

Innovation for protein self- sufficiency in Finland

Emilia Nordlund
18th November 2019

VTT – beyond the obvious

VTT is one of the leading research, development and innovation organizations in Europe.

We help our customers and society to grow and renew through applied research. The business sector and the entire society get the best benefit from VTT when we solve challenges that require world-class know-how together and translate them into business opportunities.

Our vision

A brighter future is created through science-based innovations.

Our mission

Customers and society grow and renew through applied research.

Strategy

Impact through scientific and technological excellence.

Established in

1942

Owned by

Ministry of
Economic
Affairs and
Employment

268 M€

Net turnover and
other operating
income (VTT
Group 2018)

2,049

Total of personnel
(VTT Group
31.12.2018)

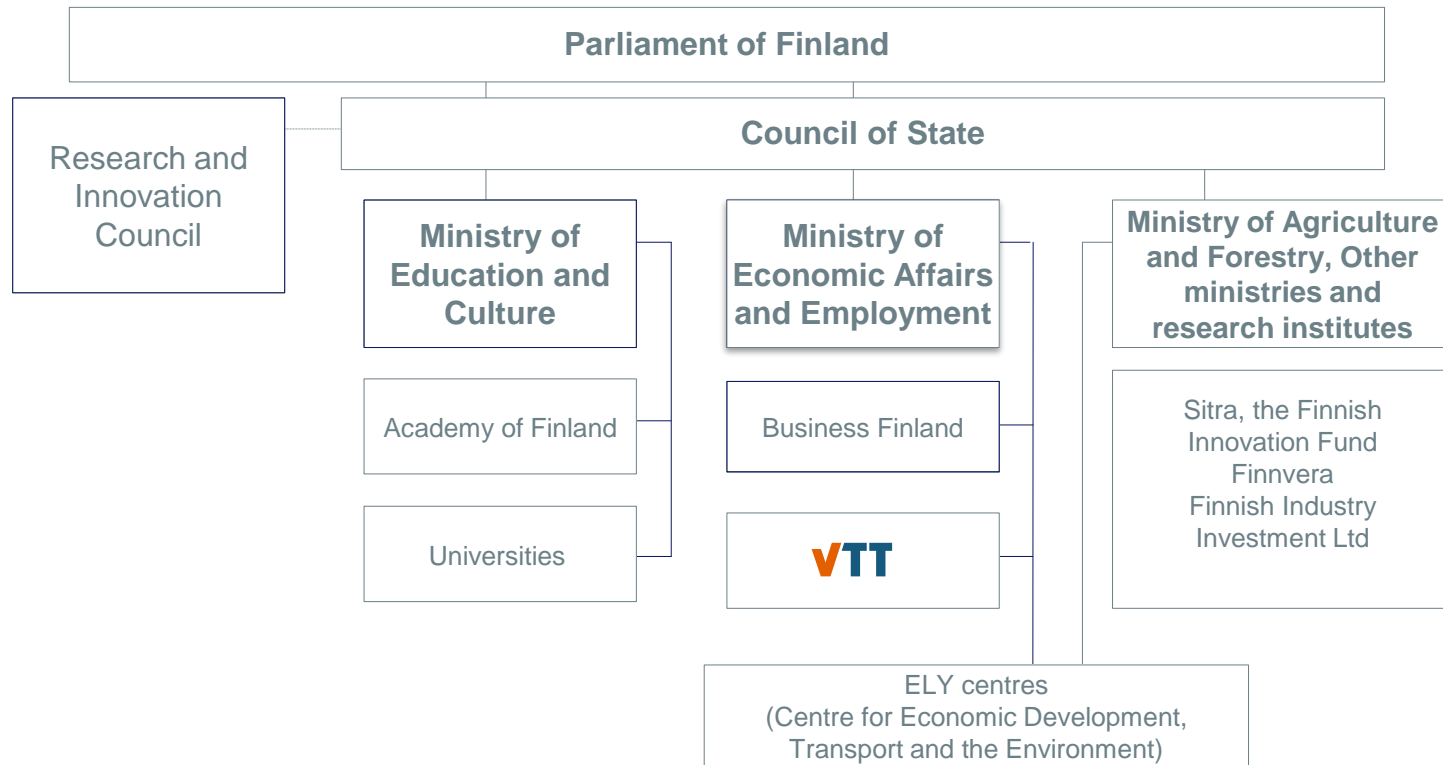
31%

Doctorates and
Licentiates
(VTT Group
2018)

44%

From the net
turnover abroad
(VTT Group
2018)

