Thursday, May 18

Keynote Presentation

How to encourage putting technological innovations for food producers and food SMEs into practice: The experience of the EU-FAIRCHAIN project

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The transition towards a more sustainable food system requires that small and mid-sized enterprises increase their economic competitiveness and resilience and strengthen their innovation capacity. However, their specific needs are often neglected, especially in innovation processes that focus on large and expensive improvements.
The H2020 project FAIRCHAIN (https://www.fairchain-h2020.eu/) proposes development and adaptation of innovations that strengthen the position of small and mid-sized farmers and processors in the food chains and allow the scale-up and expansion of the production of nutritious food at a regional level. This talk will present some technical and technological innovations devoted to SMEs and producers, which may increase food sustainability. As examples, the development of an innovative healthy fermented whey-based drink to upgrade the value of whey, a co-product of cheese manufacture ; the development of an innovative packaging machine for liquid or viscous food products in the dairy and fruit & vegetables and dairy sectors, using green or sustainable packaging materials and designed to fulfil hygienic requirements ; or the development of the blockchain technology to improve the traceability, transparence and information sharing, that is of major importance when increasing the number of intermediaries in the food chain.The main challenges in adopting these innovations have been identified thanks to a co-creation process and assessment framework. This talk will discuss these challenges, as well as supporting and hindering factors for putting innovations into practice and possible solutions for their successful implementation.

SESSION 1

Involvement of Stakeholders to Contribute to Resilience of Food Systems

Integrating principles of resilience into the regulation of food systems

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After back-to-back crises, our food systems are in a state of chronic stress. Between pandemic disruptions, armed conflict, extreme weather events, labour shortages and inflation, to name a few, the sustainability of our food supply chains is repeatedly challenged. Focusing specifically on the protein sector (both animal and plant-based), this presentation will explore what chronic stress look like in the agri-food sector and what is needed from the regulatory, business and technology sectors to improve resilience in the future. The presentation will provide an overview of key regulatory actors in the Canadian protein sector as well as the legislative and regulatory instruments governing agricultural practices. It will then consider potential avenues for legal reform that could be leveraged to mitigate existing disruptions and pave the way for more sustainable food systems going forward.

Valorization of by-products from the marine biomass processing for the bio- and agri-food sectors

Ariane Tremblay[1], Pauline Potier[1], Gabriel Vollet Marson[1], Laurent Girault[2], Francis Désilets-Mayer[2], Alain Doyen[1], André Marette[1], Geneviève Pilon[1], Réjean Drouin[3], Cynthia Amico[3], Lucie Beaulieu[1]

[1]Université Laval, [2]Merinov, [3]Cintech

The marine-processing industry in eastern Québec generates thousands of tons of by-products annually, mainly crab and lobster shells. INAF, Merinov and Cintech have developed different ways of promoting these by-products, in the form of ingredients and high-quality foods with high added value for human and animal consumption. This project has brought together marine-processing industries and food companies that are interesting to manufacture and market the ingredients developed in this project. The means of valorization selected allowed us to target large volumes of by-products and cover different levels of technical expertise, making it easier for industrial partners to integrate the processes into their operations. As a first step, the methods for separating the different types of by-products, their stabilization and a first transformation have been identified to offer a range of intermediate products. Subsequently, further separation and processing steps have enabled the various functional ingredients to be used by the industrial partners or incorporated into food products.

The direct economic benefits of this project are considerable. For marine industries in Québec, the production of intermediate products from stabilized by-products would allow plant operations to be extended beyond the fishing season, which would extend the employment of several seasonal employees. By sparing several thousand tons of organic matter from fields or landfills, by keeping them in the food chain, the project will significantly improve the competitiveness of industries and their environmental performance. Product diversification will also leave the industries less vulnerable to price fluctuations that affect their primary production. For food businesses, this project will provide access to quality raw materials and ingredients of Québec origin, at a reasonable cost, but also to manufacture and offer their customers innovative products that are original, functional with strong added value.

Food loss and waste: a first portrait for Quebec

Laura Cicciarelli[1]

[1]Recyc-Québec

How much food is wasted in Quebec? At what stage of the chain are losses and waste the most important? What type of food is thrown away the most? These questions are finally answered in the very first Quebec study to quantify food loss and waste, unveiled in 2022 by RECYC-QUÉBEC.

This first portrait specific to Quebec becomes a reference tool to guide the initiatives put in place to reduce food loss and waste. It also makes it possible to identify specific targets and to prioritize interventions.

The study reveals, among other things, that 16% of the edible food that enters the Quebec bio-food system is lost or wasted. These foods are mostly fruits and vegetables (45%), cereal products and grains (25%), and meat and poultry (13%). This last category, although less imposing in terms of tonnage, represents 59% of the greenhouse gas emissions associated with lost or wasted food.

Changes to General Standards for the Labelling of Prepackaged Foods

Anne MacKenzie[1]

[1]Codex Alimentarius

The World Trade Organization administers disputes under the Sanitary and Phytosanitary (SPS) Agreement. The Codex Alimentarius was named under the SPS Agreement as the international reference body for food standards. Within the Codex Alimentarius Committees awareness has increased on the importance of adding a "greenness" dimension to the elaboration of Standards. This has been demonstrated in the Codex Committee on Food Labelling (CCFL) through a complete revision of "date marking" in the General Standard for the Labelling of Prepackaged Foods thereby potentially reducing food waste in Member Government Countries by referencing the Standard. The reference to several countries' concerns regarding food waste is examined.

Emergence of Food Health Ingredients

Aisha Issa[1]

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With scientific and technological progress, labour shortages and the fragility of supply chains, agrifood is the only activity that conditions the social fabric and crystallizes knowledge. As such, agrifood requires social and educational innovations in order to propose production and processing trajectories that support human and soil health. Soil concerns include land use and maintains viable and resilient ecosystems.

The systematic exploration of the possibilities of nutritional improvement of food proposals leads to nutritional approaches consisting of supplementing foods with nutrients and sometimes employing research in the genetic field, transgenesis.

Under the dual effect of increasingly sophisticated analytical skills and the sensitivity of public opinion and the disruption of supply chains, several risks arise during **the transformation process:** physical, chemical and bacterial risk. With the results of the health disaster in perspective, the conference will focus on **innovation and the trajectories of resilient territorialized food** to offer an alternative: the **hope of improving one's state of health and especially our living environments**. The question of the adoption of our food production and processing methods, which will result not only from the education given to the population, but also from **innovation** in preventive and functional nutrition, deserves reflection on possible models inspired by the collaborative economy.

