

Protein Shift Innovation Scan

A landscape study of food innovators and ecosystem partners driving the protein shift in Singapore and the Netherlands



FOREWORD

This Innovation Scan marks the start of a closer collaboration between Foodvalley NL and Enterprise Singapore to create value for the food innovation ecosystem partners in the Netherlands and Singapore.

Even before Covid-19 hit, consumer demand for nutritious, sustainable and tasty food has been on the rise. With Covid-19 accelerating these trends, and the challenges around the ways we produce food to feed more people, there is a greater need for food innovation to address these unmet needs through technological advances and strong collaboration.

With the long history of agrifood excellence in the Netherlands, and Singapore's strong ambition for the future of food, we believe there is a great opportunity for more cross-border collaboration between Dutch and Singapore companies and research institutes to enable new product development, to create competitive advantage in the market and inspire new innovations.

This Innovation Scan examines alternative protein market insights and opportunities in both EU and APAC regions, food innovators, ecosystem partners such as incubators, accelerators and investors, as well as the shared facilities and pilot plants that will help accelerate new product innovations to meet consumer demand.

We hope this showcasing of the alternative protein landscape, in both countries, will inspire you to seek out new connections and new opportunities.

Miranda van Dijck
Innovation Analyst, Foodvalley NL

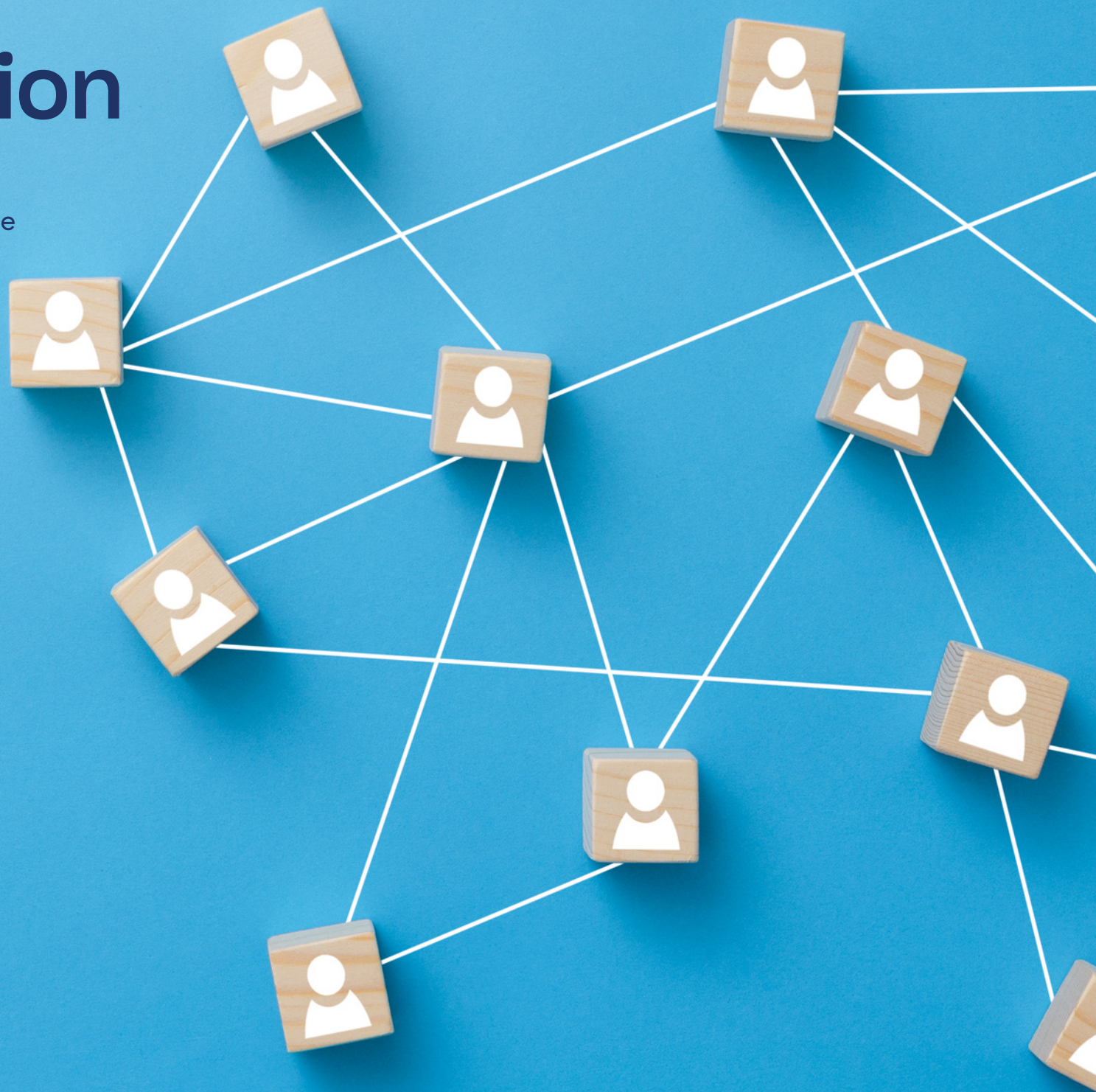
Angelin Yeo
Senior Development Partner, Enterprise Singapore