Public decision makers, financiers and R&D performers in Finland



Food innovation accelerators in Finland

Incubator programs and funds for boosting innovations

VTT
Launchpad
boosting spin
offs

Nordic Food
Tech VC
funding
for start-ups

Founders
Institute
for early state
start ups

EIT Food FAN
accelerator
program
mature start ups

Finnish
Academy
& Strategic
research council

Business
Finland
for research &
innovation

Research
programs of
ministries (MMM)

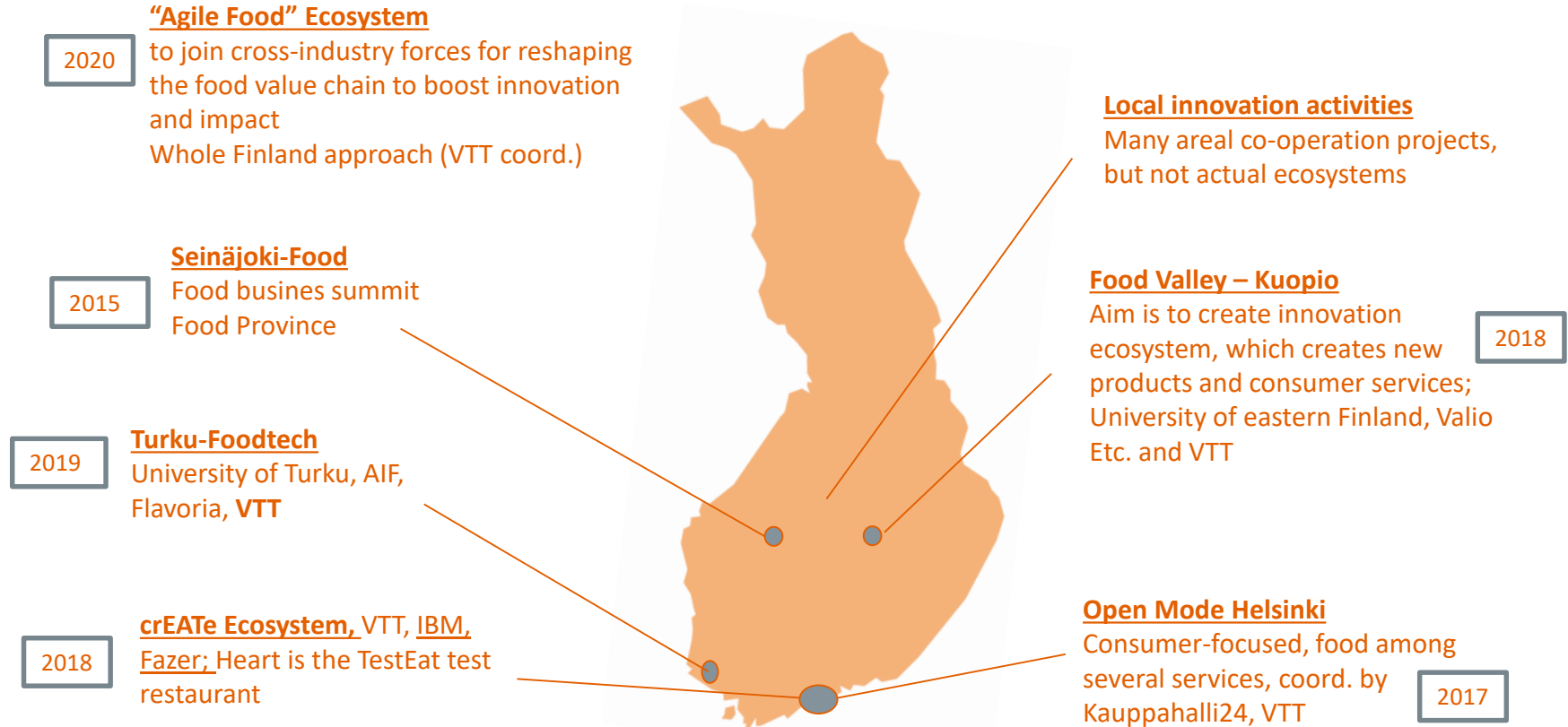
ELY centres
Sitra
Others

From 2016
the amount
of agri-food
incubator /
accelerator
programs
has raised
up from 6
to 80 at EU



Basic and applied research funding for generation of innovations

Food Ecosystems and Networks in Finland



VYR task forces for boosting protein self-sufficiency in Finland

- Working group organized by the Finnish Cereal Committee (VYR)
- The working group focuses on cereals, legumes, oilseeds and grass, and its aim is to raise Finland's status as a model country for protein self-sufficiency and sustainable food production and as an exemplary operator in the EU.
- Operators from all sections of the supply chain are in the working group
- Task forces are organized under: primary production, feed, food and market development

MORE INFO: Hanna Helkkula (VYR) & Emilia Nordlund (VTT)

