1- Synergic approach of pulsed electric fields and immobilized biocatalysts to obtain biologically active peptides from agro-food proteins

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This research project explores valorization of food by-product proteins, such as α-lactalbumin and pea proteins.

The global market for protein ingredients is growing rapidly, especially for proteins of plant origin. Indeed, the production of animal proteins is resource intensive, with high water and land consumption, and greenhouse gas emissions. Modern food industries are trying to use sustainable and diversified food systems.

That's why this project promotes the use of an animal protein and a plant protein, with the aim of the yield improving of bioactive molecules by enzymatic hydrolysis. It considers the application of pulsed electric fields (PEFs) to affect protein structure and enhance protein cleavage by enzymes thus improving peptide production performance. Indeed, PEFs, partially and reversibly unfolding the protein, improve the availability of cleavage sites to enzymes. Combined with biocatalysis using an immobilized enzyme, the main drawbacks of enzymatic process could be overcome.

The native, PEF-pretreated and preheated (control) α-lactalbumin and pea proteins were hydrolyzed using commercial free α-chymotrypsin (37 °C, Enzyme:Substrate ratio 1:100 w/w). Hydrolysis kinetics were monitored by the o-phthaldialdehyde spectrophotometric method. A degree of hydrolysis of PEF pretreated proteins were improved by more than 90 % compared to the native ones and close to the preheated proteins. Such hydrolysis improvement was due to the modifications of the protein molecular structure confirmed by circular dichroism.

Regarding the chymotrypsin immobilization step, the first results demonstrated a 99.6% immobilization rate on a porous alumina support. The immobilization will then allow to improve the activity of the enzyme thanks to a better structural stability and to reduce the cost of the enzyme by its reuse.

Therefore, the proposed novel synergistic approach can promote the peptide production from proteins, issued from by-products and having biological properties that are of interest to the food, nutraceutical and pharmaceutical industries.

2- Preparation of antimicrobial extracts from seaweed for cheese preservation

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Cheese is a food at risk of spoilage by undesirable bacteria and mold. These microorganisms can compromise the cheese's organoleptic properties, safety, and shelf life. There is also an increased consumer awareness about the composition of their food. Indeed, there is a need to develop natural antimicrobials as alternatives to conventional food additives.

It was previously demonstrated that diverse algal compounds (peptides, lectins, carrageenans, porphyrans, phenolic compounds, terpenes, fatty acids) exhibit antimicrobial activities. However, there are only a few studies about the antibacterial activity of seaweed extracts from Quebec, and their antifungal activity is undocumented. The study aimed to produce seaweed extracts and test them for their antifungal and antibacterial activity.

Food-grade aqueous and ethanolic extracts from various seaweed species (*Alaria esculenta*, *Chondrus crispus*, *Fucus vesiculosus*, *Palmaria palmata*, *Porphyra umbilicalis* and *Saccharina latissima*) were produced, as well as aqueous, hexane and ethyl acetate sub-fractions from ethanolic extracts. Their antifungal and antibacterial activities were assessed against alteration strains from the dairy industry. No antifungal activity was found. However, some ethanolic extracts and their sub-fractions exhibited antibacterial activities against thermoresistant strains (*Clostridium tyrobutyricum* MK183, *Lactobacillus plantarum* RKG 2-212) from the cheese industry. The minimal inhibitory concentrations ranged from 0.063 to 0.50 mg/mL. The results obtained show the potential of seaweed extracts as a natural agent for cheese preservation. The identification of the antibacterial molecules is currently under investigation. Future studies include scaling up the production process for the extracts and testing them on cheese matrices.

3- How to allocate the environmental impacts between co-products? Discussion on the case of dairy protein fractionation process

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Amongst human activities, food is a significant contributor to environmental impacts. The Life Cycle Assessment (LCA) method allows to quantify and analyze the environmental impacts throughout the production and transformation steps of a product. However, many agro-industrial transformations are multi-product systems and their impacts must be distributed among the different co-products. Several allocation methods exist, based on economic or physical criteria (mass, dry extract, protein content, lipid content, etc. of products)[1,2].

The objective of this work is to study the influence of the allocation choice on the environmental impacts of co-products obtained from a dairy protein fractionation process[3]. The share of impacts allocated to the production of one of these proteins, α-lactalbumin, was calculated using several allocation methods and the most contributing factors to environmental impacts were identified. The results show that, regardless of the allocation methods, the contribution of targeted protein to the environmental impacts of the system is low compared to other co-products, due to its small quantity. For example, α-lactalbumin reaches a maximum of 2.8% of contribution to the greenhouse gas emissions for dry matter allocation.

Dry matter or protein allocations attribute more impacts to α-lactalbumin than mass or economic allocations. The mass allocation penalizes the weightiest co-products (casein retentate, lactose). The economic allocation fluctuates with market prices and penalizes the cream and casein retentate, which generate the highest economic revenues. In the LCA of α-lactalbumin fractionation process, cleaning contributes from 3% to 22% of environmental impacts, depending on category. The other contributing factors are the energy of drying (from 1% to 35%) and that of membrane separations (from 0,5% to 36%).

The allocation method is therefore a strategic decision and its choice must be considered in order to achieve the eco-design of products, processes and food chains.

4- Impact of bacteriocins produced by Gram-positive and Gram-negative bacteria on the composition and dynamics of poultry colonic microbiota

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Bacteriocins are antimicrobial peptides produced by bacteria and involved in a bacterial competition to colonize an ecological niche. They show a remarkable structural diversity associated with various mechanisms of action (1). They are used in food preservation (2) and appear as a promising alternative to antibiotics.

The prolonged and unregulated use of antibiotic growth promoters has led to the emergence of antibiotic-resistant commensal and pathogenic strains that can subsequently be transmitted to humans via the environment and food and cause serious health problems. The European Union banned the use of antibiotics as growth promoters in 2006. In Canada, since 2017, the use of antibiotics belonging to categories I and II have been banned in the poultry industry. These two categories are considered of high importance in human medicine. Following these restrictions, there is an urgent need to develop alternatives to conventional antibiotics for animal production.

The objective of the study is to investigate the impact of bacteriocins produced by Gram-positive and Gram-negative bacteria on the composition and metabolic activities of the avian colonic microbiota in an in vitro colonic fermentation model. First, two different concentrations of antibiotic treatments and bacteriocins were tested using microfermentations in penicillin bottles allowing the short-term (24h) cultivation of microbial communities in static conditions from a fresh fecal sample. The collected samples are analyzed by the 16S metabarcoding method and by global and targeted metabolomic analysis. Bacteriocins are quantified in the colonic complex medium by liquid chromatography coupled to mass spectrometry. This step will allow us to choose an adequate concentration of treatments for continuous fermentation by the PoyFermS model (3).

5- BioacPepFinder: a pipeline for prediction of proteolysis-generated bioactive peptides usable for all protein sources

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Carlos and Isabelle are first co-authors.

For several decade, health and alternative medicine sectors focus their research on the bioactive peptides (BAPs) derived from food, due to their preventive and/or health benefit applications. However, the experimental approaches for BAP discovery remain long and challenging. As a consequence, *in silico* methods proved to be more strategic due to the time and cost savings, and their efficient prediction of potential BAPs [1].

In this context, we developed a comprehensive pipeline, called BioacPepFinder, that is able to perform large- scale screening in order to discover new BAPs from *in silico* enzymatic hydrolysis of proteins. This pipeline takes as input a set of amino acid sequence of proteins (in FASTA format or with Ensembl, Uniprot or NCBI id). The first step is to simulate *in silico* hydrolysis, with RPG [2] coupled to an in-house script to deal with missed cleavages. The list of generated peptides is then filtered according to two complementary criteria. Peptides are compared with Blast to specialized database of BAPs such as BIOPEP [3] and DRAMP, that contain known peptide sequences displaying proven bioactivities. We also compute for each peptide the quantitative structure-activity relationship (QSAR) score for discovering novel and potent angiotensin-converting enzyme (ACE) and dipeptidyl peptidase-IV (DPP-IV) inhibitory activities.

BioacPepFinder is implemented in Python and dependencies are managed with Conda. BioacPepFinder is modular, is extensible and freely available at https://gitlab.univ-lille.fr/bilille/bioacpepfinder.

We have evaluated the BioacPepFinder capability of BAP prediction on standard proteins such as bovine-hemoglobin or -serum albumin using the BIOPEP database and QSAR dedicated to ACE and DPP-IV.

It proved to be a new high-efficient prediction software that aims for guiding development and optimization of BAPs, in order to advance in their production. BAP prediction from agrofood proteins is ongoing.

6- Deacidification of acid whey as part of a circular economy by coupling electrodialysis under pulsed electric fields and preconcentration by nanofiltration

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Acid whey is a by-product of the dairy industry. Mainly, it is obtained from the production of Greek yogurt and certain cheeses, such as cottage cheese. A large amount of acid whey is produced every year. Considering the current Greek yogurt market growth, the amount of acid whey produced has continued to increase. Unlike sweet whey, which can easily be dried into a powder to be valorised, acid whey's drying process faces challenges due to its high calcium and lactic acid concentrations. For this reason, a demineralization and a deacidification of the acid whey prior to drying would be beneficial.

Therefore, preconcentration by nanofiltration coupled with deacidification and demineralisation by electrodialysis can enhance drying process and increase the quality of the powders. In this study, nanofiltration was carried out with a tangential unit using a membrane with a 150-300Da molecular weight cut off. Acid whey was concentrated to 4.0-4.8X concentrating factor before proceeding to electrodialysis.

