increase in fraud cases along the supply chain due to the high demand. The occurrence of adulterated olive oil could lead to economic losses, endanger public health and affect sustainable production and biodiversity in the long term. To prevent food fraud, it's essential to understand olive oil supply chain vulnerability and take targeted mitigation measures. This study aims to assess the vulnerability to food fraud in the Greek olive oil industry using the food fraud vulnerability assessment tool (SSAFE), a routine and quantitative approach to assessing supply chain vulnerability to food fraud. It has been previously used successfully to assess the food fraud vulnerability in different supply chains such as species, milk, and organic bananas. The assessment tool consists of 50 questions related to the fraud factors: opportunities, motivations, and control measures. Significant Greek companies were interviewed, including producers, wholesalers, and manufacturers. The current results indicate that the actors consider the olive oil supply chain as medium to highly vulnerable to fraud. Only a low percentage of all questions were classified as low vulnerability. Most factors related to the technical opportunities were rated medium-high vulnerability. More opportunities and economic motivations for fraud were identified, such as raw materials price, valuable components, the uncomplicated process of adulteration and the management of production lines. According to the vulnerable nodes, the mislabelling and substitution could be estimated as the primary fraud type. Most factors related to control measures were rated medium vulnerability (>80%). Considering the high vulnerability identified in the study, it is recommended that mitigation measures such as the traceability system, ethical code, and fraud control system should be reinforced throughout the supply chain.

Enhancing the Bioactive Fat Composition and Microbial Stability of Bovine Milk using Multispecies Swards

Author Information

S. Rapisarda[1], N. Abu-Ghannam[1]

[1]School of Food Science and Environmental Health, TU Dublin, Grangegorman, Dublin, D07ADY7, Ireland

Abstract

Although multispecies pastures have shown to lower the requirement for nitrogen fertilisers and reduce animal emissions in dairy production systems, information of their impact on the milk chemical and microbiological status is still limited. This study compares the fat composition of milk from multispecies to that from traditional grazing systems over the summer season, using Liquid-Chromatography and Gas-Chromatography-Mass-Spectrometry. Milk lipid oxidative stability and microbial growth were assessed using TBARS and plate count methods respectively, over a 7-day shelf-life period. Milk from multispecies showed the highest mean concentrations of polyunsaturated fatty acids (36.83 mg/g) in comparison to traditional systems (28.00 mg/g) ($p < 0.05$). Fatty acids analysis showed that milk from multispecies contains higher levels of health-promoting α-linolenic acid (10.97 mg/g), linoleic acid (16.46 mg/g) and vaccenic acid (7.16 mg/g). Notably, the average α-linolenic acid content exceeded the threshold levels established by the European Commission for the "high omega-3 fatty acid" claim. Milk from monoculture pastures contained the highest mean concentrations of monounsaturated fatty acids (284.68 mg/g), saturated fatty acids (783.45 mg/g), β-carotene (15.29 mg/kg) and α-tocopherols (10.18 mg/kg) when compared to multispecies (261.37 mg/g, 676.09 mg/g, 10.28 mg/kg and 8.53 mg/kg, respectively) ($p < 0.05$). The lower concentrations of polyunsaturated fatty acids and the higher levels of β-carotene and α-tocopherols found in milk from monoculture resulted in lower mean TBARS value (1.33 mg MDA/kg) in comparison to multispecies (1.66mg MDA/kg) ($p < 0.05$), suggesting that milk from monoculture pastures has somehow a lower lipid oxidation potential. Milk from multispecies exhibited lower bacterial count, *Escherichia coli* and *Listeria monocytogenes* when compared to traditional systems ($p < 0.05$). In conclusion, multispecies swards can offer milk with both an improved fatty acid profile and an enhanced microbiological safety status.

Exploring the potential suitability in Ireland for the current cultivation of high protein output crops and forecasted utilising three Shared Socioeconomic Pathways (SSPs) 245, 370 and 585.

Author Information

Talia Huffe[1,2,3], Lilian O'Sullivan[1], Paul Holloway[2,3]

[1] Crop, Environment and Land Use Programme, Teagasc, Wexford, Ireland
[2] Department of Geography, University College Cork, Cork
[3] Environmental Research Institute, University College Cork, Cork

Abstract

The challenge of feeding the burgeoning human population, while attempting to mitigate for significant climatic changes, soil degradation, carbon emissions and methane pollution, is an impending global concern. To identify areas where optimal conditions for cultivating high quality, human grade, protein plants could be grown on a worldwide scale, we used species distribution modelling (SDM). We combined climate, elevation, slope and aspect variables alongside the dominant FAO soil types to project the global suitability of four plant species, (*Lupinus angustifolius* LA – lupins, *Lolium perenne* LP – perennial ryegrass, *Pisum sativum* PS – dun pea, and *Vicia faba* VF – faba bean). The results were extrapolated across three future shared socioeconomic pathways (SSP) 245, 370 and 585 and across two timescales, 2041-2060 and 2061-2080. Three-fold cross validation was performed, with the resulting high accuracy AUC results of LA 0.911, LP 0.753, PS 0.940 and VF 0.830 respectively. Percentage contribution, permutation importance and spatial jack-knifing were calculated for each species to test the variables in-model importance. The original presence dataset was parameterised on a global basis, with the results refined to an Irish scale. Each SSP forecasts a different climatic environment, and our results showed that each of the four species are highly sensitive to the conditions forecasted, showing diversification across SSPs, but also within SSPs across timescales. The species least suitable for Irish conditions, across all parameters was PS, the dun pea, while the most stable across all conditions and parameters was LP, perennial ryegrass. Global suitability was also reflected within Ireland, with LP the most suitable, followed by VF, LA and finally PS. These results can be used to inform agronomists, seed merchants and production partners preliminarily to avoid funding an unsuitable species, and in the long term to begin planning for the shift towards plant based, high protein isolates and flours, and their resulting secondary products.

Evaluating the microbial quality of roof-harvested rainwater as a sustainable irrigation alternative

Author Information

Michael Arthur[1, 2], Elena-Alexandra Alexa[1], Amy McKenna[3], Michael Gaffney[3], Jesus Maria Celayeta Frias[4], Catherine M. Burgess[1]

[1] Food Safety Department, Teagasc Food Research Centre, Ashtown, Dublin
[2] Department of Food Science and Environmental Health, Technological University Dublin, Ireland
[3] Horticulture Development Department, Teagasc Food Research Centre, Ashtown, Dublin
[4] Environmental Sustainability and Health Institute, Technological University Dublin, Ireland

Abstract

Seasonal droughts and alterations in weather patterns caused by climate change have become a serious threat to water availability; hence, the use of alternative water sources such as rainwater harvesting has gained considerable attention in recent years. Despite the advantages of harvested rainwater, it is at risk of microbial contaminations arising from a range of sources including faecal matter from birds, rodents, insects and animals on roofs which can be washed into rainwater collection and storage tanks. The objective of this study was to investigate the microbial quality of roof-harvested rainwater from different roof types sampled from selected rural and urban sites in the east coast of Ireland. Over a six week period (August – September 2023), 42 rainwater samples, collected from 7 different sites were assessed for the presence of indicator bacteria: total viable counts (TVC), *Escherichia coli* and enterococci using standard culture based methods. Results indicated that 100%, 90% and 90% of the rainwater samples were positive for TVC, *E. coli* and enterococci respectively. The mean concentrations were 5.3±1.1 $\log_{10}$ CFU/mL, 1.3±0.7 $\log_{10}$ CFU/mL and 1.7±0.7 $\log_{10}$ CFU/100mL respectively for TVC, *E. coli* and enterococci. Variations in the concentrations of these bacteria across the sampling weeks were observed for all sites. The detection of these bacteria in the harvested rainwater highlights the need for treatment before any potable or irrigation use since it may pose a significant risk to consumers if used untreated.

The potential of Edible Insects as a Palatable, Safe and Sustainable Food Source.

Author Information

Ann Conway [1,2], Swarna Jaiswal[1,2] and Amit Jaiswal[1,2]

[1]School of Food Science and Environmental Health, Faculty of Sciences and Health, Technological University Dublin – City Campus, Grangegorman, Dublin D07ADY7, Ireland.
[2]Environmental Sustainability and Health Institute, Technological University Dublin – City Campus, Grangegorman, Dublin D07 H6K8, Ireland.

Abstract

Entomophagy describes the practice of consuming insects. Insects are considered to be extremely nutritious in many countries as they are a rich source of protein, fats, minerals and vitamins. However, there is a lethargic uptake of entomophagy within Europe where consuming insects and insect-based foodstuff is often regarded with disgust. Such perceptions and concerns are often due to a lack of exposure to and availability of food-grade insects as a food source, and such behaviour is often driven by neophobia and cultural norms.

More recently, due to accelerating climate change, an urgency to develop alternate safe and sustainable food-sources has emerged. There are currently approximately 1,900 species of insects approved by the "World Health Organization" as safe to eat and suitable for human consumption. However, within Europe under the Novel Food Regulation EU 2015/2283 only five species are permitted as a food source suitable for human consumption. Current species approved under the Novel Food Regulation (EU) 2015/2283 are *Alphitobius diapernius* (Lesser mealworm), *Tenebrio molitor* (Yellow mealworm), *Acheta domesticus* (House cricket), *Gryllodes sigillatus* (Tropical house cricket) and *Locusta migratoria migratorioides* (Migratory locust). Furthermore, it must be noted that the afore mentioned insect species are suitable for upscaled intensive rearing as they currently exhibit a low carbon footprint during the rearing cycle due to low greenhouse gas emissions, low ammonia emissions and low water consumption. Species can also be reared on organic waste which could potentially contribute to the advancement of a sustainable circular economy.

‘Raising the Pulse’: systems analysis of the environmental, nutritional and health benefits of pulse-enhanced foods.

Author Information

Donal M O’Sullivan[1] on behalf of the ‘Raising the Pulse’ consortium

[1]School of Agriculture, Policy and Development, University of Reading, Reading, UK

Abstract

Raising the Pulse[1] is a £2m project that takes a systems approach to making healthier and more environmentally sustainable pulse-inclusive diets available to a much wider cross-section of the UK population. It will use part-substitution of wheat flour in white sliced bread with homegrown faba bean flour as an exemplar product to demonstrate how barriers to pulse adoption can be overcome.

The project is funded from 2022-25 and highlights so far include:

- Significant variety-dependent differences in nutrient density and land requirement demonstrated that variety selection could make a critical difference to the potential health and environmental impacts associated with faba bean-derived food products.
- A scalable method for milling of faba beans into baking flour was established, and major differences in nutrient density of different milling streams was demonstrated indicating that protein and iron contents can vary several-fold depending on the specific variety x milling stream combination.
- Cross-sectional analysis of UK National Diet and Nutrition Survey data showed that existing UK pulse-inclusive diets are associated with higher energy, fibre, key vitamins and micronutrients, and lower total and saturated fat and sugars.
- A systematic review of consumer behaviour towards pulses shows health and environmental considerations are strong drivers of attitudes and that acceptance levels vary significantly by demographic and lifestyle.
- All components of the bread-related food production system from ‘farm to folk’ have been mapped in preparation for completion of a predictive, system-wide model.

In the near future, we will produce faba-enhanced bread for an acute human nutrient bioavailability study and a Student Halls of Residence intervention study where we can glean further insights about the baking and sensory performance of compositionally differentiated flours in breadmaking, data on how consumption of faba-enhanced breads impact satiety, glycaemic index, iron bioavailability and consumer preferences towards faba-enhanced breads.

[1] https://research.reading.ac.uk/raising-the-pulse/

An empirical analysis on smallholder diets in Ethiopia: examining the joint interplay between farm production diversity and market access

Author Information

Tsegay Balcha[1], Edward Lahiff[1], Nick Chisholm[1], & Trevor Donnellan[2]

[1]University College Cork (UCC), Ireland
[2]Agricultural Economic and Farm Survey Department, Teagasc, Athenry, Ireland

Abstract

Despite mixed findings on the influence of farm production diversity and market access, empirical investigation into their joint interplay on household dietary diversity is limited. This study addresses this gap using cross-sectional data from 396 smallholder households in rural Tigray, Ethiopia. A combination of robust descriptive statistics and Poisson regression model is used for the analysis. We introduce a novel measure of market access, rigorously tested for its stability, and compared against alternative measures. Our findings reveal a temporal aspect in the farm production diversity and market access relationship, highlighting an optimal point for increased dietary diversity. Remoteness exhibits a more pronounced negative influence on farm production diversity compared to its impact on households' frequency of food market visits. Farm production diversity is found significantly higher in households closer to markets than those in remote areas. Fresh food market visits emerge as contributors to diverse diets, and market day diets are more diverse than non-market days. The findings also suggest that market access not only complements but enhances farm production diversity. There is a joint positive and significant temporal relationship between farm production diversity and market access, highlighting an optimal point for increased household dietary diversity. The paper also finds that independently, farm production diversity and market access have temporal positive and significant contributions to rural smallholder household dietary diversity. We advocate for future research to focus on developing robust methods, emphasizing the underutilized potential of combining qualitative and advanced non-linear quantitative approaches for a conclusive understanding of the challenge.

Recovery of Humic Substances from Digestate Using Advanced Technologies for Sustainable Agriculture Production

Author Information

Shon George Shiju[a,b*], Patrick Quille[a,b], Eilish Broderick[a], Brijesh K Tiwari[c] and Gaurav Rajauria[d]

[a] Department of Biological and Pharmaceutical Sciences, Munster Technological University, Tralee, Ireland

[b] Plant Biostimulant Group, Shannon Applied Biotechnology Centre, Munster Technological University, Tralee, Ireland

[c] Department of Food Chemistry & Technology, Teagasc Food Research Centre, Ashtown, Dublin, Ireland

[d] School of Microbiology, School of Food and Nutritional Sciences, University College Cork, Cork, Ireland

Abstract

The rise of anaerobic digestion (AD) as a sustainable solution for organic waste management and renewable energy production has been recognised by the European Union, and world alike, for its environmental potential, and circular economic principles. This shift to AD technology brings an increased amount of digestate which is currently being sprayed on agriculture lands. Land spreading of digestate is complicated by several factors, including residual methane emissions, logistical inefficiency, limited landbank, heavy metal, and high pathogen load dispersion. Direct waste-to-energy implementation would undermine the rich carbonaceous material of its fertilising potential, especially in the case of source segregated digestates. This work explores the potential for using various urban biowaste and anaerobic digestate as a feedstock for humic based biostimulant recovery and its application in horticulture. Temporal changes in digestate composition are being investigated, to study the feasibility of using these as substrates for recovery of humic substances. Convention methods together with novel green extraction technologies (including ultrasound and microwave) were explored and optimised for higher yields and improved extraction efficiency. Biostimulation properties of humic substances were tested on Arabidopsis plant models for enhanced seed germination and improved root development. As sustainable agriculture gains precedence, humic substances stand out as valuable biostimulants that not only enhance crop productivity but also contribute to soil health and resilience. By exploring the use of AD digestate for humic biostimulant production and its subsequent application in agri-systems, this research contributes to ‘zero-waste’ solutions, via sustainable biorefining.