Protein self-sufficiency implementation plan Report in Finnish:

https://cris.vtt.fi/files/24247901/RAPORTTI_Toimeenpanosuunnitelma_Suomen_proteiiniomavaraisuuden_nostamiseksi_julkaistava_versio_8.5.2019.pdf

Renewal of Finnish food research strategy

- Together with key food research actors we aim to position Finland as a key actor in the transition towards a sustainable global food system, which will also create new economic growth opportunities.
- The strategy work discussions with key partners already started this year but the actual work will be done in 2020.
- Meeting with core partners (research partners and key stakeholders) will be scheduled for January to decide on the process
- Workshops with various stakeholders (ETL, major industry actors) will be also planned.
- More information: Nesli Sözer, research Prof VTT (nesli.sozer@vtt.fi)

Boosting protein innovations

Sustainable protein and food by smart use of resources

Reforming agrifood chain

- Plant-based food design
- Boosting biodiversity
- From side-streams to main streams
- New circular concepts for food and feed production

Food without Fields

- Cellular agriculture
- Insects as feed & food
- Circular concepts with existing food systems
- Vertical farming

Three innovation paths for the sustainable food chain

Innovation path 1

New tools for primary production

- Cultivation technologies and practices
- Smart crop rotation practices
- Breeding for better tolerant plants and quality

Case CARBO: Towards carbon neutrality in milk and meat production

- **CARBO collaboration network 2019-2021**, convened by Valio, with Atria Tuottajat, the Finnish Meteorological Institute, Natural Resources Institute Finland (Luke), University of Eastern Finland and Yara; Business Finland, total budget 8M€
- **Goals include:**
 - reducing the environmental impacts of the Finnish milk and meat chain using research data, new innovations and farm pilots
 - carbon sequestration in grass fields
 - improving profitability of Finnish agriculture and boosting export
 - responding to changes in consumer demand for more transparency and sustainability in the primary production of food

MORE INFO: <https://www.businessfinland.fi/en/whats-new/news/2019/what-kind-of-role-can-finnish-agriculture-play-as-a-mitigator-of-climate-change/>

Case MULTA: Multi-benefit solutions to climate-smart agriculture

- Funded by strategic research council of Finland; Active 2019-2025
- Consortium: Finnish Meteorological Institute (coord. Jari Liski), BSAG, University of Helsinki, INAR – Institute for Atmospheric and Earth System Research, Natural Resources Institute Finland LUKE, Finnish Environment Institute SYKE, and University of Zurich.
- **MULTA studies and develops:**
 - processes of carbon sequestration and climate impacts focusing on knowledge gaps
 - how these processes can be enhanced using farming practices and how implemented on farms
 - methodology for verifying carbon sequestration and the climate impacts
 - policies and economics that support climate-smart farming

MORE INFO: <https://carbonaction.org/en-stn-multa/>

Innovation path 2

Plant-based food design

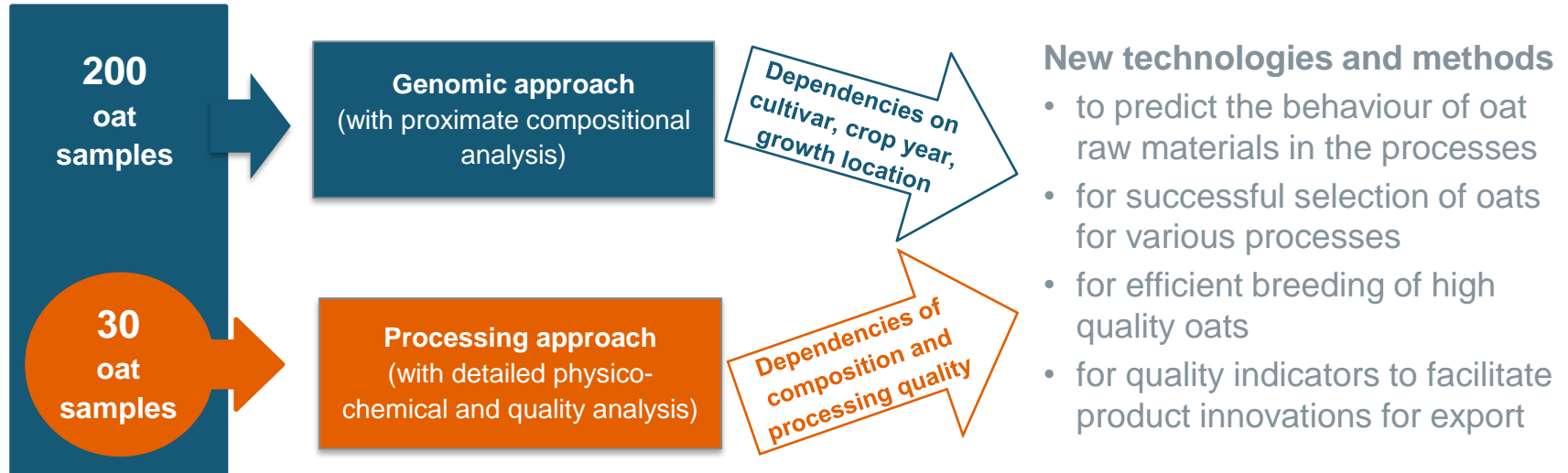
- Development of ingredient and food technologies for delicious plant based food