Electrodialysis was then performed on the concentrated acid whey until 70% demineralisation rate was reached. Three different conditions of electric field were tested such as constant current, pulsed electric field (PEF) 5s on/5s off and PEF 15s on/15s off. No significant difference in energy consumption was noticed between the three conditions. The Electrodialysis process resulted in a 46% reduction of lactic acid in the acid whey. An interesting inflection point has occurred in both the global system resistance and the number of charges transported once 50% demineralisation rate was reached.

Mineral composition analysis are currently under way for the acid whey's sample and will provide further information on this observation and the potential selective demineralization effect of PEF.

7- Reuterin as a broad-spectrum antifungal agent in cold-stored strawberries

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Strawberries are very sensitive to fungal contamination at the postharvest stage, thus careful control of temperature and relative humidity is essential to avoid this problem. However, proper management of these conditions remains an insufficient means to control fungal growth on cold-stored strawberries over a lengthy period.

The objective of this project was to validate the antifungal potential of reuterin to facilitate its postharvest use as a biofungicide. The molds tested were *Botrytis cinerea* (BC), *Colletotrichum acutatum* (CA), *Rhizopus stolonifer* (RS) and *Penicillium expansum* (PE).

In vitro tests revealed that reuterin exhibited fungicidal activity with minimum inhibitory concentrations (MIC) of 23.4, 2.92, 11.7 and 11.7 mM against BC, CA, RS and PE, respectively. Reuterin was also effective *in vivo* on strawberries stored at 4 °C since microbiological tests provided conclusive results. In addition, quality tests were acceptable, as reuterin did not affect fruit quality parameters such as firmness, color, total soluble solids, titratable acidity, and weight loss.

In conclusion, relatively low doses of reuterin, applied before cold storage can be used to prolong the shelf life of this fruit.

8- Plastic pallet shrouds extend the shelf life of wild blueberries for up to one month under cold storage.

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In 2020, blueberry production in Canada reached 148,000 metric tons; 77,000 corresponded to cultivated fruits and 71,000 to wild fruits [1]. Moreover, the province of Quebec concentrates the largest production of the latter crop in the country, accounting for 48% of total national production [1]. Of this production, 93 % is destined for processing, mainly for freezing, and only 7 % is consumed fresh [1], for a period of one month. More importantly, there are large losses due to inadequate storage management.

The objective of this project was to adapt fresh strawberry storage practices using plastic covers to generate modified atmospheres capable of extending the shelf life of wild blueberries.

Previously, in 2021, through a tailor-made fractional factorial design, an optimal combination of factors was established that prolonged the shelf life of the fruit by more than one month, using small pallets. This combination consisted of using proprietary LifeSpan® pallet shrouds, at f 0 °C, with packed fruit, at 20 % CO_2 and the addition of a SO_2-releasing patch.

These results served as a starting point for the development of the next experiment with normal-sized pallets. Despite not having completed the analysis, the use of plastic covers improved the quality of the fruit compared to the uncovered pallets, and this for more than a month.

In conclusion, the use of plastic covers not only avoids the loss of fruit during the postharvest period, but can also be used as a marketing strategy, shifting the sale of fruit in the local market.

9- Application of advanced technologies for improved extraction and nutritional properties of green lentil proteins

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Lentils like other pulses represent a sustainable and economical source of dietary proteins; their consumption has also been shown to be an effective strategy to reduce risk factors for diabetes and cardiovascular disease.

Driven by economic factors as well as the growing demand to improve the nutritional, technological and health profiles of processed foods, the food industry is actively seeking the development of high-value protein ingredients that can be used in the manufacture of healthy and nutritious foods.

Despite all these efforts, pulse proteins, like other plant proteins, face challenges for their use in food products, such as low extraction yield, low digestibility, as well as the presence of anti-nutritional factors. Emerging and advanced technologies (AT), such as treatment by pulsed electric fields (PEF), ohmic heating (OH), ultrasound (US), or microwaves (MW) have been identified with the highest potential to improve both the extraction and nutritional quality of plant proteins.

In this context, this study aimed to 1) optimize AT treatment's conditions for the extraction of proteins from green lentils and 2) to investigate the modifications that proteins undergo when they are subjected to these advanced treatments and to evaluate their nutritional and digestive properties. Soaked green lentils were treated with PEF, OH, US and MW at different intensity, duration, temperature, pH and ratio of seeds to liquid prior to protein extraction.

The results showed significant differences in lentil protein recovery and purity from the various AT treated lentils with important effects of the various conditions on protein structure, composition and digestibility.

10- Impact of cranberry juice dilution on its physiochemical parameters and electrochemical behavior.

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According to the MAPAQ, between 2007 and 2016 the consumption of cranberries in Canada has tripled. Besides the many health benefits of daily cranberry juice consumption, it can also cause undesirable effects at the gastrointestinal level due to its high concentration in organic acids. Therefore, electrodialysis with bipolar membrane (EDBM) was developed to deacidify cranberry juice. In addition to being a green technology, EDBM allows the removal of organic acids from the juice while preserving the polyphenols, responsible for its health benefits.

This electrochemical process has already been used on juices around 7 and 14°Brix (diluted in comparison with a 50°Brix concentrated juice), but has never been tested on more concentrated juices. However, the use of concentrated juice during EDBM would have several advantages, such as producing a juice concentrated in polyphenols or/and increasing the energy efficiency of EDBM. Moreover, to the best of our knowledge, the effect of dilution on concentrated cranberry juice has never been reported.

In this context, the objective of this work is to determine the impact of juice dilution on the physicochemical properties of cranberry juice and on its electrochemical behavior during EDBM. Therefore, as expected, density, polyphenol content, viscosity as well as titratable acidity of the cranberry juice decreased when the juice was diluted.

Furthermore, concerning viscosity, its decrease shows an inflection point around 25-30°Brix. However, concerning conductivity, a hyperbolic behavior during the dilution was observed, with a maximum also around 25-30°Brix. Such a surprising curve shape was observed concerning the juice global resistance in an electrochemical cell; it shows an inverse behavior of a hyperbola.

These results suggest that potentially from an electrical point of view there is an optimal concentration of cranberry juice around 25-30°Brix, for its deacidification by electrodialysis. EDBM tests are currently underway.

11- Effect of wheat flour substitution with potato flour on dough rheology, texture, and sensory properties of instant noodles

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Potato flour is one of the processed products from potato tubers prepared to mitigate the challenges of potato post-harvest loss and expand the utilisation of potatoes in the food industry. Wheat flour can be substituted with other ingredients, such as processed potato flour, to improve the nutritional quality of noodles.

However, this incorporation brings several changes that affect the dough system's microstructure and rheological properties, resulting in limited-quality noodles. In this study, wheat was replaced with potato flour (freeze-dried and partially gelatinised (PG) (low-temperature blanching)) at three levels of 10%, 30%, and 50% to make noodles. The results show that adding potato flour significantly increased the pasting properties of wheat flour. Freeze-dried potato flour blends had the highest pasting properties compared to PG potato flour blends. In addition, the substitution of wheat flour with potato flour caused increases in water absorption, dough development time, and dough stability. The highest dough development time was attained when 50% of PG potato flour was substituted.

The scanning electron microscopy showed that adding 30 % and 50% of PG potato flour produced dough with more hollows and porous resulting from fragilized gluten network. The brightness (*L**) of noodles decreased while the redness (*a**) and yellowness (*b**) increased when potato flour was added. The cooking loss significantly increased for noodles substituted with PG potato flour. When the proportion of potato flour reached 30%, the noodle quality, including hardness, cohesiveness, and chewiness, decreased significantly. Substitution of up to 30 % of freeze-dried flour resulted in noodles with the highest overall liking scores.

The findings suggest that partial replacement of 10% PG and 30% freeze-dried potato flours resulted in noodles with acceptable quality in terms of textural and sensory properties. Potato flour (gluten-free) could be an alternative to reduce the dependancy on wheat flour (replacement of wheat protein).

12- Valorization of plant co-products to obtain active peptides using green methods and valuing them in food matrices

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Replacement of animal protein by plant-based proteins is considered as an important strategy to answer to global demand for bioactive peptides. Among the plant protein sources, Alfalfa (*Medicago sativa*) is an excellent source of protein with high nutritional and functional quality.

However, RuBisCO proteins showed most interest. Indeed, this protein has been labelled the most abundant on earth; it constitutes about 65% (w/w) of soluble leaf protein of Alfalfa. A method was introduced for the purification of RuBisCO from alfalfa powder 10% (w /v), using two different solvents (water or ammonia) and pH effect.

The results obtained showed that this new method could replace some conventional industrial processes. Then, an enzymatic hydrolysis was carried out on the purified RuBisCO, which resulted in a large bioactive peptide population. The peptides obtainedd showed better antibacterial or antioxidant activity compared to the other peptide hydrolysates. Nine new antibacterial peptides have been identified and characterized by HPLC and MS and have a MIC of 2-6 mM against four species of bacteria: *Bacillus subtilis, Escherichia coli, Listeria innocua and Micrococcus luteus*.

These antibacterial peptides were purified by an adsorption / desorption method under ionic strength and pH effect. In addition, antioxidants peptide fractions were identified, their antioxidant activity was evaluated by various in vitro and in vivo tests. The four most active peptide fractions have been identified by mass spectrometry and their antioxidant power has been evaluated on oil of Colza.