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Collaboration

This section highlights existing and possible collaborations between the Netherlands and Singapore in the field of Protein Shift.



Collaboration between the Netherlands & Singapore

The world faces the great challenge of sustainably feeding billions of people, and innovation is an imperative to address these challenges. Knowledge sharing and collaboration will be the key drivers to accelerate innovation. Both the Netherlands and Singapore are countries with the strong R&D capabilities needed to drive technology and agrifood innovation. In addition, the Netherlands provides a strategic location to serve markets within Europe, while Singapore provides this for Asia.

There are many opportunities through which the Netherlands and Singapore companies and research institutes can collaborate to accelerate their innovations. For example:

- R&D collaboration to advance research in plant-based protein texturizing techniques, extraction of valuable components from manufacturing side streams, biotransformation to develop new protein ingredients and optimization of cellular agriculture processes to reduce cost of production;
- Product development to incorporate alternative protein ingredients into Western or Asian foods through partnerships with local companies and research institutes;
- Manufacturing and market testing in the Netherlands or Singapore to be closer to European and Asia Pacific customers respectively;
- Co-branding and distribution collaborations to accelerate the commercial pathway to market.

Collaboration between the Agency for Science, Technology and Research, and Wageningen University & Research

On 13 September 2019, Singapore's Agency for Science, Technology and Research (A*STAR) signed an MOU with Wageningen University & Research (WUR) to explore suitable areas for joint research development in food science and processing, agri-tech, aquaculture, waste valorization and industrial biotechnology. There are ongoing discussions with WUR to set up a joint laboratory, targeted to be operational by early 2021, that will be housed in A*STAR's new food institute, Singapore Institute of Food and Biotechnology Innovation (SIFBI).

Through this collaboration, there will be expertise and knowledge sharing around sustainable ingredient production (e.g. plant-based and single-cell based) and the subsequent structuring of alternative protein foods with a focus on the Asian market.



