



# Plant proteins from Finland

Business Finland **EXPRO**  
ecosystem project white paper



Finnish oat grains are excellent source for high quality protein ingredients (Photo: VTT)

## Abstract

In order to meet the United Nations Sustainable Development Goals and 1.5 °C global climate target a dietary shift which includes more of minimally processed plant based foods is a must. Building a sustainable food system brings in remarkable business opportunities for Finnish plant-based ingredients and alternative protein sources. There are many successful consumer products and ingredients from Finland in the international market such as

Pulled Oats®, Elovena® and Beanit® as meat alternatives, BlackGrain from Yellow Fields™ and Aurora as alternative protein sources obtained from rapeseed and oats. More is to come, since globally acknowledged R&D and strong support systems for entrepreneurship creates excellent basis to plant-based food innovations in Finland, which is one of the success factors in boosting export and business potential.

## Finnish response to the global need of protein alternatives

Global population will reach 10 billion or even more by 2050, which will lead to exponential growth in our demand for food, while global food supply will continue to be under great stress. The current livestock production can deliver only less than 20% of global world's supply of calories with the cost of 15% of greenhouse gas emissions and 80% of global agricultural land (www.fao.org). Therefore, there is an urgent need to find sustainable animal protein alternatives.

Finland, due to its unique position in the North has access to clean environment and abundant amount of water, which indicates its increasing role in protein self-sufficiency in

Europe. The recent innovative meat alternative product launches have been Gold & Green® and Beanit® based partly on home-grown crops (oats, faba beans) in Finland. A structured Finnish ecosystem of food industry and research organizations was established to find new ways to increase the protein self-sufficiency (Lampinen et al., 2021). Aim is to go beyond and export Finnish plant protein ingredients and foods as new products alternative to animal based counterparts alternative. Finland being a small country, but a country of innovations has trust between different food ecosystem actors that enables to focus on the key issues and act as a testbed for plant-based food innovations.

## Global grant challenges require immediate actions



### Global challenges

- Climate change
- Reduced crop productions
- Growing populations
- Unhealthy diets



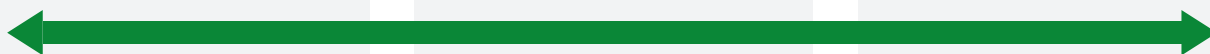
### Our actions

- Sustainable ingredients
- Meat alternatives for flexitarians
- Innovations for business opportunities
- Consumer perception



### Changes required

- Reduction in meat consumption
- Crops for food instead of feed
- More palatable choices



## Sources of plant proteins

Majority of the current meat alternatives are mainly based on soy or wheat although recently launched products also contain other plant protein sources such as pea, oat, faba bean or even lupine. Legumes (e.g. pea and faba bean) combined with cereal protein sources provide a well-balanced amino acid profile. Finland is the 2nd largest oat exporter of oats in the world and scientists have created the top-class knowledge on oats and its food-use. Fazer's Aurora Oat Protein is an example of protein product enriched from cereals for the food ingredient industry. Raisio's Oat Bran Concentrate is produced from gluten-free oat groats and is full of

both protein and fibre containing all the best parts of oats. An untapped potential in alternative plant proteins domain could be through valorization and upcycling agro-food streams (e.g. rapeseed press-cake, cereal brans) as sustainable food raw materials providing both protein and dietary fibre. Rapeseed is a challenging source of plant protein due to compact physical structure and the antinutritional components that exist in seeds. A Finnish rapeseed oil crushing mill, Avena Nordic Grain Ltd, developed a patented process that overcomes these challenges and produces ingredient named BlackGrain from Yellow Fields™ from rapeseed press-cake.

## Research and development for enhanced consumer acceptance

Consumer acceptance has a key role in development of feasible business cases around meat alternatives. Meat alternatives, also called meat substitutes or meat analogues, are products manufactured mainly from plant-derived ingredients to mimic the taste, texture, and cooking features of animal-derived meat products. Extrusion processing is by far the most feasible industrial protein structuring process for production of meat alternatives. Texturized proteins are typically produced by low moisture extrusion (moisture content < 40%) where the product needs rehydration prior to use. High-moisture extrusion (moisture content > 40%) is a more preferred process for mimicking the appearance and texture of meat. A typical high-moisture extruded meat alternative contains 50-80% water, 14-45 % protein, 0-15 % fat, 1-5% binding agent and 0-0.5% colouring agents, and a high protein content is considered essential to assure the "meat like", "juicy" structure. Besides the techno-functional properties, flavour profile of the protein ingredients used during extrusion

processing is essential in a successful product development. A lot of untapped potential is in the application of microbial communities and enzymes for the preparation of novel plant-based meat alternatives. However, better understanding of species interactions and processing conditions on the sensory characteristics, safety and functionality is ongoing to fully exploit the potential of bioprocessing for meat alternatives.

