



Protein Transition Investment Theme

Mid-term report 2019-2020



WAGENINGEN
UNIVERSITY & RESEARCH

Protein Transition Investment Theme

Mid-term report 2019-2020

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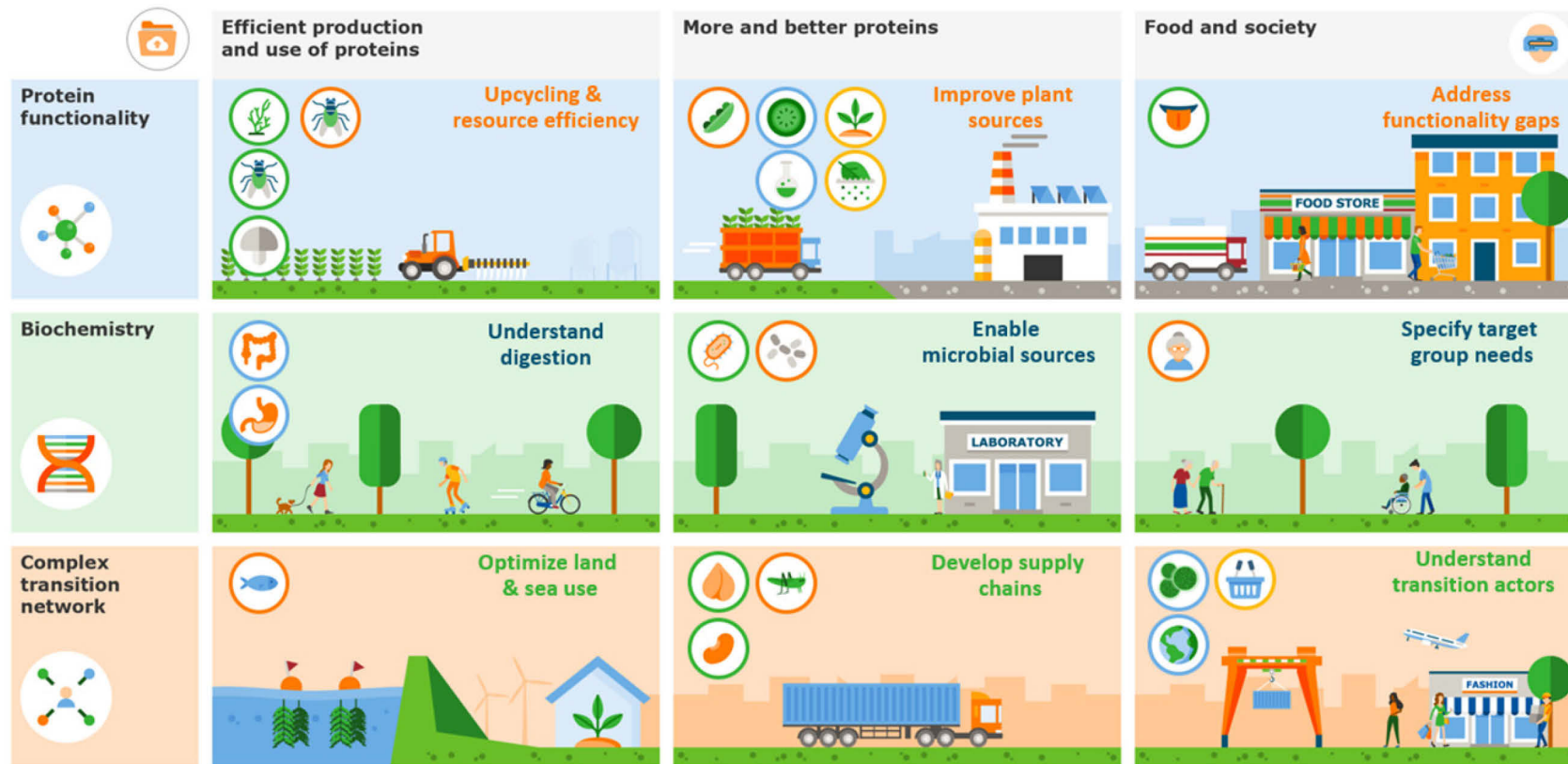
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1 Introduction



2 Science Themes

Protein functionality

Structure-function relationships, including both physical and biological functions of proteins, are still poorly understood, owing at least in part to the multi-lengthscale nature of protein structure development. A basic means to understand and model protein behaviour does not yet exist. Molecular understanding is insufficient to describe the complexity of secondary, tertiary, and quaternary structures. Further, structuring and the structure/texture experienced during eating is mostly driven by phase behaviour in complex protein-rich mixtures. In addition, most of the protein structures in traditional food and feed products are pH responsive, modulated by minerals, and processing-history specific. New tools for quantitative study of protein structuring are needed.

Projects in this science theme advance fundamental understanding of functional pathways, for example by length scale jumping, studying intrinsic functional properties, or mapping functional landscapes.

