Report on Bridge 2 Food Protein Summit 2018

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Background

Demand for dietary protein is increasing both to meet the needs of a growing population as well as to suit changes in consumer preferences. Concern over future food security and sustainability related to protein supply and demand is increasing for global governments, industries, and agricultural value chains. More consumers are embracing plant foods in their diets. Plant-based protein is the primary key opportunity in this emerging category, making up the majority of both online searches and sales for 'plant-based' products. The 'plant-based' trend isn't exclusive to dietary supplements and includes everything from food and beverage, to personal care goods, to pet supplements and bioproducts[1]. As the demand for plant protein ingredients increases, so does economic opportunity.

The Bridge 2 Food (B2F) Protein Summit 2018 was held in Lille France (October 25-26). This was the 11th year of the summit which included both a trade show and an extensive conference. The Summit focused on 'Shifting Protein Strategies'. Although the agenda was highly geared to a European audience, there were many lessons to be learned. The EU food and ingredient industry is very sophisticated and global in nature. Some companies (example Roquette) began developing and commercializing plant-based proteins in the early 2000's. Engagement with the research community has been critical to the success of the EU protein sector.

From the information and data presented at B2F, this report provides an overview of 1) key European companies and protein products; 2) Canadian proteins of interest to global protein ingredient companies; 3) key European research organizations; 4) European and global food and protein initiatives and clusters; 5) Challenges in supplying protein ingredients to the European food industry; and 6) Other observations. The objective of the report is to inform Ag West, Protein Industries Canada (PIC) and their membership as to the EU protein landscape including government, industry and research initiatives, centers and clusters.

1.0 Key European Companies and Protein Products

The B2F Protein Summit trade show presented an excellent opportunity to engage with European companies involved in the plant and dairy protein industry. These companies are described in this section.

As will be apparent by the company overviews that follow, the principle proteins that are being marketed by EU companies (and their global partners) are pea (the most significant), wheat, rice and to a minimum extent, wheat and corn. Companies are increasingly moving away from soy proteins due to concerns around GMO, allergenicity, and studies pointing to its potential in causing hormonal imbalances (though this is disputed).

[1] Zegler, J. 2017 Food & Drink Trends 2017. Mintel.

Pea protein has been growing tremendously. The following list represents the attributes that **companies are promoting** with regard to pea proteins:

- Pea protein ingredients provide important nutritional and functional benefits as well as easy handling and excellent characteristics:
    - plant-based protein
    - neutral taste
    - high content of complex amino acids, glutamic acids, lysine and arginine
    - high protein content
    - excellent digestibility
    - high PDCAAS of 0.93 (adults); complementary to wheat & other cereals proteins
    - alternative to milk and soy proteins
    - low levels of anti-nutritional factors
    - no sugar
    - gluten-free
    - lactose-free
    - non-allergen
    - non-GMO
    - fully traceable
    - environmentally-friendly crop

The following list represents the attributes that **companies are promoting** with regard to **hydrolyzed wheat gluten (88% and above protein):**

- high-protein content
- soluble protein ingredient
- PDCAAS of 0.32 (adults)
- high digestibility
- good synergies with pea & leguminous proteins in amino-acid composition
- source of beneficial amino acids (methionine + cystine and glutamic acid)
- fully-traced source
- short supply chain
- non-GMO
- renewable source
- clean processing

Functionality of a protein is important in the development of commercialization of the ingredient. Functionality has been defined as "any property of a food or food ingredient, except its nutritional ones, that affects its utilization." Food protein functionality includes the testing of fractions for various parameters of importance in successful product development[2]. The testing of functionality is very important in the development of plant-based proteins for incorporation into food products.

The function of an ingredient in a food product is key and increasingly, ingredient suppliers must demonstrate the effectiveness of an ingredient in various food systems and in comparison, to "traditional" ingredients. Thus, food functionality and the role of food science are important in determining how an ingredient will provide the attributes that the consumer seeks in a product.

[2] Webb, MF, Naeem, HA, Schmidt, KA. 2002. J Food Sci. 67(8):2896-2902.

At B2F Protein Summit, food and protein ingredient suppliers were highlighting numerous functional characteristics of protein fractions including:

- Emulsifying and foaming properties to create a firm emulsion that stays stable during shelf-life and forms a foam for producing airy gluten-free baked goods
- Water and fat binding to generate a rich mouth-feel and increases the viscosity of the product
- Use in cold and warm applications, the protein is functional in both methods of preparation
- Neutral taste – a subtle taste that does not overwhelm other flavors
- Gelling properties
- Improved solubility
- Other functional characteristics as required for the food application

1.1 European and Global Food and Protein Ingredient Companies

The following companies exhibited at the B2F Protein Summit trade show. Information summarized below is from interactions at their booth and printed and online materials.

3FBIO (Scotland)
http://www.3fbio.com/

- biotechnology company making protein sustainable by "making more with less."
- ABUNDA® is trademark of 3F BIO Ltd for ***mycoprotein a meat-free form of high-quality protein*** and is also a good source of dietary fibre. It was approved for general use in food in 1983 and has been on sale since 1985 with regulatory approval by EFSA US FDA (GRAS) and wider markets.
- unique fibrous texture which is similar to meat.
- By transforming production costs, ABUNDA® mycoprotein will become substantially cheaper than even the lowest cost meats, unlocking its potential to move from being a premium vegetarian product for Western middle classes to a mainstream low-cost source of sustainable protein for global populations.
- located within the University of Strathclyde, closely aligning technology and commercial development with the strategy of the Industrial Biotechnology Innovation Centre (IBioIC)

AM Nutrition
https://www.am-nutrition.no/

- fractionate yellow peas into ***AMN Pea Protein Concentrate, AMN Pea Starch Concentrate, AMN Pea Flour Concentrate and AMN Pea Hull Fiber*** for use in food, feed, pet food and technical applications.
- obtained by air-classification, a dry process technology that is environmentally friendly, sustainable and preserves the high nutritional and functional quality of peas.
- The production process uses no water or chemicals and has low energy consumption.
- ***Extruded products - Peatex®*** products are based on dry yellow peas, prepared by the use of extrusion cooking technology. As a result, the products have excellent binding capacities.

AMIDORI Food Company GmbH & Co. KG (Germany)
https://www.amidori.com/en

- M¡dori® *made of Water,* ***Pea Protein 32,7%, Spices, Rapeseed Oil, gluten free Whole- Grain Oats Flour, Pea Fibres, Potato Flour,*** Salt, Spice Extracts 100% vegetarian and ***containing zero soy***
- Minced, Pulled, Sticks, Stripes and Crunchlets.
- Clean label, no e-numbers, raw product, production without any additives such as hexane

BENEO (Belgium)
https://www.beneo.com/ingredients/human-nutrition/functional-proteins

- high quality ***vital wheat gluten*** that are obtained by separating proteins and starch from wheat flour for bakery, meat and other applications. Gluten is even the second biggest source of plant protein in meat applications called BeneoPro W-Tex
- ***Rice protein*** for energy bars, meal replacement mixes, baked goods, baby food and pet food thanks to their high digestibility, excellent amino acid and hypoallergenic profile.

Cargill
https://www.cargill.com/food-beverage/na/plant-proteins

PURIS™ Pea Protein
- label-friendly formulation with a creamy, delicious flavor, smooth mouthfeel and clean finish
- Minimum 80% protein content, Non-GMO, Certified organic, vegan, Gluten-free and soy-free
- produced from U.S. yellow pea seed varieties, specially selected to minimize the off-flavors normally attributed to pulses.

Prolia® Soy Flour
- 50% protein, defatted processed into a variety of soy products, including flour, flakes, and grits
- Prolía® soy flour helps create a better crumb structure, improves dough machinability (making the dough more elastic), increases water absorption and retention and replaces eggs.
- due to its film-forming properties, Prolía® soy flour can significantly increase the shelf-life stability of baked products — preventing fat migration and water uptake.

Corn Protein
- delivers 70-90% protein with a high branch chain amino acid content, particularly leucine, does not require allergen labeling, and is sourced from a sustainable, consistent supply.

Cosucra (Belgium)
https://www.cosucra.com/

- original factory, created in 1852, extracts sugar from the beetroot and inulin from chicory seeds
- ***Pisane® based on yellow pea*** is 88% protein

- The digestion rate of Pisane® is intermediate between whey protein isolate (very fast) and casein (slow). Therefore, Pisane® is an interesting alternative to these highly used proteins in sports nutrition.