The greatest benefits in the Finnish food innovation culture are the unique collaborative platform provided by research institutes (VTT Technical Research Centre of Finland and National Resources Institute Finland), many universities (such as Helsinki, Eastern Finland, Vaasa, Turku and Aalto) and commercial contract research, development and manufacturing organizations such as Foodwest supporting food industry in their innovation process. These units play well their piece in the development puzzle providing both expertise and infrastructure to support R&D of food industry for enhanced plant protein products.



Elovena Kaurajauhis is a meat substitute which provides both protein and dietary fibre (Photo: Raisio)

## Finland as emerging exporter of plant protein ingredients

New plant protein sources require high quality protein ingredients as raw materials. Finland has all the prerequisite to make its plant-based foods into an international success story and a matter of national pride. Finland is a forerunner and a testbed for sustainable food system thanks to availability and quality of relevant ingredients such as oats, faba bean and rapeseed, highly advanced knowhow on food technology, and finally proven capability on commercializing the afore mentioned assets into products desired by consumers.

Faba bean (broad bean) had a long history of growing in the Northern latitudes (Stoddard, 2009). The faba bean harvest was 14.3 Mkg in Finland in 2021 (<https://stat.luke.fi/en/>). However, it is still mostly cultivated for feed purposes. Food use of faba bean is limited due to vicin and convicin even though breeding has reduced content of these antinutrients in some new cultivars. According to our knowledge,

currently faba bean is available as a food grade concentrate (protein content 60-70%) from Finnish origin but no isolates are available, therefore the functional isolates for texture formation both in dry and wet extrusion are currently exported for Finnish food industry. On the other hand, a Finnish faba bean is launched as germinated products in the Sprau® ingredients portfolio to the global market in 2021.

Rapeseed as a food-grade plant protein is a quite recent innovation. BlackGrain from Yellow Fields™ (Avena Nordic Grain Ltd) rapeseed powder is a new 3-in-1 ingredient that has the perfect combination of protein, fibre, and oil. This partially defatted rapeseed powder is authorized as a novel food and is legally available in the EU market. Rapeseed as an oil plant is well-known by consumers which contributes to acceptance of rapeseed also as a protein ingredient. Avena Nordic Grain uses major part of rapeseed grown in Finland. Rapeseed

protein consist all essential amino acids in the nutritionally excellent ratio. More new type rapeseed ingredients as continuation to Black-Grain from Yellow Fields™ are currently under development reflecting to the needs of global food industry.

Oats are booming in the plant-based food and beverage space. Oats are gluten-free and oat protein has a balanced amino acid composition compared to other cereal proteins. In addition to proven health benefits of beta-glucan, whole grain oats have a great nutritional value including beneficial plant-based protein. Oats are naturally low in fermentable oligosaccharides, disaccharides, monosaccharides and polyols (FODMAP) making it suitable for FODMAP diet and the taste of oats is perceived as appealing by the consumers. Two Finnish companies presented herein, Fazer and Raisio Group, are both exporting various oat ingredients. Fazer's oat ingredients, that have traditionally been used mainly in bakery applications, are used more and more especially in dairy alternatives and as part of other plant-based food solutions. Fazer's Aurora portfolio includes added-value oat ingredients such as oat beta glucan and oat protein as well as oat oil. These are excellent ingredients for boosting the nutritional contents of a wide range of product types with fibre and protein. Raisio Group is a forerunner and leading producer of gluten-free oats in Finland. Raisio has its own contract farmers and has a full control in short and transparent supply chain, which enables traceable and secure supply and high-quality gluten free oat ingredients for all oat products with limited gluten contamination. The mild and pleasant taste of oats is a hit with almost all consumers and is perfect for snacking or any meal of the day.