Biochemical processes

Proteins are made by and used by living organisms; every protein-related process is biochemistry. This insight, while completely obvious, has sparked ground-breaking innovation worldwide in recent years. From the assumption that every biochemical process which takes place in a plant or animal can also take place in a lab, ground-breaking innovations have appeared in recent years. In-depth understanding of biochemistry in animals and humans provides the development guidelines for production of new functional and nutritional proteins, with demonstrated health, and other safety qualifications. The animal nutrition industry is arguably the most advanced in understanding protein-specific nutrition and conversion to muscle mass. In human nutrition, emerging research delivers insights into how specific protein-derived components impact a spectrum of biological processes: muscle, heart, cognitive, immune, endocrine, and satiety.

Projects in this science theme deliver new knowledge of biochemical pathways underpinning protein conversion, or apply known biochemical pathways in a new context to deliver new functional or nutritional proteins.

Complex transition network

The global protein market is a complex network of interconnected actors operating at divergent length scales. Each actor makes a specific individual behaviour choice within the context of societal, social, and environmental cues. The total aggregate result of all individual actions determines the collected outcome: a positive or negative impact toward, for example, the sustainable development goals. Achieving a true protein transition requires a deeper understanding of this complex, interconnected network. A transition follows different pathways and paces. Various stakeholders have different interests, constraints, and mindsets and preferences – constructive or obstructive to protein transition. To be able to achieve protein transition inside this complex network, the desirability and feasibility of various future visions and scenarios should be elucidated. Future scenarios should consider impact on land use, economics, farm livelihoods, public health, and living environment. Transition pathways of designing, experimenting, learning, and institutional innovations toward systems change should be identified and evaluated. Path-breaking ways of triggering systems change should be defined and tested.

Projects in this science theme deliver understanding of the complex network of protein-related actors, contribute to impact-based prioritization of intervention modes, or provide path-breaking processes for learning and institutional change.

3 Impact domains

Efficient production and use of proteins

- a. *We aim to improve the **nitrogen efficiency** of global protein production systems.* Circular systems for protein production can be particularly useful in preventing nitrogen runoff into fresh water and retaining soil quality. Nitrogen-fixing crops contribute to total available protein worldwide. The most novel technologies capture nitrogen directly, for example nitrogen-capturing wind energy systems (wind + air + water = nitrogen).
- b. *We aim to **reduce protein losses**.* Food loss or waste per continent ranges from 15% in Latin America to an astonishing 42% in North America and Oceania. In sub-Saharan Africa 23% of food is lost or wasted, of which 95% before reaching a potential consumer. In an areas of scarcity, this represents an enormous humanitarian crisis. Affordable, robust, and locally-appropriate supply chain solutions are urgently needed.
- c. *We aim to **reposition protein source usage**.* Wageningen scientists have already called for a return to the original role for animals in upcycling waste and valorising land and sea resources. Animals can be used to “upgrade” side streams and sources with low nutritional value, and side streams that are currently used for non-food purposes. Some animal protein sources are clearly more efficient protein providers than others. When using alternative low grade sources to feed animals, the consequences for food safety should be carefully characterized.

More and better proteins

- a. *We aim to deliver **novel protein** sources and production systems.* Some new source proteins are based on familiar food and feed components, like legumes. Other, much more novel sources, should be explored for the longer term. For example, while single-celled organisms might have the potential to be among the most efficient protein sources, their potential for food and feed production remains largely untapped. Innovative companies are pursuing yeast-expressed ‘clean milk’ or methane-based biomass growth. As-yet unknown, out-of-the-box solutions and production methods should be pursued for their potential to disrupt the status quo.
- b. *We aim to **improve and diversify the existing set of proteins** used for food and feed.* Just 15 plant crops provide 90% of the world’s food energy intake. These crops do not themselves provide adequate nutrition, neither in amino acid profile nor in micronutrient delivery, leading to nutritional (over)dependence on animal proteins. Improvements are needed in protein quantity and quality, and diversity. Existing proteins may also come from side streams, as-yet unused fractions of crops, or even by upcycling from waste.
- c. *We aim to increase **climate-robust protein** supplies for fragile areas.* The FAO estimates that 70% of undernourished people worldwide also live in regions with high exposure to climate extremes. Without climate-robust, financially sustainable supply chains in place, the coming years will see an acceleration in hunger and mass migration. Breakthrough solutions for climate-robust protein sources are urgently needed.

Food and society

- a. *We aim to integrate and explore protein production systems as an integral part of our **shared landscape**.* Protein production is a pillar of economic activity and a driver of land and sea use. Optimization for more and better proteins should be done in the context of maintaining social and societal well-being.
- b. *We aim to deliver breakthroughs in quality of **plant-based foods**.* Rich-world consumers have increased their animal protein consumption drastically in the past 50 years. A majority of Dutch consumers indicate a wish to eat more plant-based, but many report that the current offering of plant-based alternatives does not meet their demands.
- c. *We aim for a total consumer environment which motivates **(re)balanced plant-animal ratios** globally.* Excellent plant-based foods are an important part of driving consumers toward healthy, sustainable choices, but not the only solution. Various Wageningen groups have already shown that subtle nudges and social signals can influence behaviour. Western consumer culture need not

remain the global aspirational standard, and urbanizing consumers in developing countries should be offered appealing and healthy options.