Finally, the valuation of peptide (Arg-Asp-Arg-Phe-Leu) derived from the peptic hydrolysis of RuBisCO in the preservation of minced meat and tomato puree has shown that the addition of this peptide has a positive effect on the prolongation of the shelf life of minced meat and of tomato puree.

13- Enzymatic hydrolysis of duckweed proteins: a sustainable source for green production of bioactive peptides

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The World Health Organization has identified chronic diseases as the leading cause of death and disability, accounting for 70% of deaths worldwide [1]. In addition to their low environmental impact and interesting nutritional properties, plant proteins have potential in the prevention of chronic diseases because of compounds present in their matrix: bioactive peptides [2].

Among the emerging plant proteins, duckweed stands out because of its high growth rate and high protein content and quality [3]. The aim of this work was to perform enzymatic hydrolysis of duckweed proteins using several enzymes, to characterize and identify the peptide sequences generated during hydrolysis, and to evaluate the potential bioactivities (anti-hypertensive and anti-diabetic activity) of the generated fractions. Several enzymatic hydrolyses at optimal enzyme conditions were performed using pepsin, chymotrypsin, papain, and trypsin.

Samples were taken during hydrolysis at different times and were used to evaluate the degrees of hydrolysis over time using the OPA method. Centrifugation was performed following hydrolysis on a portion of the final hydrolysate to obtain three different fractions: the non-centrifuged total hydrolysate, the hydrolysate pellet and the hydrolysate supernatant. These three fractions were then compared in terms of peptide profiles and sequences as well as potential biological activities (ACE inhibition and DPP-IV inhibition). Interestingly, according to the enzyme used, the peptide profile was different and centrifugation, for certain enzymes, allows to obtain fractions concentrated in specific peptides. The analysis of the biological activities of these resulting fractions are currently under way.

This project highlights the effects of the type of enzyme used and centrifugation on the peptide population and potentially the bioactivities of the fractions obtained. The identification of bioactive sequences is also an innovative aspect, as it will allow the discovery of new molecules with demonstrated biological activities.

14- Developing Novel Micro Ohmic Cells: Evaluation of the Electrical Effect

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Ohmic direct heating is considered to be green and efficient thermal processing with a potential of additional electrical effect compared with traditional methods. However, this additional non-thermal effect is not well explored in the literature. Variety of Ohmic units have been designed and reported but limited to either atmospheric pressure and/or too big for microbial inactivation, and mainly focusing on vegetative pathogens and not the bacterial spores (Cho et al., 1999, Shin et al., 2020, Müller et al., 2020).

Therefore, novel Ohmic cells of different sizes and configurations were designed and fabricated using Corning glass applicable to higher temperature under pressure. Developed micro Ohmic cell consists of a T-shape glass cell having volumes of 2 and 3 ml with two tiny Titanium electrodes mounted on Teflon caps tightly screwed on each sides. There is an opening section on top for feeding the cell while Fiber Optic sensors inserted for the evaluation of temperature uniformity and controlling process temperature located at the cold spot of the cell. Jacketed version of the cell was used to control the product temperature. Voltage gradients 90 and 135 V/cm were applied depending on the size of the cell resulting in very rapid Come-Up-Time (CUT) compatible with conventional capillary tubes. CUT reaching target temperature up to 121°C varied from 10 to 50 second depending on products properties and system parameters such as Proportional, Integral, and Derivative (PID) controlling loop. Temperature uniformity was confirmed with less than 1°C variation across the cell.

Exploratory studies revealed that the newly assessed micro Ohmic cell is promising for inactivation studies using different microorganism and food media where small volume, rapid CUT and uniform temperature are required. Variable voltage can be applied continuously using jacketed cell while the product temperature remains low-constant to study potential effect of the electrical field.

15- Production of sustainable protein ingredients from house cricket proteins: impact of the pre-processing steps on protein profiles and structures

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House crickets (*Acheta domesticus*) represent a promising source of alternative and sustainable proteins in the development of insect-based food products. However, the pre-extraction steps could have an impact on protein structures and techno-functionalities[1]. Therefore, this study aimed to determine the impact of the killing and defatting steps on the cricket protein profiles and structures.

Frozen adult house crickets were blanched (100°C, 40s) or not (control) and freeze-dried. Hexane and ethanol were compared in three defatting methods (no defatting, suspension in solvent, Soxhlet). The proximate composition (total solids, protein, lipid, and ash) and the colour of protein concentrates (extracted by alkaline solubilization) were analyzed. Oil extraction yields (OEY) and protein recovery yields (PRY) were calculated. The amino acid composition (UPLC) and protein profiles (SDS-PAGE) were also characterized. Finally, protein structure (surface hydrophobicity, free sulfhydryl groups, secondary structures), microstructure (scanning electron microscopy), and solubility were obtained.

Results showed that blanching reduced PRY by 70% compared to non-heat-treated crickets. Moreover, heat-treated extracts had distinct protein profiles, due to the denaturation of proteins prior to extraction. Ethanol, often labelled as a greener alternative to hexane, led to lower OEY and PRY, but visually, protein extracts showed limited enzymatic browning compared to hexane-treated samples. The impact of ethanol on protein molecular weight distribution differed depending on the defatting method: myofibrillar proteins were the main proteins in the samples defatted by suspension, whereas low molecular weight proteins (<37 kDa) were predominant for Soxhlet. Surface hydrophobicity of proteins from non-blanched insects was 3-7 times higher than blanched crickets no matter the defatting solvent used. Yet, protein solubility at pH 7 remained ≥80% for all samples. Overall, methods involving the application of heat treatment had a deleterious effect on protein recovery.

Finally, using ethanol instead of hexane did not alter the structural characteristics of the extracted proteins.

16- Do hydrocolloid-based edible coatings really affect the glycemic index of French fries?

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Type 2 diabetes mellitus is one of the non-communicable chronic diseases with the most significant impact on global health, so the search for strategies to reduce the glycemic index (GI) of food is a constant concern of the food industry. Therefore, the use of edible coatings in foods is of great interest and may result as an alternative to be used to reduce the absorption of oils in fried products and reduce the GI.

Given that French fries are a highly desired food by consumers, the aim of this work was to evaluate the effect of different hydrocolloid films on french fries to reduce their GI. Eight hydrocolloids were analyzed at the highest concentration possible to generate colloidal dispersions: Arabic gum (1%), Xanthan gum (1%), Carboxymethylcellulose (1%), Psyllium (1%), Tara gum (1%), Guar gum (1), Pectin (3%), Konjac (0.75%). The french fries were immersed for 60 minutes at room temperature. The results are based on the glycemic index determination (Wolever & Jenkins, 1986) using glucose sensors (FreeStyle ®). The French fries were produced by deep-frying at 180°C for 3 min. The GI for regular French fries was tested in 14 subjects and 7 for French fries with hydrocolloid-based edible coatings.

The results were 39.1±13.7 for regular French fries, 33.9±16.6 for Arabic gum, 39.3±21.9 for guar gum; 45.0±22.8 for Psyllium; 51.2±18.3 for pectin; 55.5±28.0 for Konjac; and, 48.0±11.3 for Tara gum. Despite the high data dispersion due to the nature of the determination, it was possible to conclude that regardless of the nature of the hydrocolloid, there was no significant effect on the reduction of the GI.

17- Effects of pulsed electric fields and polarity reversal on the selectivity of peptides migration from porcine cruor hydrolysate, with electrodialysis with ultrafiltration membrane

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Porcine blood is a major coproduct from slaughterhouses. Its precipitated part after centrifugation, cruor, is mainly composed of hemoglobin. After its enzymatic hydrolysis, a wide variety of peptides is obtained, especially antimicrobials. To produce fractions of peptides with increased bioactivities and higher purity, electrodialysis with ultrafiltration membrane (EDUF) was proposed[1]. Indeed, this technology is a promising ecoefficient strategy to recover bioactive peptides[2]. EDUF is hybrid with a selectivity based on the charge and the molecular mass, thanks to the UF membrane.

Moreover, the aim was to evaluate the impacts of different current conditions (pulsed electric field (PEF) and polarity reversal (PR)) on peptide migration selectivity[3]. Hence, the direct current (DC) was compared with combination of pulse/pause duration corresponding to ratios of 1 and 10 for PEF and PR. The peptide populations in the recovery compartments were analyzed using UPLC-MS/MS. Principal component analyzes, on peptides and conditions, highlighted that PR ratio 1 generated the most significant differences concerning the migrated peptides. PEF ratio 1 was the second most different. PEF and PR ratio 10, and DC had similar migrated peptide populations.

A linear discriminant analysis based on peptides groups and their physicochemical characteristics, demonstrated that main differences were explained by the charge at pH 9, the molecular mass, and the mass/charge ratio. Indeed, DC, PEF, and PR at ratio 10 allowed the migration of mainly cationic peptides, while PR ratio 1 allowed the migration of some anionic peptides with lower molecular masses, due to the short polarity reversal. PEF ratio 1 peptides population was less explained by their physicochemical characteristics. It appeared from these results that the current condition and the pulse/pause combination strongly affected the selectivity of migration during EDUF and consequently may impact the final bioactivity. The next step is to evaluate the antimicrobial activities of the fractions produced.