There is still emerging potential in the upcycling side streams of Finnish food industry



Twin screw extruder (Photo: Foodwest)

**Oats are booming in the plant-based food and beverage space. Oat protein has a balanced amino acid composition compared to other cereal proteins.**

into new ingredients such as brewer's spent grain or use of other novel sources of proteins currently not in food use. One great and recent example of an upcycled ingredient is Fazer Xylitol that is made from oat hulls, a huge side stream from oat milling. Similar innovations can be expected for plant protein space. Often, the novel plant protein sources require Novel Food approval if they haven't been a part of human diet prior year 1997 in the European Union. Regulatory issue is a necessity and food safety requirements should be taken account in the product development starting from the idea phase. The regulatory knowledge for the required authorization is one of the strengths in the Finnish food innovation system.

## **A delicious meal promotes consumption of plant alternatives**

The plant-based meat alternatives market can be classified into B2B (food services, food industry) and B2C (grocery stores, online retail, supermarkets, food services) according to distribution channel. Restaurants, catering and food service have a key role to introduce and serve delicious meals based on the plant protein alternatives. Easily catered and palatable alternative protein products are necessity from food industry for this purpose.

Compass Group has ambitious goals aiming to become carbon neutral by 2030. One important part of this work is to offer delicious, nutritious and attractive climate friendly food options that impact and boost the change. Plant-based food contributes substantially in achieving the goal. The ambition is to develop vegetarian meals employing plant proteins in a way that the consumer feels the meal as complete regardless if it lacks meat components. Nudging can be employed in restaurants to

promote vegetarian food options among consumers (Campbell-Arvai, Arvai & Kalof, 2014). For example, vegetarian meal is listed as a first item in the menu and served before meat courses in the buffet of restaurants owned by Compass Group. However, still further investigation and new efforts are needed in order to understand on how to motivate consumers to increase plant-based food consumption as a sustainable choice.

Ultima is a chain of fine-dining restaurants located in Finland. Ultima is working for to find new solutions for meat alternatives that provides enjoyment also through taste and structures, not only by nutrition content. The knowledge on effects of different cooking processes and seasoning can provide information that could lead to better products for end users. Testing and developing the prototypes for use in different occasions from fast food to fine-dining, and beyond is Ultima's strengths.

## **Easy to cook consumer products increase everyday use of plant proteins**

Gold&Green Foods was founded 2015 with the vision to utilize Finnish oat knowhow in plant protein foods. The company developed and patented oat based meat alternatives that have high protein quality and quantity and a very short, clean label ingredient list. The novel concept and exceptional quality of Pulled Oats® quickly gained strong interest both in the home country and abroad. A viral phenomenon around it kicked off a powerful plant based movement in Finland and beyond. The major markets for Gold & Green products are Nordic and Baltic countries, Ireland, Benelux, USA and Australia. Valio Ltd, a Finnish manufacturer of dairy products and alternatives, purchased all the rights of the Gold&Green

brand, intellectual property, research and development work in March 2022.

Beanit® is the plant-based protein product made from Nordic faba beans. This palatable meat alternative is a brand product owned by Raisio Group. Beanit products are produced in Finland and exported both to retail and food service channels. Currently, Beanit Faba Bean Chunks and Mince are available in Poland and Sweden while new markets are being opened particularly in Europe.

Even though Gold&Green® and Beanit® are launched already to the global market, there is room for the new Finnish plant protein innovations. The Finnish share of the current meat alternative products in the global market



Beanit Chunks and Kaurajauhis oat mince (Photo:Raisio)

is minimal. In practice, Finland is taking the first steps to go forward to the global plant protein markets both in plant-based consumer products and plant-based protein ingredients. New food innovations are expected from R&D pipelines to reach a significant role in the global plant protein market. Media visibility and sales activities are still a continuous necessity, since as an example oats are still exported as grain products (eg. flour, rolled oats) though oat-based plant alternatives could be the choice. The estimated plant protein production is valued to 30 M€ in Finland and only a fraction of it is exported (Talouselämä, 2021). Finnish companies are investing in plant protein technology and aims to take more share of the global markets. Food from Finland which is funded by Business Finland, a Finnish funding agency for innovation, accelerates marketing activities and business know-how of Finnish

## Finland has taken first steps to be a key player in global plant protein ingredients and food market.

food-industry companies (<https://www.businessfinland.fi/en/for-finnish-customers/services/programs/food-from-finland>). Food from Finland program taken a special initiative to assist Finnish food manufacturers with plant based, healthy and sustainable products (consumer goods, HoReCa sector, ingredients) in expanding their export potential to other European countries especially Germany, France as well as East Asia, Singapore, South-Africa and United States.