- d. *We aim to **accelerate the transition**.* A transition follows different pathways and paces, various stakeholders have different interests, possibilities to act as well as different mindsets and preferences – in favour of Protein Transition or obstructive. In order to achieve a true transition, 'alternative' politics, governance, ethics and economics must help to accelerate – rather than frustrate – the protein transition.

4 Project types

Directed call projects

Investing in teams

In the areas defined by the intersection of the science themes and impact domains, directed calls are used to invite researchers from Wageningen science groups to design a transdisciplinary project to create breakthrough solutions.

Community-funded projects

Investing in content

Community-funded projects are intended for front-line innovation feasibility studies running from 6 months up to 2 years. Projects are pre-selected for their fit to the science themes, contribution to the impact domains, and high-risk, high-reward character. Funding is allocated via a 'crowd funding' type platform.

Seed projects

Investing in people

Seed projects are targeted funds to support young professionals to submit grants in topics related to the protein transition in order to attract and maintain talented scholars for WUR.

PhD projects

Three PhD projects were granted to the Theme in 2019. The PhD topics were selected to deepen the scientific developments of the three science themes.

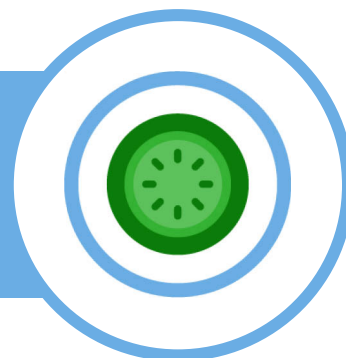
Outreach projects

Investing in engagement

Because of the importance of creating protein literacy and catalysing systems change, the protein transition group also includes the option to fund outreach projects. These projects aim to innovate in dissemination to a broad public and/or to bring together a unique set of actors.

PROTEIN FUNCTIONALITIES

DIRECTED-CALL PROJECT 2019-2020



CONTACT

Luisa Trindade
Peter Wierenga
Marinus Krimpen
*Plant Breeding, Food Chemistry,
Animal Nutrition*

AIM

To 1) Plant: chemically characterize proteins from Agricultural side and explore potentialities of novel feedstock's for food and feed applications; 2) nutritional functionality: in vitro testing; 3) feed application: new, more advanced types of in vitro models will be tested and compared with existing ones.

RESULTS

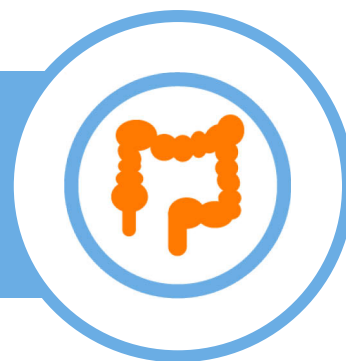
- A new high-throughput method for the characterization of foaming properties on protein from different plant sources has been developed.
- The chemical composition of a diverse set of agricultural waste streams has been characterized, including 15-30% amounts of protein.
- Potential toxic effects of protein extracts from different waste streams has been investigated on animal cells (no toxicity).

OUTPUT

- [NEW PROJECT] TKI proposal: results of chemical and functional analysis of agricultural side streams have been input.
- [NEW PROJECT] TTW proposal: toxicity of different agriculture side streams have been input.
- [OTHER] prototype testing of screening method implemented in TIFN projects.

GGI FERMENTATION

DIRECTED-CALL PROJECT 2019-2020



CONTACT

Edith Feskens
Nikkie van der Wielen
Vincenzo Fogliano
Edoardo Capuano
Wouter Hendriks
Renger Witkamp
Hauke Smidt
Paul Moughan
*Human Nutrition & Health, Animal
Nutrition, Food Quality & Design,
Microbiology*

AIM

To link amino acid composition and digestibility of an array of protein sources to the formation of unfavourable metabolites and changes in microbial composition that may be beneficial or harmful.

OTHER

Due to Covid19, planned SHIME experiments are postponed to 2021

RESULTS

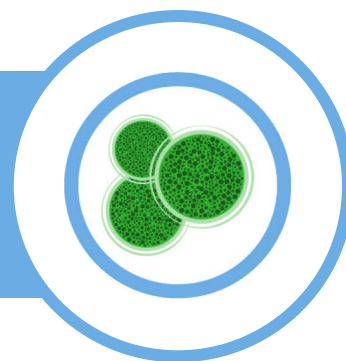
- Simulator of Human Intestinal Microbial Ecosystem (SHIME®) model, a semi-dynamic fermentation model that allows to study the metabolic fate of dietary components in different segments of the large intestine enabled to determine a workable concentration of feed for testing human ileal digesta in the system (pilot experiment).
- Commercial SHIME feed, contained higher amount of protein (higher protein density per unit of volume) that is available for protein fermentation compared to the ileal digesta.
- The level of certain microbial metabolites from protein fermentation is proportional to the amount of amino acids precursors in the ileal digesta which is highly affected by protein digestibility in the small intestine.
- In our SHIME system the majority of protein fermentation takes place in the distal colon, which is consistent with well-known paradigm that protein fermentation mostly occurs in the distal part of the colon because of the depletion of carbohydrates in more proximal segments of the colon.

OUTPUT

- [PUBLICATION 2021].