18- Machine learning-based peptidomic approach to identify electrical current modes associated phenomena inducing selective peptides migration in electrodialysis with ultrafiltration membrane

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Electrodialysis with ultrafiltration membrane (EDUF) is a technology that has demonstrated the ability to fractionate peptides from diverse hydrolysates [1,2]. In a previous study, Suwal et al [1] tested pulsed electrical field (PEF) and polarity reversal (PR) modes of current and showed their impacts on the global migration of peptides and/or amino acids from a snow-crab by-products hydrolysate (SCBPH). However, the SCBPH peptide population was not characterized, and it was impossible to link peptide migration with current conditions. Hence, a cruor hydrolysate from porcine blood, with a well-characterized peptide population (more than 100 peptides), was used during EDUF. Five electrical current conditions were tested: continuous current (CC), PEF ratio 1 and 10 and PR ratio 1 and 10. From UPLC-MS/MS results, migration rates were calculated for each peptide, in each condition of electric current.

Peptides physicochemical characteristics (molecular mass, isoelectric point, gravy score, % of basic residues, etc…) were calculated, using bioinformatic tools. A machine learning peptidomic-based approach using a supervised regression tree procedure was carried out to deepen the understanding of these data [3]. The goal was to link the migration rates of peptides in the different electrical current conditions to their physicochemical characteristics and to identify current condition associated phenomena inducing this selective migration of peptides.

The data analysis is currently under way, but the first results highlighted that the most important variable to predict migration (first node) is different for condition PR 1 compared to CC, PEF 10, and PR 10. Furthermore, PEF 1 would have an intermediary regression tree. Similarities between trees were estimated to compare electrical current conditions and to predict the main physicochemical parameters inducing different peptides migration. It was the first time that such an approach was used in the membrane processes field to explain selective separation from a complex solution.

19- Unraveling scientific research towards the green extraction of phenolic compounds from leaves: A bibliometric analysis

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Phenolic compounds (PCs) have been finding increasing applications in functional foods, cosmetic, pharmaceutical and nutraceuticals due to their nutritional and antioxidant properties. Considering the drawbacks of conventional extraction methods, there is an ongoing challenge for researchers to develop green extractions (GE) of PCs in a sustainable and eco-friendly way. A bibliometric study is a valuable tool to provide quantitative information for evaluating the scientific research activity based on the available published scientific literature.

This bibliometric study aims to unravel the scientific exploration towards the GE of phenolics from plant biomass (i.e., leaves) by highlighting most recent and relevant scientific publications.

The critical evaluation of the results showed an increase in research and scientific collaboration on GE of PCs from leaves during the last decade where Europe is found to lead in the area of ultrasound-, microwave-, supercritical fluid-, and deep eutectic solvent-assisted extraction.

20- Study of vanillin production from wood

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We eat wood, and more often than we think! The wood is made from 3 major molecules: cellulose, hemicelluloses and lignins. Hemicelluloses can be used as food supplements or as emulsifiers (gum arabic). They are found in ice cream for example. The wood industry generates many by-products such as wood chips. But these chips, which are often burned, can also be converted into value-added molecules.

In this project, we are interested in the transformation of wood molecules into vanilla flavour. This flavouring, which is very demanded all over the world, is found in vanilla pods, which contain large quantities of it. Unfortunately, natural vanilla is not sufficient to supply the world demand. To fill this gap, syntheses via petroleum-based molecules have been developed. The project presented here studies the synthesis of vanillin from wood, and more precisely from wood lignin.

The lignin used is an organosolv lignin from softwood (black spruce) and was used as a study material to compare the efficiency of different oxidizing media to degrade lignin into low weigh molecular fractions, among which we could identify vanillin, vanillic acid and acetoguaiacone. The media tested were sodium hydroxide, tetrabutylammonium hyroxide (TBAH), sodium hydroxide (NaOH) with crown ether addition and nitrobenzene with reaction times of 2, 6, 24, 48 and 72 hours.

In contrast to the literature, the results obtained showed that the addition of TBAH or crown ether did not increase the yield of vanillin during the degradation of our lignin [1].

We conclude that this type of lignin is not suitable for vanillin production. An hypothesis is that is due to the lack of b-O-4 bonds necessary for vanillin formation [2] or to a too condensed lignin, which would prevent the formation even of other by-products like acetoguaiacone.

21- Effects of ultrasonic-assisted extraction technique on the extraction of L-theanine and caffeine from white tea leaves

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L-theanine and caffeine, the main bioactive constituents of tea (*Camellia sinensis*), can pose opposite effects on individuals with anxiety disorders. Extraction of L-theanine (an anxiolytic) from tea leaves is often associated with the simultaneous extraction of caffeine (a stimulant).

Therefore, attempts were made to reduce the caffeine content in tea extracts. We previously showed that the tea type, the extraction time and temperature are important factors in increasing the L-theanine/caffeine ratio. The present study examined the effect of ultrasonic-assisted extraction (UAE) on L-theanine and caffeine extraction from white tea. Moreover, we examined the effect of UAE on the L-theanine/caffeine ratio in tea extracts to identify the optimized conditions for tea preparation with increased L-theanine/caffeine ratio, i.e. tea extracts that are rich in L-theanine and low in caffeine.

For this, 1g dry white tea leaves were extracted in 10-11ºC water, for different durations, with and without ultrasound (US). L-theanine and caffeine levels of all samples were quantified by HPLC. Comparison of the L-theanine and caffeine levels and the L-theanine/caffeine ratios in US-treated and US-untreated samples revealed that tea extracted for 14min using US had the highest L-theanine level (0.81mg/ml) compared to other conditions tested. However, tea extracted without US for 5min had the lowest caffeine level (0.16mg/ml).

Regarding the L-theanine to caffeine ratio, tea extracted without US for 5min had the highest L-theanine content relative to its caffeine content (1.29). This ratio was the lowest (0.6) for tea extracted using US for 14min. These data show that white tea extracted without US for 5min contains the highest amount of L-theanine relative to caffeine (L-theanine/caffeine ratio), suggesting that this preparation is a better source of L-theanine.

In conclusion, UAE can increase the extraction of L-theanine and caffeine from tea leaves, but this technique failed to improve the L-theanine/caffeine ratio in the extracts.

22- Tininnimiutait - characterizing the nutritional value, safety and organoleptic (taste, aroma) properties of coastal marine resources from Eastern and Northern Quebec

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The Inuit have long occupied their territory in harmony with nature, respecting and learning from their environment and using the bounty it provides to sustain their food system. Some marine resources such as seaweed and molluscs commonly known as “tininnimiutait” can be harvested from the seashore at low tide and year-round in some areas. Several past projects and consultations highlighte the importance of tininnimiutait for Inuit culture, diet, and health. Conversely, the Qanuilirpitaa Nunavik Inuit Health Survey in 2017, showed that these species are nowadays less consumed by younger generations. Hence, resources such as seaweed (*Alaria esculenta*, *Fucus* ssp. and *Saccharina longicruris*) and molluscs (*Mytilus* ssp.) are generally rich in several nutrients such as proteins, vitamins, and minerals, although their nutrient compositions and contaminant contents vary seasonally and with their growing environment.

The valorization of these resources by the characterization of their components allows 1) to draw up an overall portrait of their nutritional values including their contents in proteins, lipids, carbohydrates, fibres, vitamins and minerals; 2) to assess their eventual levels of microbiological and chemical contaminants, including marine toxins and certain metals; 3) to study their organoleptic properties and their taste, more specifically the aromas, which will benefit the creation of culinary pairings. Complementary aspects of this project include documenting Inuit knowledge about tininnimiutait, to study their abundance and sustainable harvest potential, and to co-develop fun and tasty recipes with Inuit elders and youth during youth camps.

According to the fact that the growing environment has some importance on the development of aromas as well as the concentrations of contaminants and nutritional compounds, samples from Nunavik but also from different places elsewhere in Quebec are being studied (Gaspé coast, Lower St. Lawrence, Magdalen Islands). To date, several analyzes are in progress and soon, all the results will be available.

23- Optimization of wiped-film short path molecular distillation for recovery of cannabinoids from cannabis oil using response surface methodology

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Only a few studies have explored molecular distillation techniques that improve the recovery of cannabinoids from crude cannabis oil with scale-up potential.

Wiped-film short path (WFSP) molecular distillation is commonly employed in the cannabis industry for separating cannabinoids from terpenes and heavy compounds. It is a two-cut process, where the distillation of terpenes and cannabinoids occurs at the first and second cut, respectively. In the second cut, the effects of the distillation parameters, including feed flow rate (FFR) (35 to 55 Hz) (41.6 to 71.3 mL min^{-1}) and internal condensation temperature (ICT) (60 to 90°C), were examined, and optimized using a central composite rotatable design (CCRD) towards maximizing the mass (g) and recovery efficiency (%) of cannabinoids in the distillate and minimizing the mass of cannabinoids (g) in the residue.

Results show that irrespective of the internal condensation temperature, reducing the feed flow rate increased the cannabinoid's yield and recovery. Although high distillation time was observed at low feed flow rates, the quality of cannabinoids remained unaffected. Response surface methodology (RSM) was used to optimize the wiped-film short path molecular distillation of cannabis oil.

The predicted optimal conditions were a feed flow rate of 35 Hz (41.6 mL min^{-1}) and an internal condensation temperature of 75°C. At these optimized conditions, the masses of tetrahydrocannabinol (THC) in distillate and residue were 174.4 g and 38.8 g, respectively, with a recovery efficiency of 93.4% in the distillate.