Quantitative microbial risk assessment modular framework for waste-pathogen combinations from land-spreading in Ireland

Author Information

Jennifer McCarthy[1,2], Jesus M. Frias[2], Paul Hynds[2], Declan Bolton[3]

[1]School of Food Science and Environmental Health, Technological University Dublin, Grangegorman, Dublin 7, Ireland.
[2]Environmental Sustainability and Health Institute, Technological University Dublin, Grangegorman, Dublin 7, Ireland.
[3]Teagasc Food Research Centre, Ashtown, Dublin 15, Ireland.

Abstract

Background

Recent reports highlight the importance of assessing the food and/or waterborne public health risks via land-spreading of organic wastes (i.e., biofertilisers) in Ireland. However, baseline pathogen prevalence and concentrations, spatiotemporal data, and a farm-to-fork quantitative microbial risk assessment (QMRA) modular framework of targeted waste-pathogen combinations (W-PCs) are required for this. In 2016, ≈7.2 million cattle produced faeces. In 2015, ≈46,400 tonnes of biosolids were land spread.

Methods

A scoping review of Science Direct, Scopus, and Food Science and Technology Abstracts identified 1,623 records; 786 were eligible, with 48 spatiotemporal farm-level datasets extracted and harmonised. Meta-analyses were performed for targeted pathogen prevalence. Meta-models were developed to pool extracted prevalence datasets and derive moderators explaining system variance. Distributions were fitted to extracted pathogen concentration datasets using the GAMLSS package. Finally, directed graphical model chains (DGMCs) and a system dynamics model (SDM) were developed in NetLogo, incorporating stochastic (i.e., inherent uncertainty and variability) model parameters in the farm-to-fork system.

Results

Identified priority W-PCs based on Irish environmental prevalence and epidemiological data were: bovine slurry (BS)-STEC O157/O26, broiler litter-*Campylobacter jejuni*, BS-*Cryptosporidium parvum*, and biosolids-norovirus GI and GII. Meta-analyses produced a distributed mean pathogen prevalence range of 0.13-0.43, $p<0.0001$-0.009, n: 36-113. Bioclimatic indicators (temperature and precipitation seasonality) were significant moderators across all meta-models: $p<0.0001$-0.01, explaining 34.91-54.75% of pathogen prevalence variance. Norovirus exhibited the highest model fit (Gamma distribution) for pathogen concentration. DGMCs and the SDM characterised the modular framework and epidemic model, adapted from compartmental models.

Conclusions

Meta-analyses, distribution fitting, DGMCs, and SDM for identified W-PCs represent the novel spatiotemporal QMRA modular framework for land-spreading in Ireland and potentially adaptable globally. Findings will inform safe and sustainable waste management practices in food systems and the circular bioeconomy. However, more spatiotemporal data are required to achieve increasingly robust QMRA, i.e., increasingly accurate risk estimates.

Ultrasound homogenization and its effects on certain rheological and physical properties of rich-polyphenol dairy-based beverage.

Author Information

Gontorn Putsakum [1, 2], Dilip K. Rai [1], Brijesh Tiwari [1] and Colm O'Donnell [2]

[1]Teagasc Food Research Centre Ashtown, Dublin
[2]School of Biosystems and Food Engineering, University College Dublin

Abstract

Applications of ultrasound (US) have been commonly utilised as one of the novel techniques for food processing, especially as an alternative method for conventional thermal treatment. However, functions of this technology has potentials to be applied in other processing steps as well. Therefore, the use of US treatment as a homogenization process for smoothie-like beverage consisting of milk and freeze-dried blackberry powder had been investigated, focusing into the rheological and physical properties. Beverage samples were prepared by mixing freeze-dried blackberry powder and preheated full fat milk (37°C) at the ratio of 1:20. A pilot scale Hielscher US transducer (1000 W) equipped with BS4d40 probe and B4-1.4 booster (max. amplitude full width 24 µm) was used along with a magnetic stirrer at 450 rpm as a US homogenization unit. Samples underwent US treatment at 100% amplitude power (US intensity of 10.37 W/cm^3) for 1, 3, and 5 min. Control samples were homogenized at 10,000 rpm for 1 min. It was found that the curve of storage or elastic modulus was higher than that of loss or viscous modulus in all samples in the initial stage and decreased after the level of shear strain passed at 10%. The viscosity curve indicated a shear-thinning behaviour of the samples since the viscosity of each sample decreased as the shear rate increased. All US-treated samples showed higher initial viscosity than the control, where US for 3 and 5 min had higher values than 1 min. The particle size distribution curve revealed that US treatment produced smaller particle sizes within samples, detected via laser diffraction, as the treatment time increased. Longer exposure time to US led to higher temperature of samples after the treatment as US homogenization for 5 min resulted in approximately 58°C of sample temperature, which could also enhance viscosity.

Comparison of trypsin and chymotrypsin inhibition in different fava bean (*Vicia faba*) varieties.

Author Information

Luthando Gcaza[1], Mohammadreza Khalesi[1] and Richard J. FitzGerald[1]

[1]Department of Biological Sciences, Faculty of Science and Engineering, University of Limerick, Limerick.

Abstract

The application of plant-derived proteins in food products is increasing worldwide. Fava bean (*Vicia faba* L.) is important for human and animal nutrition due to their high protein contents (24-30%). One challenge in the use of plant-derived ingredients is the presence of anti-nutritional factors (ANFs). This study evaluated the presence of enzyme inhibitory activities in different plant protein extracts. The proximate composition of, a commercial fava bean meal (FB), and 6 varieties of Irish-grown fava bean seeds plated during spring and winter was analysed. Fava bean varieties that have been selected with the desired traits such as were analysed in terms of proximate composition and physicochemical properties. Composition of protein determined by Kjeldahl analysis with a conversion factor of 5.4 were as follows: 24.07± 0.75 (g/100g) for Lynx, 27.58 ± 0.62 (g/100g) for Victus and 26.26 ± 0.88 (g/100g) for Tiffany which were spring varieties and b24.80 ± 1.54 (g/100g) for Wizard, 27.28 ± 0.67 (g/100g) for Tundra and 29.76 ± 2.44 (g/100g) for Irena which were winter varieties on dry basis. This high protein content supports their use in the alternative protein generation. The average reconstitution pH of the samples is 6.64 ± 0.05 (units/mg). Inhibition studies on the samples indicated lower inhibition value for the processed samples. The TI and CI results for the fava bean samples indicate that processing to generate meals and concentrates impacts the enzyme inhibitory activity in the plant protein samples which in turn may make these ingredients more digestible from human nutrition.

Monitoring the effect of consumption temperature of whole fat milk on in vitro gastric digestion using magnetic resonance imaging

Author Information

Conor John Fitzpatrick[1,2,3], Maja Musse[4], Guylaine Collewet[4], Jiajun Feng[5], Tiphaine Lucas[4], Mark Timlin[1], Sylvain Challois[4], Stephane Quellec[4], Didier Dupont[5], Andre Brodkorb[1], Daniela Freitas[1], Steven Le Feunteun[5]

[1]Teagasc Food Research Centre Moorepark, Ireland, [2]University College Cork School of Food and Nutritional Sciences, Ireland. [3]Vistamilk SFI Research Centre, Ireland. [4]INRAE, OPAALE, France. 5 Science and Technology of Dairy and Egg Products, France.

Abstract

This study utilized Magnetic Resonance Imaging (MRI) to investigate the behaviour of whole fat milk at varying temperature during semi-dynamic in vitro gastric digestion. The experimental protocol was designed to closely reproduce the gastric temperature profiles observed in humans after consumption of milk at 4°C, 37°C, and 60°C. Consuming milk at 4°C significantly postponed the onset of protein coagulation during the gastric phase compared to both 37°C and 60°C. MRI lipid quantitative analyses also showed that the fat-rich particles tended to fto the top of the digesta in a process similar to creaming, and after a delay that seemed to increase in the order: milk at 4°C < milk at 37°C < milk at 60°C (no floating particles within 2h). However, the released quantities of free amines in collected samples, which indirectly reflect the activity of pepsin, did not significantly vary with the milk temperature. Our findings highlight the significance of consumption temperature in modulating the structural reorganisation of whole milk during gastric digestion and illustrate some of the capabilities offered by MRI to investigate such phenomena. They also open questions on the potential consequences of milk consumption temperature on the nutrient delivery rate into the small intestine and their further breakdown and absorption kinetics.

Poster Presentations- Abstracts

Theme 1: Addressing climate challenges in agri-food production

Quantifying the environmental impact of Irish horticultural production and possible emission reduction strategies: A Life Cycle Assessment Approach

Author Information

Éamonn Walsh[1], Aiduan Borrion[2], Michael Gaffney[1], Lorraine Foley[3] and Lael Walsh[1]

[1]Teagasc, Ashtown, Dublin 15, Ireland
[2] University College London, Gower Street, London, United Kingdom
[3]Technological University Dublin, Grangegorman, Dublin 7, Ireland

Abstract

Horticultural production is regarded as comparatively low impact in relation to other food production systems. However, like all production systems there can be a range of negative impacts on the environment, from greenhouse gas emissions (GHG) to water use and eutrophication. Improvements are continually being made to cultivation practices to decrease emissions but as fresh food producers aim for more sustainable products, they are challenged by efforts to identify solutions that lower food waste and total emissions while maintaining the same quality. A major step to reducing impact on the environment is understanding the origin of emissions within the life cycle of a product. However, in many sectors there are a lack of detailed studies examining the main contributors to environmental impact. Life Cycle Assessment (LCA) is a useful tool to model the whole life cycle of a product in order to pinpoint raw materials and processes which are high contributors to emissions.

The Leaf No Waste project is modelling the impact of altering crop inputs and changing packaging solutions to support innovation and sustainability in Irish horticulture. In particular, the project evaluates how incorporating silicon biostimulants during production, alternative (e.g. compostable/biodegradable) or less plastic use, affects the shelf life, food waste and environmental profile of food. Preliminary data indicates a complex model of gains and losses. For example, changing packaging may lead to increases in emissions if energy used in its production comes from non-renewable sources. Moreover, if emissions associated with using biostimulants are not offset by longer shelf life, GHG emissions in terms of food waste may increase despite 'greener', pesticide-free production. We show that LCA can be used to make informed decisions around crop inputs, environmental hotspots and impact categories, thereby supporting Irish horticulture as it aims to lower pesticide and plastic use with silicon-based biostimulant inputs.

Variation of nutritional composition of oat varieties grown in Ireland

Author Information

Nefeli Lampoglou[1, 2], Atikur Rahman[3], Aylin Sahin[2], Elke Arendt[2], Andre Brodkorb[1], Daniela Freitas[1]

[1]Teagasc Moorepark Food Research Centre, Fermoy, Co. Cork, Ireland P61 C996
[2]School of Food and Nutritional Sciences, University College Cork, Cork, Ireland T12 K8AF
[3]Teagasc, Crop Science Department, Oak Park, Carlow, Ireland R93 XE12

Abstract

Oats are associated to numerous health claims, including reduction of blood cholesterol, glucose levels and improvements in gut health. However, the current yield-driven market focuses on agricultural production, and is somewhat overlooking the nutritional composition of available oat varieties. As a result, we are reliant only on a handful of varieties, thus reducing the agricultural biodiversity. The objective of this study was to conduct a nutritional analysis of oat varieties grown in Ireland, including some under-explored wild-type oats, and investigate the extent of intra-varietal differences. Ninety-three oat varieties were analysed for their nutritional composition. Moisture and ash were determined gravimetrically; protein by the Dumas method; fat by NMR; total starch and beta-gluten enzymatically/colourimetrically using commercially available kits. The fibre content was calculated by difference. Compositional analysis revealed a surprisingly high variations in the concentrations of measured components, which were found to significantly differ by genotype ($p<0.001$). Protein (11.0 to 22.3 % of dry matter), fat (2.4 to 10.0 % of dry matter), and beta-glucan (2.8 to 6.6 % of dry matter) contents showed a great variability. Significant negative coefficients of regression were obtained of total starch content on fibre ($r = -0.78$) and protein ($r = -0.7$), indicating that low starch varieties may have a high content of protein or fibre. Further research on the nutritional composition of available oat varieties, along with their agronomical characteristics, may aid in identifying further potential correlations, and bridge the gap between breeders, producers and consumers.

Theme 2: Bio-based solutions for food production and processing

Development and validation of a 2 dimensional ion chromatography method for the analysis of chloride, nitrite and nitrate in processed meat products

Author Information

Bradley Afanda [1, 2], Martin Danaher [1] and Christine O'Connor [2]

[1]Teagasc Food Research Centre, Ashtown, Dublin 15, D15 DY05.
[2]School of Food Science and Environmental Health, Technological University of Dublin, Grangegorman, Dublin 7, D07 H6K8.

Abstract

Meat curing is one of the oldest traditions that has been used to preserve meat for thousands of years. For centuries, curing recipes have contained nitrate and/or nitrite salts as active ingredients with the use of nitrite linked to producing the unique and attractive processed meat pink colour and also inhibiting the growth of toxic and dangerous clostridium botulinum in these products. Nitrate is usually added as a slow curing agent whereby it is reduced to nitrite over time by specific microbial in processed meat products. Despite their notable advantages, there has been a growing concern towards their use as these food preservatives have been linked to the formation of carcinogenic nitrosamine residues in processed meat products and the irreversible formation of methemoglobinemia that affects oxygen transportation in the body. In response to these findings, from 2008 the EU set strict limits of 150 mg/kg of the either salt form of nitrite and nitrate in majority of processed meat products under regulation 1333/2008/EC.

In this study, the focus was on the development and validation of an ion chromatography (IC) analytical method for the accurate and trace analysis of nitrate and nitrite in processed meat products as current methods still suffer from poor sensitivity and selectivity plus toxic, time consuming and labour intensive sample preparation and analytical procedures. In order to resolve these challenges, a two dimensional ion chromatographic (2D – IC) method coupled to suppressed conductivity and UV detection was developed and validated for the analysis of nitrite and nitrate in processed meat products. These anions were extracted from processed meat products with the aid of an aqueous caustic microwave assisted digestion prior to ion chromatographic analysis.

For the 1st time 2 dimensional ion chromatography has been applied in processed meat products for the analysis of both anions whereby excellent sensitivity, selectivity, accuracy and precision were achieved. The method was validated under Eurachem 2014 guidelines and was used to quantify both ions in commercially available processed meat products in Ireland as to monitor their exposure to everyday consumers. Several processed meat products were found to contain nitrate levels above limits set by the EU in regulation 1333/2008/EC (150 mg/kg, salt form) whereby majority of processed meat products were found to contain nitrite levels below set limits.