SUSTAINABLE PROTEIN ACCEPTANCE

DIRECTED-CALL PROJECT 2019-2020



CONTACT

Siet Sijtsema
Geertje van Bergen
Hans Dagevos
*Consumer and Chain, Consumer
Science Urban Economics*

Machiel Reinders, René de Wijk,
Gertrude Zeinstra,
Mariët van Haaster-de Winter

AIM

To understand the (sub)conscious drivers and barriers underlying sustainable protein consumption and adoption:
(a) targeting (sub)conscious processes in consumers;
(b) defining and comparing consumers segments;
(c) comparing multiple protein categories instead of investigating one protein category in isolation, and
(d) targeting intrinsic and extrinsic product properties.

RESULTS

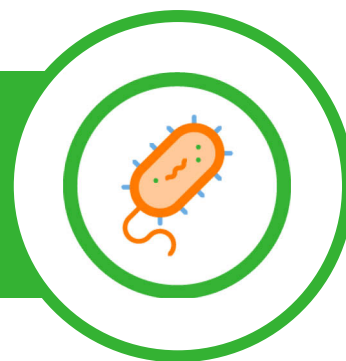
- Focus group study: the need of psychological support in terms of knowledge and skills (nutrition, recipes, preparation), and support from social and physical context for flexitarians.
- Online survey: for some visually identical dishes, consumers preferred a sustainable protein over an animal protein if they were unaware of the other option. When given the choice, animal proteins were preferred over sustainable proteins in all dishes. Consumers would rather order bean and mushroom dishes in a restaurant relative to preparing these dishes at home.
- Sensory study: meat replacers were liked better and tasted more tender to consumers who eat meat replacers more often, showing that taste preferences can change with experience. At the same time, flavour expectations prior to tasting were not met upon tasting. Highlighting the animal comparison hinders more often than drives sustainable protein acceptance.

OUTPUT

- [PUBLICATION] H. Dagevos, Finding flexitarians: current studies on meat eaters and meat reducers. Submitted to Trends in Food Science & Technology (IF:11.08) (in revision).
- [PUBLICATION] Manuscript on focus group study to special issue of Sustainability – Food innovation for planetary health (IF:2.57) (in preparation).
- [PUBLICATION] Manuscript on sensory study results to Food Quality and Preference (IF:3.68) (in preparation).
- [OTHER] Management summary including recommendations for intervention strategies (pending).

MICROBIAL MEAT

COMMUNITY-FUNDED PROJECT 2019-2020



CONTACT

Jeroen Hugenholtz
BBP Bioconversion

Mark Sturme, Laurice Pouvreau,
Piyali Chakraborty,
Rick van de Vondervoort,
Frits de Wolf, Marc Werten

AIM

All required components for “microbial meat”- various proteins, fat, and nutrients – can be produced by fermentation.

A meat-like food product can be constructed from these individual components.

RESULTS

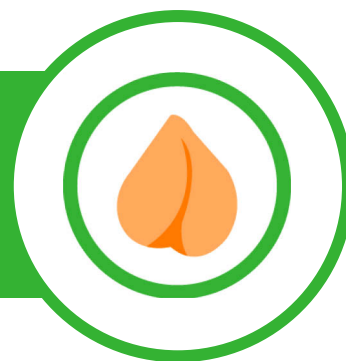
- Protein content in microbial biomass was above the minimum required values for good processing by 3D-printing and shear cell technology, while dry weight and fat (lipid) content were a bit below the desired levels for good processing by both technologies.
- IP opportunities with regard to protein production by *Yarrowia lipolytica* and *Bacillus subtilis*.

OUTPUT

- [PRESENTATION] GFI Symposium on Fermentation, 20/10/20.
- [NEW PROJECT APPROVED] TKI 2020 project on Microbial Heme for meat alternatives; start: April 2021.
- [NEW PROJECT APPROVED] Two bilateral projects with new partner on microbial heme production.
- [OTHER] Contribution to the Nationale Eiwitstrategie.

WEST AFRICAN PROTEIN CROPS

COMMUNITY-FUNDED PROJECT 2019-2020



CONTACT

Thom Achterbosch & Gijs Kleter
International Policy/ Microbiology & Novel Technologies

Arnout Fischer, Ruerd Ruben,
Atze-Jan van der Goot,
Matthijs Montsma, Klaas van Rozen,
Ken Giller, and other WUR experts

AIM

To highlight how African pulses can serve as novel, nutritious and more diversified protein sources, and to search for novel applications for pulse & legume proteins in human food and livestock feed. For the latter it is also important to stress that it will aid in securing a protein supply for the EU as long as it has not become self-sufficient yet, whilst contributing to food safety in quality in Africa as well.

RESULTS

- The European protein transition might give traction to the development of West-African food systems. West-African pulses and legume crops in the EU have market prospects in the EU as a safe, ethical, and environmentally acceptable alternative to current imports.
- There is untapped consumer demand and supply potential for pulses for human consumption in West Africa. Finding market opportunities abroad that will strengthen Africa's pulses and legume sectors.
- Future trade and business opportunities with EU are for pulse grains in low-processed and high-processed form and must be rooted in an African pulses transition (soybean, cowpea, bambara groundnut).