The study provides the distillation conditions to be considered for the cannabis industry to obtain a cannabinoid rich-distillate, with potential as a food ingredient, from the molecular distillation process without affecting the cannabinoid quality.

24- Impact of hierarchical cation-exchange membranes' chemistry and crosslinking level on electrodialysis demineralization performances of a complex food solution

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Ion-exchange membranes (IEMs) are integral part of electrodialytic processes that have various applications in food industries including wastewater treatment, whey and molasses demineralization, fruit juices deacidification, etc. without major impact on the environment. But, the high cost of IEMs, due to their complex fabrication methods and highly engineered precursors, significantly contribute to the investment cost of these processes thereby hindering their applications at industrial scale.

Therefore, hierarchical cation-exchange membranes (hCEMs) fabricated by blade coating and UV crosslinking of ionomer on top of a porous substrate have been developed as an alternative. The use of commodity precursor as an ion-exchange layer in combination with energy efficient fabrication processes ensures a low-end cost for hCEMs. These membranes demonstrated promising results performing NaCl demineralization. In the food industry, complex solutions are used and hCEMs were never investigated before for such food applications. Two chemistries (urethane acrylate based: UL and acrylic acid based: EbS) with various crosslinking densities were formulated. The impacts of hCEMs properties and crosslinking density on whey demineralization performances by electrodialysis (ED) were evaluated and compared with CMX, a high performing CEM for whey demineralization by ED.

The crosslinking density had an impact on the hCEMs area specific resistance, and on the ionic conductance for EbS membrane. However, 70 % demineralization of 18 % whey solution was reached for the first time for hCEMs without any fouling observed, and with comparable performances to the CMX benchmark. Although some properties were impacted by the crosslinking density, the global performances in ED (limiting current, demineralization duration, global system resistance, energy consumption, current efficiency) for EbS and UL6 membranes were similar to the CMX benchmark.

These promising results suggest the possible application of these hCEMs for whey demineralization by ED and more generally complex products as an alternative in the food industry.

25- Development of ethyl cellulose shell-coated alginate droplets in w/o emulsions by electrospraying

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This research investigated the use of ethyl cellulose (EC) in w/o emulsions to stabilize dispersed aqueous alginate droplets in 0:100 or 90:10 (w/w) medium chain triglyceride (MCT): canola oil continuous phases.

When the aqueous alginate solution (2 % w/w) was electrosprayed in the oil phases containing dissolved EC, a thin layer of EC shell was formed rapidly around hydrophilic alginate droplets, thereby stabilizing the dispersed phase [1,2]. As EC concentration in the oil phases increased from 0.2 to 1.0 % (w/w), the interfacial tension value (determined from pendant drop tensiometry) increased from 7 to 11 mN/m for canola oil but decreased from 3.87 to 0.21 mN/m for MCT/canola oil blend. At 2 kV applied voltage, as EC increased from 0.2 to 1.0 % (w/w), the electrosprayed alginate droplet diameter decreased from 1600 to 2000 µm and from 1600 to 800 µm for canola and MCT/canola blend, respectively. At 7 kV, the droplet diameter decreased from 220 to 110 µm and from 160 to 70 µm for canola and MCT/canola blend, respectively.

The changes in alginate particle size can be attributed to the process-dependent EC depletion rate in the continuous phases that altered the surface activity at the w/o interfaces. The emulsions prepared in MCT/canola blend were more stable than those prepared in canola oil. For example, at 1 % (w/w) EC and 7 kV, the w/o emulsion stored at 22 ^{o}C for 14 days resulted in 91 and 38 % (initial emulsion volume) settlement, for canola and MCT/canola, respectively.

Overall, this study showed that EC is promising for forming an elastic shell on electrosprayed alginate droplets in w/o emulsion systems.

26- Enzymatic hydrolysis of industrial white water for optimal production of antifungal peptides

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The dairy industry produces large amounts of wastewater, including white and cleaning wastewater originating principally from rinsing and cleaning-in-place procedures. Therefore, to improve the sustainability of dairy plants and as part of a circular economy, there is an opportunity to valorize, dairy constituents present in white water such as proteins.

Enzymatic hydrolysis resulting in the formation of bioactive peptides has been highlighted as a major approach to protein valorization and, more specifically in the case of these effluents, the production of antimicrobial peptides to be used on final dairy products. In this work, the physicochemical characteristics of white water from an ultrafiltration system of skimmed (collection) milk were first evaluated. The amount of total solids was 1.38% including 1.28% protein compared to 3.2-3.5% protein in milk. Then, enzymatic hydrolysis tests were performed according to the optimal conditions of four different enzymes: pepsin, trypsin, thermolysin and pronase E. The degree of hydrolysis (DH) was quantified by the o-phthalaldehyde (OPA) spectrophotometric technique.

Among the four enzymes, pronase E exhibited the highest DH reaching up to 13.79% after 240 minutes of reaction. Pepsin and trypsin led to lower DH of 3.66% and 4.65%, respectively. The hydrolysates were analyzed by HPLC-MS/MS to validate the hydrolysis mechanisms and to identify the peptide sequences present in each hydrolysis condition.

The physicochemical and structural characteristics of the identified peptides were studied using bioinformatics databases in order to identify peptides with potential antibacterial and antifungal activities. These peptides were also statistically analyzed, and peptide sequence identification was performed from known milk proteins. The first analyses showed a great variability between the peptide sequences found in the hydrolysates suggesting completely different bioactivities.

These results form a promising database for the selection of potential antifungal peptides whose antifungal effects are currently under study.

27- Environmental impact associated with the cultivation of underutilized crops versus well-established counterparts – A case study of black (Desi) and white (Kabuli) chickpeas cultivation

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The current food system is at an impasse: it needs to keep growing to be able to feed the growing population but it needs to decrease its environmental impact. Besides the high environmental impact, the current diets are getting similar due to globalization. The same raw materials are required in different parts of the globe, creating a global co-dependent network, with a high risk of disruption. The use of underutilized crops can be beneficial as they can adapt to different climate challenges (e.g.: drought, low availability of soil nutrients) and improve the stability of the chain in the short and long term. This study was conducted to assess the impact of the cultivation of an underutilised chickpea crop (desi chickpea, bioproduction-DC) versus the cultivation of the commercially available counterpart (kabuli chickpea, conventional or organic production-KC).

The data relating to desi farming stage was collected and provided by the farmers on-site, while data relating to kabuli farming stage were collected from farmers and different available databases. Data was analysed with the SimaPro software with ReCiPe Midpoint(H) methodology. The results show that the production of organic KC carries an overall lower environmental burden than the production of DC. Data for conventional production of KC shows that in most categories (e.g.: Climate change 1.53kg CO2 eq., Marine eutrophication 1.71E-2kg N eq.), it carries a higher environmental impact than DC bioproduction (1.07kg CO2 eq. and 1E-3kg N eq., respectively). One reason for this is that the production of DC is being produced at a small scale and is not optimised, with a big input of human labour. Whereas the production of KC has been optimised over the years and that's why it is currently more widely available.

Further processing of these crops for novel product development will deliver different environmental burdens and nutritional profiles.

28- Biocontrol of Listeria monocytogenes on ready-to-eat pork-cooked ham by treatment with porcine hemoglobin hydrolysates: A circular economy approach for the slaughterhouse blood valorization

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Listeria monocytogenes is one of the most problematic foodborne pathogens representing a serious concern for ready-to-eat (RTE) meat products due to its persistence in production facilities.[1,2]

Among the different strategies for the control of this pathogen, the use of antimicrobial peptides, in the context of circular economy, has emerged as a biocontrol strategy with great potential, especially when the peptides are derived from food by-products such as slaughterhouse blood proteins.[3]

This study evaluated for the first time the use of porcine hemoglobin peptide hydrolysates as a biocontrol strategy of *L. monocytogenes* on ready-to-eat cooked pork ham. Pure porcine hemoglobin (Hb-P) and porcine cruor (P-Cru) were hydrolyzed with pepsin for 3 h at different temperatures (37 °C for Hb-P and 23 °C for P-Cru). Afterwards, the hydrolysates were characterized in terms of their degree of hydrolysis (DH), peptide population, color, and antimicrobial activity (*in vitro* and *in situ*) against three different serotypes of *L. monocytogenes*.

The reduction in the hydrolysis temperature for P-Cru affected the enzyme performance, resulting in 2 percentage units less DH compared to Hb-P hydrolysate, as well as some differences in the peptide population. However, the antimicrobial activity (*in situ*) was not significantly affected, decreasing the viable count of *L. monocytogenes* by ~1-log and retarding its growth for 21 days at 4 °C. The color of the product was visibly altered by product application towards more saturated reddish and yellowish colors and lower brightness. Nevertheless, discoloration of the hydrolysates can be considered to overcome this concern.

This biopreservation approach could also be applied to other meat products and represents a good alternative for the valorization of slaughterhouse blood, the production of new anti-listerial compounds, and the reduction of the risk of listeriosis infection under a circular economy concept.

29- Optimization of protein extraction from water lentils followed by a qualitative study of the extracted proteins and some of their functional properties.

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Water lentils are free-floating aquatic plants which can grow almost anywhere on Earth. They have a great agronomic potential since they can double their biomass in less than 24h[1] and are very rich in RubisCO[2], a protein that can be quite easily purified on laboratory-scale, though the extraction yields are very low when high protein purity are achieved[3]. RubisCO showed promising properties for human consumption since it is tasteless, odourless, and white coloured as well as having a high nutritive value and excellent functional properties[3]. However, their use for human food is limited because of the protein extraction step[1]. Therefore, in this work, an optimized protocol was developed to extract water lentils proteins. The proteins were first solubilized using heat and pH shifts followed by an isoelectric point precipitation. For each step, the protein concentration, temperature and/or pH values were optimized to maximise protein yield and purity.