The use of biopolymer-based growing media for the use of plant and food production

Author Information

Kaleum Meaney[1,2], Yuanyuan Chen[1], Declan Devine[1], Crevan O'Donnell[1], Michael Gaffney[2]

[1] PRISM Research Institute, Technological University of the Shannon: Midlands Midwest, Old Dublin Road, Athlone, County Westmeath, N37 HD68, Ireland

[2] Horticulture Development Department, Teagasc Ashtown Research Centre, Dublin Ireland

Abstract

Biopolymers which are derived from renewable sources, have emerged as promising alternatives for growing media in soilless food production. Conventional growing media, such as peat and/or rockwool, pose environmental concerns due to their non-renewable nature and adverse ecological impact during extraction and disposal. Projections indicate that the volume of growth media required worldwide will double from 67m m^3 in 2017 to 283m m^3 in 2050, with the added context that in 2017 60% of the growth media was peat based, and it's likely that the use of peat will be restricted in many territories in the near future. Biopolymers, derived from natural sources, such as agricultural waste, fermented plant starch, and microbial fermentation offer an eco-friendly substitute. These materials possess unique properties favourable for plant growth, including water retention, aeration, nutrient availability, and biodegradability. Their application in hydroponic and soilless cultivation systems enhances crop yields while minimizing environmental footprint. These media not only support plant growth but also mitigate soil degradation and reduce dependence on finite resources. The adoption of biopolymer-based growing media presents a transformative solution for sustainable food production and processing. Their applications contribute to environmental conservation, enhance crop productivity, and offer a viable pathway toward a more sustainable and resilient food system. Within this context biopolymers and foaming additives have been utilised to create a porous structure suitable for retaining water and providing a rooting substrate for plants. These materials have been characterised (pH, E.C., Water Holding Capacity), and the impact of altering the rate of additives to improve the water retention characteristics has been evaluated. Embracing these biodegradable materials signifies a progressive shift towards a greener and more sustainable future for agriculture and the food industry.

A comparison of Protein Digestion in the older adult versus adult using *in vitro* gastrointestinal models

Author Information

Aoife Burke[1, 2], Barbara Biduski[2], Aylin W. Sahin[3], Eimear Gallagher[4], Paula O'Connor[1], Janette Walton[2,] Michael Callanan[2], Linda Giblin[1].

[1]Teagasc Food Research Centre, Moorepark, Co. Cork, P61C996, Ireland.
[2]Department of Biological Sciences, Munster Technological University, Co. Cork, T12P928, Ireland.
[3]School of Food and Nutritional Sciences, University College Cork, Co. Cork, T12K8AF, Ireland.
[4] Teagasc Food Research Centre, Ashtown, D15KN3K, Ireland.

Abstract

By 2051 there will be 1.6 million people over 65 years in Ireland. One important consequence of ageing is the gradual decline in muscle mass and strength, which leads to frailty. An increase in dietary protein intake improves muscle mass and strength in the older adult. This study aimed to track protein digestion in the older adult using a static in vitro gastrointestinal model for this life stage.

Test samples (buckwheat bread, lentil beverage), were subjected to gastrointestinal digestion using INFOGEST methods for adult and older adult, respectively. To mimic the older gut, enzyme activities were reduced and gastric time and pH were increased. Samples were collected at 4 time points (oral O2, gastric G120, gastric G180 and post-intestinal I120). The evaluation of protein digestion included the degree of protein hydrolysis (OPA method), peptide size (size exclusion chromatography) and free amino acid analysis.

For buckwheat bread, I120 sample from the older adult model had significantly increased protein hydrolysis and free amino acids than adult I120 ($P<0.05$). For lentil beverage, I120 sample from the older adult model had significantly more free amino acids than the adult I120 (3783µg/ml +/-0.25SD, 3069.18µg/ml +/-0.33SD) ($P<0.05$).

The increase in free amino acids observed for both food matrices is surprising. Future work will focus on peptides sizes and tracking amino acid bioavailability using *in vitro* models of the gut barrier.

Application of Si biostimulants to reduce pesticide use in strawberry crops

Author Information

Daniela Costa[1], Orla O'Halloran[1], Anthony Gargan[1,2], Zoia Arshad Awan[1], Caroline Elliott-Kingston[2], Michael Gaffney[1] and Lael Walsh[1]

[1] Teagasc – Agriculture and Food Development Authority, Horticulture Development Department, Ashtown, Dublin 15, Ireland, D15KN3K

[2] School of Agriculture and Food Science, University College Dublin, Belfield, Dublin 4, Ireland

Author

Pesticides are widely used in agriculture to protect crops against pests and diseases, although, their use is associated with negative impacts on the environmental and human health. The European Commission has set the goal to reduce by 50% the use and risk of chemical pesticides by 2030. Such a reduction in pesticide use has raised concern about reduction in production yields and food security. For these reasons, more sustainable alternatives need to be evaluated. The use of biostimulants may offer some potential for pesticide reduction, by acting synergistically in crop defence against disease. Silicon based biostimulant products (Si-bio) offer a potential option to move towards more sustainable food production. Commercial formulations of Si-bio are available in the market and reports indicate their potential to reduce disease pressure. In strawberry crops, the application of Si-bio is reported to increase plant growth and some fruit quality parameters. Despite this, the research developed using Si in strawberry production, especially to evaluate its effect on disease development at commercial scale is still limited. There is a need to evaluate different formulations and methods of application on the disease development in plants and generate evidence on its potential to decrease disease pressure. The impact of two different Si-bio applications were evaluated on strawberry production and disease development in glasshouse and polytunnel experiments. Si-bio treated plots were compared with negative (no treatments) and positive controls (recommended pesticide programme in Ireland) in a randomised design. Preliminary data indicates limited effect on disease in low disease pressure conditions. Further research is being carried out to determine effects at molecular-levels and in high disease pressure environments. This work will contribute to knowledge on the efficiency of these biostimulants in strawberry production and disease management to reduce pesticide application, and food loss.

Exploring the influence of food sources on dietary diversity: examination of servings in rural smallholder households in Tigray, Ethiopia

Author Information

Tsegay Balcha[1], Edward Lahiff[1], Nick Chisholm[1], & Trevor Donnellan[2]

[1]University College Cork (UCC), Ireland
[2]Agricultural Economic and Farm Survey Department, Teagasc, Athenry, Ireland

Abstract

Studies using a range of methodologies couldn't find a one-to-one relationship when it comes to examining the extent of the influence of farm production diversity and market access on dietary diversity, with most results being smaller than anticipated. Though identifying the extent of influence is important for policy priority, efforts targeting the specific problem are scant. By directly evaluating the ingredients of household servings and tracing back to their origins, this study examines the extent of influence of food sources on rural smallholder household diets. Moreover, the paper investigates the factors determining households' adoption of specific food sources. A cross-sectional household survey was conducted on 396 rural smallholders in Tigray, Ethiopia. Purchases, own farm production, Productive Safety Net Program (PSNP), and transfers were identified as the major food sources in the study area. The findings using the Poisson and Ordinary Least Squares (OLS) estimations revealed that purchased, own farm-produced, and transferred foods are significant contributors to household dietary diversity. Purchased foods show the greatest scale of influence indicating that an additional purchased food group increases household dietary diversity by an average of 0.863 to 0.883; followed by own farm produced (0.626 to 0.686) and transfer foods (0.426 to 0.485). The magnitude higher compared to previous findings. This may be considered as the benefit of our approach. Regarding household food source adoption, we identify irrigable farmland size as a key factor influencing purchased food consumption while it prevents access to PSNP foods. Sub-districts, marital status, and gender collectively shape the adoption of own farm-produced foods. Purchased foods showed a higher extent of influence, hence, we recommend initiatives on income-generating activities to enhance food purchases by rural smallholders without compromising own farm production for improved household dietary diversity. Apply caution when generalizing due to the context-specificity of the food sources and potential self-reporting bias on household servings.

The effect of commercial Si-based products on spinach crop yield and characteristics

Author Information

Zoia Arshad Awan, Michael Gaffney and Lael Walsh

Teagasc Food Research Centre, Ashtown, Dublin 15, D15 DY05

Abstract

The positive, if inconsistent impacts of Silicon application on horticultural crops are well documented. A glasshouse experiment was designed to evaluate the effect of commercially available Si-based products on the growth and yield of spinach [F1-Hybrid (51-707)]. Four different commercially available Si-based products were selected and applied at 2 different doses (half commercial 0.5X and full commercial doses 1X) using 2 different application methods (drench and foliar). There were eight Si treatments and one control (n=8) arranged in a randomized complete block design to evaluate the effect of Si-based products on agronomic traits, chlorophyll fluorescence parameters, SPAD index, relative water content (RWC), membrane stability index (MSI) and electrolyte leakage (EL). The results showed spinach grew well in peat under the effect of Si applications. Differences in yield between treatments were non-significant although dry weight was significantly increased by 8-14% after Si application as compared to the Si-untreated control. Si applications also showed non-significant variations in RWC and chlorophyll fluorescence parameters such as total chlorophyll content (a+b), carotenoids and SPAD index. Two of the Si-based products applied by drench improved the MSI of spinach by 16-25% while EL was significantly reduced by 18-27%. Additionally, foliar application of one Si product significantly improved MSI (12%) and reduced EL (16%) as compared to control. In conclusion, the effects of Si-based products indicated non-significant differences in agronomic traits but significant impacts on MSI and EL were detected after applying commercial doses (1X) of two Si-based products which may improve the shelf life of spinach. Results emphasize the need to better understand the mechanisms by which Si products function and how best to formulate and apply them. Preliminary data indicates that the application of Si-based products as biostimulants may be a promising sustainable approach to improving crop shelf life.

Theme 3: Data and digitalisation advances in food systems

Analytical Advancement in Whiskey Profiling for Authenticity and Quality Control

Author Information

Okolo, Chioke A[1,4]., Kilcawley, Kieran N[2,3] and O'Connor, Christine[4]

[1]FOCAS Research Institute, Technological University Dublin, Camden Row, Dublin 8, Ireland.
[2] Food Quality & Sensory Science Department, Teagasc Food Research Centre, Moorepark, Fermoy, P61 C996 Co Cork, Ireland.
[3] School of Food and Nutritional Sciences, College of Science, Engineering and Food Science, University College Cork, T12K8AF, Cork, Ireland
[4] School of Food Science & Environmental Health, Technological University Dublin, Grangegorman, Dublin 7, Ireland.

Abstract

Due to the growing global market for whiskey, the potential for fraud has sparked significant economic and public health risks. To ensure the integrity of whiskey products and prevent fraudulent or counterfeit practices, it is imperative to implement high throughput solutions that are both robust and reliable while also maintaining rapid processing times. Such measures will help safeguard the products' authenticity and maintain consumers' trust. Implementing specific analytical strategies can present significant challenges or costs when performing routine analyses. The screening of whiskey products on a qualitative basis has been previously conducted. However, it is necessary to employ a more quantitative confirmatory technique due to the non-specific nature of the chemical compounds involved, and thus, a database of fingerprints of whiskey products can be built. This step is essential to establish the integrity and geographical indication of the whiskey analysis results. Hence, combining spectroscopic analytical and chemometric methods has been fundamental in differentiating and classifying whiskey samples. This study reviewed the various analytical techniques employed in whiskey analysis for authentication and quality control over the last five years, including spectroscopic, chromatographic, and novel technologies. These analytical techniques' ethical and environmental considerations, technical challenges, and prospects are also emphasized.

Steps toward a digital twin for functional food production with increased health benefits

Author Information

Helena Mylise Sørensen[1,2], Dermot Brabazon[2], Christine Loscher[1] Susan Maye[3] and Brian Freeland[2],

[1] School of Biotechnology, Dublin City University, D09 DX63 Dublin, Ireland
[2] I-Form, Advanced Manufacturing Research Centre, Dublin City University, D09 DX63 Dublin, Ireland
[3] Dairygold Co-Operative Society Limited, Clonmel Road, Co. Cork, P67 DD36 Mitchelstown, Ireland

Abstract

Lactobacillus rhamnosus (L. rhamnosus) is a commensal microorganism with well-established health-promoting properties and is widely used in the continuously growing multi-billion-euro functional food industry. The production of L. rhamnosus biomass can be optimised using artificial neural network (ANN) modelling to improve process control and monitoring, leading to increased volumetric productivity.

This study presents the development of three ANNs to predict biomass and growth rate in both batch and fed-batch bioprocesses using skim milk powder as a dairy-based substrate. The immunomodulatory effect of *L. rhamnosus* was also investigated and found to have anti-inflammatory properties.

This research aims to maximise the production of *L. rhamnosus* biomass through optimized and robust control of bioprocesses. Real-time data from on-line measurements is taken during the bioprocess and will be used to estimate the biomass and growth rate and leveraged to create a digital twin of the process. This digital twin serves as an estimator and can be used to regulate the addition of feed to the bioprocess, leading to more precise control and increased productivity.

The outcome of this study highlights the immense potential of ANN modelling and digital twin development for the optimization of *L. rhamnosus* biomass production to be applied as a functional food ingredient. By integrating advanced computational techniques into the bioproduction pipeline, this research contributes to the ongoing development of innovative strategies in the functional food industry, paving the way for more efficient and economically viable production processes.

Bovine tissue discrimination using NIR spectroscopic data and machine learning methods

Author Information

Jyoti P. Mishra[1], Alessandro Ferragina[1], Stephen Hegarty[2], and Ruth M. Hamill[1*]

[1] Food Quality and Sensory Science Department, Teagasc, Ashtown, Dublin 15, Ireland
[2] Centre for Advanced Photonics and Process Analysis, Munster Technological University, Bishopstown Campus, Cork, Ireland

Abstract

The objective of this research was to explore the potential of using near-infrared (NIR) spectroscopic data coupled with machine learning techniques for the differentiation of various tissue types, including bone, cartilage, marrow, fat, muscle, ligaments, and tendons. The study incorporated near-infrared spectra from 142 bovine tissues, encompassing bones (n=32), cartilage (n=21), fat (n=13), ligament (n=16), marrow (n=17), muscle (n=28), and tendon (n=15). Initial investigations involved the application of unsupervised methods such as Principal Component Analysis (PCA). The results revealed that PC1, PC2, and PC3 contributed to 35.7%, 29.2%, and 19.4% of the variability, respectively. PCA score plots (PC1 vs. PC2, PC2 vs. PC3) distinctly exhibited the discrimination of tissues such as fats, marrows, muscles, and ligaments among themselves and from other tissues like bones, cartilages, and tendons. Based on these findings, classification models were developed using supervised machine learning methods, including Random Forest (RF), Naive Bayes (NB), Support Vector Machine (SVM), K-Nearest Neighbour (KNN), Linear Discriminant Analysis (LDA), and Partial Least Square Discriminant Analysis (PLS-DA). The spectral dataset was randomly split into 121 training data and 21 test data points. The entire analysis and model development were conducted using R packages such as randomForest, caret, e1071, klaR, kernlab, and mdatools. The accuracy rates obtained from different models were as follows: RF (0.95), NB (0.76), SVM (1), KNN (0.90), LDA (1), and PLS-DA (0.94). Notably, both SVM and LDA exhibited 100% prediction efficiency, with a 95% confidence interval ranging from 0.83 to 1. However, misclassifications were observed in the RF, NB, KNN, and PLS-DA models, particularly in distinguishing tendons, cartilage, and ligaments. These findings underscore the potential of NIR spectroscopy and machine learning for tissue discrimination, while also highlighting the some challenges associated with certain tissue types.