DuPont Nutrition & Health (Global)

https://www.dupontnutritionandhealth.com/products/trupro-2000-pea-protein.html

- Has launched a ***pea protein ingredient*** TruPro 2000
- With excellent solubility, suspension stability and dispersibility, TRUPRO™ 2000 Pea Protein is ideal for high-protein dry blended beverages.
- free-flowing powder, TRUPRO™ 2000 Pea Protein is 83 percent protein (dry basis), light tan in color and derived from North American yellow peas that are naturally non-GM.

DSM (Global)

https://www.dsm.com/corporate/science/resources-circularity/feed-a-growing-population.html

CanolaPRO™

- Non-GMO
- Solvent-free
- Gluten-free
- Functional
- Bland/neutral taste
- High solubility, also at low PH
- High foaming and emulsifying capacity
- Anti-nutritional factors:
- Low levels of phytate, glucosinolates and phenolics

Component	Specification
Protein	> 90%
Fat	< 2%
Ash	< 4%
Carbohydrates	< 7%
Phytate	< 1.5%
Glucosinolates	< 1 umol/g
Phenolics	< 1000 ppm

- Canola PRO Functionality
    - Solubility High over a broad PH-range
    - Foaming Very good, comparable with egg albumin
    - Emulsification Very good
    - Gelatin and viscosity Good
    - Taste & Flavour Bland/neutral (sweetish/liquorish)

- Nutrition
    - High nutritional value
    - Free from anti-nutritional factors
    - Not on any allergy list

    - GRAS panel approved
    - FDA letter of no objection and Novel Food approval in EU expected

- Taste
    - Neutral taste
    - No beany flavour or other negative taste characteristics
    - Pleasant mouthfeel and no grittiness

- Functionality
    - High solubility over the full PH range of food and beverage applications
    - High foaming and emulsifying capacity, comparable with egg white/yolk

- Sustainability
    - Excellent sustainability profile
    - Available worldwide in large quantities
    - No Solvents
    - Non-GMO, gluten-free, non-dairy

Emsland Group (Germany)

www.emsland-group.de

- internationally operating company that manufactures innovative products for the processing industry based on raw materials from vegetables
- potatoes and peas are the foundation of product developments
- production of native and modified starches, fibers and proteins, as well as potato flakes and granules
- ***new pea protein isolates Empro® E 86 / Empro® E 86 HV as well as extruded protein crisps Empro® Tex. Empro® and Empro® Tex*** can be used in a wide variety of applications, e.g. breakfast products, bars and snacks

Fermentalg (France)

https://www.fermentalg.com/en/component/users/?view=reset&Itemid=140

- Experts in ***microalgae culture***, Fermentalg offers concentrated products and natural extracts from industrial fermentation processes that are innovative, durable and highly controlled.
- PROTÉALG® Naturally rich in essential amino acids and including powerful antioxidant molecules (phycocyanin and carotenoids), this vegetarian ingredient is characterized by a neutral taste

FrieslandCampina DMV (Netherlands)

https://www.frieslandcampina.com/en/brands/dmv/

- extensive portfolio of ***functional and nutritional dairy protein ingredients***.
- ultra-clean whey protein isolate, Nutri Whey Isolate, pure, clean-tasting, nutritionally balanced protein
- protein-rich sports nutrition range under the Vifit Sport brand

Gold & Green Foods (Finland)

https://goldandgreenfoods.com/

- Patented meat alternative made of Nordic oats, faba beans and peas
- Pulled Oats - unique vegan protein
- 30% of protein (more than beef or chicken) and all nine essential amino acids, making it a complete protein
- free from GMO, additive or preservatives, filling agents
- Superior taste and mouth feel
- 100% Animal Free
- Easy & Versatile
- No Soy
- Optimal amino acid composition: Oats is rich in sulfur-containing amino acids, legumes in lysine. Thus, oats and beans make a perfect match of complete protein
- Unique dietary fibres of oat, beta-glucan
- Most of the fat from oats

Ingredia (France)

https://www.ingredia.com/fields-of-expertise/functional-nutritional-proteins/

- markets a whole range of functional and nutritional ***milk proteins (PROMILK ®) and nutrition (PRODIET®)***

Ingredion (North America, Global)

http://emea.ingredion.com/findingredients/foodbeverage/proteins.html

VITESSENCE™ Pulse proteins

- "clean flavour profile", which allows food manufacturers to formulation across a wide range of applications, without altering taste
- products which can be labelled 'source of protein' or 'high in protein'
- Sustainably sourced from ***chickpea, faba bean, yellow lentil and yellow pea*** for bakery products, snacks and cereals, pasta, batters and breadings to meat substitutes

- Announced on December 14, a combined $140 million of strategic investments which will seek to expand the broad range of plant-based protein solution
- Will transform a soy processing facility in South Sioux City, Nebraska, to produce protein isolates from peas, having purchased the site in February. This also includes plans to include production of isolates from other pulses as well.
- The facility will produce ingredients that enhance the company's current VITESSENCE pulse protein isolate line, to include higher protein isolates primarily for the nutrition, health and wellness categories.
- Ingredion has also entered into a ***joint venture agreement with Verdient Foods*****,** Vanscoy, SK.
- Investments are being made within the existing facility to make ***pulse-based protein concentrates and flours from peas, lentils and fava beans for food applications.***

Ingredion's strategic intent is to be the leading solutions provider in ***non-soy plant proteins and this requires a diverse portfolio of flours, concentrates and isolates.***

Innovopro (Israel)

https://innovopro.com/products/#applications

- ***CP-Pro 70® Chickpea Protein***; following products from chickpea protein:
  - Egg Free Mayonnaise: A delicious clean label mayonnaise free of modified starches.
  - Pudding: This healthy, delicious, non-dairy dessert uses pure chickpea protein to replace modified starch, carrageenan, maltodextrin, and pectin.
  - Vegan Ice Cream: Vegan, natural, and delicious. Made with chickpea protein in place of lecithin, starch, carrageenan, guar gum, and LBG.
  - Non-Dairy Milk Beverage: Based on chickpea protein, this non-dairy milk is delicious, nutritious and completely vegan.
  - Veggie Burger: Our veggie burger contains chickpea protein as a protein source as well as a functional ingredient.
  - Energy Bar: Contains CP-Pro 70® chickpea protein as a protein source, combined with dates and coconut. It is gluten free, allergen free and has excellent taste.
  - Baked Snack: Our baked snack contains chickpea protein as a protein source, and chickpea starch. It is gluten & egg-free.
  - Chickpea protein is process friendly for various applications such as baking, homogenizing, extrusion, etc. All applications are clean label, GMO free, gluten free, dairy free.

Roquette (France, Global)

https://www.roquette.com/food-and-nutrition/selected-ingredients/food-nutralys/

- **Since the 70's, Roquette has innovated intensively in protein technology and applications** to meet market expectations for trusted, environmentally-friendly and affordable protein solutions.
- large range of plant proteins produced from various renewable raw materials:
  - *Pea (NUTRALYS®, LYSAMINE®)*
  - *Corn (SOLULYS®)*
  - *Potato (TUBERMINE®)*
  - *Wheat (NUTRALYS®, VITEN®)*
- Sold to food, pet food, feed and fermentation industries.

Pea and Wheat Protein isolates with specific characteristics and available in several particle sizes to meet Food and Nutrition application needs include

NUTRALYS® F grades: pea protein isolate - 83% protein DS
NUTRALYS® S grades: pea protein isolate - 83% protein DS
NUTRALYS® S85XF pea protein isolate - 83% protein DS
NUTRALYS® S85PLUS pea protein isolate* - 83% protein DS
NUTRALYS® B85XF pea protein isolate - 83% protein DS
NUTRALYS® T70S textured pea protein - 70% protein DS

NUTRALYS® T65M textured pea protein - 65% protein DS

NUTRALYS® WHEAT W: hydrolysed wheat gluten 88% protein DS
NUTRALYS® WHEAT WF: hydrolysed wheat gluten 89% protein DS

Tereos (France)
https://tereos.com/

- **new pilot unit for food based on plant proteins to be commercialized under the brand name "Le sauté végétal"**
- nearly 50% of its R&D budget to nutrition
- world's second-largest producer of ***native wheat protein***
- a new product, "GenVie" and commercialized as "Le sauté végétal" – is prepared in shredded form. "Le sauté végétal" is 100% plant-based, and composed of ***wheat proteins and chickpea flour***, patented process
- among the founders of "Protéines France" (French Proteins), a consortium of seven leading French processors of agricultural raw materials

1.2 European and Global Flavor Companies

Edlong (Global)
https://www.edlong.com/

- Global leaders in dairy and dairy-free flavors for authentic-tasting, while masking off-notes.
- more than 250 dairy-free and vegan flavor options

Givaudan (Switzerland)
www.givaudan.com/flavours

- creation of flavours and fragrances for food, beverage, consumer product and fragrance
- presence in over 100 locations
- comprehensive knowledge of local flavours
- Founder of MISTA an incubator or accelerator, that advances innovation by helping companies develop new ways of thinking through a hyper-connected platform with a more collaborative and inclusive approach. Joining Givaudan as founding members of MISTA are Danone, Mars Inc. and Ingredion Inc.
- From alternative protein to health and well-being and biotechnology, MISTA helps companies develop new strategies. Opening early next year in San Francisco, the MISTA Optimization Center (MOC), will provide access to a product development facility, equipment for pasteurization and fermentation, experts providing market and leadership development strategies, as well as input from world-renowned culinary and food scientists.