OUTPUT

- [REPORT] Introduction of project as factsheet.
- [REPORT] Project report that contributed to several funding proposals.
- [PUBLICATION] Fractioning analysis will be integrated into a PhD article "Miek Schlangen: Comparing attributes of pea, cowpea and mung beans as alternative protein sources" (to be submitted).
- [PUBLICATION] Review paper (to be submitted in second quarter 2021).
- [NEW PROJECTS] new proposals a. Norad 2021, b. Tki agri&food pps balance 2021, c. H2020 diet-shift; reworked proposals a. Rvo sdg partnership program 2019, b. Tski agri&food (not approved).
- [COLLABORATION] Investors briefing.

TASTY PROTEINS

COMMUNITY-FUNDED PROJECT 2019-2020



CONTACT

Guido Sala
Elke Scholten
Physics and Physical Chemistry of Foods

Layla Broers

AIM

To understand more about the perception of alternative protein-based foods (meat analogues); improve the quality of foods with regard to mouthfeel and to develop tools to improve their quality; overall aim: improvement in quality would increase acceptability of meat analogues to increase choice for consumers; RQ: What is the relationship between Sensory, Texture & Structure of meat analogues?

RESULTS

- To increase liking of different meat analogues, it is very important to further understand the link between structural and textural aspects and juiciness.
- Also, we have shown that this is not a simple relation, but that juiciness is a combination of multiple aspects.
- Reasons for not buying meat analogues were linked to unappealing flavour and texture:
 - in terms of texture, hardness, chewiness, cohesiveness were not related to liking;
 - in terms of sensory properties, juiciness was related to liking, yet, no structural characteristics could explain juiciness (e.g. moisture or fat).

OUTPUT

- [PRESENTATION] shared with other FBR project "Plant Meat Matters" and "PlantPROMISE" and discussions are ongoing.
- [PUBLICATION] scientific publication: Q1 journal (to be submitted).
- [NEW PROJECT APPROVED] Overview of results as input for PPS proposal "Improved sensory quality of meat analogues".

SEaweeds

COMMUNITY-FUNDED PROJECT 2019-2020



CONTACT

Adrie van der Werf
Ingrid van der Meer
Rumyana Karlova
*Agrosystems Research, Bioscience,
Laboratory of Plant Physiology*

AIM

To research seaweed extract application, to increase drought and salinity stress resistance of protein crops which will enable the substantial augmentation of arable land use especially under the climate change challenges that are expected.

RESULTS

- Effect of seaweed extract on production of crops in greenhouse (20-25% higher under salt stress).
- Effect of seaweed extract on root growth of seedlings under salt stress.
- Effect on tomato seedlings after transfer to soil under salt stress.
- Insight in mode of action via metabolomics analysis needs to be continuing (running to 2021).

OUTPUT

- [PUBLICATION] Review article has been submitted but needs re-writing and re-submission. In progress.

WATER LENTILS

COMMUNITY-FUNDED PROJECT 2019-2020



CONTACT

Ingrid van der Meer
Bioscience

AIM

To finalise research on using the WUR patented extraction method that was developed for extraction of high value protein (mainly RuBisCO) from sugar beet leaves for the extraction of high value protein from the new plant protein source, water lentils.

OTHER

Sub project of "Seaweeds" that was conducted in 2020

RESULTS

- Insight in the use of water lentils as source for high-value proteins (mainly RuBisCO).
- Possibility to use water lentils in between the campaign of sugar beets of which the leaves are used for extraction of RuBisCO.
- Proteomics analysis applied to show the composition of the raw protein extract and the concentration/ extraction of water lentils high-value proteins that mainly consist of RuBisCO after extraction.

OUTPUT

- [PUBLICATION] Isolation and gelling properties of duckweed protein isolate [IF:4.19]. (under review).
- [MEDIA] I.v/d Meer (2020). Eendenkroos ook voor mens een smakelijk en gezond hapje? Scientias.

INSECT BREEDING

SEED PROJECT 2019



CONTACT

Esther Ellen
Aniek Bouwman
Animal Breeding & Genomics

AIM

To apply quantitative genetics and animal breeding that will be applied supporting development of healthy insect populations and to capture variation between individuals, to breed specific populations with distinct traits on waste products.

INTENDED FUNDING

TKI Agri & Food – PPS Call

OUTPUT

- [PRESENTATION] EAAP, exploiting genetic variation in insect populations, 03/12/2020.
- [NEW PROJECT APPROVED] contributed to an IRFD **research proposal** in collaboration with Aalborg University (Denmark).
- [COLLABORATION] Started to **collaborate** with an **insect company**.
- [OUTREACH] initiated an **EAAP session** on insect genetics (2020).
- [OUTREACH] Masterclass 'Insect Biology, genetics and breeding'.
- [OTHER] Wrote a **vision** for Wageningen Livestock Research and Animal Breeding to use animal breeding to improve health and performance of insect populations.
- [OTHER] Signed up for **cost-action on insects**.

ANIMAL FREE MILK

SEED PROJECT 2019



CONTACT

Etske Bijl
Food Quality and Design

AIM

To make large steps towards developing a sustainable, highly nutritious and animal-free alternative to cow's milk proteins that can be used to make vegan milk and dairy products.