Influence of horn status on bovine *Semitendinosus* muscle proteome: An analysis of the canonical pathways, upstream regulators and interactive networks

Author Information

Sudipta Hazra[1,2], Ruth M. Hamill[1], Mohammed Gagaoua[3], Joe P. Kerry[2], Anne Maria Mullen[1] and Claudia Terlouw[4]

[1] Food Quality and Sensory Science Department, Teagasc Food Research Centre, Ashtown, D15 DY05 Dublin, Ireland

[2] School of Food and Nutritional Sciences, College of Science, Engineering and Food Science, University College Cork, T12 K8AF Cork, Ireland

[3] PEGASE, INRAE, Institut Agro, 35590 Saint-Gilles, France

[4] Université Clermont Auvergne, INRAE, VetAgro Sup, UMR Herbivores, F-63122 Saint-Genès-Champanelle, France

Abstract

Stress levels within bovine animals are influenced by several factors, one of which is the horn status of the animals in the herd. Previous research from our group identified 95 differentially abundant proteins (DAP) in M. semitendinosus in relation to horn status, when other factors were controlled [1]. Here, a bioinformatics analysis was applied to these DAP to identify canonical pathways, upstream regulators and interactive networks associated with differences in bovine horn status. The most activated canonical pathway in muscle from disbudded bovines was "Glycolysis I" with 10 of 27 proteins of this pathway observed, all more abundant in muscle of disbudded animals. Several pathways were inhibited in disbudded animals, including some involving proteasome proteins ("Regulation of Apoptosis" and "Metabolism of Polyamines"). The most significant upstream regulators were DMD (predicted activated, Z-score +2.6) and sesaminol (predicted inhibited, Z-score -3.2). The most activated and inhibited upstream transcription factors were MEF2C (Z-score +2.4) and NFYC (Z-score -2.8), respectively. The results demonstrate that energy metabolism was enhanced in disbudded animals, while protein turnover was inhibited. Previous studies also showed that the presence of horns has implications for the animal's metabolic and physiological status. More specifically, horn growth is dependent upon the presence of various hormones associated with energy metabolism, including; growth and thyroid hormones, prolactin, and testosterone. Horn status appears to influence overall energy and physiological status of the animal, with consequences for specific metabolic muscle characteristics as evidenced in this study.

Reference:

Ben Mbarek, R., Terlouw, C., Hamill, R., Kerry, J., Picard, B., Mullen, A.M., Reiche, A-M., Silacci, P. & Gagaoua, M. **(2022).** Effect of rearing practices and pre-slaughter handling on the *Longissimus thoracis* and the *Semitendinosus* muscle proteomes of young bulls. *In*: Proceedings of the 68th International Congress of Meat Science and Technology, pp. 168. 22th to 25th August, Kobe, Japan.

Theme 4: Engaging the consumer and society

How do the sensory profiles of nitrite-free and meatless bacon and ham alternatives compare to their conventional counterparts?

Author Information

Stergios Melios [1,2], Simona Grasso [2], Declan Bolton [1], Emily Crofton [1]

[1] Teagasc, Ashtown Food Research Centre, Ashtown, D15 DY05 Dublin
[2] School of Agriculture and Food Science, University College Dublin, Belfield, Dublin 4

Abstract

The global market for bacon and ham is undergoing significant transformation, with both nitrite-free and meatless alternatives emerging as leading trends. However, there are currently limited data available on the perceived sensory profiles of these newly developed products. The objective of this study was to compare the sensory profiles of commercially available nitrite-free and meatless bacon rashers and sliced cooked ham products with their conventional counterparts, using Temporal Dominance of Sensations (TDS) and Partial Napping (PN) with Ultra Flash Profiling (UFP) techniques. A trained sensory panel (n=9) applied TDS to determine dynamic changes in perception of sensory attributes during consumption, while PN and UFP were used to investigate differences in product appearance. Unsmoked-brine-cured and unsmoked-nitrite-free bacon showed significant differences in the dominance of “saltiness” during consumption. These differences were not observed in their smoked counterparts. Meatless bacon had significantly lower dominance of “saltiness” compared to meat-based bacon, while smoked meatless bacon was dominated by the attribute “dry”. Nitrite-free and conventional ham products were similar in terms of appearance and temporal sensory profile. Meatless ham was dominated by the attribute “smoky”, which was perceived by panellists as “artificial”. PN and UFP differentiated meatless bacon and ham alternatives from meat-based samples and were associated with attributes such as “artificial” and “processed”, and "fake" and "unappealing", respectively. The results from this study highlight the potential success for nitrite-free products on the Irish market. On the other hand, the distinct appearance and temporal sensory profiles of meatless bacon and ham alternatives could impact future uptake of these products by consumers. This study provides new information and valuable insights regarding the sensory profiles of nitrite-free and meatless bacon and ham products, and has implications with respect to future product development efforts for a healthier and more sustainable food production system.

Theme 5: Safe, healthy and sustainable food innovation

Impact of process and machine variables on the rheological, textural and structural properties pea-protein isolates during pilot-scale high moisture extrusion

Author Information

Animesh Singh Sengar[1,2], Shay Hannon[1], Uma Tiwari[2], Shivani Pathania[1]

[1] Food Industry Development Department, Teagasc Food Research Centre, Ashtown, D15 DY05 Dublin, Ireland

[2] School of Food Science and Environmental Health, Technological University Dublin, City Campus, Central Quad, Grangegorman, D07 ADY7 Dublin, Ireland

Contact email: Animesh.sengar@teagasc.ie

Abstract

High moisture extrusion has the potential to develop meat like fibrous structures through compounding thermo-mechanical stress. Cooling die plays an essential role in structural realignment of protein molecules. This study aims to determine the impact of varying water feed rate and cooling die conditions on anisotropic structure formation. Clextral EV025 pilot-scale extruder was used to develop high moisture extrudates of pea-protein isolates (>80% protein concentration). Extrusion process parameters such as solid feed rate, screw speed, and barrel temperature profile were kept constant at 4.0 Kgh^{-1}, 400 rpm, and 30/40/50/60/80/90/110/120/130/135ºC, respectively. Three different water feed rate were used i.e., 4.5 Lh^{-1}, 5.0 Lh^{-1}, and 5.5 Lh^{-1} to determine its impact of structuring of pea-protein isolates. Cooling die length (300 and 450 mm) and temperature (40 and 60ºC) were modified to determine their influence on structure development. Specific mechanical energy of the process was found to decrease with increasing water feed rate, whereas, it was incremented as the cooling die length increased. The developed extrudates formed visible bubbles in the middle section of the extrudate sheets. Irrespective of the water feed rate, expansion bubbles had solid (S_{eb}) and layered (L_{eb}) inner structures, with no significant differences in hardness, springiness, and chewiness in longitudinal and transverse flow directions. The fitted Ostwald-de Waele model described the flow properties of extrudates (R^2>0.988) with significantly high consistency index (k) for meat extrudates developed in condition 4.5 Lh^{-1}, 450 mm, 60ºC. FTIR characterisation indicated differences in the amide I band range of the developed high moisture extrudates. Structural development was observed for all the extrudates. However, moisture content of 5.0 Lh^{-1}, cooling die length of 450 mm and temperature 60ºC resulted in an appealing, processable extruded product which could be used in vegan product development formulations.

Effects of inclusion of hydrocolloids on technological properties of hybrid beef patties

Author Information

Zuo Song[1, 2], Joseph P. Kerry[2], and Ruth M. Hamill[1]

[1]Teagasc Food Research Centre, Ashtown, Dublin 15, Ireland
[2]Department of Food and Nutritional Sciences, University College Cork, Ireland

Abstract

For consumers seeking to increase the consumption of sustainable plant-based protein in their diet, hybrid meat products (HMPs) that incorporate large fractions of alternative proteins are emerging as a prospective alternative format that may more closely match the sensory experience of traditional meat products (TMPs). However, minimising textural differences between HMPs and TMPs is a technical challenge. Therefore, the objective of this study is to investigate the effect of incorporating different types of hydrocolloids on technological properties of hybrid beef patties. A control and eight experimental formulations of beef patties were prepared using 95% visual leanness beef cuts, where approximately 30% meat was substituted with hydrated commercial pea protein concentrate (PPC, protein content 80%), and faba bean protein concentrate (FBPC, protein content 88%). Technological properties of hybrid patties containing 1% hydrocolloids (Carboxymethylcellulose (CMC), Xanthan gum (X), and carrageenan (CN) were assessed. Hydrocolloid additions resulted in lower cooking losses compared to hybrid patties without hydrocolloid additions and the control. Incorporating hydrocolloids into HMPs effectively increased water-holding capacity during cooking, resulting in lower cooking losses. Hardness, chewiness, and gumminess values for hybrid patties containing added CMC and X were lower than hybrid patties without hydrocolloids. Hardness values of hybrid FBPC beef patties incorporating CN (120.05 N) was higher than other hybrid patties, while lower than the control (163.30 N). Hybrid beef patties incorporating various hydrocolloids showed variability in technological quality. This research highlights the importance of selecting suitable hydrocolloids in the production of HMPs to optimise technological properties.

Designing and Developing Health Promoting and Sustainable Meat-based Comminuted Products.

Author Information

Ciara Kenny[1,2,3], Roisin Burke[1], and Catherine Barry Ryan[2]

[1] School of Culinary Arts and Food Technology, TU Dublin
[2] School of Food Science & Environmental Health, TU Dublin
[3] Kepak Group, Clonee, Co. Meath.

Abstract

The demand for sustainable innovations within the food industry, particularly in the context of safe, healthy, and sustainable products, cannot be overstated. With the food industry's significant contribution to greenhouse gas emissions, addressing this challenge is vital to meet the needs of a growing population while reducing environmental impacts. This study aims to develop and evaluate protein alternatives to replace a percentage of beef in a burger patty product, with an emphasis on optimising sensory properties and sourcing these alternatives locally to minimise carbon and water footprints. In the initial phase of the development process, a food composition database was developed to quantify and characterise various alternative protein sources, considering essential factors like carbon and water footprints, sourcing efficiency, protein content, and nutrient composition. To assess nutrient patterns, statistical methodologies accounting for nutrient interrelationships were employed, including Principal Component Analysis to provide insights into the similarities and distinctions among the alternative proteins. In alignment with the sustainability goals of both the United Nations Sustainable Development Goals (UN SDGs) and the Kepak Group, life cycle assessments were conducted to evaluate the environmental impact of the final products. Sustainability is a core focus of the Kepak Group, with a 2022 sustainability report outlining the steps and future objectives of the company. Among the alternative proteins assessed, algae emerged as a promising choice, with the potential for local sourcing along the coasts of Ireland. Algae not only serves as an alternative protein source but also contributes to water pollution biomonitoring and remediation, as well as the production of eco-friendly energy sources (Roy et al., 2022). Sample products, such as algae-based beef burger patties, demonstrated favourable sensory attributes when compared against a control beef-based product ($p<0.05$) and showed an overall acceptance ($p<0.05$), demonstrating their potential for sustainable and health-conscious food innovation. This research addresses the critical need for environmentally responsible and nutritious food innovations while aligning with the goals of sustainability and reducing the meat industry's environmental impact.

Antimicrobial Activity of Selected Natural Antimicrobials for Potential use in the Development of Antimicrobial Active Packaging

Author Information

Kamau, P.G[1], Calderon, P.A[1], Cruz-Romero, M.C[1], Morris, M.A[2], & Kerry, J.P[1]

[1] Food Packaging Group, School of Food & Nutritional Sciences, University College Cork, Cork Ireland.
[2] AMBER and the School of Chemistry, Trinity College Dublin, Dublin 2, Ireland

Abstract

The objective of this study was to apply the combination approach to develop natural antimicrobials (NAM) with enhanced antimicrobial activity (AA) for Antimicrobial Packaging Applications. The developed NAM were tested against Staphylococcus aureus:(NCDO 949), *Escherichia coli*:(NCIMB 11943), *Pseudomonas fluorescens*:(NCIMB 9046), and fish microflora. The minimum inhibitory concentration (MIC) of the individual antimicrobials (low molecular weight chitosan (CS), Thyme essential oil (TEO) and commercially available mix of organic acids (Articoat-DLP-02 (ART) & Sulac) indicated that CS exhibited the highest AA against all bacteria tested including fish microflora followed by TEO and Sulac with MIC values of 0.125, 0.3 and 3.75 mg/mL, respectively. Compared to pure cultures, fish microflora was more resistant to TEO (0.5 mg/mL) and ART (50 mg/mL); however, the AA of CS and Sulac against fish microflora was not significantly different. A synergistic action of ART & TEO and ART & CS was noticed by the checkerboard assay and calculation of the Fractional Inhibitory Concentration Index (FIC≤0.5). Synergistic effect of ART & TEO was noticed against *Staphylococcus aureus, Escherichia coli* and fish microflora at concentrations of ART (mg/mL): TEO (mg/mL) (6.25: 0.08), (12.5: 0.08) and (12.5: 0.16), respectively. For ART & CS, synergistic effect was noticed against *Escherichia coli, Pseudomonas fluorescens* and fish microflora at concentrations of ART (mg/mL): CS (mg/mL) of (6.25: 0.08), (12.5: 0.08) and (12.5: 0.16), respectively. The synergistic effect of the antimicrobials was confirmed by the time-kill test, which also confirmed the bactericidal effect of the combined NAM.

Overall, results indicated that the developed antimicrobials with enhanced antimicrobial activity can be potentially used to develop antimicrobial active packaging materials for shelf-life extension of food products thus reducing food waste and enhance sustainability.

Antimicrobial potential of Irish seaweeds: challenges and opportunities

Author Information

McGurrin, Ailbhe [1,2]; Maguire, Julie [3]; Tiwari, Brijesh K. [2]; Garcia-Vaquero, Marco [1]

[1]Section of Food and Nutrition, School of Agriculture and Food Science, University College Dublin, Belfield, Dublin 4, D04 V1W8, Ireland.
[2] TEAGASC, Food Research Centre, Ashtown, Dublin 15, D15 DY05, Ireland.[1] section of Food and Nutrition, School of Agriculture and Food Science, University College Dublin, Belfield, Dublin 4, Ireland.
[3] Bantry Marine Research Station Ltd, Gearhies, Bantry, Co. Cork, P75 AX07, Ireland.