Case OatHow – boosting oat-based innovations

Co-Innovation project funded by Business Finland; From Jan 2019 to Dec 2020;

Partners: Research: VTT (coord.), Luke, University of Helsinki, University of Turku; Industry (in total 13 companies); **Budget:** 2.0 M€



Case LEG4LIFE - Legumes for sustainable food system and healthy life

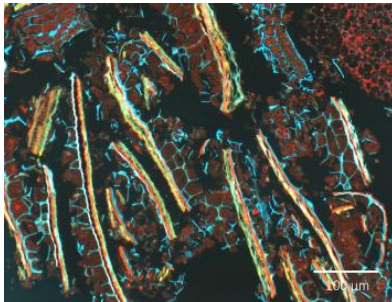
- Project funded by strategic research council of Finland; Active during 2019–2025
- Consortium: University of Helsinki (coord. Anne-Maria Pajari), National Institute for Health and Welfare, and Natural Resources Institute Finland
- System-level project with focus on grain legumes (pea, faba bean, and lupin) that are feasible to be cultivated in Finland
- Promotes legume-supported agriculture, tasty and healthy legume foods for food services and individual consumers
- Studies the effects of increased legume production

MORE INFO: <https://www.aka.fi/fi/strategisen-tutkimuksen-rahoitus2/ajankohtaista/2019/kahdeksan-keinoa-joilla-palkokasvit-parantavat-maailman/>

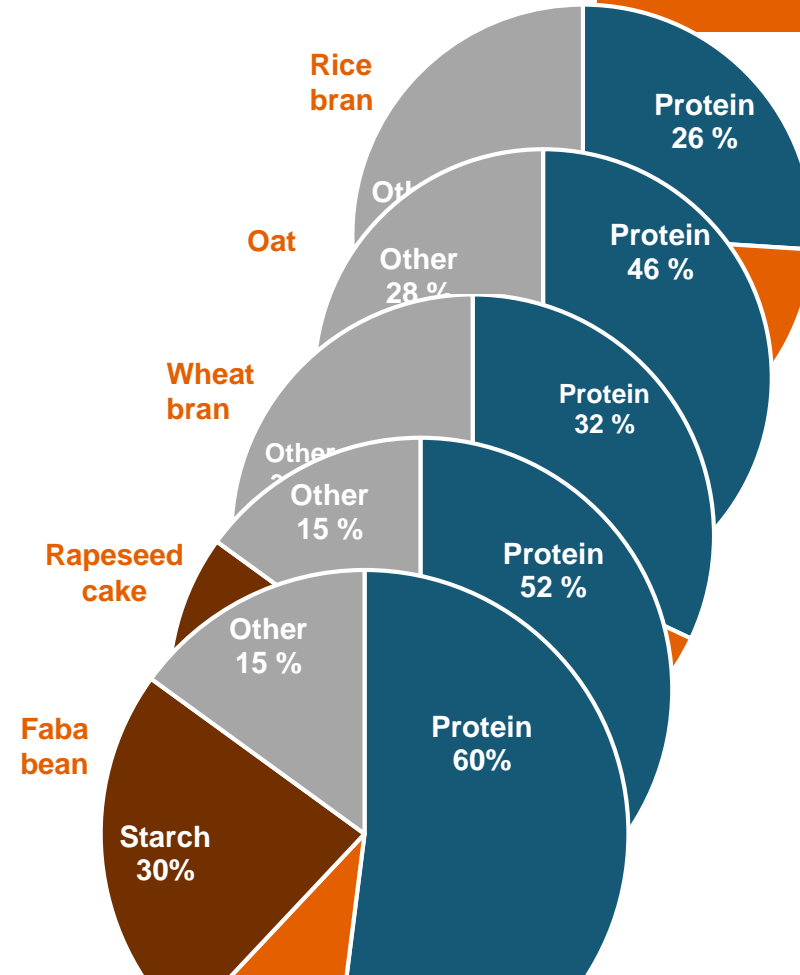
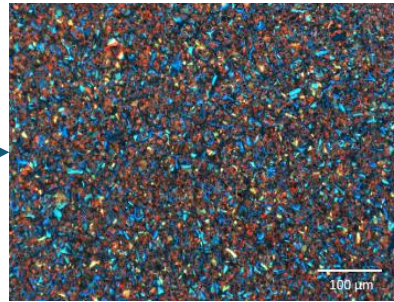
Case Hybrid Ingredients