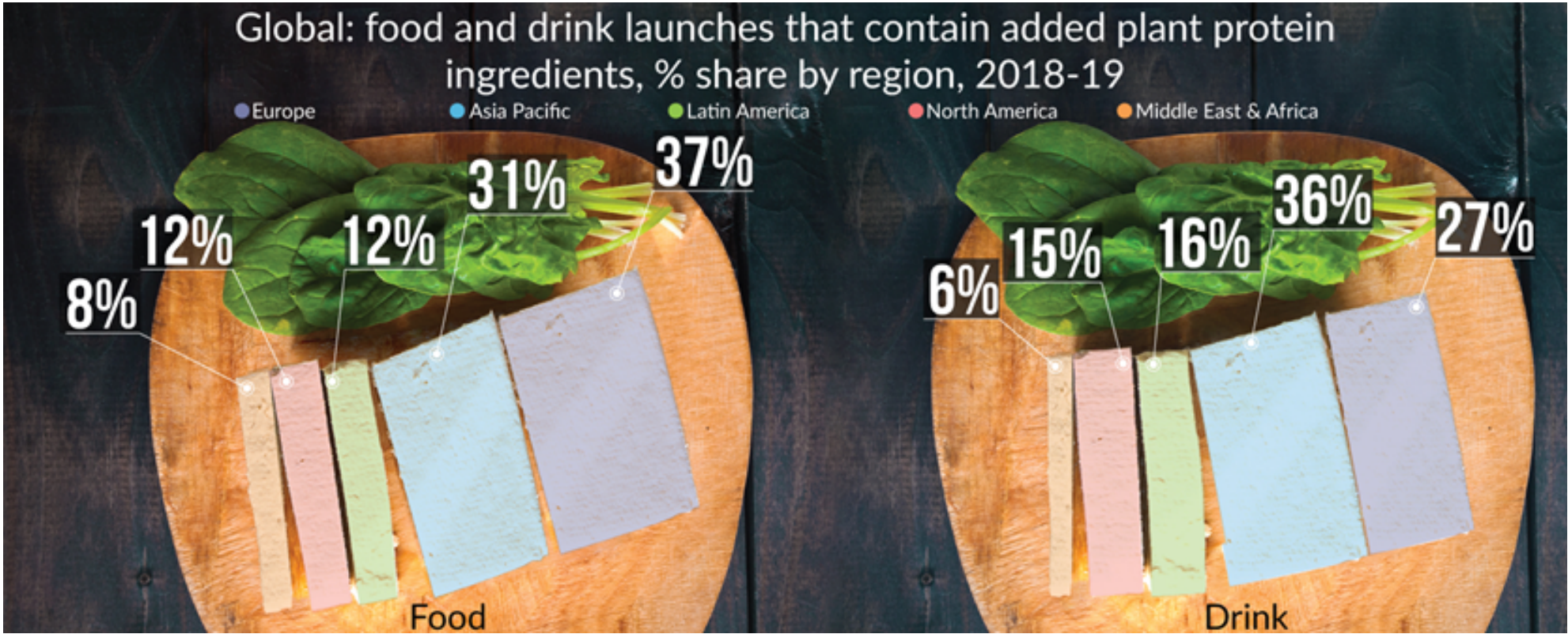
Market Insights

This section gives an overview of the drivers of the growing plant-based market and of market trends in both Europe & APAC.



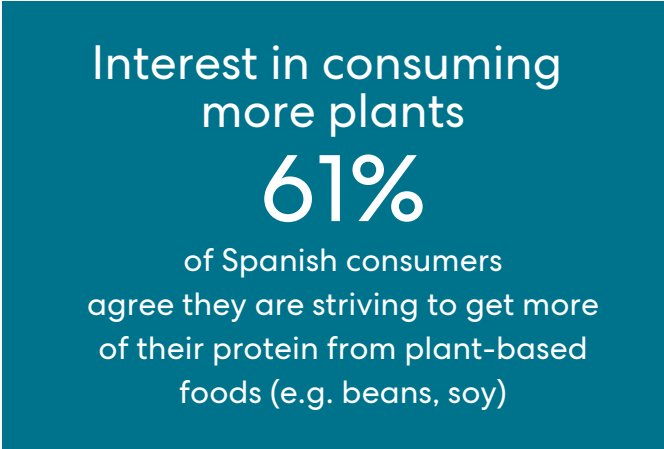
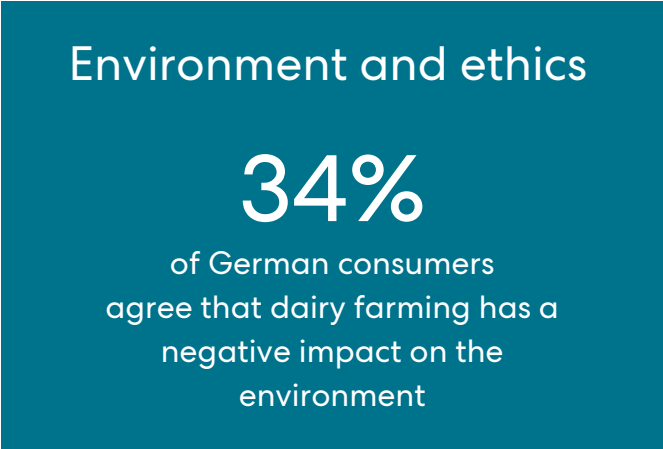
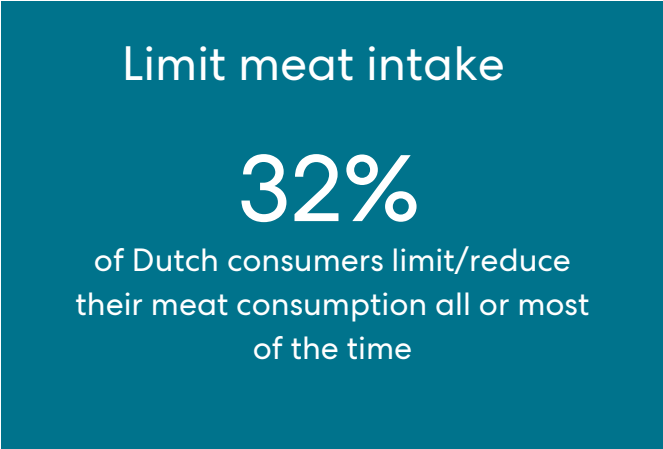
Global plant-protein landscape