SESSION 2

GastronomiQc Lab's International Rendez-vous - Sustainable Food in Gastronomy

Keynote Presentation

Living-Lab Mycotour: Towards a Sustainable Use of Wild Forest Mushrooms and Truffles as a Driver for Rural Development and Territorial Attractiveness

Fernando Martínez-Peña[1]

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Fungi provide most of forest biodiversity and play an indispensable ecological role in ecosystems. They also generate multiple socio-economic benefits and contribute to human health and well-being. Consequently, they help to achieve the United Nations Sustainable Development Goals (SDGs) and are a source of nature-based opportunities aligned with European policy priorities.

One of the main ecosystem services provided by wild edible mushrooms is mycotourism. This is a specialised tourism product attracting individuals to a territory with high mycological productivity (mushrooms and truffles) to enjoy harvesting and mycological culture which eventually converge towards gastronomy.

Mushrooms are highly appreciated in the cuisine of many European countries for their diversity of aromas, textures, flavours, colours... But also, for being rich in bioactive compounds with important therapeutic qualities such as antibiotics, anti-tumour, immunomodulators, anti-inflammatories, neuronal protectors and immune system boosters. They stand out for their nutritional properties and are perfect for gluten-free and vegan menus, as they are an alternative and sustainable source of protein with low environmental impact. However, the culinary offer has not yet incorporated most of the potential values of mycological resources, and both the stakeholders involved in the mycotourism experience and local facilities need to adapt to the diversity of mycotourist profiles, to international tourism and to inclusivity.

The MYCOTOUR project proposes improving the mycotourism experience and exchanging best practices between territories through the creation of an experimentation environment or "Living-Lab" where users, scientists and stakeholders (local chefs, harvesters, travel agencies, mycological guides…) will be able to co-create culinary products and services tailored to consumers. Aspects such as the organisation and training of stakeholders, digitalisation, territorial attractiveness, sustainable management, adaptation to climate change, internationalisation, inclusiveness, and citizen science will be addressed in this Living-Lab.

Reterritorialization of food: socio-economic and environmental analysis for three categories of products from territorialized food chains in two regions in France

Hélène Simonin[1], Gaëlle Petit[2]

[1] Institution Agro Dijon; UMR PAM, [2] Sciences Po Renne; UMR Arènes

The environmental performance of territorialized sectors is still little addressed by scientific research. The increase in food production yields paradoxically makes it possible to reduce the environmental impacts of products thanks to economies of scale, but also to lead to significant environmental impacts due to the geographical and logistical choices of the value chains. In addition, the results of analysis of the environmental impacts of agri-food chains are product-dependent. The good or bad performance of the quantifications of the environmental impacts of different food systems would in fact depend on determinants linked to the management and organization of the systems, i.e. the value chains. The objective of this research is to analyze the major determinants of the environmental performance of local sectors of processed food products and to question the conditions for the environmental and social sustainability of these sectors. In particular, it must be interested in the question of the impact on the environmental performance of the organizational and technological choices of the food chains tested. The life cycle analysis results for three product categories highlight the absence of a direct correlation between proximity between actors and environmental performance. For two products, beer and processed vegetables for mass catering, packaging is one of the stages of the life cycle with the greatest impact on agricultural production. With regard to the effect of the scale of production, it is shown that the increase in volumes leads to an economy of scale on certain impacts but can have rebound effects on other impacts. Thus, there would rather exist an optimal scale compromise with regard to the environmental performance of FATs. In perspective, the discussion calls for a better consideration of the role of organized proximity (including trust) between actors, which we believe determines environmental performance.

The process of creating and developing a digital tool identifying product sustainability for institutional foodservice: social innovation, participatory research and Living Lab.

Alain Girard[1]

[1]GastronomiQc Lab - ITHQ

In 2020, the Quebec government established a national strategy for the purchase of Quebec food products, which requires institutional food services (IFS) to adopt purchasing targets. However, research conducted by the GastronomiQc Lab shows that the managers and buyers of these institutions do not have a clear vision of their purchases because of the lack of traceability of products and of information from distribution chains and because there is no management analytical tool to work with (1). This fact is a major obstacle to increasing the purchase of more sustainable products in this sector, which spends more than two billion dollars annually on food products (2). This same research indicates that a management tool allowing the analysis of IAS purchases would allow significant progress in terms of responsible purchasing for all IAS in the health, education, early childhood care, and public service networks. The development of this tool, which will take a web application form, is underway and will be completed at the time of this communication. This presentation will put forward the development of this tool by showing that it is based on both captured and concerted social innovation initiatives and participatory research (action research) embedded in Living Labs. Finally, this presentation will show that the researcher's presence directly involved in the development of a technology with all stakeholders is not only an innovative data collection strategy on a complex problem but also contributes to the project's success thanks to the knowledge generated in real-time and reinvested in the development process for the benefit of all stakeholders (3).

Red lentil purees as fat replacers in mayonnaise sauces: characterization and application

Auriane Feroussier[1,2,3], Rémy Couture[1,2], Guillaume Morin[1,2,3], Véronique Perreault[2,3,4], Sylvie L. Turgeon[1,2,3]

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The emergence of plant-based low-processed food ingredients has been triggered by environmental newcoming challenges for the food industry. This presentation aims at demonstrating the capacity of red lentil puree, an easily prepared protein-rich ingredient, to replace oil in mayonnaise sauces.

Mayonnaises were made using red lentil puree to reduce oil from 80 wt% to 60, 40 and 20 wt%. Purees at different solid contents (15, 20 and 25 wt%) were added. Optical microscopy and static light scattering were used to characterize the mayonnaises' structure, combined with textural and rheological analyses. The results indicate that purees acted as fillers in the oil droplets emulsified network. The rheological properties varied according to the oil content (lowest thixotropy and yield stress at 40 wt% oil). Firmness showed higher values at higher purees solid content.
To investigate further how the purees could stabilize the emulsion, lentil ingredients were studied based on the rheology of their fractions composed of different particles. The cotyledon cells and cell clusters fractions were highly elastic and unstable to dilution, oppositely to the cell fragments fraction. This suggests that the big complex structures bring rigidity to the purees while the small particles contribute to the network cohesion. The effect of solid content and pH (4 and 6.5) on textural properties of purees was also investigated, showing a higher firmness at high concentration and at pH 4 (the pH of mayonnaise), which may be explained by increased macromolecular aggregation and close-packing between cell-wall particles in these conditions. Understanding the network structure would help to optimize the use of lentil purees as ingredients in low pH products.