Solvay (UK)
https://www.solvay.com/en/our-company

- focus on protein off-note masking to overcome challenges associated with off-flavours and mouthfeel in high-protein applications.
- more than 130 years' experience
- three production sites - Saint-Fons (France), Baton Rouge (USA) and Zhenjiang (China)

ICL Food Specialists (Global)
https://www.iclfood.com/

- develop and deliver tailored formulations that optimize the texture and sensory experience.

1.3 European Insect Protein Companies

Protix (Netherlands)
https://protix.eu/

- verifiable and scalable insect breeding ***using black soldier fly (hermetia illucens)***
- **insects can turn low-grade food waste into body mass quickly and sustainably**. They need very little room to grow, making for a far smaller carbon footprint than alternative sources of protein.

Protifarm (Netherlands)
https://protifarm.com/products/

- **high quality insect ingredients of the buffalo for the food and personal care and pharmaceutical industry** under the EntoPure brand. Protifarm products are HACCP certified and the factories are certified FSCC22000, ISO14000 and ISO26000.
- ***buffalo (Alphitobius diaperinus) for large scale production*** due to its excellent and complete amino acids, vitamins, minerals, digestibility and short production time thanks to in-house and yearlong sustainable breeding and rearing methods. The buffalo offer a protein and fatty acid structure comparable to beef. The larvae consist of 35% dry matter of which 60-85% is crude protein. All insects are fed only on vegetable streams and GMP+ certified feed. No antibiotics, chemicals and/or hormones are used. Each batch is traceable from the birth of the animal until the final product leaves our factories.
- insects are natural and non-GMO. Organic and gluten-free ingredients can be delivered upon demand.

2.0 European Research Organizations

Four European research organizations with significant expertise in the development of plant-based proteins exhibited at the B2F conference. They are described here with particular emphasis on their work with the industry. Information summarized below is from interactions at their booth and printed and online materials.

German Institute of Food Technologies (DIL, Germany)
https://www.dil-ev.de/

- 150 member companies from the food industry and related fields
- operates as a research institute working in the areas of product development, process development and analysis
- Forming a bridge between science and practice, DIL supports its partners in the innovation process
- In 2009, DIL took on the responsibility of coordinating the EU research network Hightech Europe which culminated in the opening of its new building (total of 9,000 square meters)
- work in research and development creates technological innovations to allow the user to economically produce competitive, high-quality products
- Has a test laboratory, which offers space to develop and test new technologies and has approval to operate as a food production establishment, has expanded mechanical engineering facilities at its disposal
- work began on the implementation of a "**Business and Innovation Park Quakenbrück**" (BIQ) in 2012. Since 2015, companies and entrepreneurs are being provided with the opportunity to locate at the BIQ site of approximately 2,700 square meters and benefit from the capacities available at DIL.

Improve (France)
http://www.improve-innov.com/en/improve-en/plant-based-proteins/

- Located in Dury near Amiens, IMPROVE is the first open European platform for research and development fully dedicated to proteins
- Funded through a French Public/Private Partnership
- partner of academics such as INRA, UPJV, LaSalle Beauvais Polytechnique Institute, UTC and ESCOM and technical partners such as CVG, PIVERT and BRI
- expertise from fundamental research to market knowledge
- 800 m2 of technical plant and 170 m2 of laboratories for:
    - Reducing time to market for new proteins products
    - Enabling breakthrough innovations that meet market's needs
    - Developing proteins products based with comparable or better characteristics (performance, price, availability, sustainability) to existing products.
- focuses on the following markets: Food, Feed, Cosmetic Agro Materials
- work in six essential domains for the proteins:
  1 – Native Protein extraction: Properties assessment
  2 – Protein functionalisation: Aggregation, Crosslinking, Interaction with other proteins or polysaccharides

3 – Controlled Enzymatic Hydrolysis and fractionation for functional, nutritional and biological properties
4 – Biological properties: Mechanism of interaction with Human or animal metabolism: Bioactive peptides, allergenicity and digestibility
5 – Proteins modifications, Chemicals: Sustainable chemistry, Enzymatic, Thermochemical
6 – Market, societal & Economical Studies

- To implement its roadmap, IMPROVE has pilot equipment for the definition of production process, samples and product characterization (composition in proteins and amino acids, functional properties, biological properties.
- Opportunities for scale-up for industrialization and production of larger samples (> 1 t)

NIZO (Netherlands)

https://www.nizo.com/expertises/protein-application/

- **private research and development company.**
- **headquarters are in Ede, the Netherlands.**
- work for food and health companies worldwide, applying expertise in proteins, bacteria and processing.
- have protein extraction protocols at lab scale which can be scaled up into economically feasible processes using a unique food-grade Processing Centre facilities
- develop or optimize the procedures for isolating protein, and its fractionation and processing, so as to maintain or enhance that the protein's functionality
- Process ScanTM provides direct input into optimizing manufacturing process for effective runtimes, less fouling or higher yields/outputs, while maintaining optimal product properties.
- Protein application - successful product requires good taste, stability and shelf life
    - expertise in protein functionality combined with the ability to understand which taste and texture properties of the final product the consumer prefers
- Benchmarking protein
    - first step in the protein supply chain is protein extraction
    - provide tools to select the optimal ingredient for your protein application, allowing a more precise and flexible procurement of your ingredients.
- Reformulation
    - clean label, the application of plant proteins or the reduction of fat, sugar or salt
    - performance of reformulated products and/or ingredients with expertise in microstructural analysis using confocal laser scanning microscopy (CLSM) performs real-time visualization of complex food matrices, elucidating product microstructure at the same time as obtaining composition information
    - can be extended using add-ons to quickly scan and to tackle stability issues, tailor mouth feel, and optimize products and processes
- Protein-flavour relationships
    - Food products containing a high concentration of proteins and/or proteins from plant sources, often have a characteristic off-flavour and a specific mouth feel (e.g. astringency) that consumers often do not like
    - state-of-the art tools (e.g. tribometer, LC-MS/MS, and PTR-MS) in combination with sensory studies can also be used to improve the quality of foods

- Product-process interactions
    - understanding the interactions between proteins and other ingredients in food products and the impact of processing. A prototype product or ingredient is usually developed at lab scale. Translating lab scale development to industrial processing scale requires a lot of effort to ensure requirements in quality, production volumes and yield
    - vast understanding of product–process interactions will efficiently scale up the production of new (protein) ingredients, maximize your process efficiency and shorten time to market
- Protein applications in clinical and sports nutrition
    - High-protein foods (like clinical and sports nutrition), in many cases, need improvement from a sensory perspective
    - Assist by removing the (native) flavours from the raw materials, prevent off-flavour development during the manufacturing of the protein isolated or mask residual off notes
- Part of **PULSE (Protein Utilisation from Legumes for a Sustainable European crop)**, a recently approved SIA-RAAK consortium, focuses on developing high-quality protein ingredients from legumes. This consortium is a collaboration between HAS University of Applied Sciences and contract research organization NIZO, together with six other companies: Limagrain, GEA, Cosucra, MFH Pulses, Ruitenberg Ingredients and Sofine Foods. The members of the consortium cover the entire supply chain, from seed breeding to consumer products.