## Concluding remarks

Finland has all the prerequisites to make its plant-based foods into an international success story and a matter of national pride. The position as a forerunner of food transition is within reach thanks to availability and quality of relevant ingredients from oats, faba bean and rapeseed, highly advanced knowhow on food technology, and finally proven capability on commercializing the afore mentioned assets into products desired by consumers.

Benefiting from the global food transition requires far-sighted and wide-ranging national policy. In order to create significant value

from the food transitions, the policies must be consistent all the way from farm to fork. This means ensuring conditions for versatile range of ingredients in primary production, establishing coherent value chains in the industry ecosystem, and finally supporting the shift in food habits and diets. The journey of Finland as a key player in plant protein market is in an early phase of a success of story. The Finnish persistent R&D work behind the scenes will be seen in the emerging plant protein ingredient and consumer product portfolios and a significant global market share in future.

## Impact assessment of plant based meat alternatives innovation ecosystem

Current status	Input	Output	Impact
Centralized supply of protein isolates	R&D in meat alternative formulation	Protein concentrates to meat alternatives	Self-sufficiency in local nutritious unprocessed protein ingredients
Trial and error in product development	Systematic monitoring of extrusion process	Fastened R&D cycles and step toward process simulation to predict structure-function	Controlled processes in meat alternative industry
Meat alternative consumption is marginal in the populational level	Understanding on motivational factors behind consumers' meat alternative acceptance	Facilitate to reduce animal protein consumption	Mitigate climate change
Off-flavours and softy structures	Sensory and structure monitoring in a step-wise R&D	Tasty meaty structures attractive to flexitarians	Healthier diets and people will lead to reduced health-care cost

## Authors and other contributions

This white paper is compiled as an initiative of a Finnish research consortium (EXPRO) aiming to develop globally competitive processing technologies for meat alternatives. Consortium is a combination of top-class R&D (VTT Technical Research Centre of Finland Ltd., University of Helsinki, University of Vaasa and Foodwest Ltd.) and food industry expertise from ingredient and food manufacturing industries to food services (Apetit Group, Compass Group, Fazer, Foodwest, Gold&Green, Lihel, Raisio, Ultima, WestMills). These participants present the whole value chain innovation approach from

raw materials via ingredients to food design as well as consumer and business insight. The research activities in consortium are funded by Business Finland from year 2020 to 2022. Business Finland is a governmental organization for innovation funding, trade and travel and investment promotion. The authors of the white paper are Nesli Sözer (EXPRO project coordinator, research professor), Kaisu Honkapää (EXPRO project manager, senior scientist), and Kaisu Riihinen (research team leader) from VTT. The text has been reviewed by company partners mentioned in this white paper.



(Photo:Roam in color/Unsplash)

## References

Campbell-Arvai, V., Arvai, J. & Kalof, L. (2014) Motivating Sustainable Food Choices: The Role of Nudges, Value Orientation, and Information Provision', *Environment and Behavior*, 46(4), pp. 453-475, <https://doi.org/10.1177/0013916512469099>.

Lampinen, M., Voutilainen, E., Mattila, O., & Nordlund, E. (2021) Protein cluster to speed up national co-operation: Ecosystem model as a practical implementation, <https://doi.org/10.32040/2021.978-951-38-8831-2>.

Stoddard, F. L., Hovinen, S., Kontturi, M., Lindström, K., & Nykänen, A. (2009) Legumes in Finnish agriculture: history, present status and future prospects. *Agricultural and Food Science*. 18. 191-205, <https://doi.org/10.2137/145960609790059578>.

# Plant proteins from Finland

Business Finland **EXPRO**  
ecosystem project white paper

**August 2022, Espoo, Finland**

DOI: [10.32040/EXPRO.WhitePaper.2022.PlantProteins](https://doi.org/10.32040/EXPRO.WhitePaper.2022.PlantProteins)