- Hybrid ingredients by dry fractionation: sustainable, resource efficient
- Technological and nutritional benefits various components of plant materials
- High protein and fibre foods with a single ingredient

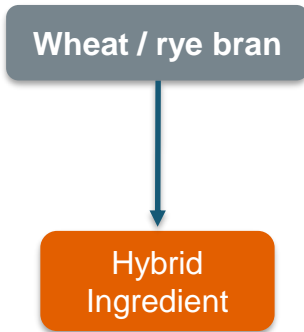
Cereal bran raw material



Hybrid ingredient from bran

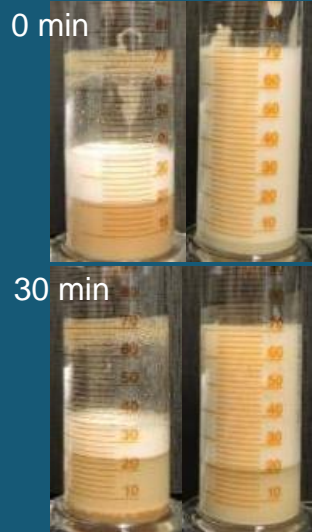


Hybrid ingredient Case 1: Wheat bran fraction functional in baking

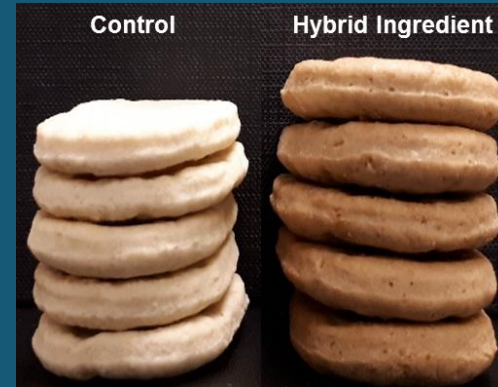


Foaming properties

Wheat bran
raw material hybrid
 ingredient



Crackers enriched with wheat bran hybrid ingredient



- Increased protein and fibre content
- Crispier
- Richer in flavour

Hybrid ingredient Case 2: Rapeseed press cake fraction functional in wet-extrusion

Rapeseed
press cake



Hybrid
Ingredient

Formation of a fibril structure with a single ingredient
• 22% protein, 14% dietary fibre



High moisture extrusion

Innovation path 3

Emerging technologies for protein production

- Food without Fields technologies can enable using more of the cultivated land for food production