VTT (Finland)

https://www.vttresearch.com/services/bioeconomy/key-technology-platforms-for-bioeconomy/cell-factory/protein-production

- More than 30 years of experience in protein production technology in different host systems
- offers world-class competence in the development of protein production systems in microbes, plant cells and plants
- provide custom recombinant protein production in Expression service
- improve protein production hosts and carry out research to understand the molecular background and physiology of protein production.
- The major global enzyme companies Genencor and AB Enzymes, have been long-term research partners
- leading research institute in the development of the filamentous fungus Trichoderma reesei as a production host
- skilful and experienced personnel, excellent gene technology and systems biology tools and proprietary technology for protein expression and recovery and production system development
- provide technology transfer of protein production systems and technology to customers
- protein production research is connected with VTT's fermentation technology up to the pilot scale and with enzyme development, protein engineering and metabolic modelling competences

3.0 Canadian Proteins of Interest to the EU Industry

Several EU companies exhibiting, as well as other global companies, attending the B2F summit (i.e. Ingredion, Nestle, General Mills, Bunge and Mars) expressed interest in learning more about protein and other plant-based ingredients from Canada.

Following the B2F meeting, Canadian companies supplying a number of different crop-based products were connected with EU and global representatives for samples and potential business interactions. The proteins and other plant-based products of interest (in order of priority and number of requests) are described here.

Of particular interest were ***faba beans, lentils and chickpea*****.** These are high in protein (approximately 20 to 25% by weight) and fibre, and are low in fat. Popular ingredients include whole, split, dehulled (faba), flours and fractions (protein, starch, fibre, bioactive components).

Pulse protein is relatively low in methionine and cysteine, and moderately deficient in tryptophan. Pulses should be consumed in combination with foods rich in these amino acids, such as cereal proteins or hemp. However, unlike hemp or cereal proteins, pulse protein is rich in lysine[3].

Fava Flour and Protein were of great interest. A meeting was set up between Roquette and a Western Canadian fava bean ingredient supplier (occurred in early November). Fava beans (to farmers "faba"; to the food industry "fava") are part of the Leguminosae family (fabaceae). Fava has several nutritional advantages including being higher in protein and fibre than pea, chickpeas, whole wheat, oat flour and quinoa, and low in fat. For food formulators, fava have low color and flavor (taste), are non-GMO, are allergen and gluten free and sustainable. Fava bean flour and flakes can be included at levels of up to 50% without adverse effects on taste or functionally.

Flaxseed is rich in proteins, 22.4% in whole dry seed and for defatted flaxseed meal (from 35% to 40%). Flaxseed proteins are composed of two major fractions; a predominantly salt-soluble fraction with high molecular weight and a water-soluble basic component with low molecular weight. Flaxseed protein has an amino acid composition similar to soy. The amino acid composition of brown-seeded and yellow-seeded are similar. The amino acids Lys, Thr, and Tyr are the limiting amino acids of flax protein[4].

Hemp protein is produced commercially from the meal which is the by-product of oil extraction. In general, the removal of oil from hemp seeds involves a single-stage mechanical expelling ("cold pressing"). Commercial hemp protein products generally claim a protein content of 50% although some are as high as 70%. Products (which is usually a 3 Tbsp. serving) provide ranges of 10 to 15g and 20 - 25g of protein, respectively.

Hemp contains mainly storage proteins. Approximately 75% of hemp protein consist of the globular (legumin) protein, edestin, which closely resembles the globulin found in human blood plasma[5]. Edestin

[3] Anderson, J.W., Smith, B.M. and Washnock, C.S. 1999. Am. J. Clin. Nutr. 70(3): 464S-474S.
[4] Wanasundara, JPD, Tan, S, Alashi, AM, et al. 2017. Proteins From Flaxseed: Current Status. In: Sustainable Protein Sources. Eds. Nadathur, GR, Wanasundara, JPD and Scanlin, L. Academic Press, Elsevier Inc. U.K.
[5] Wang, X.-S., Tang, C.-H., Yang, X.-Q., & Gao, W.-R. 2008. Food Chem., 107, 11-18.

is easily digested, absorbed, and utilized by humans. The remaining protein, (about 25%) in hemp is albumin, which is a highly digestible protein because of its globular shape. Albumin is a major free radical scavenger and is similar to the high-quality protein found in egg whites. The absence of protease inhibitors is believed to contribute to enhanced protein digestibility properties[6].

Hemp protein contains all 21 amino acids and is also high in non-essential alanine, tyrosine as well as histidine. Hemp protein is also a good source (and higher than most pulses) of methionine and cysteine. Lysine is the first limiting amino acid for hemp protein.[7]

Canola Industrial canola oil extraction emphasizes maximizing oil yields and decreased protein extractability. The pressing and de-solventizing steps used result in heat stress on seed constituents causing protein denaturation and irreversible interactions with other components of the seed[8]. Thus, canola meal is mostly used for animal feed for milk, eggs, and meat production[9].

Approximately 90% of the proteins found in canola are storage proteins including approximately 60% cruciferin and about 40% napin[10]. Napin is rich in sulfur amino acids and has cysteine levels two times that of whey protein. Napin is suitable for use in ready to drink beverages, powdered beverages, frozen desserts, aerated desserts, nutrition bars and other functional foods. Cruciferin is a good emulsifier making it suitable as an egg replacement in food. It also has potential for use as a meat extender, and in baked goods and snack bars[11].

Other proteins discussed and of interest included wheat, mustard, quinoa, sunflower and potatoes.

There are considerable opportunities (and a need) for Ag West and PIC to provide "match-making" introductions between Canadian food and protein ingredient developers and marketers, and the European (and global) food and ingredient industry.

[6] House, JD, Neufeld, J and Leson, G. 2010. J. Agric. Food Chem. 58:11801–11807.
[7] House, JD, Neufeld, J and Leson, G. 2010. J. Agric. Food Chem. 58:11801–11807.
[8] Wanasundara, JPD, Tan, S, Alashi, AM, et al. 2017. Proteins From Canola/Rapeseed: Current Status. In: Sustainable Protein Sources. Eds. Nadathur, GR, Wanasundara, JPD and Scanlin, L. Academic Press, Elsevier Inc. U.K.
[9] Bos, C., Airinei, G., Mariotti, F., Benamouzig, R., et al. 2007. J Nutr, 137, 594-600.
[10] Crouch, M. L., Sussex, I. M. 1981. Planta, 153, 64-74.
[11] www.burcon.ca/

4.0 International Food and Protein Initiatives

Food and protein focused initiatives including both clusters and centers are operational in the EU and internationally. Many of these initiatives can serve as models for the development of PIC.

In a report completed by NutriScience Solutions (2018) using some data from New Nutrition Business (2017), twenty international initiatives, centers and clusters were examined primarily through secondary data analysis (on-line websites, social media, etc.).

Information presented at B2F Protein Summits (2017 and 2018) on EU country-specific initiatives is also described in this section.

Best practices were identified in four areas:

1. Market-ready Research Focus
2. Funding
3. Leadership and Governance
4. Market Driven Focus and Economic Impacts

4.1 Market-ready Research Focus

- Activities within clusters and centers strongly focus upon research and in particular, that which is market-ready.
- A strong science and technology base are a precondition for success.
- Cluster/Centers strive to nurture strong links between industry and technology/university centers.
- The most successful cluster/centers have strong relationships with industry and commercialization partners.
- Other key success factors with regard to research include specialization in a limited number of areas and collaboration with stakeholders along the value-chain from producer through to consumer.

4.2 Funding

- Funding is a key factor in the establishment of international initiatives/clusters/centers focused on industry and/or research excellence. A commitment over a long time period is necessary. Upwards of ten years of some secured funding was often necessary to allow initiatives/clusters/centers to become established.
- Funding for these initiatives/clusters/centers (both physical and virtual) has been obtained from a number of sources that include government, research grants and private sector memberships or through investments.
- The majority of initiatives/clusters/centers have industry funding, either from memberships or from operating as a business with paid projects and services. Government/state funding only and combined with industry funding are the second most common source of funding. University funds, in-kind contributions (materials, staff) or project-based funds are also used.

- The establishment phase (first two years or so) is challenging as the initiatives/clusters/centers builds credibility and launches services. The need for public funding in the early stages is essential.

4.3 Leadership and Governance

- Dedicated (both in terms of resources and human skills), strong leadership, backed by a board representing major stakeholders is a key area to the success. This is second only to funding. A clear governance model is vital from the beginning to identify how the initiatives/clusters/centers will be working with industry, and to define involvement with stakeholders.
- A clear strategy is required, one which is easily understood by all stakeholders and have objectives that include:
    - facilitating communications among stakeholders, including bringing together people who might not otherwise meet;
    - activities that encourage a focus on the competitive environment; international networking; near-market activity and involve stakeholders from government, SMEs, research community and academia, investment community;
    - assisting companies with finding funding and technical help to enable them to turn science into products in the market-place;
    - assisting companies to test products in their home and provide linkages to food manufacturers, on-line retail and/or the supermarket shelf;
    - involving international venture capital and other commercial investment funders as stakeholders.