Protein samples were analysed using LC/MS/MS to qualify the extracted proteins in terms of mass for each condition. Following the optimized procedure, combining the best conditions of pH, temperature and protein concentration, a protein concentrate containing 55% protein with a protein yield of 60% was produced. These combined yield and purity were the highest reported in the literature for leaf protein concentrates extracted by isoelectric point precipitation. Furthermore, the secondary and tertiary structure of the protein extracts were studied and compared to the initial raw material using FTIR and DSC analyses.

This concentrate also showed excellent foaming properties since it had a better foaming capacity and the same foaming stability as egg white, while the egg white solution contained 7.3 times more proteins. Its digestibility by pepsin at pH2 was also assessed and showed that the proteins were more digestible in the initial raw material compared to the end-product.

30- Production of an insect protein isolate by ultrafiltration/diafiltration: impact of blanching treatment on filtration performance

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The projected population growth will require an increase in protein demand. Edible insects have been identified as a potential alternative source but the low acceptability for insect visibility in diet represents the main issue of product developments in Western countries.

However, the use of insect ingredients was identified as a solution to improve the consumer acceptability. Consequently, the objective of this work was to generate an insect protein isolate by ultrafiltration/diafiltration (UF/DF) and to determine the impact of blanching treatment on filtration performance. Two blanching conditions, 90°C for 3 min (90/3) and 75°C for 20 min (75/20), applied on mealworms before protein extraction and concentration by UF/DF were evaluated. As expected, the UF/DF improved the protein content by 14,86 %.

Moreover, we showed that UF performance (filtration duration, permeate flux, membrane resistance) was similar regardless the blanching parameters applied. However, significant differences were obtained regarding the composition of mealworm protein isolate. Indeed, the protein content was higher for 75/20 isolates (69.08 ± 0.16 %) compared to 90/3 (64.45 ± 0.88 %). The lipid content was lower for the condition 75/20 (4.53 ± 0.11 %) compared to 90/3 (7.28 ± 0.32 %) and surprisingly, the variation in lipid content before and after UF/DF was significantly improved for 90/3 compared to 75/20 (27.01 ± 2.95 and 2.01 ± 4.65 %). Consequently, we demonstrated that the use of UF/DF had an impact on isolate composition, mainly by increasing the protein content.

The next step will be to characterize in detail the state of denaturation/aggregation and interaction of protein as a function of blanching treatment and to evaluate the techno-functional properties of the different mealworm protein isolates.

31- Food waste management with an automated, modular system based on *Hermetia illucens* larvae and heterotrophic alga *Galdieria sulphuraria*

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Food waste at the end of the value chains is a challenging problem currently solved with incineration, composting (or landfilling) and anaerobic digestion technologies. They are associated with high environmental impacts and low recycling of valuable nutrients, which can be achieved in a cascading upcycling of nutrients with live organisms (Pleissner & Smetana, 2020). Methods to process such wastes into biomass of defined composition automatically and in decentralized locations are lacking. The study presents modular designs of food waste treatment relying on insect larvae of *Hermetia illucens* (Pahmeyer et al., 2022a) and continuous production of the heterotrophic alga *Galdieria sulphuraria* (Pahmeyer et al., 2022b). Modular design was dictated by the need to have a mobile system of decentralized food waste treatment close to the point of origin, abilities of species to process the biomass and potential for maximal automation.

A life cycle and economic assessments were carried out on the hypothetical design to define whether the proposed systems would be viable. The designs resulted in continuous and semi-continuous designs able to produce dry biomass of 3.55 € per kg (*H. illucens*) and of 4.38 € per kg (*G. sulphuraria*), which would make them profitable in 5 years. Production of 1 kg of dry biomass of insects and microalgae was associated with impacts in global warming potential: 2.77 and 3.8 kg CO_2 eq; in non-renewable energy use: 55.24 and 69.9 MJ; in arable land occupation: 0.68 and 0.09 m^2 annually. Relying on 1 kg of proteins as functional unit it was possible to demonstrate that even small-scale insect and microalgae production processes have sustainability benefits when relying on food waste as feeding media.

Moreover, present automated, modular technology waste treatment is demonstrated to be more environmentally friendly than most waste treatment technologies applied to the end of the chain wastes.

32- Is the application of a hexane defatting step during the production of pea protein isolate by membrane filtration is necessary in a context of sustainable processing?

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The use of pea protein isolates (PPI) in the formulation of plant-based products has surged with the increasing demand for sustainable proteins [1]. The PPI process typically includes a defatting step with hexane, followed by alkaline extraction and isoelectric precipitation (IEP) of proteins. However, these steps generate a large amount of non-eco-friendly organic and acidic/alkaline wastewaters.

Consequently, eco-friendly approaches, such as elimination of the defatting step or replacement of IEP by ultrafiltration/diafiltration (UF/DF), were developed, but their impact on PPI composition and properties are not well discussed [2]. Consequently, this work aimed **1)** to study the effect of the hexane-defatting step on protein profiles and techno-functionalities of PPI and **2)** to evaluate the impact of different UF membrane molecular weight cut-offs (MWCO of 30, 100 and 300 kDa) on PPI composition. Thus, PPI were produced by UF/DF (30 kDa) with and without a hexane defatting step, and protein profiles and techno-functionalities were compared.

Firstly, we showed that the hexane-defatting step had no impact on protein electrophoretic profiles and surface hydrophobicity. Only a slight difference was obtained between defatted and non-defatted PPI for protein net surface charge (-20.68 and -17.83 mV, respectively) and particle size (monomodal (0.2 µm) for defatted PPI and bimodal (0.3 and 1.9 µm) populations for non-defatted PPI). Techno-functionality (solubility and emulsifying properties) was not affected by the defatting step, except for foaming stability, which reached up to 97% for defatted PPI. Consequently, the defatting step is not crucial for PPI production. Secondly, results showed that UF/DF performances as well as composition and protein profiles of non-defatted PPI were similar, regardless the UF MWCO. However, some differences were observed in terms of protein species and molecular weights.

Our findings can be used to improve the sustainability of PPI production with limited impact on the ingredient techno-functionalities.

33- Effect of short ultrasound treatment as a chitin pre-treatment: a strategical step to transform shell wastes in chitooligosaccharides

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Chitooligosaccharides (COS) are innovative bioactive oligosaccharides obtained from chitin with applications in many areas such as in food and health as a bioactive ingredient. Québec has a huge potential in the production of these molecules because of its relevant role in the processing of marine products such as snow crab and American lobster, which generates huge amounts of shell wastes, rich in chitin. Although chitin from marine shells constitutes an interesting source of COS, the latter high crystallinity hinders the transformation of chitin into COS without the use of toxic and pollutant chemicals.

The objective of this work is to assess the effectiveness of ultrasound (US) treatment on the diminution of chitin crystallinity and relaxation of the hydrogen bonds in it. Particle's size distribution was standardized and then 1% (m/v) chitin suspensions were US-treated at 40 W for 15 min (30s cycle, ON/OFF), in an ice-bath, in a high-intensity ultrasonic processor (model Vibracell VCX 750 Sonics, Sonics and Materials Inc, Newtown, United States), with a 13 mm tip and an amplitude of 40%. Two commercial chitins: from crab (naturally more crystalline) and from squid (less crystalline structure) were compared to extracted chitins from shell wastes of crab and lobster. Differences in water solubility, crystallinity (X-ray diffraction, XRD), deacetylation degree and chain bonds relaxation (FT-IR) were monitored in treated and non-treated samples. The US treatment was able to promote a higher increase in solubility in squid chitin, followed by the commercial crab chitin, crab and lobster. Characteristic chitin peaks (2θ) at nearly 10° and 20° in the XRD analyses indicated a decrease in crystallinity in US-treated samples in different extents for each chitin source.

These results encourage the investigation of emergent and green technologies such as US in the transformation of food wastes into high added-value ingredients.

34- Evaluating price sensitivity for plant and animal protein foods by socioeconomic status: A study of grocer loyalty program data from Quebec and Finland

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Many green food innovations have been launched on the market in recent years. Yet, actual consumer demand for green products has been slow to grow. In this article, we study food prices as an entry point for the transition of consumer diets away from animal protein consumption toward new plant-based alternatives. Using loyalty program data from two large grocery retailers in Quebec and Finland, we investigated how socioeconomic status (SES) impacts consumer price sensitivity for 21 plant and animal proteins categories. Longitudinal data containing consumer purchasing behaviors for 58,267 loyalty program cardholders in Quebec and 29,131 in Finland were included in the analyses. Separate multilevel mixed effects Tobit regression models were used for each category. Random-effect models were used in a meta-analysis to summarize key results.

The average daily consumption of plant proteins was less than one-tenth that of animal proteins in both countries. Overall, results show that low SES consumers are more price sensitive than high SES for animal proteins ($p<0.001$), but not plant proteins ($p=0.28$). Consumers are overall more sensitive to plant protein prices ($\beta= -22.97$, $p<0.0001$) than animal protein ($\beta= -13.83$, $p<0.0001$). Within plant proteins, some categories, such as plant-based cheeses, yogurts, and simulated meats, did not have significant interactions between SES and price. In ancillary analyses, we observe that the number of brands, but not the number of products, is one mechanism contributing to the differential in price sensitivities across SES groups.