Abstract

Macroalgae (seaweeds) have recently attracted the interest of the research community as a novel and sustainable source of biologically-active compounds with multiple health benefits and a wide variety of applications as functional foods and nutraceuticals. These bioactive compounds from seaweeds have reported strong antimicrobial, and also antioxidant, anti-hypertensive, and anticancer properties amongst others. Antimicrobial activities from seaweeds show promising potential due to increased awareness of antimicrobial resistance. Moreover, a rise in consumer demand for products derived from natural sources has driven preferences for natural food preservatives, cosmetics, and cleaning agents, as opposed to conventional chemically synthesised compounds. The main classes of antimicrobial compounds investigated from seaweeds include polyphenols, polysaccharides, and proteins. A variety of mechanisms of action from these antimicrobials has been reported, from interactions with the bacterial cell wall to occlusion of nutrients from the culture medium by antimicrobials. Preliminary results covered in this work have shown that polysaccharides from macroalgae have antimicrobial activity against *E.coli*. Currently only 1% of Irish seaweeds are being converted into higher value products (which accounts for 30% of total commercial revenue), and thus, the development of antimicrobials from seaweed presents an opportunity to grow Ireland's marine bioeconomy and the development of sustainable food systems. Challenges for the widespread adoption of antimicrobials from seaweed include industrial-scale cultivation of seaweeds, and extraction of bioactive compounds. These challenges are covered in this work, together with the current processes and future prospects of the use of seaweeds as antimicrobials for food applications.

In vitro gastrointestinal digestion data and gut barrier health checks of four sustainable protein ingredients

Author Information

Ailynne Sepúlveda-González[1,2], Ever Hernández-Olivas[1], Myriam Grundy[3], Michael Callanan[2], Andre Brodkorb[1] and Linda Giblin[1]

[1]Teagasc, Food Science Research Centre, Ireland.
[2]Munster Technological University, Ireland.
[3]PEGASE, INRAE, Institut Agro, France.

Abstract

To reduce the global overreliance on proteins from animal sources, there is a quest to identify sustainable alternative dietary protein sources. Protein food ingredients derived from these sources must be characterized for their digestibility.

Four protein food ingredients (honey chlorella vulgaris, fava bean isolate, cricket powder and microbial biomass) underwent static in vitro gastrointestinal digestion using the INFOGEST static method for the adult human. Digestibility was quantified by the degree of protein hydrolysis (OPA method) and visualized by SDS-PAGE assay. To assess for adverse gut health effects, 21-day-old polarised Caco2-HT29-MTX monolayers were treated with gastrointestinal digested samples for 2 hours, and gut barrier integrity was monitored by measuring their transepithelial electrical resistance.

At the end of the intestinal digestion, fava bean isolate had a 100 ± 0 % digestibility by OPA method, followed by cricket (87 ± 5 %), honey chlorella vulgaris (74 ± 3 %), and microbial biomass (73.5 ± 0.8 %). Transepithelial electrical resistance values were similar for cell monolayers treated with different digesta samples and buffer digesta control ($p>0.05$), and all monolayers were above 700 Ω/cm^2 at the end of the incubation period.

This EU-Horizon-Giant Leaps study delivers in vitro digestibility data for four sustainable food protein ingredients and provides in vitro evidence that these ingredients do not damage gut barrier integrity.

Metabolic characterization of lactic acid bacteria in legume protein fermentation

Author Information

Angeleigh Rose Cirunay[1,3], Ruth Hamill[2], Catherine Barry-Ryan[3] and Olivia McAuliffe[1]

[1]Teagasc Food Research Centre, Moorepark, Fermoy, Co. Cork
[2]Teagasc Food Research Centre, Ashtown, Dublin
[3]School of Food Science & Environmental Health, Technological University Dublin, Grangegorman, Dublin

Abstract

Legume protein as an ingredient for plant-based meat alternatives comes with various challenges in terms of organoleptic characteristics, functionality, and undesired flavours. Fermentation is a process that can modify protein properties and potentially overcome the challenges with plant-based ingredients; however, there is limited information on the characteristics of microorganisms in different plant protein substrates. The objective of this research is to evaluate microbial strains for their growth performance on plant protein suspensions, ability to produce enzymes involved in generating precursors of flavour compounds, and produce exopolysaccharides to improve the texture of plant-based products. Proteins to be evaluated in this study include a variety from Irish-grown crops, including fava bean, pea, and lupin, with microbial strains derived from the raw material itself and from culture repositories. To date, protein isolates were extracted from fava beans and yellow pea (7-Orchestra), with protein contents of 96.2% and 89.13%, respectively. A bank of lactic acid bacteria (LAB) strains isolated from fava beans and other plant origins were selected from the Teagasc DPC culture collection, including species of the genera *Pediococcus, Lactobacillus*, and *Lactococcus*. These strains were tested for their ability to grow on the fava bean protein suspension (1% w/v). Preliminary results showed an increase in the cell densities of *Pediococcus pentosaceus* and *Lactobacillus paracasei*. This indicates that fava bean protein, as the sole nitrogen source, can support the growth of certain LAB species. The findings of this research will generate new scientific knowledge on plant protein–microbial culture combinations to develop innovative processing technologies for designing novel fermented plant-based foods with enhanced organoleptic appeal.

Effect of silicic acid on agronomic parameters and physiology of fresh produce

Author Information

Anthony Gargan[1], Lael Walsh[1], Michael Gaffney[1], Daniela Costa[1], Orla O'Halloran[1], Caroline Elliott Kingston[2]

[1]Teagasc, Horticulture Development Department, Ashtown, Dublin15
[2]UCD School of Agriculture and Food Science, Belfield, Dublin 4

Abstract

Biostimulants show promise as sustainable crop inputs. They act independently or synergistically to promote plant growth and development, and may even reduce the need for pesticide inputs. This research contributes to understanding the plant physiological changes associated with silicon-based biostimulants, in terms of their effect on growth, yield, productivity, and ultimately on product shelf life. Research was carried out on strawberry and spinach crops during the spring/summer of 2022/2023. Experiments were set up in a randomised block design in protected structures and treated with various commercially available silicon-based (si) products. Positive controls were included based on standard commercial fertigation approaches. Crop parameters were measured during both the growing phase and post-harvest, and these included; stomatal conductance, chlorophyll content, sugar content, yield, fruit quality and density. Initial results show that in low-stress, controlled environment conditions, the impact of biostimulant use is likely minimal with no significant differences observed between treatments and controls. Also despite the use of different commercial formulations of silicon, there was no significant difference in most of the measured parameters. However a significant difference was detected in strawberry fruit density. This suggests si-based biostimulants promote fruit wall thickening with potential for better product shelf life. These results link plant physiological response during cultivation with product shelf life, although further work is needed to understand the relationship between parameters. We show the impact of using si-based biostimulants as a sustainable crop input for better product shelf life and food waste reduction.

Effect of growing time on the phytochemical content of Brassica microgreens

Author Information

Belay Dereje, Jean-Christophe Jacquier, and Niamh Harbourne

Institute of Food and Health, University College Dublin, Ireland

Abstract

Recently, microgreens have gained increasing attention as they are easily cultivated with minimal growth inputs, can be grown in small spaces, and are harvested after a short production cycle. They are also rich sources of vitamins, minerals, and other health-promoting phytochemicals. However, the effects of growing time on the phytochemical contents of microgreens remain unknown. This information is vital for growers, and consumers and will encourage the consumption of microgreens as a recognised of these health-promoting compounds. In this study, cress and rocket were grown in a dark growing chamber under two modules of white lights placed 35 cm above them with a 16-hour photoperiod and harvested on day 7, 11, 15 and 19. Results indicated that the effect of growing times on the phytochemical content was dependent on the variety of microgreens. The total phenol, flavonoids, antioxidants (DPPH, and FRAP) and carotenoids content of rocket microgreens were significantly influenced by the growing time ($p \leq 0.05$), however, for cress microgreens growing time had no significant effect on any of these parameters. Furthermore, the total chlorophyll content of the cress significantly increased from day 15 to day 19, whereas the total chlorophyll content of the rocket did not significantly change between days 7 and 19. There was a significant increase in the anthocyanin content of both microgreens. This study lays a foundation in terms of selecting the optimum harvesting time for the highest phytochemical contents of both cress and rocket microgreens which plays a significant role in promoting human health properties.

The Effect of Heat Treatment on the Microbial Quality of an Industrial Pepperoni Recipe with Reduced Salt and Nitrite.

Author Information

Ciaran Crowley[1], Geraldine Duffy[2] and Joseph Kerry[1]

[1]School of Food and Nutritional Sciences, University College Cork, Cork, Ireland
[2]Teagasc Ashtown Food Research Centre, Ashtown, Dublin 15, Ireland

Abstract

With growing public awareness of the health effects posed by excessive consumption of processing salts and fats in processed foods, legislative and consumer pressure is forcing food manufacturers to assess the levels employed. One such industrial food sector is processed meats. In this study, an investigation was undertaken to determine if the addition of alternative hurdle technologies, such as the employment of heat treatment during product manufacture, would allow for the specific reduction of salt, nitrite and fat levels in fermented pepperoni meat samples without compromising the microbial quality of the product. A commercial, industrially-produced pepperoni was used as the experimental model employing original salt and nitrite contents of 2.5% and 150ppm of salt and sodium nitrite, respectively (Controls). These concentrations were decreased to 1.4% salt and 50ppm nitrite, respectively. Heat treatments were then applied to the various product formats using 53.5°C for 60 minutes, 61°C for 40 minutes and 64°C for 20 minutes and used as an additional processing hurdle to potentially enhance product safety.

Pepperoni were manufactured following eight recipes with reduced salt, nitrite, and a range of heat treatments. These recipes were tested for their physicochemical attributes and microbial profile at four time points; pre-fermentation, post-fermentation, post-heat treatment and post drying. From this study, it was determined that in reduced-salt and -nitrite pepperoni recipes, heat treatment applied at 53.5°C for 61 minutes was insufficient to ensure microbial quality. This was seen in recipe 1, which contained *Pseudomonas* and *Enterobacteriaceae* counts of 3.3 $\log_{10/}$cfu and 2.15 $\log_{10/}$cfu respectively, in the ready-to-eat (RTE) product. Heat treatment applied at 61°C for 40 minutes was moderately effective against all pathogenic and spoilage species. This heat treatment eliminated hazardous species in the RTE product but with a slower rate of reduction than the third heat treatment of 64°C for 20 minutes, whereby salt and nitrite were reduced to 1.4% and 50 ppm respectively. The addition of this heat hurdle was sufficient to inhibit spoilage and pathogenic species. All species of interest were eliminated in the RTE product with a faster rate of reduction in contrast to other heat treatments.

Challenges in Nitrate/Nitrite Reduction in Meat Products: Opportunities and Strategies for Reformulation and Processing

Author Information

Jan Roland G. Molina[1, 2], Jesús María Frías Celayeta[2], Declan J. Bolton[3], Cristina Botinestean[1]

[1]Food Industry Development Department, Teagasc Food Research Centre, Ashtown, Dublin 15, Ireland
[2]Environmental Sustainability and Health Institute, Technological University Dublin, Dublin 7, Ireland
[3]Food Safety Department, Teagasc Food Research Centre, Ashtown, Dublin 15, Ireland

Abstract

Traditionally, nitrites and/or nitrates are used in products like ham, bacon, and fermented sausages for preservation, colour, flavour and antioxidant properties. Possibilities for reducing or replacing nitrites and nitrates in cured meat products, considering health concerns and evolving consumer perspectives, are currently being explored. These include natural nitrate/nitrite sources from plants and microbial fermentation, plant extracts, emerging processing technologies, innovative packaging, and hurdle technology. Natural sources like broccoli, spinach, and lettuce might have a potential to provide a "clean" meat product label. Alternative ingredients such as raspberry, tea polyphenols, red grape pomace, and microbial pigments could possibly be used for colour, antioxidant, and antimicrobial properties.

The recent legislative changes by the European Commission have set significantly lower limits for nitrites and nitrates as food additives to reduce consumer exposure to carcinogenic nitrosamines while still protecting against foodborne pathogens. EU food business operators have two years to adapt to these new limits. This legislative aspect adds a critical dimension to the discussion, influencing the direction of research and the development of alternative solutions. This is a challenging task for the Irish processed meat sector, as these ingredients play important techno-functional role to the meat products' quality, safety and identity.

Optimization studies and combinations of natural alternatives are needed to replicate synthetic nitrites' multifunctional role. Investigation into packaging technologies, including nitrite-embedded films and active edible films containing natural extracts, colour stability enhancers, and microbial resistance, is underway.

While progress has been made in exploring alternatives, challenges persist in ensuring applicability across a diverse range of meat products and promoting industrial sustainability. Further research is crucial to address these challenges and advance the development of nitrate/nitrite-free or reduced meat products.

Unravelling Molecular Markers of Meat Flavours for Cultured Meat Production

Author Information

Gemma Lyons[1], Victor Sayous[2], Marion Gaff[2], Jesus Frias[1]

[1] Environmental Sustainability and Health Institute, Technological University Dublin, Grangegorman, Dublin 7, Ireland [2] Gourmey, Paris, 75011, France

Abstract

Over the last 10 years, cultured meat (also known as cell-based or cultivated meat) research and development has gained momentum, with academic and industrial stakeholders racing to provide the next generation of animal proteins in a scalable, sustainable and profitable manner (1,2). The challenge to re-create meat products of all possible textures and flavours, indistinguishable from traditional meat, is an enormous biochemical expedition. The essence of what makes sensory experience is hard to describe and even harder to quantify. Many of these flavours result from centuries-old animal handling practices (3). From an Irish perspective, our world-renowned beef quality is a culmination of our heritage, climate, rich soil and grassland (4).

To produce cell-based meat that upholds a reputation of this calibre, the biochemical signature of the product must be understood. Advances in analytical chemistry over the past few decades provide the tools to quantitate the chemical compounds of meat (5). Hundreds of potential flavour precursor molecules can be identified, however the real quest is understanding which ones have the impact worth focusing on for cell-based meat product developers.

In this work, we demonstrate how the role of the conditions of animal rearing can provide insights into what shapes our meat flavour chemistry, using a traditional French meat product as a model; *foie gras*. The profile of volatile compounds and their possible precursors are monitored at several time-points throughout the production (force-feeding) of foie gras. A statistical approach is described to correlate the data from several analytical techniques to identify chemical drivers of *foie gras* flavour. This approach will influence the future design of media and process conditions for cultured meat production, and indeed may be transferred to the development of Irish cell-based meat products.

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Regulatory requirements of new sustainable proteins for food, feed, and non-food biobased applications.

Author Information

Nicola Sunderland, Lubna Ahmed and Catherine Barry-Ryan

Environmental Sustainability and Health Institute – ESHI, Greenway Hub, Grangegorman, Dublin 7.
School of Food Science and Environmental Health, Technological University Dublin – City Campus, Grangegorman, Dublin 7.