4.4 Market Driven Focus and Economic Impacts

- Successful initiatives/clusters/centers are market-led rather than science-led. A measurement of the success is in part, how large a proportion of annual income is generated from commercial revenues and /or commercialization of new products in partnership with industry. This income is often necessary to replace government funding.
- The majority of initiatives/clusters/centers include partnerships with research institutes or universities, food and beverage companies (many times via memberships/funding) and the government/public sector (also funding oriented).
- A strong manufacturing sector and access to an assured supply chain are both helpful for success.

Examples of physical and virtual centers and some of the services offered

Services	Physical Center	Virtual Center
Networking	Skåne Food Innovation Network - In Malmö, Sweden - It hosts a range of events and workshops aiming to promote matchmaking,	IFR Institute of Food Research - A virtual knowledge exchange network (plus physical facilities too) - It provides a forum for knowledge exchange

	networking, innovation and development in the regional F&B industry - Industry actors are part of the board and events are created with them as a key target group. The SFIN currently have 150 partners and members	within industry and academia into four categories: food chain sustainability; gut health; food safety; food & health. - The network currently consists of around 250 businesses, including 70 SMEs
Training	FOODINNOVATION CENTRE - In Melbourne, Australia - In addition to other services, FIC offers industry workshops and innovation capability programs - For example, they have held training programs for Chobani	fial Food Innovation Australia Ltd - In Melbourne, Australia - Offers virtual services such as maps providing a national overview of agriculture & food science courses on offer - Also offer physical training: development programs, workshops and collaborative circles
Commercialization	thefoodhub - In Drumshanbo, Ireland - It offers 26,000 square feet for food business to set up and offers food production facilities and a community kitchen - Also offers training on food labeling, NPD, food safety, branding etc.	DANISH FOOD CLUSTER - In Aarhus, Denmark - Virtual (with a coordination office), offers a point of entry to the industry, networking events, visibility and matchmaking - Through partnerships with major organizations, such as main retailer Bilka, it offers SMEs access to the store shelves, useful contacts, services and expert opinions
Development & technology	RUTGERS Food Innovation Center - In New Jersey, USA - Facilities enable new product prototypes tested and produced in a food processing facility - The Rutgers Food Innovation Center Incubator includes: refrigerated foods processing room; beverages and tot	NA

	processing room; bakery and dry processing room; cold assembly/clean room	
Research	 - In Dublin, Ireland - FHI focuses on the development of ingredients and functional food products - Research partners include several universities and institutes	 - In Ireland - Members can access an online archive with research articles, data, tools and programs

4.5 EU Food and Protein Initiatives

The EU has dedicated resources to various initiatives, clusters and centres. These have been the focus of presentations at B2F Protein Summits (2017 and 2018) and are described here. A newly established U.S. based protein academic-industry network is also described.

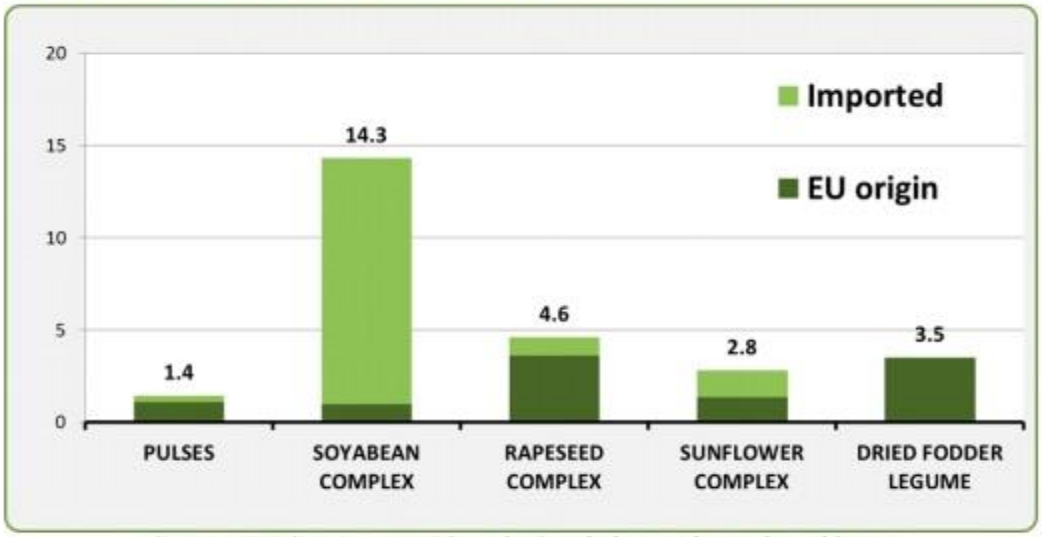
Food 2030 (EU Commission)[12]

- The European Commission is exploring how to harness the potential of EU protein plant production, responding to the needs of farmers, producers and consumers.
- Newly released report, "***The Development of Plant Proteins in the European Union***" reviews the supply and demand situation for plant proteins in the EU and explores the possibilities to further develop their production in an economically and environmentally sound way[13].
- Background to the report: Stakeholder survey; 4 workshops (research and innovation, agronomic practices and environmental benefits, the supply chain in the EU sector and the demand in different market segments. The report results are summarized here.

- Most common protein-rich plants are soybean, legumes (grain and fodder) and oilseeds.
- EU has a major deficit in plant proteins, importing most of what the EU agricultural sector needs.
- In 2016/17, the EU demand amounted to approximately 27 million tons of crude protein and the EU's self-sufficiency rate varies substantially depending on the source (79 percent for rapeseed and 5 percent for soya).
- In the case of pulses such as field peas, faba beans, lentils, and chickpeas, production has almost tripled in the EU over the last five years.

[12] Information from: http://ec.europa.eu/research/bioeconomy/index.cfm?pg=policy&lib=food2030; "The Development of plant proteins in Europe" EU Commission Report. Presentation by Karel van Bommel, Market Officer Arable Crops and Olive Oil, DG Agriculture & Rural Development, European Commission (Belgium)
[13] https://ec.europa.eu/info/sites/info/files/food-farming-fisheries/plants_and_plant_products/documents/report-plant-proteins-com2018-757-final_en.pdf

Graph 1 2016/17 EU use of proteins and their sources (in million tonnes of crude protein)

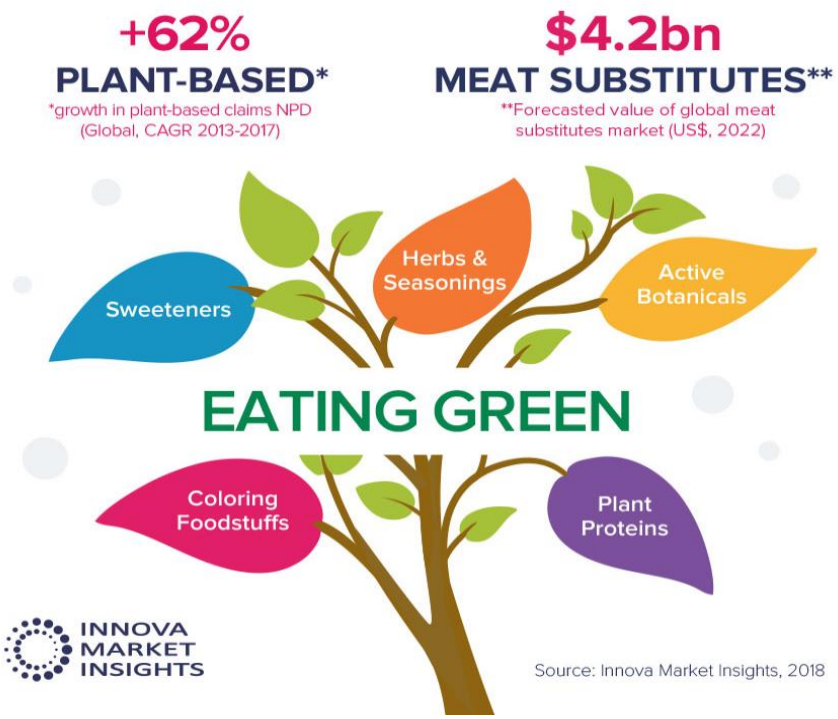


Source: EU Commission. "Complex" includes meals, seeds and beans

Market is Growing in the EU & Globally

- EU - Number of new plant-based dairy alternative drinks launches has grown continuously, with a CAGR of +19.5 percent (2013-2017). Market for meat and dairy alternatives, with annual growth rates of 14 percent and 11 percent respectively
- EU - Between 2013 and 2017, soy continued to be the top ingredient for plant-based dairy alternative drinks, however, the market penetration is decreasing. Almonds and oats show strong growth with the CAGR +39 percent and +36 percent, respectively (2013-2017).
- Global - Plant-based product claims increased by 62 percent (CAGR, 2013-2017)[14].