For the first time, complex protein-rich ingredients and their use in culinary products were investigated. This opens up new perspectives for the development of healthy clean-label ingredients destinated to restaurants or to the food industry.

Macroalgae from Quebec: Effects of the growth environment and processing on nutritional, bioactive composition, aromas and consumer behavior

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Macroalgae have a high nutritional value and many bioactive molecules. These qualities can vary depending on the growth environment and food processing. The first objective of this study was to determine the impact of macroalgae harvest months on the nutritional composition and bioactive potential of two macroalgae. The results indicate that *Saccharina latissima* (Sl) harvested in May contained more proteins, minerals, iodine, iron, and carotenoids; while those of June contained more carbohydrates and a higher potential of antioxidant peptides. The nutritional composition of *Palmaria palmata* (Pp) would be more appreciable in June than in October, and the antioxidant potential would be equivalent between seasons. The second objective was to understand how food processing modified the nutritional composition and bioactive potential. Blanched Sl contained higher content of proteins and carbohydrates, but this processing promoted massive mineral leaching as well as steaming. The drying of Sl preserved the best quality and presented higher antioxidant potential of the peptides. For Pp, drying the specimens of June appeared to be the best treatment to preserve its quality. The third objective was to determine the aromas of Sl, Pp and *Ulva lactuca* involving sensory analysis with chefs. Tests were conducted and are being analyzed. Finally, the fourth objective was to determine if the appropriation of culinary skills on seaweeds would promote their consumption. Quebec consumers were divided into a group that participated in a single chef-supervised culinary workshop and another that received a gift bag with seaweeds. The culinary workshop showed encouraging results, with a significant increase in seaweeds cooking skills. However, no change was observed in attitude towards seaweeds. The study (through culinary workshops or gift bag) promoted the introduction of seaweed into the food habits. The use of a culinary workshop or a gift bag could be interesting strategies to develop seaweed consumption.

Identifying the factors affecting the implementation of food waste reduction strategies in independent restaurants: Moving towards eco-efficiency

Jade Lévesque[1,2,3,] Laurence Godin[4,2], Véronique Perreault[3,2,5], Sergey Mikhaylin[1,2,3]

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Reducing food waste (FW) has been identified as one of the best ways to achieve a sustainable food system1. The foodservice sector must make efforts in this direction as FW is omnipresent. Food waste reduction strategies (FWRSs) must therefore be implemented in food establishments in order to achieve a significant FW reduction. In addition, it represents an excellent opportunity for restaurants to improve their eco-efficiency by increasing their profits and reducing environmental impact. However, many factors can make this task difficult or impossible to accomplish. This study aims to identify the factors affecting the implementation of FWRSs to promote FW reduction with a view of maximizing restaurants' eco-efficiency. To achieve this, interviews with 16 independent restaurant owners, managers and chefs were conducted. They were asked about their perception of FW, eco-efficiency and FWRSs and their experiences of implementing FWRSs. The results of this study were then analyzed according to the framework of the social practice theory. The results of this study allowed the identification of 12 main factors affecting the implementation of FWRSs (e.g. consumer perception, staff creativity, lack of time). It emerges from the analysis that these factors diverge according to the characteristics of the restaurants (fine dining and family-style/casual dining). The main outcome is that FWRSs to be implemented in family-style and casual dining restaurants should aim to reduce FW at source (preventive approach) while it is also possible for fine dining restaurants to implement FWRSs that limit FW once it was generated (corrective approach). From this, the most promising ways to operationalize the reduction of FW according to the restaurant category were identified. This research will therefore guide restaurant managers in their efforts to reduce FW from the perspective of maximizing their restaurant's eco-efficiency.

SESSION 3

Food Losses and Waste Reduction

Towards Integrated Green Supercritical Fluid Biorefineries: A Case Study on Utilization of the Tomato Processing Waste

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With the rapid growth of the bioeconomy, major conceptual developments are occurring for biorefineries to maximize utilization of renewable resources. Supercritical carbon dioxide (SC-CO_2) technology has a major role to play in modern biorefineries. Currently, applications of the SC-CO_2 in industry are limited to extraction due to lack of information on its potential to replace various unit operations in food and material processing. Expanding the utilization of SC-CO_2 technology to the processing of high-volume commodity raw materials or wastes requires taking full advantage of the benefits of SC-CO_2 via a more integrated approach to process development, not just extraction alone.

In this presentation, our perspectives on how to integrate these unit operations to build supercritical biorefineries to generate various high value fractions and products will be presented. A case study on processing of tomato industry's waste will be presented. The tomato processing industry generates large amounts of waste that contain lycopene, but lycopene extraction requires the use of hazardous and toxic organic solvents. Moreover, lycopene degrades in the presence of light and oxygen, and has low bioavailability. Therefore, there is a critical need for clean methods to isolate lycopene from alternative sources and then convert it into stable and bioavailable forms. Our efforts to develop an integrated green extraction-reaction-particle formation process to separate and enrich lycopene in a more bioavailable form from tomato processing wastes and then to convert it to a high value lycopene formulation will be presented.

SC-CO_2-based biorefineries could play a key role in moving toward a sustainable bioeconomy via process intensification, by reducing waste streams, and increasing process efficiencies while providing a range of food and industrial products. It will be shown that SC-CO_2 extraction is not only a green extraction method, but also has the potential to improve health benefits of the extracted bioactive compounds.

Valorization of brewer's spent grain for the production of more sustainable materials

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[1]Université du Québec à Rimouski, [2]Centre de développement bioalimentaire du Québec

Global beer consumption is growing steadily, generating increasing quantities of co-products. Brewer's spent grain (BSG), which represents approximately 85% of these total residues, is currently undervalued. It is primarily used as an animal feedstock, which is logistically challenging as wet BSG has a short shelf-life and breweries are often at inconvenient distances from animal husbandry farms. Moreover, the demand for BSG as an animal feedstock is lower than the supply available. This project proposes a novel use for BSG as the starting material for biodegradable microbeads for personal hygiene products, as well as films for packaging purposes. In regard to bead production, the methodology is inspired by a process for the production of cellulose microbeads, which uses 3 to 7 wt% pretreated, purified cellulose in the beads' formulation. Our work reduces this to 1 wt% cellulose, with the remaining solid material obtained from a NaOH-ZnO-BSG slurry. A co-product of this method is a hemicellulose-rich acid filtrate, which can be used in other applications. As for the formation of BSG films, our protocol allows to valorize the entirety of the biomass in a single application, as opposed to the fractionation method elaborated for the production of microbeads. After acid hydrolysis pretreatment, we demonstrate that the acid-BSG mix can be directly dissolved by adding ZnO and a solution NaOH of a higher concentration. The resulting slurry is shaped into films by solution casting and may or may not be acid-regenerated. The resulting composite nature of the microbeads and films grants their interesting, albeit complementary, mechanical and chemical properties, characterized through various techniques. Consequently, our work simultaneously yields novel uses for the primary residue of an ever-growing industry and provides promissing alternatives to conventional plastic products.