Abstract

With the global population estimated to reach ten billion by 2050 it is expected that there will considerable challenges faced in producing enough high-quality protein to sustain the growing population, without further increasing the pressure on our natural resources. As it stands the EU relies heavily on imported protein sources, including soybeans, for food and feed leaving Europe at risk of a protein gap. As such, there is a now a pressing need for the EU to find new sustainable protein sources that are high quality, healthy and have the desired functional properties that meet consumer needs and expectations. The InnoProtein project seeks to promote protein self-sufficiency in Europe by investigating the application of novel sustainable protein sources. The project aims to examine the suitability of Single Cell Proteins (SCPs) including bacteria, microalgae, and fungi, as well as entomological alternatives for use as high-quality proteins for food and feed applications. While proteins outside of this spec will be utilised for non-food biobased applications. Furthermore, InnoProtein has adopted a circular, zero waste approach to protein production and intends to valorise any residual biomass that is produced. A study of the regulatory requirements for new sustainable proteins has been conducted to determine their relevance to the project. This was done using keyword searches on national, European, and international databases including EUR-Lex, FAOLEX and Codex Alimentarius. An inventory of regulations and guidelines for the InnoProtein project has been developed which assesses the regulatory requirements for the project. This inventory is extensive, providing regulatory information on the broader aspects of the project as well as those related to specific tasks. This inventory will be a reference guide for the InnoProtein partners, providing them with the necessary regulatory information they may require. These regulations will be closely monitored, and the inventory updated as the InnoProtein project progresses.

Novel fermentates can enhance key immune responses associated with viral immunity

Author Information

Dearbhla Finnegan, School of Biotechnology, Dublin City University

Abstract

Fermented foods have long been known to have immunomodulatory capabilities. In recent years the emergence of the novel research area of fermentates, derived from the lactic acid bacteria of dairy products, has found that such functional food components can modulate the immune system. In our research we have used skimmed milk powder to generate novel fermentates using *B. infantis*. Using macrophage models of both J774.A1 and bone marrow derived macrophage (BMDM) we induced a viral immune response in the cell via activation with loxoribine (LOX). We demonstrate here that these fermentates can enhance key immune mechanisms that are critical to the immune response to viruses. We show that our novel fermentates R0419, and Aerobic R0033 can positively impact on cytokine and chemokine secretion, nitric oxide production, cell surface marker expression, and phagocytosis in macrophage models. We demonstrate that fermentates R0419, and Aerobic R0033 increase the secretion of cytokines IL-1β, IL-6, TNF-α, IL-27, and IL-10, promote an M1 proinflammatory phenotype for viral immunity via NO induction, decreases chemokine expression of MCP, increase cell surface marker expression, and enhance phagocytosis in comparison to their starting material.

These data suggest that these novel fermentates have potential as novel functional food ingredients for the treatment, management and control of viral infection.

Response Surface Optimisation for Solid-Liquid Conditions for the Extraction of Polyphenols from Perennial Rye Grass (Lolium perenne L.)

Author Information

Verhulst, E.P[1,2], Brunton, N.P[2]., and Rai, D.K [1]

[1]Department of Food Biosciences, Teagasc Food Research Centre Ashtown, Dublin 15, D15KN3K, Ireland.
[2]UCD School of Agriculture and Food Science, University College Dublin, Dublin 4, D04 V1W8, Ireland.

Abstract

Grassland crops, such as perennial rye grass (PRG) are typically produced for the purpose of rearing agricultural livestock. However, given the large volumes of biomass that grassland represent and global shortages in protein production, grassland may have the potential to contribute towards food security as an alternative source of proteins. Proteins are recovered from plants through a series of steps involving the extraction of the protein, such as isolation and drying. This results in the accumulation of residual, non-protein biomass. The biomass contains a rich source of antioxidants known as 'polyphenols' which possess health benefits to include anti-inflammatory, anti-diabetic and anti-cancerous properties. Polyphenols may demonstrate a potential within the area of food or nutraceutical products.

Within this study, PRG was assessed to identify optimal extraction conditions with regard to percentage ethanol (EtOH) concentration (60-80%), time (15-45 minutes) and temperature (40-80°C) parameters for the recovery of antioxidants in PRG using response surface methodology (RSM). Preliminary studies showed that the concentration of polyphenols increased with ethanol concentrations up to 80% EtOH. Longer extraction durations from 30-45 minutes also resulted in higher recovery of polyphenols. The optimal extraction parameters proposed by the RSM were: 80% EtOH at 80°C with extraction time of 30 minutes. At this condition, the total phenolic content yielded 4.36 mg GAE/g dry weight, which was 4-fold higher than the least TPC proposed with the model.

Meat Replacement in White Pudding by Pea Protein

Author Information

Farhan ALI[1], Prabhav Moholkar[1], Maurice O'Sullivan[1], Seamus O'Mahony[1], Joseph Kerry[1]

[1]Department of Food and Nutritional Sciences, University College Cork, Ireland

Abstract

The global population is anticipated to reach 9 billion by 2050, leading to a surge in meat consumption. However, traditional meat production poses challenges such as high resource demand, environmental stress (deforestation, loss of biodiversity, and damage to hydrogeological reserves), and adverse health effects such as coronary heart disease, and diabetes, with red meat even classified as carcinogenic by the World Health Organisation. These factors have focused on sustainable, environmentally friendly, and healthier meat replacements using plant-based meat alternatives. Pea protein stands out as the most prominent among plant proteins owing to its high yields, accessibility, and processability (high protein & low-fat content). The purpose of the present study is to develop a novel, more sustainable white pudding by replacing pork meat with varying concentrations of pea protein isolates (PPI, 84% protein) and Micro-ionized pea protein isolates (MPPI, 84.2% protein) and to evaluate the impact of these protein isolates on the compositional, pH and sensory profile of the white pudding and identifying the optimal replacement level that was acceptable to consumers. Sequential replacement of pea proteins was carried out in 10% increments from 10% to 50% for both PPI and MPPI, resulting in 11 products with 5 of each PPI and MPPI and 1 control (100% pork meat). Products with higher plant protein concentrations (50%) exhibited increased protein, ash content, and pH values but were noted to be crumblier, drier, and spicier leading to lower overall acceptance. Moisture content was decreased while fat remained constant. There was no significantly accepted sample in PPI formulation However PPI could replace up to 10% of pork meat (118.3g) without a noticeable loss in sensory attributes. Notably, the white pudding with a 20% MPPI (238.1g) formulation was significantly accepted in terms of sensory qualities, highlighting an even more promising alternative to 10% PPI utilization.

The Microbiome Modulating Effects of Superheated Steam (SHS) Treatment of Fibres

Author Information

Fatma Koc[1, 2, 3] , Ivan Sugrue [1], Kiera Murphy [1,2] , Stefano Renzetti [4], Martijn Noort [4], Paul Ross [1,3], Catherine Stanton [1,2]

[1]APC Microbiome Ireland, University College Cork, Cork, Ireland
[2]Food Biosciences Department, Teagasc Moorepark Food Research Centre, Cork, Ireland
[3]School of Microbiology, University College Cork, Ireland
[4]Wageningen Food & Biobased Research, Wageningen University & Research, Wageningen, Netherlands

Abstract

While a high fibre diet is associated with a healthy gut microbiome, daily fibre intake is below than the recommended level with associated negative impact on gut health. SHS treatment is a method used to inactivate oxidative enzymes and increase bioactive compounds in bran fibres. In this study, wheat and oat bran fibres were subjected to SHS treatment to investigate the potential prebiotic effect of SHS treated fibres. Brans were processed using SHS treatment prior to in vitro digestion, followed by exposure to MicroMatrixTM in vitro fermentation. 16S rRNA sequencing, and short chain fatty acid analysis with GC-FID system were used to assess changes in gut microbiota and metabolomics, respectively. Alpha, beta diversity and taxonomic composition analysis were performed to explain microbiome data. SHS treatment of both bran fibres resulted in significant differences in beta diversity and in several taxa, compared to untreated controls. PCoA revealed significant separation between SHS-treated oat and non-treated (NT) oat, and between SHS-treated wheat and NT wheat. Ruminococcus and Lactobacillus were higher in SHS-treated oat than NT oat, while Escherichia_Shigella and Alistipes were lower in SHS-treated oat group than NT oat group. Butyrate was higher in SHS treated oat than NT oat. Our results indicated that the microbiome modulating effect of oat bran was more effective than wheat bran. In conclusion, SHS treatment of bran fibres results in improvement of their prebiotic potential.

Dietary guidelines for health and sustainability in Europe: Guidelines vs reality

Author Information

M.C Conway[1], S.N McCarthy[1]

[1]Dept Agrifood Business and Spatial Analysis, Teagasc Food Research Centre, Ashtown, Dublin 15

Abstract

Food based dietary guidelines (FBDG) provide information on the foods necessary for a healthy diet. Food consumption contributes approximately 30% of total greenhouse gas emissions (GHGE); however, relatively few countries have incorporated sustainability measures in their FBDG. The aim of this study was two-fold, firstly to determine the extent to which national food consumption compares to FBDG across a selection of European countries. Secondly, this study aimed to evaluate the GHGE associated with this consumption and the consequences if national diets complied with FBDG. Published studies from European countries were included if national food consumption data (g/day) was reported alongside the GHGE associated with this intake (gCO2eq/day), and FBDG were available. Food consumption data were aggregated into food groups and compared to FBDG recommendations. The GHGE of national food consumption was computed, and the potential changes in both consumption and associated GHGE to meet FBDG was estimated. Seven European countries (Ireland, UK, Italy, France, Finland, Sweden, and the Netherlands) were included. Consumption of fruit, vegetables, and legumes was below FBDG recommendations for all countries. In Ireland, Italy, France, and the Netherlands, dairy consumption was below recommendations with no specific dairy recommendations for the other countries. Consumption of animal protein, including red meat, is above recommendations in all countries. Discretionary foods, which should be eaten sparingly, account for substantial amounts of food consumed. Plant-based food groups contributed lower GHGE than animal-based foods. In all countries, the "meat, poultry, fish" group was the highest GHGE contributor (35-53%). Up to 33% of GHGEs can be attributed to discretionary foods. Changes to food consumption are required to meet FBDG including increased consumption of plant-based foods, and dairy foods. Decreases in discretionary foods, alongside decreases in meat, poultry and fish are needed to meet guidelines and will also result in a reduction in GHGE.

An investigation on the effect on high pressure processing on the water holding capacity of dry aged beef.

Author Information

Mary Ann Kent [1,2], Anne Maria Mullen [1], Eileen O'Neill [2]and Carlos Álvarez [1]

[1]Department of Food Quality and Sensory Analysis, Teagasc Food Research Centre Ashtown, Dublin, D15 DY05, Ireland, Dublin, Ireland

[2]School of Food and Nutritional Sciences, University College Cork, Western Road, Cork, T12 YN60, Ireland, Cork, Ireland

Abstract

Dry ageing involves storing cuts of meat, unwrapped, under controlled conditions (in terms of temperature, humidity and airflow) to produce a characteristic premium flavour and texture. High pressure processing (HHP) which involves the application of high pressure (up to 600 MPa) to muscle has been found to effect the water-holding capacity (WHC) of wet-aged muscle. Changes in the WHC of muscle has implications on cook loss and the juiciness of the cooked product. The aim of the current study was to examine the effects of HPP on the WHC of dry-aged meat by measuring drip loss, cook loss and myofibrillar fragmentation at different time points during dry aging. Bovine *Longissimus lumborum et thoracis* sections were subjected to 200 MPa for 20 min, at an ambient temperature. Treated and non-treated (control) meat was dry aged in refrigerated conditions (4 °C, 80% HR) for 28 days post-treatment. HPP significantly increased drip loss over the 28 days storage period, while drip loss reduced over time of storage. No significant differences were observed in cook loss between pressure treated and control samples at any aging time point; however, cook loss decreased significantly over time. The higher drip loss of muscle that underwent high pressure processing could be linked to higher protein denaturation and fragmentation. Myofibrillar fragmentation was found to be significantly higher at all time points following pressure treatment compared to control samples. Further sensory analysis should be carried out to determine if increased drip loss has an impact on flavour and juiciness of meat.

Under pressure: High pressure processing and quality attributes of dry aged beef

Author Information

Mary Ann Kent [1,2], Anne Maria Mullen [1], Eileen O'Neill [2]and Carlos Álvarez [1]

[1]Department of Food Quality and Sensory Analysis, Teagasc Food Research Centre Ashtown, Dublin, D15 DY05, Ireland, Dublin, Ireland

[2]School of Food and Nutritional Sciences, University College Cork, Western Road, Cork, T12 YN60, Ireland, Cork, Ireland

Abstract

Dry ageing involves hanging post rigor muscle under controlled temperature, relative humidity and airflow conditions generally for 14-28 days to produce premium beef with a characteristic texture and flavour. Since the water holding capacity of muscle has been found to decrease following the application of high pressure, high pressure processing (HPP) is a post-mortem intervention that could potentially increase the rate of water loss during dry aging and thus, potentially accelerate the dry ageing process. The aim of the current study was to examine the effects of HPP of muscle prior to dry aging on the quality of dry aged beef, in particular tenderness, colour and lipid oxidation. Bovine *Longissimus lumborum et thoracis* sections were subjected to 200 MPa for 20 min, at an ambient temperature. Treated and non-treated (control) samples were dry aged in refrigerated conditions (4 °C, 80% HR) for 28 days post-treatment. High pressure treatment significantly increased the shear force values of muscles compared to control muscles. When colour was measured following blooming, lightness (L* values) and blueness (b* values) were significantly higher in pressure treated muscles when compared to control muscles. Redness (a* values) was significantly higher in pressure treated muscles at day 0. However, no significant differences in redness (a* values) were observed between pressurised and control muscle after 14 days of storage. Pressure treatment promoted lipid oxidation, as TBARS values were significantly higher in pressure treated muscles, compared to control muscles, throughout the aging period. Overall, the HPP conditions used in this study had a negative impact on the quality parameters of dry aged beef.

Impact of heating on in-vitro protein digestibility and functionality of fava bean protein isolates

Author Information

Neha Sharma, Shannon Gwala and Andre Brodkorb

Teagasc Food Research Centre, Moorepark, Fermoy, P61 C996 Co. Cork, Ireland

Abstract

The substitution of diet from animal protein with sustainable alternative such as protein-rich beans mitigates the climate footprint associated with food production. Fava beans (*Vicia faba L.*) are one of the most consumed legumes worldwide and are good and sustainable source of protein. The present study evaluates the effect of thermal treatment on the in vitro protein digestibility and functionality of fava bean protein isolates obtained from three different pre-extraction processes.

(1) A conventional fava bean protein isolate was extracted from milled whole fava beans. (2) Fava bean protein isolates was extracted from dehulled and milled fava beans. (3) Pre-soaking of the beans was included in the process. Protein extraction was carried out by alkaline solubilization and isoelectric precipitation. Free amino acid composition was analysed by high-performance liquid chromatography (HPLC). Structural differences in the heated (~95°C for 30 min) and unheated isolates were determined using Fourier Transformed Infrared spectroscopy (FTIR). The solubility (%) of the heated and unheated protein isolates was determined at pH 3 and pH 7. The heated and unheated protein isolates were subjected to *in vitro* digestion by applying the harmonised INFOGEST static method. Thereafter, digestibility of the proteins was evaluated using the Proxy in vitro digestible indispensable amino acid ratio (Sousa et al., 2023) by using total protein digestibility obtained by Total Nitrogen and Free amines analysis.