This research makes contributions to marketing theory by showing how the impact of SES on price sensitivity is category-dependent and moderated by brand variety. Insights for food policy and retail strategies will also be discussed.

35- Production of polyphenols-enriched cranberry juice through electrodialysis with filtration membrane: How physicochemical properties of filtration membranes impact anthocyanins migration and selectivity during electrodialysis.

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Health-promoting effects credited to anthocyanins have been extensively studied and recent discoveries have suggested their impacts on the modulation of the gut microbiota[1].

Cranberry juice - a goldmine of anthocyanins - could be enriched to enhance its heath benefit. In previous studies[2],[3], electrodialysis with filtration membrane (EDFM) selectively enriched juice in anthocyanins. The present study focused on this green and promising technology especially on understanding how physicochemical properties of filtration membranes impact global and selective anthocyanin migration during EDFM. Thus, six polyether sulfone (PES) and polyvinylidene fluoride (PVDF) membranes with molecular weight cut-offs (MWCO) of 150kDa, 200kDa, 250kDa, 300kDa and 500kDa were characterized and used during EDFM treatment.

Membranes were characterized in terms of thickness, conductivity, contact angle, % of hydrophilic pores, porosity, zeta-potential, roughness. Juices were analysed using UV-visible spectroscopy to assess the global anthocyanins enrichment and HPLC was used to determine the individual anthocyanins, proanthocyanidins and organic acids migration. Results have shown an impact of MWCO and membrane material on anthocyanin's enrichment.

Data are currently analysed by redundancy analysis (RDA) and multivariate regression to understand the correlation between membrane physicochemical properties and global and individual anthocyanins migration during EDFM: migration predictive models will be generated.

36- Effect of pulsed electric field pretreatments on protein extraction from brewery spent grains

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Efforts are underway globally to minimize processing waste and encourage the recycling of generated secondary products to support a sustainable economy over the coming decades[1].

For the beer industry, the recovery and use of brewers' spent grains (BSG) proteins is of great interest to improve its sustainability. The present study proposes to explore the bioactive potential of peptides obtained via enzymatic hydrolysis using trypsin, chymotrypsin and pepsin, from the BSG proteins. Protein extracts were obtained by alkaline extraction with NaOH alone or by adding 5% w/v L-cysteine reducing agent followed by isoelectric precipitation at pH 3.8. The precipitate obtained via extraction with NaOH and L-cysteine demonstrated the best percentage of proteins compared to the one resulting from NaOH extraction only with contents respectively 68.8 ±0.8% and 56.6 ±1.2%.

To obtain the peptides from extracted proteins, several conditions were tested, including the hydrolysis time (3h and 5h) and enzymatic inactivation (HCl/NaOH or heating). The degree of hydrolysis (DH) obtained after 3 hours and with acid/base enzyme inactivation was the lowest for the 3 enzymes, especially for trypsin which demonstrated a final DH of 1.4% only. Heating, compared to acid/base, as well as increasing the hydrolysis time to 5 hours, increased the DH by 9 times for trypsin hydrolysates and by 2 times for chymotrypsin ones. The hydrolysates from NaOH alone (inactivation at 90°C/10 min) had the best DH compared to those obtained with L-cysteine, with average values between the enzymes of 9.6% and 7.7% respectively.

Further studies will focus on the characterization of the resulting peptides as well as improving protein extraction[2] and enzymatic hydrolysis efficiency using pulsed electric fields as a pre-processing step to improve overall performance of the process and to promote applications of the proposed approach on an industrial scale[3].

37- Effect the maturity stage on the physico-chemical composition of pulses

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Pulses and legumes are highly prized for their rich nutritional profile (high protein, carbohydrates, and fiber). However, their consumption is hindered by the presence of anti-nutrients. Furthermore, the chemical composition of these crops may vary based on the cultivar and soil, but there is limited research on how maturity stage impacts this constitution.

The aim of this study was to investigate the effect of maturity stage (fresh (FMS) ≈45% dry matter (DM) and dry stage (DMS) ≈90% DM) on the chemical composition (total solid, protein, lipid, and ash content) and amino acid (AA) composition of four legumes: red, black and borlotti beans and chickpea. The protein profiles of the protein concentrates (obtained after flour alkaline solubilization) were evaluated by gel electrophoresis.

Results revealed that black beans at FMS had the highest protein content (25% DM), with no significant difference in ash and lipid content, or essential AA. The protein profile also varied, displaying an increase in vicilin and α-amylase inhibitors in the DMS. The FMS had the highest protein content (29 % of DM) and the lowest lipid content (1.4% of DM) in red kidney beans. Nevertheless, no significant differences were found in the protein profile.

The content of several essential AA (phenylalanine, leucine, isoleucine and histidine) was improved. In contrast, for chickpeas, FMS had the highest lipid content (6 % DM) and the lowest protein content (15% DM), while similar essential AA was observed. There was, however, a drastic reduction of the albumin band in the DMS. For borlotti beans, no significant effect of maturity stage was observed on its composition. A slight reduction was only observed in vicilin and phytohemagglutinin with DMS.

These findings indicate that the chemical composition of beans and chickpeas can be modulated, potentially leading to the generation of products with improved nutritional properties.

38- Untargeted metabolomic analysis of strawberries exposed to pulsed electric fields and cold plasma prior to postharvest storage

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Strawberries undergo a decrease in the concentration of nutrients as well as functional compounds, mainly anthocyanins, during the postharvest period. In addition, this fruit is very susceptible to deterioration caused by phytopathogens. Since postharvest losses account for up to 50% of total production [1], the development of a physical method complementary to refrigeration to reduce these losses is a worldwide objective, due to a global market of $19 billion per year [2].

The current pilot project will use two non-thermal technologies, pulsed electric fields (PEF) and cold plasma (CP), to test their effectiveness in maintaining phytochemical integrity (i.e., polyphenol and volatile compound content) in exposed strawberries, as well as to try to reduce the incidence of phytopathogens.

A PEP treatment of 1 pulse in 3 L of water allowed a very significant accumulation of volatile compounds, however fruit firmness was considerably affected during cold storage. On the other hand, a CP treatment at 15 % (210 watts) for 1 min did not affect fruit quality parameters and allowed a relative accumulation of aroma compounds.

Based on these results, strawberries treated with CP are being analyzed under an antifungal and metabolomic approach. If the results are positive, CP could be not only a useful tool to reduce pathogenic fungi, but also to improve the sensory and phytochemical characteristics of the fruit.

39- Effect of hydrolysis duration and pH on peptide populations of peptic hydrolysates derived from turkey cruor: slaughterhouses blood valorisation in a circular economy approach

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Global pressure is growing to minimize the environmental impact of slaughterhouses. One way to answer this issue is to valorize by-products such as blood, by the production of bioactive peptides using enzymatic hydrolysis[1]. To the best of our knowledge, no research has been previously performed regarding the pepsic hydrolysis of turkey cruor which contains, after blood centrifugation, hemoglobin, a protein not yet valorized since the main use of blood is focused on its colorless part (plasma)[2]. This project aims to optimize the enzymatic hydrolysis conditions of turkey cruor and to evaluate the potential antimicrobial and antioxidant activities of peptides produced. Enzymatic hydrolysis of turkey cruor was carried out by pepsin (37°C, E:S ratio of 1:11 and pH 2, 3, 4, and 5). The kinetics of hydrolysis was evaluated by hydrolysis degree determination employing o-phtalaldéhyde (OPA) spectrophotometric assay and the peptide characterization was performed by reverse-phase high-performance liquid chromatography coupled with mass spectrometry (RP-HPLC-MS). A Gram+ bacterium (*Listeria ivanovi* HP B28) and a Gram- bacterium (*Escherichia coli* MP 4100), a filamentous fungus strain (*Mucor racemosus* LMA-722), and a yeast strain (*Rhodotorula mucilaginosa* 27,173) were tested to evaluate the antimicrobial activities of the time-dependant hydrolysates. Their antioxidant activities were tested by using DPPH free radical scavenging and ORAC tests. This project is expected to take advantage of slaughterhouse blood by the production of bioactive peptides with the respect of circular economy principles, the adoption of which is currently being encouraged in the food industries.

40- Impact of pre-concentration on the extraction of protein from tofu whey by a combination of electrodialytic processes

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Tofu whey is a by-product generated in very large volume during tofu processing. Although rich in nutrients, this by-product is mainly thrown away, after treatment to decrease its environmental impact, since no recovery method has been integrated to industrial production. Treatments that must be applied before its disposal represent important costs for the industries as well as a significant waste of resources. Indeed, tofu whey contains soy proteins, which have a high nutritional value and interesting functional properties. In 1999, Bazinet et al. demonstrated the feasibility of extracting proteins from tofu whey by an innovative process which couples conventional electrodialysis (ED - lowering of ionic strength) with electrodialysis with bipolar membrane (EDBM - acidification). However, the process should be optimized in order to improve the protein recovery. In this context, the aim of this work was to study the impact of a pre-concentration step by Nanofiltration prior to the ED+EDBM treatment on the process performances, particularly on protein recovery. Three conditions were tested : tofu whey without pre-concentration (1X) and concentration factors of 2X and 3X. Results show that protein recovery in the 3X condition allows a recovery 20% higher than the 1X. Protein recovery values, expressed in % w/w, were 16.2% ± 0.7%, 16.9% ± 2.7% and 19.4% ± 1.7% for FCV 1X, 2X and 3X respectively. Also, protein purity of the recovered fraction was similar for these three conditions, with 45.3 %, 44.0 % and 45.2 % on dry powder basis respectively. Although we demonstrated that protein recovery was improved by the pre-concentration step, protein recovery is still pretty low and should be increased by an additional optimization step. Proteins has also been characterized by SDS-Page and proteomic analysis results will be received soon to identify specifically which proteins were precipitated from the tofu whey after acidification.