[14] Innova Market Insights, 2018



Challenges to EU plant protein sector include:

- the agronomic conditions in Europe, not optimal for large-scale production of plant proteins
- the economic profitability of these crops in Europe
- the competitiveness of EU protein crops compared to imported plant proteins
- competition over the use of arable land
- a lack of research on breeding, agronomic practices and different uses

The five priorities in EU report include:

- **Supporting farmers** growing plant proteins via the proposed future CAP, by including them in national CAP strategic plans, in particular through **rewarding the benefits of legumes for environment and climate objective**s through eco-schemes and environmental/climate management commitments under rural development programs; mobilizing rural development support e.g. to stimulate investments and cooperation along the food chain; coupled income support;
- **Boosting competitiveness through research & innovation** from EU and member states' research programs and the doubling of the budget of the Horizon Europe program for 2021-2027;
- **Improving market analysis and transparency** through better monitoring tools;
- **Promoting the benefits of plant protein** for nutrition, health, climate and environment with the support of the Commission's promotion program, amounting to close to €200 million **(US$227million) in 2019;**
- Increased sharing of knowledge/best practice in supply chain management and sustainable agronomic practices through a **dedicated online platform.**

- EU research and innovation policy response to the recent international policy developments including the SDGs and COP21 commitments
- Built on key Food and Nutrition Security priorities:
    - NUTRITION for sustainable and healthy diets: Ensuring that nutritious food and water is available, accessible and affordable for all. It involves reducing hunger and malnutrition, ensuring high levels of food safety and traceability, reducing the incidence of non-communicable diet-related diseases, and helping all citizens and consumers adopt sustainable and healthy diets for good health and wellbeing.
    - CLIMATE smart and environmentally sustainable food systems: Building climate smart food systems adaptive to climate change, conserving natural resources and contributing to climate change mitigation. It seeks to support healthy, productive and biodiverse ecosystems. Ensuring diversity in food systems (including production, processing, distribution and logistics) including in terms of cultural and environmental diversity. Natural resources (water, soil, land and sea) are used sustainably within the planetary boundaries and available to future generations.
    - CIRCULARITY and resource efficiency of food systems: Implementing resource-efficient circular economy principles across the whole food system while reducing its environmental footprint. Circularity is applied for sustainable and resource-efficient food systems and food losses and waste are minimised throughout.
    - INNOVATION and empowerment of communities: Boosting innovation and investment, while empowering communities. A broad innovation ecosystem leading to new business models and value-added products, goods and services, meeting the needs, values and expectations of society in a responsible and ethical way. More and better jobs across the EU, fostering thriving urban, rural and coastal economies and communities. Through closer partnerships with industry and food producers, markets that function in a responsible manner thereby fostering fair trade and pricing, inclusiveness and sustainability. Scientific evidence and knowledge from a wide diversity of actors underpinning the development and implementation of FNS relevant policies, at all geographical scales (Local to Global).

- Developed EU R&I Policy Framework and process to
    - Structure R&I (alignment, leveraging, EC, MS, etc)
    - Connect R&I (systems approach, land/sea & actors)
    - Scale-up R&I (digital, 'open', invest, skills, etc.)
    - Raising the political profile of R&I for FNS
    - Anticipating post 2020 EU R&I, etc.
    - H2020 Calls for proposals 2017-2020

- Successful projects in FP7 and Horizon 2020
    - PROTEINSECT: Insect protein for animal and human nutrition
    - PROTEINTOFOOD: Innovative plant proteins from seed and legume crops
    - PROMINENT: Protein-based ingredients from cereal side streams
    - GreenProtein: Proteins from waste of packed salad processing

Forum for the Future: Protein Challenge 2040
https://www.forumforthefuture.org/protein-challenge

- first global coalition of its kind, aiming to tackle the question: How do we provide 9 billion people with enough protein in a way that is healthy, affordable and good for the planet?
- coalition is led by international businesses, NGOs and organizations, including leading retailers Ahold Delhaize, Target and Waitrose, feed ingredient companies Evonik and Volac, food manufacturers Firmenich, The Hershey Company, Nestle and Quorn, and WWF

- Goals:
    - Making livestock and fish-based protein production more sustainable
    - Encouraging the consumption of more plant-based proteins

- Impact to date:
    - founded in 2015
    - consulted informally towards the Meat: The Future white paper written for and debated by the World Economic Forum 2018; consulted for the Livestock Levy report on the concept of meat taxes by FAIRR; and catalysed the first international event focusing on sustainable animal feed, the Feed Protein Vision 2018 event, with leading trade titles Feed Navigator and Food Navigator.

Green Protein Alliance / GreenProteins4ALL (Netherlands)
https://twitter.com/hashtag/greenproteins4all

- unique alliance between 25 retailers, the catering industry, food producers and 10 knowledge partners, supported by the Dutch Government
- Goal - restoring a healthy and sustainable balance in protein consumption.
- current ratio of plant-based: animal protein in the Dutch diet is 37:63. Goal is a 50:50 balance by 2025.
- New collaboration funding to accelerate development of novel proteins from seaweeds, oilseed press-cake, micro-algae and pulses
- 150 International matchmaking vouchers offered for SMEs to work with research capacity
- Project length: 36 months, project starts in November 2018 (after approval)
- Partners: Food Valley NL, Regional development agency Oost NL, NIZO Food Research, Eura AG, Valorial, VIVES Hogeschool, Inagro, POM West, Vlaanderen
- Associated Partners: BDI / Alpro /Flanders' Food / ARDO /Pro VEG International / EVA /WUR 0nderwijsloket/ HAS Applied University /Green Protein Alliance/Seaweed Forum Wales / NIFDA
- Support innovations. E.g. New Food Challenge
- Support publications with Reference Document: Towards a more Plant Based Diet
- Support green protein campaigns. E.g. Marley Spoon Eat Green campaign.
- Support education: Minor plant-based future
- Jeroen Willemsen from the Green Protein Alliance - "We are facing a historic "Green Protein Big Bang. Entrepreneurs seize the opportunity, investors anticipate. In the chaos that will follow, governments need to step in."

Nordic Food Policy Lab (Finland)

norden.org/foodpolicy

- overall aim is to encourage the use of Nordic policy solutions to help address the food issues identified as challenges in the UN Agenda 2030 Sustainable Development Goals
- one of six flagship projects under the ”Nordic Solutions to Global Challenges” initiative launched by the five prime ministers of the Nordic countries in 2017.
- curates and disseminates examples of Nordic food policy for health and sustainability
- an international node that assembles, curates and spreads Nordic solutions in the area of food policy
- establish opportunities to advocate for innovative close-to-the-consumer policies promoting nutritious and sustainable diets

Protéines France (Paris FR)

http://www.proteinesfrance.fr/en/make-france-world-protein-leader

- Founded in 2017, Protéines France is the French consortium of enterprises
- aims to speed up the development of the plant-based and alternative protein sector in order to make France a world leader in this field; Enable the creation of added value in France while strengthening the protein security of the country; Gather all actors according to shared priorities
- Better valorise proteins in numerous applications ranging from ingredients dedicated to the nutrition and the health of humans, pets and livestock to biobased products for various sectors such as chemicals, materials...
- Ease the development and public support of innovation projects on the value chain: from renewable resources production to the development of new solutions
- Facilitate investment in industrial plants that contribute to job creations and market growth
- Encourage the creation and development of start-up likely to develop breakthrough innovations
- Support communication and information related to market introduction of innovative products, in a stable regulatory framework
- Based on 3 axes
  1) Plant protein production and low-input livestock and dairy
  2) Research and education
  3) Governance
- Recent initiatives bringing a contribution
  - New agriculture law - Protein diversification in mass catering
  - National strategy on low carbon
  - National strategy against imported deforestation
  - National program on nutrition and health
  - A value chain transition plan launched by the inter-branch organisation Terres Univia

Members

- enterprises, cooperatives, distribution, innovation and research centers ...
- entire value chain: from feedstock production (cereal crops, oilseed crops, pulses, insects, algae, yeasts) to their transformation into ingredients and finished goods as well as distribution. (Companies: ARBIOM, AVRIL, EPI DE GASCOGNE, HERTA, LABIOCRAC, LESAFFRE, LIMAGRAIN,

NUTRITION & SANTE, OLMIX, SOUFFLET, TEREOS, TERRENA, ROQUETTE, ROYAL CANIN, TRIBALLAT NOYAL, VIVESCIA, ŸNSECT)

- IMPROVE, an innovation centre, is associate member.