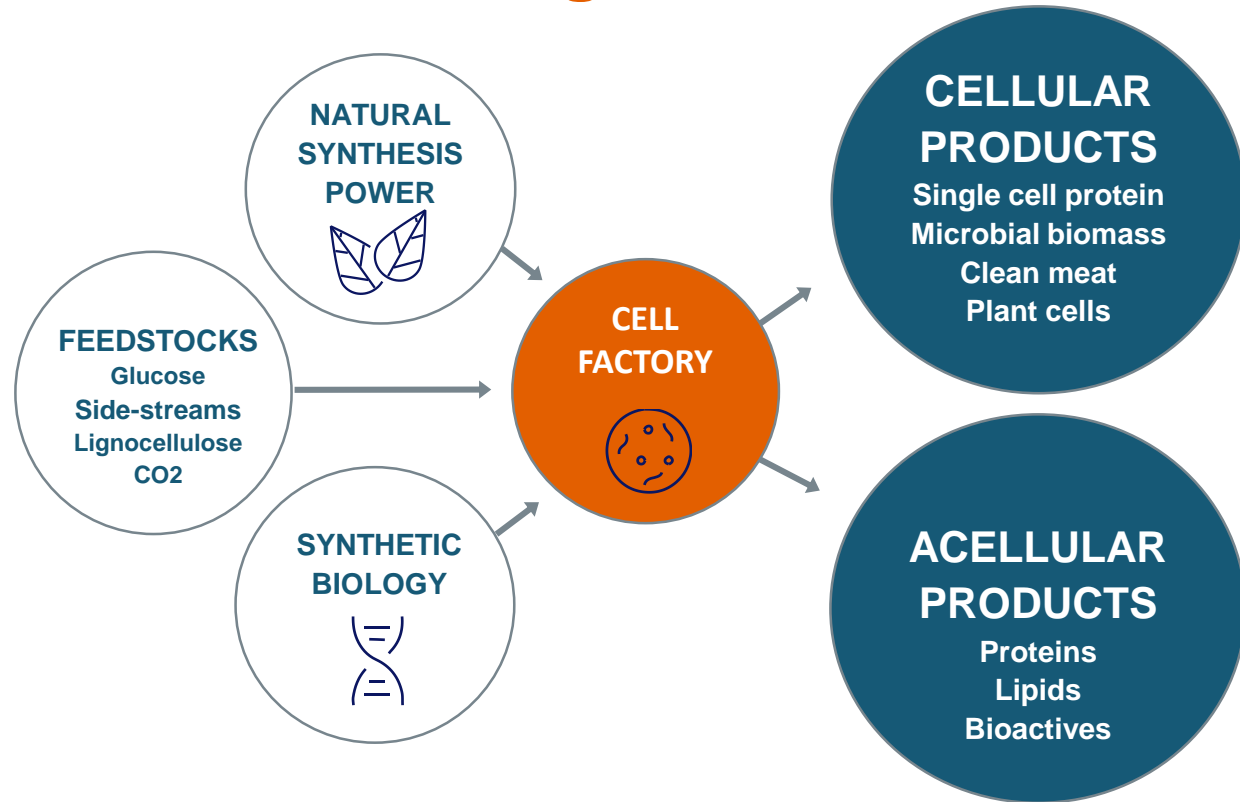


Biobased streams are versatile nutrient sources, but not always for human use

Can we utilize those streams for protein production via bioconversion and circular concepts?

Food without Fields - Cellular agriculture

- Using single cell organisms and bioreactors for production of food ingredients
- They turn simple feedstocks into complex products



Cells as Food Products is not new

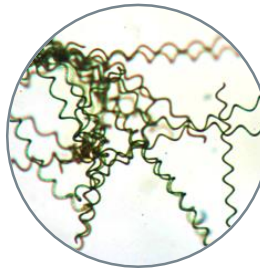
Tradition for using single cell organisms as food exists

Microalgae, such as ***Spirulina*** *platensis* has long history as food

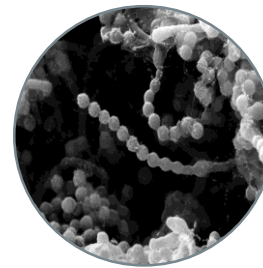
Pekilo - *Paecilomyces variotii* was grown for food and feed in Finland in the 70's

Quorn is produced from *Fusarium venenatum* fungus and it is widely available on the market

Spirulina



Pekilo



Quorn



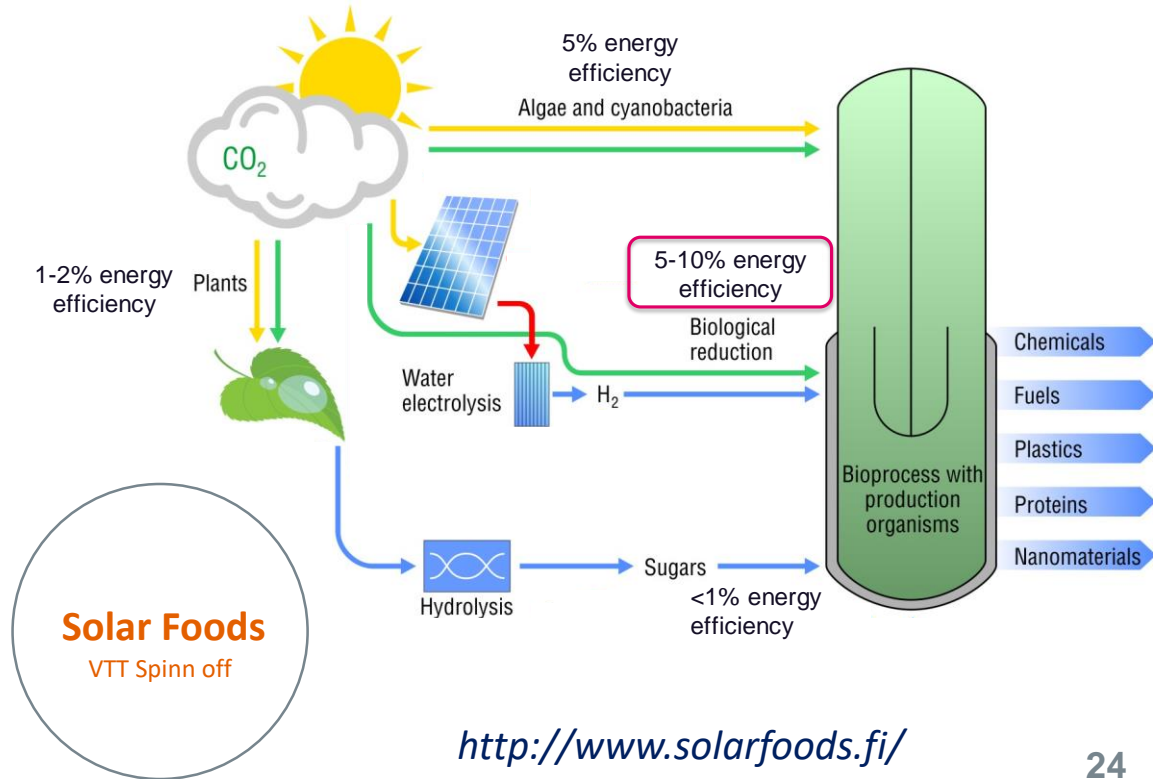
Food from Air is new!