Fighting Shelflation: Reduction of Food Loss and Waste at Consumer Level by Chemometric Characterization, Predictive Modelling of Organoleptic Quality Loss Throughout the Food Value Chain.

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Almost 40% of all the food produced in Canada become food lost and waste (FLW). 60% of this is attributed to the consumer. Almost half of FLW by consumers is fruit and vegetables. Recently, a decrease of the shelf life of produces is being reported by consumers, to the point of being coined “shelflation” in the media.

The quality of fruits and vegetables is never better than at the previous stage of its journey: the actions upstream have consequences on all the stages downstream. In this context, it is important to study the "propagation" of this degradation rather than putting the blame of the end user.

The journey of food through the value chain and the local, national and international distribution network is complex. It includes multiple interrelated stakeholders, covers great distances to reach remote and indigenous communities, suffer from large temperature differences (-30 °C to +35 °C for ground transport in Canada alone). Fruits and vegetables are greatly affected by those conditions. Several solutions aimed at limiting FLW are implemented throughout the value chain, but they have limited effect of the end-user shelf life as they are primarily aimed at increasing profitability for the actor implementing them. We therefore propose a global approach, aiming to quantify the impacts of the various actions throughout the food system in order to reduce FLW.

Numerous research articles on a number of fruits and vegetables report how hyperspectral imaging (HSI) technology can predict organoleptic quality through the use of chemometrics algorithms. This allows the development of methods aimed at the food industry. Using HIS and statistical algorithm (AI), we wish to be able to describe, diagnose, predict the quality of the produces and prescribe appropriate actions. On-going developments of such approach are presented.

Pilot-scale chitin extraction from shrimp shell waste using an enzymatic treatment and its application as a plant biostimulant

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Shrimp processing generates large amounts of waste every year, which becomes a major environmental concern for the environment due to its slow degradation. Shrimp waste contains valuable components such as chitin, protein, and pigments. Chitin, one of the most abundant polysaccharides in nature, is the most valuable component of the shell with a variety of applications[1].

The purification of chitinous shells from crustaceans has been studied by many authors and now represents an important economic activity, particularly in the context of shrimp shells value-enhancing schemes. However, commercial chitin isolated from crustacean shells is obtained after chemical treatments. The chemical procedures used imply the generation of undesirable corrosive by-products and allow only a small part of the biomass to be value-added[2]. In this study, we aimed to extract chitin from industrial shrimp processing waste on a pilot plant scale for use as an organic fertilizer and/or biostimulant in strawberry cultivation. The extraction was carried out in an enzymatic way involving two steps: a demineralization step, where the shells were ground and suspended in a medium acidified with H_3PO_4 and a deproteinization step using Alcalase. Calculated on the basis of the initial dry shell, the extraction yield of chitin was 14.37 ± 1.54%. Based on characterizations (FTIR, XRD, TGA, SEM), the percentage of ashes and proteins was drastically reduced under the conditions used below.

The enzymatic digestibility of the extracted chitin was lower than that of commercial shrimp-derived chitin[3], suggesting that this enzymatic extraction process would therefore prove more suitable to preserve the structural integrity of the polymer.

The pH and electrical conductivity (1:5 extract in water) were low, i.e., 4.0, and 39 µS/cm, respectively, and were low compared to other types of chitin from shellfish waste. In contrast to other types of chitin, the chitin was not phytotoxic for cress seedlings.

Vision and approach on application of advanced technologies in circular economy and reduction of food waste and loss: interest and limitations

Fadi Ali[1], Reza Zareifard[1]

[1]Agriculture and Agri-Food Canada

There is a big demand in the global food markets for fresh, natural, safe, nutritional and value-added foods especially from plant materials. The green emerging food processes promise to respond to these demands by delivering higher quality and better food products targeted consumer preferences. These techniques are a major key to the economical and environmental sustainability development of food industry as it perform well in decreasing energy and water consumption as well as green house gas emission (GHG). Researchers and industries have shown interests in innovative emerging food processing technologies such as ohmic heating, ultrasound, pulse electric field and microwave during the last decade. Most of these advanced technologies are still at various development stages and need more research works to reach a wide industrial adoption. The purpose of this oral presentation is to present the main topics of R&D activities using these technologies to respond on the priorities of circular economic from farm to fork to farm and reduction of food loss and waste. This includes an investigation of the factors that effect the efficiency of Advanced Technologies-Assisted Extraction (ATAE) and the eco-efficient scores of these technologies. An overview of the main equipment of emerging technologies available at the pilot plant and laboratory scale in the St-Hyacinthe Research and Development Centre (SHRDC) of Agriculture and Agri-Food Canada (AAFC) will be highlighted.

Friday, May 19

Keynote presentation

Food System Challenges - Solutions for a sustainable future

Rob Vos[1]

[1]International Food Policy Research Institute (IFPRI) - USA

Agricultural production is both strongly affected by climate change and a major contributor to it, with agriculture and associated land-use change and post-farm food sector activity accounting for one third of total global greenhouse gas emissions-more than for transport or industrial uses combined. Climate change is already affecting agricultural productivity, especially in tropical agriculture, putting pressure on food systems ability to meet growing and changing food demand.

Food systems have shown enormous innovative capacity in past decades, but to meet tomorrow's challenges, technological progress will need to change fundamentally to enable production practices that are climate-resilient and environmentally sustainable and are focused on efficient delivery for healthy diets.

Currently, food systems benefit from substantial government support, costing at least US$800 billion per year worldwide. Past and current support have an impact on greenhouse gas emissions by influencing the composition and location of output, and production practices.

In this presentation, I will review the evidence regarding key trends in the paradox of expanding food production and still rising food insecurity and malnutrition and how environmental concerns explain this paradox in part. I will subsequently focus on a range of technological innovations for climate-resilient food systems, reduction of food loss, and other interventions that would enable a sustainable food system transformation. I will close with a discussion of how "repurposing" existing agricultural support could provide market incentives for the adoption of green innovations and how this could contribute to achieving global societal objectives of abatement of climate change while improving food security and nutrition.