INTENDED FUNDING

NWO (proposal NWA-ORC 2019)

OUTPUT

- [NEW PROJECT APPROVED] Submitted to NWO; approved by NWA-ORC, "Animal-free milk proteins"
<https://www.wur.nl/en/newsarticle/Green-light-for-research-on-animal-free-lactoprotein-and-robust-landscape.htm>.

PROTEIN PUZZLE LATER LIFE

SEED PROJECT 2019



CONTACT

Pol Grootswagers
Human Nutrition & Health

AIM

To benefit our understanding of the potential of alternative protein sources in improving muscle mass in older adult.

INTENDED FUNDING

ZonMW calls

OUTPUT

- [NEW PROJECT] Submitted proposal to AAL Call 'Healthy Ageing with the Support of Digital Solutions' August 2020 (not approved).

FROM LEGUME PROTEIN MOLECULES TO PROTEIN FUNCTIONALITY DIRECTED-CALL PROJECT 2020



CONTACT

Laurice Pouvreau
Twan America
FFC Food Technology, Bioscience

Peter Wierenga

OTHER

Due to Covid-19, latest results will be expected in 2021.

AIM

- To provide new tools to screen for glycosylation of storage proteins in different cultivars of seeds.
- To provide insight to which extent the glycosylation of plant proteins determines their bio-/techno-functionality.

RESULTS

- The aim of the project was to evaluate difference in legumin:vicilin ratio and in glycosylation between different pulses, and moreover to determine if these differences are linked to differences in functional properties.
- This project implemented a new experimental and data processing approach to detect and quantify protein glycosylation by LC-MS, which revealed in high detail the presence of different glyco-forms of peptides. When compared to periodic acid staining (PAS) of protein gels, the LC-MS method proved to be more sensitive and provided actual isoform specificity.
- Surprisingly, a glycosylated isoform of vicilin was detected which was only abundantly expressed in two out of eight yellow pea cultivars tested.
- Work is ongoing to link functional performance to the detected differences in glycosylation.

OUTPUT

- [PUBLICATION 2021].

UNDERSTANDING PROTEIN DIGESTION OF NEW ALTERNATIVE SOURCES THROUGH A UNIQUE MULTI-PLATFORM PIPELINE DIRECTED-CALL PROJECT 2020



CONTACT

Diederik Esser
Sylvia Brugman
*FFC Food, Health & Consumer
Research, Host-Microbe
Interactomics*

Kasper Hettinga,
Nikkie van der Wielen,
Paul Smeets, Anja Janssen

OTHER

Due to Covid-19, latest results will be expected in 2021.

AIM

- To better understand structure-function relations underlying protein digestion.
- To connect expertise to create a multi-platform pipeline that can be used to test and quantify specific properties that affect digestibility.
- To better understand the ground rules of protein digestion and to facilitate the protein transition towards more sustainable sources of high nutritional quality.

RESULTS

- A literature study was used to select a protein source to be characterized across platforms. Pea protein was selected.
- In-vitro digestion experiments are ongoing.

OUTPUT

- [PUBLICATON 2021].

UNDERSTANDING THE GEOGRAPHIES OF PROTEIN TRANSITIONS

CROSS-SCALE INTERACTIONS IN THE ALTERNATIVE
PROTEIN INNOVATION SYSTEM
DIRECTED-CALL PROJECT 2020



CONTACT

Laurens Klerkx
Alwin Gerritsen
*Knowledge Technology &
Innovation, Regional Development
and Spatial Use*

Barbara van Mierlo,
Anne-Charlotte Hoes,
Ellen Bulten, Remco Kranendonk

OTHER

Project runs from mid-2020 to mid-2021.

AIM

To describe, compare and assess knowledge intensive activities such as protein research, innovation and commercialisation in the context of a wider alternative protein innovation system that includes innovation support, policy making, etc. across multiple scales (local, regional, national, continental, global).

What are the characteristics of alternative plant-based protein innovation systems, cross-scale interactions of its knowledge intensive activities within it, and what does this imply for the governance of the protein transition?

RESULTS

Will be added mid-2021.

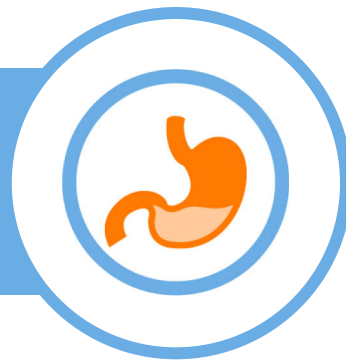
OUTPUT

- [PUBLICATON 2021].

UNDERSTANDING PROTEIN DIGESTION

NEW ALTERNATIVE SOURCES THROUGH A UNIQUE MULTI-PLATFORM PIPELINE

DIRECTED-CALL PROJECT 2020



CONTACT

Diederik Esser
*FFC Food, Health & Consumer
Research*

AIM

- To calculate the total taken up by the blood during digestion.
- The new approach, based on curve-fitting is relevant as the blood samples were taken in a three-hour period and in some cases the amino acid levels did not fall back to the original steady state level. In addition, the results are more robust against noise and outlying observations and provide us with a standardised fast tool to handle such datasets.