Case Solar Foods

Gas Fermentation to produce microbial biomass for food

Rhodococcus opacus
sequesters carbon dioxide and
oxidases hydrogen for energy

When hydrogen is provided
using photovoltaics, it turns sun
light into biomass more
efficiently than algae or plants

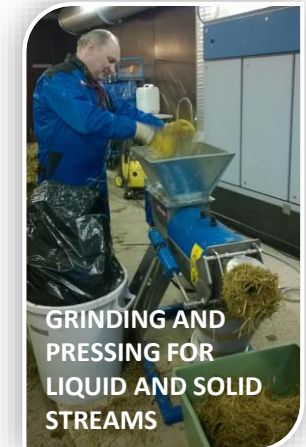
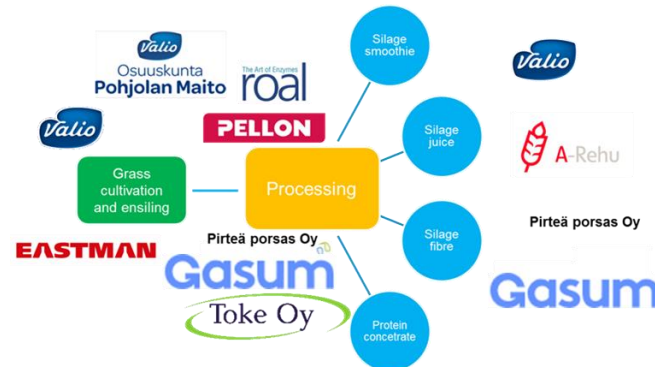


Case INNOFEED - Biorefining ensiled grass into inventive feed products

Project:

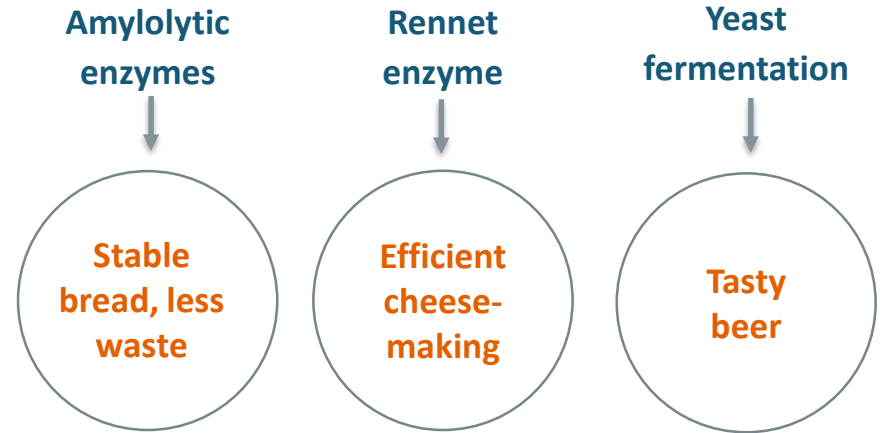
- Defined the best grass cultivars for protein rich silage production
- Developed technologies for feed production from silage
- Tested Pekilo fermentation for boosting protein in feed
- Verified processes by techno-economic evaluation & nutrient LCA
- Tested the feed prototypes in pig and dairy cow feeding
- Evaluated the export and commercialization possibilities

Funded by Business Finland; Duration 2015-2018; Partners VTT, Luke and FIN industry



Production of Acellular components for food manufacturing is neither new

Enzymes (food processing aids), and additives (flavours, vitamins, etc.) are produced in cell factories



Production of high performance food proteins is new!