SESSION 4

Advancements in Green Food Technologies

Industrial Applications of Pulsed Electric Field in Extraction Process

Oleksii Parniakov[1], Stefan Toepfl[1]

[1]Elea Technology GmbH

Extraction process is one of the most used unit operations in the food industry. However, usually this process has low efficiency and not very sustainable. Traditionally, temperature and time has a big impact on the extraction yields but the usage of high temperature induce degradation of thermosensitive valuable compounds as well makes extraction not selective. Therefore, food industry is looking for the new ways of extraction enhancement. One of the most promising emerging ways to make extraction more efficient and sustainable is application of pulsed electric field (PEF) as a pre-treatment. The PEF is based on the mechanism of electroporation that due to the electro-compression forces induces the pores of different shape and diameter on the cell membrane, hence improving mass and heat transfer processes. Several studies have shown that PEF can increase the extraction rate and yield of desired compounds (Barba et al. 2020). Moreover, the application of this technology makes extraction more selective. It has been demonstrated that PEF can be used for practically all types of extractions, such as extraction by diffusion and by pressing. Nowadays, there are more and more food factories that are included PEF in their production line. For example, PEF treatment of olive paste increase the oil yield and reduces the process time and temperature, overall making this process more sustainable (Leone et al. 2022). This presentation will summarise all industrial applications of PEF in the extraction sector. Moreover, it would provide some insides of industrial benefits induced by PEF.

Ion exchange membrane processes for food processing: recent studies on detoxification, desalination, and colloid adjustment

Yang Zhang[1], Ming Tan[1], Yang Liu[1]

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In order to improve the fermentability of lignocellulose hydrolysate, a comprehensive detoxification process by employing advanced oxidation coupled with electrodialysis process (AOcoED) was developed and patented. Results show that more than 70% of total phenolic compounds, and 98% of organic acid in the pre-hydrolysate were removed by AOcoED, while the rate of sugar loss was only 2%.

Furthermore, Donnan Dialysis (DD) was developed for continuous removal of fluoride from Antarctic krill by using seawater or concentrated seawater as the receiving solution. Results show that RO concentrate (1.0 mol L-1 NaCl) got the highest fluoride removal efficiency (93.66%) with three stages at 0.01cm s-1 flow velocity. Results also showed a lower loss of amino acids and proteins in comparison of conventional methods. A techno-economic evaluation showed that 4.0 USD per ton of Krill solution can be expected by this DD process.

To reduce salt content and keep nutrients such as amino acids, ED was employed for soy sauce desalination. Results showed that the amino acid loss could be controlled to 13.8% under a desalination rate of 90% by using a tailored thin-film composite (TFC) cation exchange membrane.

To eliminate discharge problems of sugar cane hydrolysate and achieve resource recovery, sulfuric acid was removed and up-concentrated by a conventional ED. Results showed that the ED process could successfully reduce the sulfuric acid concentration to 0.02% with the sugar loss less than 5%.

Last but not least, our recent investigation found that colloidal size could be adjusted by ED: the applied electric field elevated the particle size by 54.52 times (119.9 ± 13.66 to 6537.5 ± 64.35 nm). When the initial feed concentration elevated 10 times (0.1 to 1 mol/L NaCl), the particle size upsurged 149-fold (5.99 ± 0.57 to > 150 μm), and flocs were generated.

Hybrid catalysis concept for the valorization of bio-based molecules to value-added chemicals for potential food-grade applications

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Current environmental considerations encourage the production of bio-sourced chemical intermediates through sustainable and environmentally friendly processes that require the design of new, custom-made, recyclable catalytic systems. The combination of biological catalysis and chemical catalysis, called "hybrid catalysis", is part of these new concepts that can meet the emerging challenges posed by the biomass valorization to produce platform molecules which could be used as substitute for synthesis of food-grades polymers, for cosmetic applications, etc. In this context, I presented two examples developed between UMRtBioEcoAgro for enzyme biocatalysis and UCCS for heterogeneous catalysis: an innovative hybrid process two-pots one-step for obtaining 5-hydroxymethylfurfural (5-HMF) from D-glucose, and a one-pot one-step hybrid process which allows a direct conversion of 5-HMF into AMFC (*5*-aminomethyl-*2*-furancarboxylic acid), combining immobilized transaminase and heterogeneous catalyst.

Concerning the first example, the compatibility issues related to the coupling of the D-glucose isomerization enzyme and the chemical dehydration catalyst have been solved by the implementation of a liquid membrane carrying the D-fructose. A hybrid catalysis process was then implemented in a specially designed innovative "H-reactor". This process made it possible to remove the lock related to the compatibility of the operating conditions and to exceed the yield limitation related to the thermodynamic equilibrium of the isomerization reaction, theoretically about 50%.

Concerning the second example, the process includes an intermediate reaction product which is 5-aminomethyl-2-methylalcohol furfural (HMFA) obtained through the action of transaminase onto the aldehyde moiety of the HMF. The remaining alcohol function is then oxidized into carboxylic acid by the heterogeneous catalyst. This process resulted in a 77% yield of the desired product, with 100% conversion of 5-HMF and only one by-product, FDCA, another high value compound. A one-pot/one-step process is currently being developed using a newly discovered thermostable transaminase.

Novel synbiotics from lactic acid bacteria and natural exopolysaccharides are effective in inhibiting gastrointestinal E. coli

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Synbiotics are an important source of emerging functional food ingredients that can be produced sustainably. While various synbiotics have been studied, often with demonstrated antibacterial effects (1-3), synbiotics obtained by enriching probiotics with naturally occurring exopolysaccharides (EPS) have never been studied. This study aimed to assess the proteolytic activity of three synbiotics consisting of autolysin-rich probiotics enriched in their respective EPS on the gastrointestinal pathogen *Escherichia coli*.

The autolytic activity of *Lactococcus lactis* (from Université de Moncton's Food Research Center), *Bifidobacterium lactis* and *Lactobacillus casei* (from commercial yogurts) was determined in sodium phosphate and citrate buffers, with or without NaCl (2%) to assess the effect of the medium. Synbiotics were prepared by enriching each probiotic strain with their respective EPS (1% or 2% w/w). The effect of synbiotics, probiotics and EPS alone on *E. coli* lysis was measured by determining the inhibition zone diameter.