Preliminary results showed the impact of heating affected the secondary structure of the protein isolates from Fava bean as shown by FTIR spectra. Solubility was significantly higher for the heated samples than that of the unheated samples ranging from 3.93%-8.68% at pH 3 and 3.412%- 11.37% at pH 7, respectively. Whereas, for total protein digestibility, heating did not showed a high impact on the digestibility but it clearly has more proteolytic effect than digestibility without heating process. The comprehensive heat treatment did not adversely decrease the quality of fava bean protein isolate, but somehow improved the digestibility of it.

Assessing perennial ryegrass as a source of proteins with potential functional properties for food applications

Author Information

Sara Pérez-Vila[1,2], Mark A. Fenelon[1,2], James A. O'Mahony[2], Laura G. Gómez-Mascaraque[1]

[1]Teagasc Food Research Centre, Moorepark, Ireland;
[2]School of Food and Nutritional Sciences, University College Cork, Ireland

Abstract

There is undoubtedly an increasing demand of novel sources of proteins nowadays. Accordingly, there is a need to look towards alternative protein enterprises to improve the diversification of protein resources. In this context, green leaves are proposed as a source of RuBisCO (ribulose-1,5-bisphosphate carboxylase/oxygenase), this is an enzyme that takes part of the photosynthesis and is considered the most abundant protein in leaves (Ellis 1979). Due to its abundance in Ireland, perennial ryegrass was explored as starting material to produce grass protein concentrates (GPC) that were characterized and used to produce model food systems.

Two different extraction approaches were used to produce GPCs, differing in the absence or presence of a heating step (at 50°C for 30min) aimed to improve the removal of chloroplast material. RuBisCO was identified as the main protein in both GPCs (by HPLC and electrophoresis) and they presented a complete amino acid profile covering the FAO (2011) recommendations, showing the potential to become an alternative source of proteins for food applications with a good nutritional value.

Regarding the differences between both GPC, the incorporation of an additional heating step to improve the removal of chloroplast residues considerably decreased the extraction yield, but resulted in improved solubility, over 90% from pH 6. This greatly influenced the emulsifying capacity and stability of the GPCs, which performed as good as WPI at non-acidic pH. On the other hand, a greater extraction yield was achieved without the heating step, although the resulting GPC had limited solubility, which restricted its applications as emulsion stabilizer. Overall, remarkable differences were observed between both GPC. Both presented potential for development of novel plant-based food products enriched in protein; however, final application of the protein extract should be considered in the selection of the extraction method.

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Extraction and Profiling of Non-Volatile Dietary Biomarkers in Forage and Feed linking Flavours in Meat

Author Information

Sarah E. Kearney[1, 2], Nigel P. Brunton[1] and Dilip K. Rai[2]

[1]School of Agriculture and Food Science, University College Dublin
[2] Department of Food Biosciences, Teagasc Food Research Centre Ashtown, Dublin

Abstract

Three feed samples, Perennial Ryegrass (PRG), Good Silage (GS), and Bad Silage (BS) were assessed. Samples were extracted using 60% acetone with a solid: liquid ratio of 1:20 for approximately 20 hours. Samples were filtered and the filtrates were collected to assess for free or unbound phenolic contents. The residual precipitates were subjected to alkali and acid hydrolysis to release bound phenolics. Optimisation of acid and alkaline hydrolysis was carried out using 5M HCl and 0.75M NaOH, respectively. The Total Phenolic Content (TPC), Total Flavonoid Content (TFC), and Total Carotenoid Content (TCC) were determined in the unbound and bound feed extracts, and these were subsequently subjected to UPLC-MS/MS screening for individual polyphenols using an in-house library. For the three feed samples, the TPC, TFC and TCC data showed a similar trend, where Free Phenolics > Alkaline Hydrolysis > Acid Hydrolysis. At least 32 phytochemicals were detected in the feed samples using the UPLC-MS/MS. A maximum of 17 phytochemicals were detected in the free phenolic extracts, a maximum of 12 phytochemicals were detected in the alkali hydrolysed extracts, and a maximum of 7 phytochemicals were found in the acid hydrolysed extracts. Although alkali hydrolysis was more efficient than acid hydrolysis, both processes will be performed for the feed samples used in this project to better reflect gastric conditions in ruminants. Future work will involve using similar feed samples to produce beef and lamb in locations around Ireland, and thereby to establish dietary biomarkers, i.e. phytochemicals, originating from the feed regime. These dietary biomarkers will be used to discriminate lamb and beef grazed in pasture-fed in targeted locations in Ireland. These could then be used to contribute to Protected Designation of Origin (PDO) claim for the meat products from these locations in adherence to EU Regulation No 1151/2012.

Meat enriched with fibres and other nutrients obtained from ungraded green leafy vegetables

Author Information

Shivam Yadav[1,2], Cristina Botinestean[1], Uma Tiwari[2], Carlos Álvarez[1]

[1]Teagasc Food Research Centre, Ashtown, D15 DY05 Dublin, Ireland.
[2]School of Food Science and Environmental Health, Technological University Dublin, City Campus, Dublin, Ireland.

Abstract

The Irish agricultural system yields a diverse array of leafy vegetables around the year, with the primary production season spanning from July to March. During the harvest of these seasonal products, a substantial quantity of co-products or discarded materials is generated due to imperfections in appearance and quality. However, these perfectly edible materials contain valuable functional components like fibres, proteins, carbohydrate, minerals, and phytochemicals. To harness these resources, a bio-refinery methodology will be implemented, leveraging a fusion of conventional technologies with innovative methods such as ultrasound, microwave, combined ultrasound-microwave, and high-pressure processing, etc. The extracted ingredients will undergo characterization for their compositional, nutritional, technological, and biological properties. Subsequently, these ingredients will be utilized to reformulate various meat products like burger patties, breakfast sausages, and cooked hams, chosen based on the technical properties and applications of the ingredients—serving as protein extenders/replacers, emulsifying agents, binding agents, preservatives, or for fiber enrichment, among other roles. The impact of these novel ingredients on the final properties of the reformulated meat products, including texture, colour, oxidative status, emulsion stability, shelf-life, and sensory attributes, will be thoroughly assessed. Finally, a life cycle analysis will be conducted to evaluate the environmental feasibility of this approach. The primary objective of this approach is to alleviate the environmental strain caused by agricultural waste by repurposing the valuable components of unused seasonal sources, ultimately developing healthier meat products for human well-being and environmental sustainability.

Genomic and Phenotypic investigation into a collection of *Bifidobacterium longum* strains destined for probiotics use

Author Information

Peter Myintzaw[1,3,4], Ghjuvan Grimaud[1,3], Aoife N. O'Donovan[1,3,4], Paul Ross[2,3], Catherine Stanton[1,3,4]

[1] Teagasc Food Research Centre, Moorepark, Fermoy, Co. Cork, Ireland;
[2] University College Cork, Cork, Ireland;
[3] APC Microbiome Ireland, University College Cork, Cork, Ireland;
[4] VistaMilk SFI Research Centre, Teagasc Moorepark, Fermoy, Co. Cork, Ireland

Abstract

The gastrointestinal commensal *Bifidobacterium* is known to contribute immensely to the host's health. Studying the genetic and phenotypic traits of *Bifidobacterium* is integral to gaining insights into its functionality, safety, and potential applications. In this study we explore a number of *B. longum* strains (n = 6) about their growth, Exopolysaccharides (EPS) production capability and their genetic traits which implicate the suitability of the strains to be used in combo as probiotics. All strains exhibited different growth rates in an appropriate media duration of 45 hours with the specific growth rate ranging from 0.016 ±0.001 to 0.019 ±0.001 h^{-1}. When one cell-free supernatant was used to the other in a well diffusion assay, no evidence of antagonistic properties was observed. Screening of EPS production by streak plate method on MRS agar supplemented with 2.5, 5, and 10% glucose, fructose, sucrose, galactose or lactose respectively reveal that all strains produced EPS at 2.5% but strain variation in growth at 5 and 10 %. Pan-genome analysis using Roary revealed that the pan-genome of this set of strains contains 1157 core genes, 157 softcore genes, 1369 shell genes, and 2213 cloud genes. There is no evidence of virulence genes or plasmids present in all of the strains. RAST annotation revealed that 15–16% of annotated genes are involved in carbohydrate metabolism. A BLAST search on human milk oligosaccharides (HMOs) utilisation gene cluster using *Bifidobacterium longum subsp. infantis* ATCC 15697 genes (blon_2331– 2361) in our strain database, revealed that all strain harboured at least four different HMO utilising gene clusters with 75.4–100% identity. These results highlight potential suitability of *B. longum* to be used as probiotics. An additional *in vivo* model is now being considered to assess the probiotic potential with regards to weight gain, blood lipid profiles and changes in the gut microbiome in early life.

Physical properties of jams and marmalades

Author Information

Irem Calis, Anna Lesniak-Podsiadlo and Ronan Gormley

School of Agriculture and Food Science, University College Dublin, Belfield, Dublin 4

Abstract

Good rheological and colour properties of foods are essential for consumer acceptance. In the current study gel strength, fracture force, brittleness, adhesiveness and colour were measured in 27 jam/marmalade samples purchased in three chain stores (A, B, C) comprising raspberry jams, blackcurrant jams and marmalades with three replicates (3x3x3 trial design). Gel properties were measured (in-jar-centre point) using Stable Micro Systems (SMS) equipment (cylindrical probe; diameter 1.27cm; test speed 2mm/sec; penetration depth 2cm). Gel strengths for raspberry jams from the three stores were similar and ranged 68.8-73.2g-force. Corresponding values for blackcurrant jams were different ($p<0.001$) i.e. 44.3 (Store A), 117.5 (Store B), 82.3g-force (Store C) as were marmalades, 167 (Store A), 28.3 (Store B), 25.2g-force (Store C) ($p<0.001$). Fracture force values were higher than those for gel strength which in turn were higher than adhesiveness values but the pattern/shape of SMS plots for all three were similar. A correlation matrix for gel strength, fracture force and adhesiveness showed a strong relationship ($p<0.001$; correlation coefficients >0.91). °Brix values were similar (circa 60%) except for low sugar marmalade (Store C) at 37%. pH values were similar and ranged 2.80-3.10. Store A products were labelled as preserve (raspberry, blackcurrant) and marmalade; Store B as jam (raspberry, blackcurrant) and Seville orange marmalade; Store C as preserve (raspberry), conserve (blackcurrant), and Seville orange low sugar marmalade. Fruit contents of raspberry jam, blackcurrant jam and marmalade were 56, 40, 35% (Store A), 50, 40, 20% (Store B) and 55, 50, 55% (Store C) respectively. Minolta red/yellow (a*/b*) colour ratios were similar for raspberry jam (all stores) and marmalade (all stores) but the ratio for blackcurrant jam was lower in Store B ($p<0.001$). The results from the study show that there was considerable variation for most of the variables/parameters tested for both jam/marmalade types and for stores.

Recovery of High Protein Extracts from Lemnaceae (Duckweed sp.) by Ultrasound-Assisted Enzymatic Extraction

Author Information

Jack Prendeville [1]*, Laura M. Hinds [2], Marcel A.K. Jansen [3], Brijesh K. Tiwari [4]

[1] Teagasc Ashtown Food Research Centre, Teagasc, Ashtown, Dublin 15, Ireland.
[2] School of Biological, Earth and Environmental Sciences, University College Cork, Distillery Fields, North Mall, Cork, Ireland.

Abstract

Due to the increased demand for plant-based protein, duckweed has gained considerable interest as a sustainable source. Protein was extracted from dry duckweed biomass (Lemna minor) using a cocktail of carbohydrase enzymes (Viscozyme L). An enzyme concentration of 0.2% was employed with a sample to solvent ratio of 1:20. Three extraction protocols were compared: ultrasound (US) at 100% amplitude, 25 kHz, 10 min, orbital shaking (OS) for 4.5 hrs, 40°C, 95 rpm and a combination of both together (US-OS). Overall protein yields for the US, OS, and US-OS methods were 50.04 ±6.78%, 45.48 ±2.75%, and 31.07 ±9.85%, respectively. There were significant differences ($P > 0.05$) between the effectiveness of each extraction method. Energy consumption was reported as 0.052 ±0.016, 1.01 ±0.29 and 1.062 ±0.234 kWh for US, OS, and US-OS respectively.

After filtration and centrifugation, three fractions were obtained: residue, supernatant, and pellet. For the US, OS and US-OS methods, the supernatants had a dry matter content of 1.79 ±0.14, 2.21 ±0.50, and 2.45 ±0.25 g/100 mL, respectively. Supernatants obtained for the US, OS and US-OS methods had protein levels of 23.93 ±6.80%, 25.62 ±6.49%, and 24.36 ±0.95%, respectively. The pellet after centrifugation for the US, OS and US-OS methods had protein levels of 44.72 ±0.51%, 41.42 ±2.26%, and 43.02 ±0.46%, respectively. The US method provided the pellet with the highest protein value. The remaining biomass residue after the US, OS and US-OS extractions had protein levels of 12.13 ±1.24%, 10.73 ±0.87%, and 28.69 ±1.04%, respectively. This research shows duckweed is a source of protein, the novel ultrasound method yielded the highest protein content while using the least amount of energy.

Microencapsulation of hybrid wall matrix using low methoxyl pectin with whey protein isolate and grass protein concentrate

Author Information

María Gloria Mora Sáenz[1, 2, 3], André Brodkorb[1], Laura G. Gómez-Mascaraque[1]

[1]Teagasc Food Research Centre, Moorepark, Ireland
[2]Scientific and Technological Nucleus on Bio resources (BIOREN), Chile
[3]Universidad de la Frontera, Chile

Abstract

Encapsulation is an approach to enrich food products. Polysaccharides and proteins are commonly employed as encapsulating systems as they are suitable for human consumption. Currently, there is a focus on plants as an alternative source of protein. Green leaves provide a complete profile of essential amino acids, considered important for novel food applications with good nutritional value. The aim of this work is to develop a wall structure for microcapsules using pectin and whey protein isolate (WPI) or grass protein concentrate (GPC) as a novel material to encapsulate potentially bioactive compounds.

Four different commercial citrus pectins (TS2710 DM 30%, TS2711 DM 35%, TS2712 DM 40% and one amidated TS2705 DM 35%) were used as a wall matrix with WPI in three different ratios 3:1, 1:1, 1:3 pectin: protein respectively, to compare the protein content and the loss percentage of protein. TS2710 1:1 WPI ratio showed the higher encapsulation percentage (96.2%) and the lower percentage loss (8.3 ± 4.04%).Then according to external gelation in $CaCl_2$, the microcapsules were made by Encapsulator:, using CP Kelco pectin, TS2710 1:1 mixture with WPI or GPC. The structural characterization was carried out using FTIR and Confocal Laser Scanning Microscopy (CLSM) the sample were stained with fast green for show the presence of protein. In addition, the protein content was evaluated by Dumas method.