- The 2030 Innovation Commission submitted a report to the President of France that identified plant proteins as one of seven "Innovation Goals". The Commission expressed the wish that French industry "would mobilize and develop new, attractive food products based on plant proteins in order to change our eating habits and thus create a sustainable food solution, employment in France, and export capability".

Sustainable Food Initiative (Netherlands)

http://www.ispt.eu/sustainable-food-initiative-launched/

- Established June 2017 by the Dutch State Secretary of Economic Affairs
- The initiative aims at research for achieving a systemic leap in sustainable food processing in order to be able to meet future demand for sustainable healthy and safe food. This includes research on reducing footprint, circulating food production, reducing waste in the chain and at the consumer and supporting consumers in making a healthy and sustainable choice. Within the initiative, attention is also paid to the rapid introduction of innovations in the market, through start-ups
- Wageningen UR's campus is the physical hub where researchers and innovators will work together to innovate
- The challenges looking into are for example the production of natural foods on an industrial scale, circular food packaging, the protein transition, etc
- R & D projects currently submitted: Protein Compass, Consumer insight, Internet of Food and AccePT (Accelerating the Protein Transition), Intended budget by 2025: $22M.
- 6 Dutch provinces are involved in developing field labs.
- Partners include Unilever, Institute for Sustainable Process Technology, Top Institute Food and Nutrition, Cosun, KraftHeinz, DSM, NIZO Food Research, Topsector Agri & Food, Avebe, Heineken, Province Gelderland, University Utrecht

The Novel Protein Sources for Food Security (ScenoProt, Finland)

https://www.luke.fi/scenoprot/etusivu/

- Finland is highly dependent on imported crop-derived protein, mainly used for animal feed
- project aims to promote biodiversity, resource efficiency and circular economy. The change requires re-evaluating current production, processing, marketing, policy and consumption practices, to increase internal protein production
- Finland Futures Research Centre structures alternative ways to achieve the 2030 target in protein self-sufficiency. These can include, for example, various production and supply-side paths to both increase resource efficiency and to promote novel protein products. After preliminary identification of the possible paths to reach the target, their potential, feasibility and internal compatibility will be analyzed by the backcasting scenario method.
- The consortium is coordinated by the Natural Research Institute Finland (LUKE), and includes a number of other research institutes in Finland, funded by the Strategic Research Council of the Academy of Finland during 2015–2018.
- Goal is Supplementary protein self-sufficiency from 20% to 60%

The Plant Protein Innovation Center (PPIC) (U of MN)
https://ppic.cfans.umn.edu/

- first center of its kind in the U.S. for plant and other alternative proteins
- will bring together interdisciplinary researchers and industry partners to produce and study nutritious and functional plant protein ingredients for food applications.
- will address industry-identified plant-protein challenges and opportunities to develop a wealth of interdisciplinary research that will bring to the supply chain new nutritious and functional plant protein ingredients and products, working all the way from breeding and genetics to processing, formulation, and marketing
- will invite scientists both internal and external to the University of Minnesota to be part of a research cohort.
- will have a ***technical committee*** and an ***executive board***. Serving on the Executive Board will be by invitation, and will be for a renewable three years term. The Executive Board will have at least 3 members and at most 10 members. The Technical Committee will consist of industry representatives, university researchers, and other stakeholders. The Executive Board will be selected by the Director of the PPIC and be composed of a diverse group that will provide objective input for the benefit of the community.
- PPIC Director will manage some research programs as appropriate and will be responsible for leading the administrative, strategic and technical functions of the PPIC.
- There are two involvement levels with the PPIC (two membership options):

1. **Associate:** This will entail a yearly membership fee of $6,000 for companies that have less than $5 million annual revenue, and for organizations wishing to join the center. As an Associate of PPIC, benefits will include contribution to research ideas, access to non-proprietary research findings, involvement in research projects, access to workshops and training courses, and interaction with scientists from various disciplines.
2. **Partner:** This will entail a yearly contribution of $20,000 for companies that have $5-100 million annual revenue; and $40,000 for companies with more than $100 million in annual revenue. As a Partner of PPIC, benefits will include having an R&D scientist on the technical committee, contribution to research ideas, access to non-proprietary research findings, involvement in research projects, access to workshops and training courses, and interaction with scientists from various disciplines.
3. The bulk of membership dollars will go into research allocations and funding graduate students and post docs. Fifteen percent of the membership dollars will go toward indirect costs assessed by the college of Food, Agricultural and Natural Resource Sciences (CFANS) and up to 10% will go toward sustaining the center's function (administrative cost). CFANS and the Department of Food Science and Nutrition (FScN), will cover the administrative costs for the first two years. The hope is for the center to grow and be self-sustaining within two years of its launch.
4. The Center will also seek funding from foundations, federal and state agencies, and private donors/investors. Additional funding will be used for research, graduate students and post docs. Some additional funds may also be used to acquire necessary instrumentation and cover indirect costs and administrative fees.

5.0 Challenges in Supplying Protein Ingredients to Europe

5.1 Regulatory

Novel Food Regulations in the EU

- Commercializing novel foods and ingredients – including plant-based proteins – can be challenging for SME as the regulatory burden can be significant. The EU has established new regulations for safety approval of novel foods which include proteins and other extracts. These are similar to Canadian Novel Food regulations and Generally Recognized as Safe (GRAS) in the US.

- It is recommended that when entering the EU market, dossiers are structured such that they are compliant with regulations in Canada and the US.

- In the EU, two key questions determine the level of safety substantiation required for a new ingredient: Was the protein in food use prior to 1997 and/or has processing altered the molecular structure? This is significant for hemp proteins as they have not been on EU market prior to 1997 BUT do have food approval in Canada.

PIC could partner with Canadian regulatory organization(s) to provide assistance to Canadian companies to access EU (and other markets where proteins are determined to be novel).

New Regulation 2015/2283 on Novel Foods came into effect January 2018[15]; may include new proteins if they are determined to fall within the following definition:

> "[ingredient/food/extract] … consisting of, isolated from or produced from plants or their parts, except when the food has a history of safe food use within the Union and is consisting of, isolated from or produced from a plant or a variety of the same species obtained by:
> traditional propagating practices which have been used for food production within the Union before15 May 1997; or non-traditional propagating practices which have not been used for food production within the Union before 15 May 1997, where those practices do not give rise to significant changes in the composition or structure of the food affecting its nutritional value, metabolism or level of undesirable substances;
> food consisting of, isolated from or produced from cell culture or tissue culture derived from animals, plants, micro-organisms, fungi or algae;
> food resulting from a production process not used for food production within the Union before 15 May 1997, which gives rise to significant changes in the composition or structure of a food, affecting its nutritional value, metabolism or level of undesirable substances".

[15] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32015R2283&from=EN&utm_source=Food+Compliance+Int.&utm_campaign=b31ff195b6-Monthly+Article+December&utm_medium=email&utm_term=0_9c47d7151f-b31ff195b6-78467493

- **Scientific data required for novel food approval** [16]**:**
  Minimum requirements:
  - data on the identity,
  - the production process,
  - the composition,
  - the specifications,
  - the use levels and anticipated intakes
  - For other data, justifications must be provided if the data are missing.

- **Traditional food from third countries [including Canada] benefit from a simplified procedure if they have been consumed** (i) as part of the customary diet; of a (ii) significant number of people for (iii) at least 25 years. They should derive from primary production only. There is no further clarification on what those criteria mean in practice except that non-food uses or uses not related to normal diets do not count.

- With new deadlines in place, the Commission expects that the **average time goes down from 3.5 to 1.5 years.**
- Once a novel food is authorized, it will be added to a positive list and there will be no need to apply for substantial equivalence in order to use it. This will occur only as from the beginning of 2018, when any pending substantial equivalence application will be obsolete and without purpose.

- Advantages to the New Regulations include the ability to protect the investment of the applicants, there is a period of **5 year of data protection**, which means that the newly developed information used to get approval cannot be used by other applicants. This may provide a monopoly on the marketing of the food or food ingredient for 5 years, unless the applicant agrees to share the data or if another applicant obtains their own information to get approval.