All the probiotics studied were rich in autolysins. Their autolytic activity was significantly influenced by the medium conditions. Moreover, *L. lactis* autolytic activity was superior ($p<0.05$) to that of *L. casei* and *B. lactis*, regardless of the buffer used. The anti-*E. coli* activity of the synbiotics was superior to that of the probiotics alone. EPS alone showed no inhibition of *E. coli*. Their synbiotic activity did not differ significantly among strains. However, symbiotic activity increased with EPS concentration, regardless of the probiotic considered.

The novel synbiotics studied effectively inhibited *E. coli* growth *in vitro*. These findings suggest that EPS addition to probiotics is a promising strategy to enhance the bioactive action of autolysins and the functional properties of the resulting synbiotic ingredients. EPS addition can serve as emerging technology for the control of gastrointestinal pathogens. Further studies are needed to assess the efficacy of EPS-enriched synbiotics against different pathogens.

Identification of microbial strains with potential biopreservation activity in cheeses against contaminating microbiota

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Within the frame of replacement of chemical preservatives to the extend shelf-life of food stuffs and concomitantly meet the consumers expectations in terms of naturalness, the isolation and characterization microorganisms fulfilling criteria defined in the Biopreservation guidelines is nowadays of major importance. Cheese ecosystems are known for their rich and microbial diversity which is associated with their typicity, aromatic profiles and technological properties. In spite of numerous studies, the cheese ecosystems remain endless sources of novel microorganisms with potential applications as starters, probiotic, as well as hurdle flora because of their antimicrobial activities.

To this end, we have undertaken an exhaustive study with aim to compare the microbiota content of two typical artisanal cheeses from the north of France (Bourle Roncquoise and Carré du Vinage) and two cheeses from Quebec (Cheddar and a semi-soft cheese). After which, we proceeded with the isolation of 800 microbial isolates and tested their potential of inhibition against 3 yeasts, 4 undesirable filamentous fungi, 9 pathogenic bacteria, including 4 Gram-positive bacteria and 5 Gram-negative bacteria. This screening enabled to select 17 isolates endowed with anti-yeast activities and 11 isolates endowed with antibacterial activities. These antagonistic microorganisms were then identified molecularly by sequencing of the 16S rRNA gene (bacteria) or the ITS region (yeast).

The microorganisms deemed suitable for the biopreservation of cheeses are currently tested on a curd cheese model. Our data will perhaps suggest their use as potential bio protecting agent in the future.

Exploring emerging technology at pilot plant scale – from a food safety point of view

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Climate change is largely attributed to greenhouse gas emissions to which food production and processing contribute. The growing world population is also putting pressure on the food system. Emerging technology can be part of the solutions for tacking environmental, economical and social challenges. The rapid pace of innovation and new technology offer a flourishing playground for scientists. On the other hand, one of the major barriers to the commercial adoption of technologies by the food industry is regulation. Many countries require premarket safety approval including nutritional, toxicological, allergenicity and chemical considerations to ensure consumer safety. The food industry is not likely to undertake this journey alone. To this end, booming scientific researches on this subject could be used to gather relevant scientific data to accelerate the adoption phase. Exploring the key elements to address when exploring a new technology is then necessary with regard to food safety. Pulsed electric field to treated milk at pilot plant scale will be used as a case study. When harnessing novel technology, it is of interest to compare with the conventional treatment aimed to be replaced to ensure that the novel technology is adequate for the food matrix to be studied. The targeted end food attributes including food safety-related one have to be known. It is noteworthy that the processing environment, cleaning procedure, equipment design are one of those to take also in consideration. Standardized protocols among research team could help to build comparable data. Emerging technology offers then a great potential for producing sufficient, safe and sustainable food which scientists can play a role in science-driven data with the aim of accelerating the pace of commercial adoption.

Session 5

Multicriteria Sustainability Assessment

Economic-environmental tradeoffs of energy efficiency improvement in craft brewery

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More and more US consumers are willing to support craft beer because of its wide variety of styles. However, due to small production scale, energy efficiency is a great challenge to craft breweries. Instantaneous water heater (IWH) is a potential hot water supplier for beer brewing to profit craft breweries because it works by rapidly heating the water when streaming through the heater. This study developed a model integrating techno-economic analysis (TEA) and life cycle assessment (LCA) to evaluate the economic and environmental consequences of replacing steam boiler with IWH in an US commercial craft brewery. The main variable costs of craft beer included labor, packaging and raw materials. Although IWH saved the labor and gas costs, its investment was unprofitable to the brewery studied. Raw material production and beer processing were identified as the environmental hotspots of craft beer. IWH was found to decrease the global warming potential associated with gas use by ~3%. Increasing the brewery's annual barrelage not only justified the IWH investment but also reduced the environmental footprint of beer. This integrated TEA-LCA model is a holistic tool for craft brewers to assess energy efficiency improvement opportunities for an economically viable and environmentally sustainable beer production.

Reduction of environmental impacts of caffeine extraction from guarana by using ultrasound assistance

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Extraction of caffeine from guarana seeds was studied, comparing conventional extraction (CE) and ultrasound-assisted extraction (UAE). Preliminary studies allowed selecting operating conditions for kinetics studies of both processes (water solvent, 10:1 mL/g liquid-solid ratio). UAE allowed strong enhancement of caffeine yields and process kinetics compared to CE at room temperature. At higher temperature (50 and 70 °C), the advantage of UAE over CE was still clear for extraction kinetics, but not for maximal extraction yield. Performing Life Cycle Assessment of both processes permitted to highlight ultrasound assistance ability to reduce extraction duration (up to 4.9 times), energy consumption (up to 6.2 times) and environmental impacts (more than twice for some impact categories) compared to CE at the same studied temperature. Environmental impacts of CE and UAE processes were studied in more detail using three different functional units. It contributed to a better knowledge of extraction process of caffeine from guarana seeds and allowed selecting the operating conditions maximizing benefits provided by ultrasound assistance. The environmental gains of UAE over CE at high temperature were relatively small when targeting a caffeine extraction yield close to the maximal attainable (at this temperature), but increased strongly for lower target yields.