GastronomiQc Lab poster session

1- Revealing the potential of Brewer's Spent Grains In Human Nutrition: Exploration of Protein Extraction Performance and Functional Properties

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To reduce the environmental and waste management costs of the brewing industry it is necessary to find new ways to increase the value of brewer's spent grain (BSG), the main organic waste associated with beer production. Currently, most of this by-product is relegated to animal feed or landfills but it could have other potential uses with higher economical value such as human consumption. BSG's protein content is of particular interest for human consumption (1).

To investigate BSG proteins and identify potential food applications, native BSG, alkaline extract and alkaline extract with reducing agent (L-cysteine) were compared for a wide range of functional properties at pH 2, 4, 6 and 8.

Both methods of protein extraction yielded extracts with higher protein content than native BSG. Extractions with reducing agent (L-Cysteine) doubled protein content (from 20 to 40 %) while extractions with solely NaOH yielded smaller increases (from 20 to 30 %).

Native BSG showed no emulsifying and foaming properties while both types of protein extracts demonstrated significant improvements of these functional properties, which were comparable with casein and pea proteins (2). In all cases, functional properties were improved in higher pH conditions (pH 6 and 8) and were the lowest at pH 4 where isoelectric precipitation was observed. Overall, low BSG proteins solubility in acid conditions is the main obstacle to food applications but extractions using a reducing agent showed increased protein solubility in almost all tested pH ranges.
Extraction methods used were simple enough to be easily implanted in breweries, eliminating the need for transportation to another processing factory. BSG protein extracts have interesting potential applications in human consumption especially regarding their emulsifying and foaming properties.

However, future food applications should focus on low acid foods to maximise BSG protein extracts' application potential.

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

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Reducing food waste (FW) has been identified as one of the best ways to achieve a sustainable food system[1]. 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.

3- Guide of eco-efficient practices in the food service sector

Mélanie Faucher[4], Jade Lévesque[1,2,3], Annie-Pier Mercier[4], Jean-Luc Bernier[5], Stéphanie Vézina[4], Anne-Sophie Morriset[2,6,7], Véronique Provencher[2,6,7], Marie-Ève Labonté[2,6,7], Véronique Perreault[2,3,8], Sergey Mikhaylin[1,2,3].

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Climate emergency and population health are major challenges of the 21st century. Among the actions that can be taken in response to them, food is a powerful lever to work simultaneously on both issues. Besides, by their scope, both in terms of societal purchasing power and as a living environment, institutions constitute a favorable sector for the deployment of health promoting and environmental actions. Thus, the aim of this work was to propose an approach, developed in the form of an implementation guide for institutional food service managers, to produce eco-efficient meals, which have high nutritional quality and low environmental impacts.

To evaluate meal eco-efficiency, the Nutrient-Rich Food Index 9.3 is used to calculate the nutritional quality, whereas the environmental impact is represented by greenhouse gas emissions in kg of CO_2 equivalents. Therefore, the step-by-step approach of the guide increases eco-efficiency, whether by modifying the existing meal recipes or by introducing new meals. To do so, six recommendations can be followed: five are related to the ingredients used in the meal recipes (e.g.: favor the use of plant-based foods, ensure a proportion of 50 % of fruits and vegetables per meal, etc.) and the sixth reaches to limit food waste. The guide includes two levels of involvement from the food services and its approach is based on 4 steps: 1) diagnosis realization, 2) development of objectives, 3) implementation of recommendation and 4) deployment of a communication strategy. These steps are carried out differently according to the level of involvement chosen, but in either case, each step is clearly expanded in the guide.

This guide and its approach can be used by any institutional food services but is currently deployed at Université Laval in a project granted by Recyc-Québec.

4- Effects of Xanthan, Agar, Gelatin, and Pectin on physicochemical and rheological properties of canola protein microgel stabilized Pickering emulsions as a Potential Animal Fat Replacer

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Due to the negative effects of saturated fat on human health such as elevated plasma cholesterol and cardiovascular diseases, elimination or significant decrease in animal fat content in foods has gained more attention over recent years. To achieve this objective, the use of structured vegetable oils in form of Pickering emulsion as an animal fat replacer is one of the privileged and promising methods[1].

In this context, this study aimed to investigate the influence of the type and ratio of four hydrocolloids, namely xanthan, agar, gelatin, and pectin, on the stability, physicochemical, and rheological properties of the Pickering emulsions stabilized by canola protein microgel as a potential fat replacer.

Microscopic and FTIR analyses were also carried out to explore the structure and possible interactions. Hydrocolloid addition was done in two ratios of 1:1 and 2:1(Pickering emulsion: hydrocolloids). In both ratios, adding xanthan, gelatin, and agar increased G" and G' values. However, the sample with pectin did not show the same behavior and it was far from a gel-like structure. Individual Pickering emulsion fabricated without any hydrocolloids was unstable after one day, while no phase separation was observed after adding xanthan, agar, and gelatin over 40 days of storage.

Microscopic images and particle size analysis showed that the Pickering emulsion with xanthan had the smallest particle size. Moreover, adding hydrocolloids in the same proportion as Pickering emulsion leads to a significant decrease in span and less polydispersity. Based on the rheological measurements, adding xanthan, agar, and gelatin increased elasticity, solid-like, and viscose behavior of the Pickering emulsions. The samples with agar represented the most elastic solid-like and viscose character.

We believe that such stable viscoelastic gel-like systems could find potential applications as animal fat replacers in developing novel low/non-fat food products, consequently reducing the health risks caused by animal fat consumption.

5- Yellow pea and black Beluga lentils purees: novel ingredients to modulate the texture of pound cake

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To meet the growing interest in plant-based and local food, this study uses black Beluga lentils and whole yellow peas - two different pulses cultivated in Quebec province - in an innovative way to modulate pound cakes characteristics.

The pulses were separately cooked and grounded in their cooking water to produce purees ingredients. A formulation of pound cake was used as a model to study the impact of 20, 40, 60 and 80% substitution of the wheat flour by pulses puree on the physical characteristics of the cakes. To isolate the effect coming from the dry matters' composition of the purees, formulation without purees were produced to match the amount of humidity of those containing pulses puree.

Flow behaviour of cake batters was measured to determine their consistency index (CI) using the Power law model, the specific volume of the cakes (SV) was measured by seed displacement (AACC 10-05.01) and texture characterization was performed by texture profile analysis. The substitution of the flour by pulses puree significantly increases the CI of the batter. This could be explained by the higher amount of protein and fibres and the presence of gelatinized starch coming from the purees in the batters. As the substitution level of the flour by pulses puree increases, the SV of the cakes decreases.

Addition of purees resulted in cakes with higher SV as compared to controls made of wheat flour and water. A positive correlation was found between CI of the batters and the SV of the cakes (r=0,90) meaning that batters with a higher consistency produce less dense cakes. Moreover, the substitution of the flour by pulses purees generally decreases the hardness of the cakes.

This study highlights the interest to use pulses puree as an innovative ingredient to expand the sensorial diversity of pastry products.

6- Promoting the use of Quebec Forest mushrooms in cooking through a better description of their sensory characteristics

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Although local edible forest mushrooms were once considered as niche products not very accessible for the vast majority of Quebecers, the enthusiasm for these products has increased among consumers in recent years[1]. Professional chefs and cooks are one step ahead of this craze. Sensory description is identified as a judicious tool to support the promotion of a wider variety of products, which is in line with a perspective of sustainable development[2]. The main purpose of our initiative is to document some sensory characteristics (aromas, texture) and some related physicochemical properties specific to each species of a selection of edible forest mushrooms from Quebec. This first study focuses on texture properties. Ten (10) species harvested by professionnal pickers in Mauricie (Quebec) during summer and fall 2022 were selected aiming for a wide diversity of textures and a good representation of various forest mushrooms available. Upon receipt, the fresh mushrooms were cleaned and sliced into 5 mm thick slices. Mushrooms' texture was measured for each species at fresh and cooked/stir-fried states with a texturometer (TA.XTplus, Stable Micro Systems) by uniaxial compression using a knife probe, which allowed to obtain various texture parameters including firmness, hardness, resilience, and elasticity (Young's modulus).

According to the results, three texture groups can be identified among the selected mushrooms: firm and tough mushrooms (*Hypomyces lactifluorum*, *Laetiporus sulfureus*, and *Tricholoma magnivelare*), medium firm mushrooms (*Boletus chippewaensis*, *Cantharellus cibarius*, and *Chlorophyllum rhacodes*), and less firm- crumbly mushrooms (*Lactarius lignyotus*, *Pleurotus ostreatus*, *Sarcomyxa serotina*, and *Suillus cavipes*).

These first results will feed an upcoming sensory study involving chefs, professional cooks and mycology experts to generate sensory descriptors for the different mushrooms species. All this, hoping to support the sector in promoting a diversity of species and to better guide consumers and chefs in their selection for culinary uses and innovation.

7- 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.