5.2 Challenges in using Protein Ingredients

Challenges with regard to protein functionality within foods are among the hurdles that Canadian companies must overcome to ensure that their proteins will be used in various food matrices. Flavor, anti-nutritionals and stability are key issues when dealing with plant-based proteins. When formulating clean-label products, plant proteins require strong emulsifying, water and oil binding properties as well as off white color and neutral taste.

Consumers care primarily about flavor and sensory perspectives citing taste as top of the priority list when choosing protein products. In fact, a recent survey of 200 food and beverage formulators found that taste is the most valued attribute in protein ingredients[17]. Inherent off-flavors of high-protein products, regardless of protein type, can present a significant formulation challenge, with consumers and formulators alike, attesting to the need to balance the benefits of proteins with good- tasting products that appeal to the mainstream and broader category.

[16] The New Protein Regulatory Landscape. Presentation given at Bridge 2 Food Protein Summit 2018 by Katia Merten-Lentz, Partner, Keller and Heckman LLP (Belgium)
[17] NSM Research, Inc. 2018 Industry survey.

Plant-based proteins are often prone to bitter or 'beany' off-flavours. Understanding how particular plant proteins and combinations of proteins react to specific production techniques (extrusion, kneading etc) is also crucial.

Oil-derived plant proteins (such a canola) also often have off-flavours and oxidize on the shelf. Novel technologies for improved extraction and formulation of protein fractions from protein crops have been identified but commercial scale-up has proven elusive. Innovation is required to develop novel, scalable, economically viable technologies for extracting, fractionating, purifying and formulating plant-based proteins into food products.

To address these challenges, new processing technologies for extraction, fractionation and development of protein ingredient are being developed and several were highlighted at the B2F trade show. These include advanced fine milling and air-classification, ionic liquids, supercritical fluids, ohmic heating, pulsed electric field, and aqueous enzymatic processes; and advanced purification and de-flavouring technologies. Novel plant-based proteins require examination of hedonic and functional characterization in addition to the development and prototyping for food and beverage applications.

6.0 Other Observations

Highlights of three interesting B2F presentations with significance to protein development and commercialization of Canadian plant and animal ingredients are summarized in this section.

SWOT Analysis for Plant Protein Industry[18]

- STRENGTHS
    - High nutritional value
    - Low cost
    - Globally accepted among various cultures
    - Lower carbon footprint and high sustainability
- WEAKNESS
- GM crops particularly soy have lower acceptability in Europe
- OPPORTUNITIES
    - Growing potential for plant and dairy proteins in blended formulations
    - Increasing opportunity for improving protein delivery through further R & D
- WEAKNESS
    - GM crops particularly soy have lower acceptability in Europe
- THREATS
    - Dairy proteins were first introduced into the market and are well-known as compared to plant proteins
- CHALLENGES
    - Low awareness rate - Especially among consumers regarding the health benefits of various protein ingredients. This is mainly due to the lack of marketing initiatives and

[18] From Presentation at Bridge 2 Food: Jean-Christophe Roubin, Directeur de l'Agriculture, Agroalimentaire et Marches specializes, France "Protein Ingredients SWOT.

scientific evidence on these products.
    - Highly fragmented market
    - Due to the presence of numerous vendors is another factor affecting the profit margin of vendors
- Stringent government regulations - pertain to permits, regulations for the entry of new players, the launch of new products, and expiry dates for certain products.
- RAW MATERIALS VOLATILITY
    - An increase in the price of a certain protein in the market is pressurizing the food and beverage manufacturers to switch to other alternative protein ingredients.

Using Capital Markets to drive Sustainable Food Models: The FAIRR Initiative[19]

FAIRR believes that intensive livestock production poses material risks to the global financial system and hinders sustainable development. Our mission is to build a global network of investors who are focused and engaged on the risks and opportunities linked to intensive livestock production[20].

Background

- To keep under 2^{O}C, the average citizen needs to eat 75% less beef, 90% less pork and half the number of eggs.
- 2018 - 18% Brazil's soybean exports by value to China through first seven months of the year.
    - 52% Increase in annual deforestation in the Amazon in 2017, from a record low in 2012.
- 2026 - 27% China's share of world's meat consumption
    - 48% Additional soy imported into China versus what Brazil will export
- By 2050 - 700% Soy exports from South America to China for use as livestock feed. 1990 to 2010

Intensive farming presents global risks

- 14.5% Global Greenhouse Gas Emissions
- No.1 User of freshwater resources on the planet
- No. 1 cause of deforestation due to cattle ranching and soy production
- Manure & Fertilizer runoffs are causing widespread land and water pollution
- No. 1 Global User of Antibiotics, including shared-class antibiotics
- Health -High Risk of Non-Communicable Diseases & Food-Borne Illness
- Labour-Poor Visibility of Supply Chains
- Welfare-Close confinement and mutilations

Intensive farming presents investment risks (and opportunities)

- $273 Mn – Punitive damages slapped on pork producer Smithfield over hog waste disposal
- 22% sheep herds slaughtered in South Africa due to the drought in 2018
- $2.3 bn Loss in market value from meat producer JBS after corruption & deforestation scandal
- 12% US households now purchase plant-based news

[19] Observations from Bridge 2 Food presentation: Using Capital Markets to drive Sustainable Food Models. Aarti Ramachandran, FAIRR Initiative.
[20] http://www.fairr.org/about-fairr/

FAIRR: Launched in 2015
"Modern methods of intensive farming have helped the livestock sector become profitable. Investors know that this reality is changing as trends like climate change, food technology and a broad consumer shift towards healthier food gather pace."
~ Jeremy Coller, CIO of Coller Capital & Founder, FAIRR Initiative

Coller FAIRR Protein Producer Index Results:

- 60% of Index companies fail to achieve basic management thresholds across critical sustainability risks.
- Greenhouse gas emissions - 72% of Index companies worth $176 billion, classified as "high risk" on emissions as they are not disclosing or managing climate risk.
- Antibiotics - 77% of Index companies (worth $240 billion), are classified as "high risk" on management of antibiotics.
- 8% - Only three livestock companies have an explicit zero-deforestation commitment for relevant commodities.

Current engagements:

- Antibiotic use in livestock production
    - Routine use of antibiotics in the livestock supply chain
    - Global Investor Statement on Antibiotic Stewardship and FAIRR's best practice antibiotics policy
- Protein diversification
    - Sustainable protein supply chains
    - Responsible meat and dairy sourcing
    - Global Investor Engagement on Meat Sourcing
- Protein diversification in global food companies
    - 73 Institutional Investors $5.3 Trillion in Assets

- Our ask: develop a global, evidence-based approach to diversify protein offerings.

Nestle View on Plant-based Proteins[21]

- Trends that will shape the future of Plant Based Foods….and the science of Food
    - Authenticity
    - New Health
    - "Insperiences"
    - Me & My World

- Nestle is innovating in a Simply Good way, to build trust and transparency

    - We believe in the taste and goodness of food. Every second, we deliver more than 5700 food servings worldwide. Our strategy is built on taste & balance and our commitment to 4 simply good values.

[21] Observations from Bridge 2 Food presentation: Moving Protein Panels: Which Way Forward
Sean Westcott, Nestle Research and Development

    - We craft tasty products only with ingredients you know and love.
    - We put nutrition at the heart of what we do.
    - We care from field to home.
    - We inspire and support good food habits.

- Sustainable Nutrition is the physical and economic access to sufficient, safe and nutritious food and water to fulfill dietary and cultural needs to enable an active and healthy lifestyle without compromising the ability of future generations to meet these needs.

- Plant protein sources differ from animal sources in terms of digestibility, amino acid composition and the presence of anti-nutritional factors:
    - Once plant cell wall constituents are removed, the inherent digestibility of plant proteins may be indistinguishable from that of animal proteins
    - Lower digestibility attributed to anti-nutritional factors in plants (beans) and high heat processing conditions (breakfast cereals)
    - The main nutritionally significant differences between the amino acid compositions of plant protein and animal protein is the absence of essential amino acid lysine

- **Nestle needs from Plant Proteins:**
- Natural
    - Simpler, fewer processing steps that release nutrients
    - Biotransformation to improve quality and eliminate antinutritional factors
- Taste
    - Clean and neutral taste that can be further developed and improved by biotransformation, recipe and cooking.
- Texture
    - Sesoriality, Processability, Functionality in range of applications
- Appearance
    - Light colour or neutral colour that can be developed and improved by cooking
- Affordability
    - Provide amino acid needs, with low-cost cereal or other staple diets to developing communities equal to the higher cost carefully selected mixed diets consumed by affluent vegetarians.