Exploring the Beliefs of Quebec Consumers About Environmental Impacts of Food

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Food is a major contributor to household environmental impacts. Environmental labelling is one of the tools proposed to guide household's choices towards options that minimize these impacts. However, there is little data on knowledge, uses and preferences regarding this type of labeling among Quebec consumers. The objectives of this study are to characterize their preferences and behaviors in relation to environmental labelling on food products through an exploratory literature review on eco-labelling and to evaluate the beliefs of Quebec consumers about the environmental impacts of their food. For this purpose, a questionnaire was developed based on the work of Hartmann (2021) to evaluate the level of knowledge of Quebec consumers and to explore their behavioral responses. N= 218 were collected through the online platform LimeSurvey. Our results show that 68% of consumers underestimate the production impact and 60% overestimate the transport impact, especially when one of the proposed choices was local. Our results also show that Quebec consumers have a basic knowledge to compare two products with only one different variable but have difficulty in the more complex situations, however, more common. Moreover, the literature shows that labels can make it possible to modify the behavior of consumers, but they rarely use life cycle analysis and do not allow the consumer to compare different products. Consumers seem to be ill-equipped to make environmental choices related to food. It would therefore be interesting for research to investigate the implementation of meta-labels based on life cycle analysis, which would allow consumers to have a clear vision of the impact of their food purchase and to compare one product to another.

Milk alternatives from an environmental and nutritional point of view – Life Cycle Assessment of plant-based beverage: Hemp milk and derived products

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Milk consumption in humans lasts longer than in other mammals' species. Today consumers' awareness of the environmental burden that some products carry keeps growing. Thus, they look for alternatives that are more environmentally friendly and nutritionally similar. One example of growing demand can be found in plant-based beverages, as these have a lower environmental impact, though not nutritionally comparable to bovine milk (1). Though these beverages bring benefits (e.g.: overall lower environmental impact), there are also disadvantages (e.g.: high water consumption in almond beverages). One promising plant is industrial hemp, as all parts of the plant can be used in different ways (e.g.: fibres for paper production, seeds for animal feed or milk production). This type of plant does not require many inputs and is capable of mitigating soil desertification. Though some studies show the potential of hemp milk as a more sustainable alternate plant-based beverage, there are no LCA studies. This research aims to explore the lack of data, using fat and protein-corrected beverage (1kg of FPC beverage). The boundaries are from farm to industry gate, leaving out transportation, retail and consumer-related impacts and, data was collected from licensed agricultural farmers, databases and literature. The methods used were ReCiPe 2016 Midpoint (H) (V1.06) and Cumulative Energy Demand (V1.01). It was found that hemp milk has a high impact on human carcinogenic (7.61E02kg 1,4-DCB) and non-carcinogenic (3.04E05kg 1,4-DCB) toxicity, marine (7.90E02kg 1,4-DCB) and freshwater (6.67E02kg 1,4-DCB) ecotoxicity when compared to bovine milk (5.44E-1, 4.39E-2, 4.02E-2 and 3.23E-2 kg 1,4-DCB respectively). On the other hand, bovine milk had higher values for global warming potential (1.54 kg CO_2 eq.), land use (7.69 m^2a) and water consumption (3.86E-2 m^3). In conclusion, overall, the environmental impacts associated with this plant-based beverage are lower than animal milk, as reported for other similar beverages in literature.

Assessing the potential environmental impacts of microplastic emissions from food packaging with life cycle assessment

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Life cycle assessment (LCA) is a tool commonly used to assist environmental decision-making. Within LCA, different impact categories are assessed (climate change, ecotoxicity, etc.) that cause potential damage to ecosystem quality. A shortcoming of LCA is the lack of methodologies for quantifying the potential impacts of plastic pollution, which limits the application of LCA for assessing and comparing the impacts of plastic products and their alternatives. The international working group MarILCA (MARine Impacts in LCA) was founded in 2018 to address this gap.

This work contributes to MarILCA's outputs by providing a methodology for quantifying the potential impacts of aquatic (marine and freshwater) microplastic emissions. These emissions can come from primary sources (e.g. pellets used for the production of plastics) or secondary sources (fragmentation of larger plastic objects into microplastics). This work's methodology comprises fate factors which assess the distribution and longevity of microplastics in the aquatic environment, and exposure and effect factors which address the ingestion of microplastics and subsequent adverse effects on aquatic organisms. The fate, exposure and effect factors are combined to deliver so-called characterization factors. These characterization factors link the microplastic emissions (in kg of plastic) with the potential damage they cause to ecosystem quality (in PDF x m^2 x year/ kg plastic; PDF: Potentially Disappeared Fraction of species).

The characterization factors are applied in three LCA case studies within the recent UNEP report on supermarket food packaging (2022): 1. To-go food containers used in Canada. 2. Fresh-cut produce (lettuce) bags used in Italy. 3. Crates for fruit and vegetable transportation used in Spain. The magnitude of the potential impacts from microplastic emissions is compared to other LCA impact categories. In most cases, climate change impacts predominate and are several orders of magnitude higher than the impacts from microplastic emissions.

Keynote Presentation

Urban farms: between an ecological transition of the city and development of an urban food system

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Urban farms have been growing for just over a decade, but it more and more present in cities around the world. Development of urban agricultural enterprises is in many agricultural sectors, as rooftop market gardening, mushrooms and microgreens microfarms, breeding of insects, aquaculture/aquapony and indoor production of leafy vegetables or fruits (strawberries) indoors. With 125 urban agricultural enterprises, 56 in Montréal, Quebec is at the forefront in the field, while showing growth of more than 20% annually. Urban farms have also the particularity of being part of the urban metabolism. Most of urban farm used urban resources (energy or organic matter) or have social and environmental impacts for more ecological cities.

On other hand, urban farms are new actors in local food system and are active in development of urban food system. Urban farm products are marketed to restaurants, local zero waste groceries and social street markets, but large urban farms with their direct contact with consumers become food distributors. With urban farm sectors growth, farmers should find you way to market their food production, one of this way is high value products as hot sauce, mushrooms jerky, etc.

In this presentation Eric Duchemin will present urban farms movement in Montréal, with comparison to other cities. From this overview he will present opportunities, issues of urban farms and how urban farm is an actor to city ecological transition and urban food system.

SESSION 6

Processing of Emerging Foods and Food Ingredients

Alternative sources of proteins as sustainable matrices for animal-based products substitution

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The modern food system is characterized with high environmental impact, which is in many cases associated with increased rates of animal production and overconsumption. The adoption of alternatives to meat proteins (insects, plants, mycoprotein, microalgae, cultured meat, etc.) might potentially influence the environmental impact and human health in a positive or negative way but could also trigger indirect impacts with higher consumption rates. The study provides a condensed analysis on potential environmental impacts (global warming, land use, non-renewable energy use and water footprint), resource consumption rates and unintended trade-offs (often processing related) associated with integration of alternative proteins in complex global food system in the form of meat substitutes.