The CLSM images confirmed the entrapment of the proteins within the pectin matrix in the microbeads. .The FT-IR spectra of microbeads confirms the component's interaction, where three amide bands and the main functional groups of pectin were found, and the spectrum of the supernatant showed protein fraction loss from the microbeads, according to its nitrogen content value. This study shows that CLSM, FTIR and Dumas techniques were useful to confirm the protein presence into the microcapsule and to evaluate the remainder protein in the supernatant.

The effects of active modified atmosphere packaging on the shelf life of strawberry (cv. centenary) fruits

Author Information

Mehraj Fatema Z. Mulla[1], Tigist Shonte[1], Lorraine Foley[2], Michael T. Gaffney[1], Shivani Pathania[1]

[1]Food Industry Development Department, Teagasc Food Research Centre, Ashtown, D15 DY05 Dublin, Ireland

[2]Environmental Sustainability and Health Institute, Technological University Dublin, Ireland

Abstract

Modified Atmosphere Packaging (MAP) has gained attention from commercial horticulturalists, in extending the shelf life of bulk and retail packaged fresh produce. Storing strawberries in an atmosphere with high carbon dioxide levels at low temperatures could prolong their postharvest storage life alongside it can also preserve the flavour or aroma of strawberry (cv. centenary) fruits. Active MAP is a process wherein the atmosphere is created inside the package by adding or removing gases from the interior of the container. Therefore, the impact of active MAP technology on gaseous composition (oxygen and carbon dioxide) inside the package and the quality parameters i.e brix, color, electrolyte leakage and density profile of fresh strawberries (cv. centenary) was studied to determine optimum MAP atmosphere to extend the shelf life of strawberries. Strawberries packaged in commercial packaging with micro holes under normal atmosphere was studied as a control sample. Three gas compositions were selected with CO2 concentration from 15 to 30% and the O2 concentration from 7.5 to 10%. Freshly harvested strawberries were packaged in a PET punnet with PET/PE as lidding film using an automatic tray sealer. The packaged strawberries were stored at 4 ^{o}C. Storage studies revealed a significant variation in the gaseous composition of all treatment samples. Control sample showed visible fungal growth on 13th day of packaging wherein 45% of strawberries were spoiled on the same day. Greater electrolyte leakage was observed for the treatment with higher (30%) CO2 and commercial packaged sample with higher O2 concentration on 13th day of storage ($P<0.001$). No significant difference in density value was observed for all the treatments. L* value showed a decreasing trend in strawberries stored in commercial package with higher O2 concentration for 13 days, while it was well maintained in the treatments containing 7.5 and 10% O2 up to 15 days. The strawberries packaged in 7.5 and 10% O2 showed a marketable shelf life up to 15 days.

Theme 6: Zero waste approaches to address food loss and waste

Effect of multiple freeze-thaw cycles on rheological, textural and functional properties of industrial Gouda cheese

Author Information

Digvijay[1, 2], Alan L. Kelly[2] and Prabin Lamichhane[1]

[1]Teagasc Food Research Centre, Moorepark, Fermoy, Co. Cork, Ireland
[2]University College Cork, Cork, Ireland

Abstract

Freezing cheese is widely used to extend its functional and consumable shelf life, reduce waste and to promote its global trade. However, freezing causes dehydration of the casein network as well as the formation of concentration gradients within the cheese matrix, leading to an adverse impact on its texture-functional attributes. In a first such study (in triplicate), industrial Gouda cheese samples (ripened – 9 months) were subjected to multiple freeze-thaw cycles (FTC) to map the impact of wide-scale temperature fluctuations, inevitable during frozen storage, shipping, and distribution, on its microstructural, rheological, textural, and functional properties.

The samples were subjected to 1 – 5 cycles of blast-freezing (-18 ±1°C) and overnight thawing (6°C) for 5 consecutive days. No significant changes were observed in moisture, fat, or pH, but the colour values (L, a, b) changed significantly. Small-scale dynamic oscillatory shear tests indicated that at higher frequencies (ω>1 Hz), both storage and loss modulus reduced upon increasing the freeze-thaw cycles; however, at ω<1 Hz, there were no significant differences among the treatments. Increasing the intensity of temperature fluctuations led to reduced hardness, springiness, adhesiveness, and chewiness, indicating weakened textural compaction. CLSM (confocal laser scanning microscopy) images indicated that larger fat pockets got redistributed into smaller elongated fat pools, which could be due to structural expansion leading to the squeezing of fat pools during freezing and thawing.

Fourier Transform Infrared spectroscopy indicated spectral shifts in the amide-I and amide-II regions (wavenumber 1500–1700), indicating changes in proteins' secondary confirmations (α-helix, β-sheets, and random coil) due to FTC treatments. These microstructural changes, along with moisture readjustments, could have led to increased melting and oiling-off in FTC samples, as indicated by the modified Schreiber test and the oil-ring test. Thus, for preserving functionality, minimizing thermal shock during frozen storage and distribution of ripened Gouda cheese is important.

Evaluation of the potential for Silicon biostimulant formulations to improve mushroom quality

Author Information

Orla O'Halloran[1], Lael Walsh[1], Joy Clarke[1,2], Michael Gaffney[1], Helen Grogan[1].

[1] Horticulture Development Department, Teagasc Ashtown Research Centre, Dublin, Ireland
[2] Department of Biology, Maynooth University, Maynooth, Co. Kildare, Ireland

Abstract

Steady increase in global food demand and food waste levels place a need for crops to be grown with a focus on reducing waste and increasing shelf life. Biostimulants have shown some promise in improving crop growth and reducing need for reliance on chemical formulas such as fertilisers and pesticides. Unlike chemical products, biostimulants are based on natural extracts or beneficial micro-organisms to improve crop response. Biostimulants focus on aiding crops to resist abiotic stresses, and support growth and productivity. The EBIC (European Biostimulants Industry Council) reports the nutrient uptake being increased by 25% due to the use of biostimulants. Silicon, used as a biostimulant, has been found to benefit crops under stress, improve stem strength, and to increase plant resistance to some fungal pathogens. The impact of silica acid on mushrooms is unknown. As a valuable horticultural crop in Ireland, any improvement to the crop's production would be beneficial to the sector. The aim of this research was to examine the effects of silica, under different formulations and rates, on mushroom qualities including; yield, post-harvest quality, shelf life, and susceptibility to fungal pathogens. An experimental mushroom tunnel was set up with 0.2m² crates growing Agaricus bisporus (commonly known as cultivated mushroom). Three commercially available Silicon products were tested at different rates (x0.1, x1, x10) using of the recommended label rate as it pertains to plant crops as guidance. Preliminary data suggests an effect on yield and growth rate of mushrooms between flushes, but no other effect on mushroom quality. Future work will focus on the growth rates and texture of mushrooms when exposed to different silica formulas and rates. Further investigations on impact of different biostimulant concentrations on fungal and bacterial pathogens are planned. This research aims to optimise mushroom produce and prevent food loss due to disease incidence.

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Optimization of chitin extraction from crab shells and its characterisation

Author Information

Rifna Elenjikkal Jerome [1], Brijesh K Tiwari [1]

[1] Teagasc Food Research Centre, Ashtown, Dublin, Ireland.

Abstract

The crab meat is relished globally by seafood lovers and health seekers owing to its delicate texture, rich flavours, and nutritional aspects. Commercial crab processing industries generate discards of up to more than 50 % of the raw material comprising outer shells, exoskeletons, organic matter, and other solid wastes. Interestingly, this processing waste has been identified to be a rich source of chitin, the second most ample polysaccharide in nature subsequent to cellulose. The objectives of the present work was to optimize and assess chitin extraction conditions for crab shells. The extraction process was carried out at numerous process parameters regarding HCl concentration (0.5-1.5), time (1-24hrs), NaOH concentration (0.1-1), and temperature (30-90 ˚C) for highest chitin yield, demineralization efficiency and deprotenization efficiency. The modelling and optimization of the process variables were performed using the tools artificial neural network and response surface methodology respectively. The value of mean square error demonstrated the least and R^2 showed highest value for artificial neural network model when related to model developed using response surface methodology. The extracted chitin were characterized with FTIR, SEM micrographs their viscosity, whiteness index, and mineral content. Therefore, identification of extraction condition of chitin in its most pure form will be regarded as a competent technique to develop chitosan loaded with natural antimicrobials revealing its potential application in food, pharmaceutical and, nutraceutical formulations with increased stability.

Assessment of novel sustainable packaging system using recycled PET on shelf life of Irish Agaricus bisporus mushrooms

Author Information

Tigist T Shonte, Mehraj Fatema, Helen Grogan, Michael Gaffney, Orla O'Halloran, Lorraine Foley, Shivani Pathania

Food Industry Development Department, NPCFC, Teagasc Food Research Centre, Ashtown, Ireland

Abstract

Sustainable packaging alternatives such as recycled polyethylene terephthalate (rPET) support circular economy approach by the use of recycled materials in food packaging. Synergistic use of recycled materials with green preservation technologies such as modified atmosphere packaging (MAP) can result in positive outcomes in terms of maintaining quality and shelf life of Irish horticultural produce. Mushroom industry is the largest horticultural sector in Ireland. In 2022, approx. 68,000 tonnes of white button mushrooms *(Agaricus bisporus)* were grown in Ireland, contributing ~130 million euros to the Irish economy. This study aimed at evaluating the effects of two-perforation size of 0.53 mm on the top film (TFP) and bottom tray (BTP) on quality and shelf life of mushroom. rPET packages were thermoformed using 85 °C forming/90 °C bottom pre-heating, product filling followed by 90 °C top pre-heating and 175 °C sealing temperatures. Respiration rate (gas composition within the packaging system), colour, total soluble solids (TSS), density and electrolyte leakage of strawberry samples were evaluated at one-day interval during one-week storage period at 4°C. An increasing trend in electrolyte leakage (24.95-55.41), CO_2 (4.23-8.0%) and O_2 (13.6-15.28%) concentrations, whereas a decreasing trend in L* value (93.8-91.84), TSS (6.96-4.5 °Brix) and density (690–634 g/cc) of mushrooms were observed during the storage period. Specifically, electrolyte leakage increased by 24% in BTP and 40% in TFP, TSS decreased by 11% in BTP and 34% in TF, density decreased by 2.7% in BTP and 8% in TFP resulting in a better quality maintenance of mushrooms packaged in two perforation of 0.53 mm on BTP compared to TFP of the same number and size of perforation. In conclusion, the passive MAP with two holes of 0.53 mm on the bottom tray with no holes on the film provided an optimized atmospheric conditions for maintaining the quality and extending the shelf life of mushrooms.

Dough rheology properties as affected by the inclusion of oat-drink residue flour: a multivariate analysis approach

Author Information

Mahmoud Said Rashed[1,2], Eimear Gallagher[3], Jesus M Frias[2], Shivani Pathania[1]

[1]Food Industry Development Department, Teagasc Food Research Centre, Ashtown, Dublin 15, Ireland
[2]Environmental Sustainability and Health Institute, Technological University Dublin, Dublin, Ireland
[3]Food Quality and Sensory Science Department, Teagasc Food Research Centre, Ashtown, Dublin 15, Ireland

Abstract

While the whole world is currently experiencing a transition to consume plant-based food products, the increasing accumulation of side streams from these products could cause another sustainability dilemma. The present work was carried out to evaluate the rheological properties of bread dough as affected by the incorporation of dry fractionated oat-drink residue flours as a functional ingredient. The optimum condition for incorporating fibre-rich ingredients in bakery products were identified. Mechanically dry fractionated dried oat-drink residue flours, having particle sizes of F1: >150, F2: 150-224 and F3: 224-300µm were blended with bread wheat flour at 10%, and 20% substitution levels. The blended flours were assessed for their rheological characteristics. Results from Mixolab, Rapid Visco Analyser, and gel texture properties revealed that 10% F3 blends showed the highest peak viscosity; 20% inclusions of F2-type flour exhibited the highest water absorption value (66.7%), whereas 20% F2 flour showed the lowest gel hardness level compared to control. Principle component analysis showed that the specific surface area of the flour composite is a key feature determining dough rheology properties. Additionally, cluster analysis results revealed that, within measured parameters, flour-pasting properties are the most representative of the flour composite characteristics. Moreover, it was possible to discriminate between different flour composites based on their rheological properties. The TOPSIS-Shannon entropy approach was used to compare different flour formulations to improve the nutritional quality of the bread formulation while maintaining the structural quality of the bread. The comparison between different flour composites via TOPSIS analysis revealed that 10% F2 flour was the best formulation when compared with the other flour composite, to produce fibre-rich bread. It was observed that the effect of inclusion level outweighs the effect of particle size distribution on incorporated fibre-rich ingredients. Results highlight the potential application of fractionated oat-drink residue flour in modifying wheat flour properties for producing different fibre-rich bakery products.

Extrusion of plasticized pectin/polycaprolactone blends for food packaging applications

Author Information

Monjurul Hoque[1,2], Matias Menossi[3,4], Amar Mohanty[3,4], Manjuri Misra[3,4], Joe Kerry[2], Shivani Pathania[1]

[1]Food Industry Development Department, Teagasc Food Research Centre, Ashtown, D15 KN3K Dublin, Ireland

[2]School of Food and Nutritional Sciences, University College Cork, T12 R229 Cork, Ireland

[3]Bioproducts Discovery and Development Centre, Department of Plant Agriculture, Crop Science Building, University of Guelph, 50 Stone Road East, Guelph, Ontario N1G 2W1, Canada

[4]School of Engineering, Thornbrough Building, University of Guelph, 50 Stone Road East, Guelph, Ontario N1G 2W1, Canada

Abstract

In this study, thermoplastic pectin and polycaprolactone were extruded to prepare compostable packaging materials. For plasticization of pectin, 30 and 40% w/w glycerol was added into the pectin and mixed using a kitchen mixture for 30 min at room temperature. The mixture was kept overnight in a zip-lock plastic bag to facilitate uniform distribution of glycerol into pectin powder. Further, 1% citric acid, 1% stearic acid, and 10% w/w water were added into the above mixture, uniformly mixed in a kitchen mixture for 15 min, and kept for 3h. The plasticized pectin was blended with PCL at 25:75 and compounded using LabTech extruder using a temperature profile of 90/90/90/90/90/90/90/85 °C. The prepared pellets were dried to a moisture content of less than 1 wt% (wet basis) and then cast into films by using a cast film extruder (Randcastle) at 105/105/105/105/110 °C. The developed films were homogenous and demonstrated high compatibility between PCL and pectin. The FTIR studies showed the formation of new bonds influencing thermomechanical properties. The mechanical studies showed that the TS of PCL film was 19.97 ± 2.38 MPa and decreased to 3.99 ± 0.59 MPa. Similarly, elongation at break (EAB) of the PCL film decreased from 524.0 ± 40.29 % to 136.19 ± 11.66 %. Some of the properties of PCL/pectin composite film decreased compared to neat PCL film. Still, it is optimal for food packaging due to the cost reduction and expected fast compostability.