OTHER

Sub project of "Understanding protein digestion of new alternative sources through a unique multi-platform pipeline" and started in July 2020 – November 2020.

RESULTS

To evaluate the digestion derived amino acid contents it is important to obtain an accurate description of the data in the form of a mathematical function. This will lead to an accurate determination of the area under the curve, representative for the amino acid uptake, and the speed of the uptake, even in cases where the amino acid levels were not back at their starting value at the end of sampling. The model explicitly incorporates sampling times which means that even using different sampling frequencies, or irregular samplings, results can be compared.

OUTPUT

- [PRESENTATION] Outcomes will be presented in a workshop about statistical challenges in chemometrics, April 2021.
- [OTHER] A software package was developed which allows accurate and fast statistical analysis of amino acids in the blood in future studies.

BREEDING BETTER PROTEIN-BUILDING INSECTS

COMMUNITY-FUNDED PROJECT 2020-2021



CONTACT

Esther Ellen
Bas Zwaan
*Animal Breeding & Genomics,
Laboratory of Genetics*

Aniek Bouwman,
Bart Pannebakker,
Teun Veldkamp,
Adriaan Vernooij

OTHER

Project runs from mid-2020 to mid-2021.

AIM

To develop breeding programs for the targeted use of insects in the protein transition.

RESULTS

Will be published in 2021.

OUTPUT

Will be published in 2021.

MUSHROOM-FORMING FUNGI

COMMUNITY-FUNDED PROJECT 2020-2021



CONTACT

Arend van Peer
Karin Scholtmeijer
Plant Breeding

Arnout Fischer,
Ben van den Broek

OTHER

Project runs from mid-2020 to mid-2021.

AIM

To explore the opportunities to produce new proteins by using the mycelia and the fruiting bodies of mushroom-forming fungi.

RESULTS

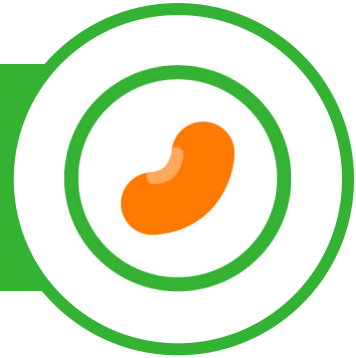
Will be published in 2021.

OUTPUT

Will be published in 2021.

SOY10: ETHIOPIA AND NL

COMMUNITY-FUNDED PROJECT 2020-2021



CONTACT

Judit Snethlage
Water and Food

Confidence Duku,
Hester Biemans, Remko Vonk,
Ruud Timmer, Sjaak Conijn,
Tewodros Tefera

AIM

To calculate the effects for the climate, health and the environment if consumers switch from cow's milk to soymilk and from meat to soy alternatives, comparing the Netherlands and Ethiopia.

OTHER

Project runs from mid-2020 to mid-2021.

RESULTS

Will be published in 2021.

OUTPUT

Will be published in 2021.

LEGUME PROCESSING

SEED PROJECT 2020



CONTACT

Konstantina Kyriakopoulou
Food Process Engineering

Eddy Smid,
Atze Jan van der Goot,
Maarten Schutyser

AIM

To design processes to obtain sustainably refined protein enriched components from otherwise underutilized legumes and seeds due to their high content in antinutritional factors (ANFs).

INTENDED FUNDING

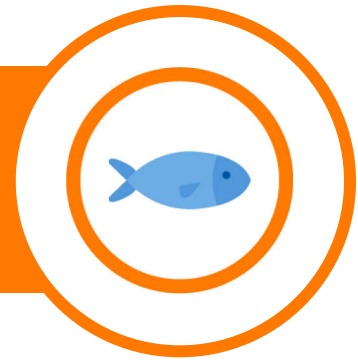
Open NWO-TTW program, domain
Applied and Engineering Sciences

OUTPUT

- [NEW PROJECT] Healthy & Tasty Protein awaiting co-finance letters from companies, and will be submitted beginning 2021 to NWO.

SUSTAINABLE AQUACULTURE

SEED PROJECT 2020



CONTACT

Sem Jacobs
Cell Biology and Immunology

Sylvia Brugman

AIM

To test sustainable proteins sources (seaweed, duckweed, microalgae, etc.) in fish for their ability to provide healthy, nutritious fish filets for human consumption.

INTENDED FUNDING

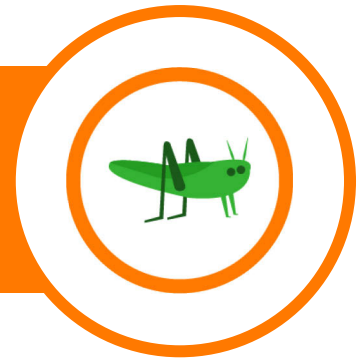
NWO-TTW, Applied Sciences

OUTPUT

- [NEW PROJECT] Awaiting co-financing letters from companies, and will be submitted by beginning 2021.

INSECT VALUE CHAINS

SEED PROJECT 2020



CONTACT

Mebratu Teklehaimanot
Marketing and Consumer Behaviour

Paul Ingenbleek

AIM

To develop value chains for insects consumption in the context of food systems of developing and emerging (D&E) countries.