It is concluded that meat substitution with alternative proteins could reduce the environmental impact of food system. However, in some cases impacts of alternative sources (e.g., microalgae, insects, purified protein fractions) can have the same level of impact as chicken meat. Higher level of processing is normally increasing the environmental impact and prices of alternative protein products, aimed to increase concentration and purification of resulting fractions. Thus, processed plant-based meat substitutes had 1.6-7 times higher environmental impact than less processed sources (e.g., tofu, pulses, and peas). However, extended processing associated with incorporation of water in the product (e.g., high moisture extrusion) results in products with reduced environmental impact (per 1 kg of consumable product) and improved consumer attitude. Hybridization of alternative proteins could be a viable strategy to improve the processability (texture formation, taste improvement) and environmental impact of protein sources. On the basis of protein comparisons, it was identified that for most categories (except for water footprint) the range from most impactful to least impactful can be drawn: beef, microalgae, cell meat, poultry meat, insects, plants, with mycoprotein, microalgae, and meat cultures demonstrating a positive development tendency.

Trends for novel hybrid foods and its processing challenges

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Along with the constantly growing population and consequently the increasing protein demand, innovation in the food sector is critical to support the growth. Bearing in mind the high environmental impact of animal proteins and the poor functionality of plant proteins alone, considering hybrid protein diets is among the most promising innovative strategies. The concept of hybrid protein is very recent and consists in replacing parts of animal proteins with plant proteins. While the environmental and nutritional benefits are clear, it is also of major interest economically, especially for the development of “more affordable protein products” in countries with limited resources. The combination of animal and plant proteins is of high interest, especially due to their complementary properties. In recent years, research on hybrid protein systems has only focused on conventional technologies, and as of today, only a few products have emerged commercially. The problematic being that compared to animal proteins, plant proteins are associated with better environmental scores, yet lower nutritional scores, especially after extensive heat treatments required to produce plant-based products. In addition, available plant-based meat and dairy alternatives are not clean-label and are highly processed due to the poor functionality of the plant proteins. Thus, the development of novel hybrid protein-based products (animal/plant) with similar or improved sustainable, nutritional, and sensorial properties remains challenging in terms of processing. This work reviews the state of the art as well as opportunity, trends and challenges associated with hybrid protein products.

Advanced technologies for the preparation of innovative and value-added protein ingredients

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There is an increasing demand for high-quality and more sustainable food proteins. This demand can be met by the development of new protein ingredients from alternative sources such as plants or insects. This has however proven to be quite challenging due to issues associated with poor protein yield, digestibility, off-flavour, the presence of anti-nutritional factors and allergenicity. Advanced technologies, such as pulsed electric fields (PEF) and ultrasound (US) can offer a means to improve the extraction and recovery of proteins from complex matrices. Treatments by these technologies can damage cell membrane and increase permeability and porosity of the biological matrix leading to rapid permeation of intracellular compounds of interest, such as proteins. With their proven capacity to modify the structural and functional properties of biomolecules, these advanced technologies have been also proposed as versatile, fast, clean and eco-efficient alternatives to conventional heat treatment to improve the nutritional and functional properties of food proteins while potentially reducing their allergenicity. This presentation discusses existing and new knowledge in PEF and US assisted extraction of proteins, and their impact on the structural and functional properties of proteins with case studies highlights from author's recent research. It is expected to help researchers and industrials understand the principles and importance of these technologies, and to realize their potential in the development of innovative protein products, while securing the sustainable development of the food industry.

Impact of industrial process on gastrointestinal digestion of milk micellar caseins and development of low bitterness casein hydrolysates.

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In 2019, global milk production was approaching 840 million tones. The academic/industrial partnership aims to constantly develop and market products based on milk (especially caseins) enzymatic hydrolysates that have the capacity to provide the nutritional, physiological, organoleptic and techno-functional qualities desired by customers.

The ruminant milk caseins represent 80% (w/v) of the total milk protein content. The valorization of those proteins by enzymatic proteolysis is economical, not dangerous, non-polluting, does not cause degradation or racemization of amino acids [1], minimizes the production of undesirable by-products, and preserve, promote and/or decrease the nutritional, physiological, organoleptic and techno-functional properties of peptides [2].

The goal of studies of the last two years was **i**) to determine the impact of industrial processes on the digestion of various milk protein matrices using the harmonized INFOGEST in vitro static digestion protocol, **ii**) to develop a reliable, statistically validated, fast, and robust method to evaluate the bitterness of hydrolysates as a sensory panel can do it.

Results showed that **i**) the industrial process affected not only the protein distribution of the matrices but also most likely the protein structures. Indeed, differences arose in terms of peptide populations generated when the caseins were reticulated or when their calcium concentrations were reduced, **ii**) the principal component analysis of the more relevant peptidomics data appears as a convenient, reliable, fast, and economic intermediate method to evaluating the bitterness of enzymatic hydrolysates as a trained sensory panel can do it, **iii**) a total of 22 peptides formed during the enzymatic proteolysis of micellar caseins and influencing the bitterness the most were identified through a statistically compared kinetic peptidomics approach of two enzymatic hydrolysates of bovine milk caseins.

Green Processing and Related Technologies in Creating Functional Vegetables via Sustainable Agricultural Practices and Smart Vertical Farming

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Green technology associated processing has gained its attention over the years, and its connotation with food science was highly recognized by many food scientists as provision of lower carbon footprint[1]. Traditional agricultural practices use a lot of agro-chemicals and harmful pesticides creating major environmental and health issues. Hence, sustainable agricultural practices are often admired in the current context[2]. Northern Manitoba and its surrounding areas are suffering from prolonged winters, shorter cultivation times, and poor soil quality, limiting to the fresh food accessibility. Consequently, a need of an advanced and smart technology incorporated agricultural practices are at a rise. Opaskwayak Cree Nation (OCN) has created a solution for the current issue with the implementation of a smart vertical farming (SVF) system to produce fresh vegetables[3]. SVF is a computer assisted optimal growth controlling system for a high-density LED lighting nutrients, temperature, pH, and water supply. Facilitation of individual needs of the plants has a potential in creating highly nutritious vegetables/fruits creating functional vegetables with improved nutrients[3]. In addition, with the inclusion of associated innovative green food processing technologies the functionality of each type of vegetables could be further improved. Our preliminary data illustrates that incorporation of food processing improves total phenolic content, total flavonoids, and its antioxidant activity.