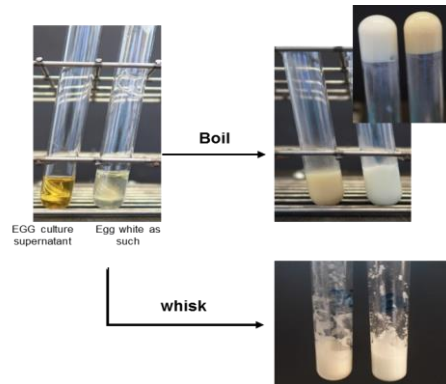
Case Animal proteins

Egg without Chicken

Trichoderma reesei was used as a host to produce chicken ovalbumin – egg white protein

Functional testing has been done to confirm that it forms gel structures and foams

4 g
Productivity
per litre

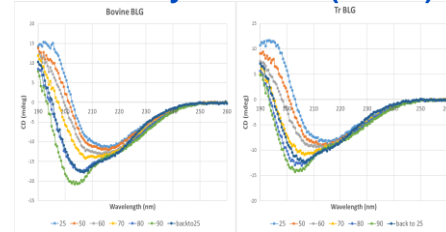


Milk without Cow

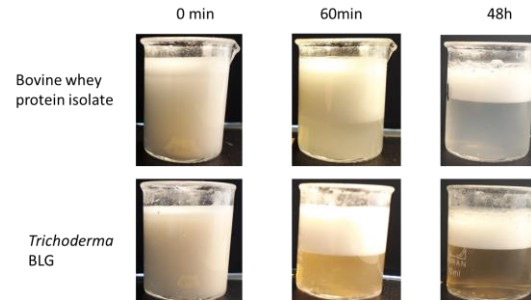
Beta-lactoglobulin (BLG), whey protein from *T. reesei*

BLG has similar structure and emulsions compared to bovine BLG

Secondary structure (far UV)



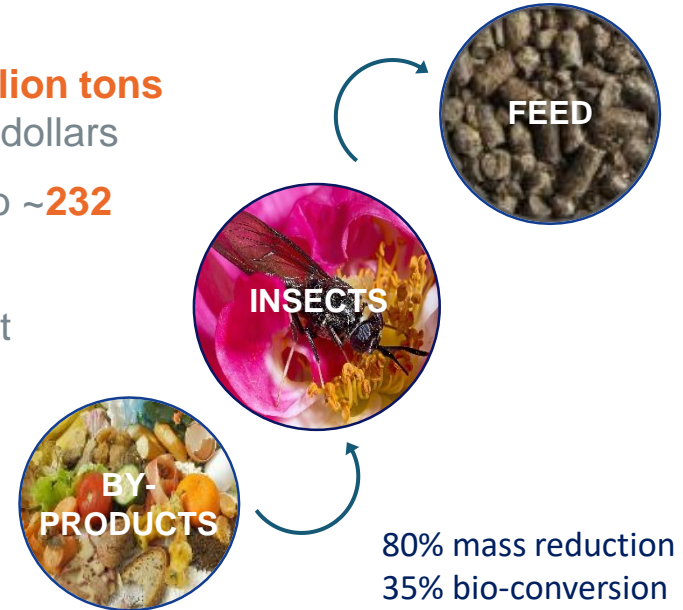
Emulsions made with 0.05% gellan gum



1/3
FOOD
IS LOST

Case Insects: From food waste to feed

- Worldwide every year **1.3 billion tons** food is lost – impact 1 billion dollars
 - What if, we could convert it to ~**232 million tons** of insects?
- Black soldier fly** is uniquely positioned as the most efficient insect that can be reared in large scale
 - Larve composition is similar to soybean
 - Waste management + production of feed in one solution



READ MORE:

- <https://www.vttresearch.com/media/news/vtt%E2%80%99s-deep-tech-incubator-teams-come-up-with-two-solutions-to-meet-the-need-for-new-sustainable-fish-feed>
- <https://www.jamk.fi/en/JAMK-information/annual-report-2018/black-soldier-flies-are-being-raised-in-tarvaala/>

Rethinking the food production – again!

Where Have All the Oats Gone?



Paul Shapiro [Follow](#)

Apr 3 · 5 min read ★

(And What Happens to Ag Jobs When Alt-Protein Rises?)

....As **1987 USDA** report put it: “Oats remained a major crop in the United States until about the midfifties when acreage and production began to decline. Replacement of horses by tractors, trucks, and cars greatly reduced the population of a major consumer of oats.”

Consequently, the **decline in oat production coincided with a sharp increase in those crops**, which to this day have maintained a virtual hegemony in U.S. feed crop production. In other words: **farmers still farmed, just different crop...**

<https://medium.com/@PaulShapiro/where-have-all-the-oats-gone-4eaeb679cb1b?sk=326259eb0ee1f02a177e71b2d84ae2ca>

Let's venture beyond the obvious

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