INTENDED FUNDING

INREF, (Bill and Melinda Gates Foundation, FAO, EU, NWO/WOTRO)

OUTPUT

- [NEW PROJECT] to be submitted in 2021.

OTHER

Delaying to 2021, due to Covid-19 and Mebratu living in Ethiopia.

AGRICULTURAL SIDE STREAMS

PHD PROJECT



CONTACT

Yafei Yu
Food Process Engineering
Marietheres Kleuter
Plant Breeding

AIM

To develop genetic and processing tools that enable efficient extraction of high-quality proteins from agricultural side streams, namely leaves and stems. For that we will investigate which factors determine the shape of the yield-purity curve.

1. Understanding interactions in plant materials: consequences for fractionation and plant breeding.
2. Valorization of agriculture side streams.

TIME FRAME

Yafei Yu
Start: 15-09-2020
End: 14-09-2024
Marietheres Kleuter
Start: 01-11-2020
End: 01-11-2024

RESULTS

We will further use these insights to better understand current fractionation processes and the potential of altering plants via dedicated plant breeding concepts. The knowledge developed in the first half of the project will be applied to agricultural side stream as occurring in Sub-Saharan Africa region.

OUTPUT

- [2 DISSERTATIONS 2024].

FROM GOOD BEHAVIOR CHANGE INTENTIONS

TO A POPULATION-LEVEL CONSUMPTION SHIFT
PHD PROJECT



CONTACT

Christa Blokhuis
Consumption and Healthy Lifestyles

AIM

To research why and for whom consumer-reported behavior changes do not align with (aggregated) consumption data.

TIME FRAME

Start: 15-11-2020
End: 14-11-2024

RESULTS

These insights are needed to draw valid and reliable conclusions about the state of a consumption shift, and to develop adequate methods for evaluating efforts to shift consumption at the population level. The focus will be on the global North.

OUTPUT

- [DISSERTATION 2024].

INSIGHT PLATFORM



CONTACT

Jim Groot
*FFC Supply Chain & Information
Management*

AIM

To create a comprehensive database of global protein production and consumption worldwide.

RESULTS

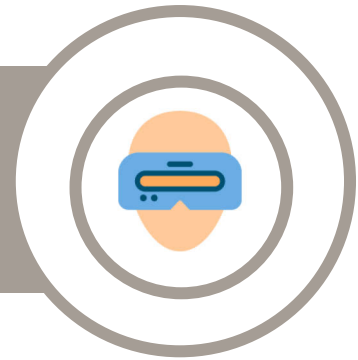
Insight platform: The general approach is to create a database on country level consisting of volumes of production, import, export, processing, seed, feed, waste and consumption of food (related) products. These data is enriched with amounts of protein and even amounts of essential amino acids. The database gives a 'current situation' or 'protein map' of the protein network of the world on country level and is the basis for comparing future scenario's. These future scenarios can help other research on i.e. individual behaviour choices within the context of societal, social, and environmental issues. The future scenarios can also be made linked to other performance indicators like costs or GHG emissions.

OUTPUT

- [PRESENTATION] Results included in "Plant-based protein future: myths and realities" presentation.
- [PUBLICATION] "A Worldwide Hotspot Analysis on Food Loss and Waste, Associated Greenhouse Gas Emissions, and Protein Losses".
- [PUBLICATION 2021].

TASTE LESSONS

OUTREACH



CONTACT

Fieke Franken
Consumer and Chain

AIM

If we would like to make an impact on the consumption on alternative proteins, children are a valuable target group. They form a new generation to be exposed to new innovative foods. We can educate them and let them experience alternative proteins by enriching and adding these new proteins and their applications to our existing food education lesson programme.

RESULTS

Our delivery is a new 'Taste Mission' Lesson, which fit within the broader existing offer of Taste Missions within Taste Lessons. The Taste Mission new proteins was launched in 2020, including a VR tour of a plant-based burger factory.

OUTPUT

- [MEDIA]: Wageningse schoolklas heeft primeur: leren over duurzame eiwitten met een VR-bril. *De Gelderlander* (23-06-20).
- [MEDIA]: Wageningen Universiteit & Research lanceert gratis Virtual Reality les voor basisscholen. *Emerce* (24-06-20).
- [MEDIA]: WUR lanceert virtualreality-les over alternatieve eiwitbronnen voor basisscholen. *The Economic Board* (25-06-20).
- [MEDIA]: Smaaklessen voor een gezond eetpatroon: smaakmissie avontuurlijke eiwitten. *Regio Foodvalley* (30-06-20).

Wageningen University & Research
P.O. Box 9101
6700 HB Wageningen
The Netherlands

The mission of Wageningen University & Research is "To explore the potential of nature to improve the quality of life". Under the banner Wageningen University & Research, Wageningen University and the specialised research institutes of the Wageningen Research Foundation have joined forces in contributing to finding solutions to important questions in the domain of healthy food and living environment. With its roughly 30 branches, 6,500 employees (5,500 fte) and 12,500 students, Wageningen University & Research is one of the leading organisations in its domain. The unique Wageningen approach lies in its integrated approach to issues and the collaboration between different disciplines.

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