According to Mintel, consumer concern over planetary health, animal welfare and human health are the key driving factors behind the plant-based food trend, which stretches from strict diets like veganism through to flexitarian consumers looking to reduce their meat and dairy intake. Globally, launches of food and drink products that contain added plant-protein ingredients have been rising, especially in Western markets. Consumer interest in plant-based diets has driven a wave of innovation in plant-based meat and dairy alternatives, creating opportunities for plant-protein ingredients.



Source: Mintel GNPD

Drivers of the growing plant-based market in Europe



Base: The Netherlands:1,000 internet users aged 18+; Germany: 2,000 internet users aged 16+ (2019); Spain: 2,000 internet users aged 16+ (2019)
Source: Lightspeed/Mintel



Base: 1,031 internet users aged 16+ who buy meat-free foods
Source: Lightspeed/Mintel

European consumers are looking for protein-rich options

Whether consumers are looking to reduce their meat intake with a flexitarian diet or are eliminating meat entirely, highlighting the high protein content of meat-free substitutes can reassure consumers that their protein needs are being met while complementing their dietary choices.

Indeed, more than a quarter of meat-substitute consumers in the UK would choose one meat substitute over another, depending on which had the higher protein content.



Drivers of the growing plant-based market in APAC

Limit meat intake

32%

of Singaporean consumers look to limit their meat intake most or all of the time

Health concerns

36%

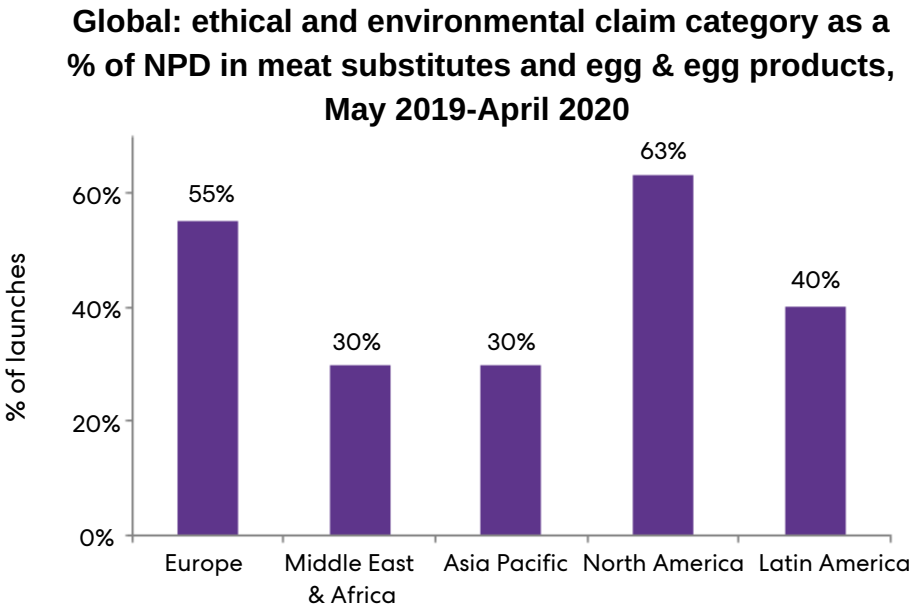
of Thai consumers eat protein substitutes because of health concerns, compared to 10% who do so for religious and cultural reasons

Environmental/sustainable

55%

of Singaporean consumers agree that plant-based foods are better for the environment than meat and dairy products

Base: Thailand: 1,383 internet users aged 18+ who have plant-based proteins as their main sources of protein; Singapore: 1,000 internet users aged 18+
Source: KuRunData/Mintel; Dynata/Mintel



Base: 1,000 internet users aged 18+
Source: Mintel GNPD

Asia Pacific lags behind Europe in eco and ethical innovation

Asian consumers are aware of the environmental cost of meat-produce consumption and are keen to change their purchase habits to help tackle the climate crisis.

However, ethical and environmental claims, pertaining to sustainable and recyclable packaging, ethical ingredient sourcing and less carbon-intensive production, are lagging behind in APAC new product development for meat substitutes and egg & egg products.

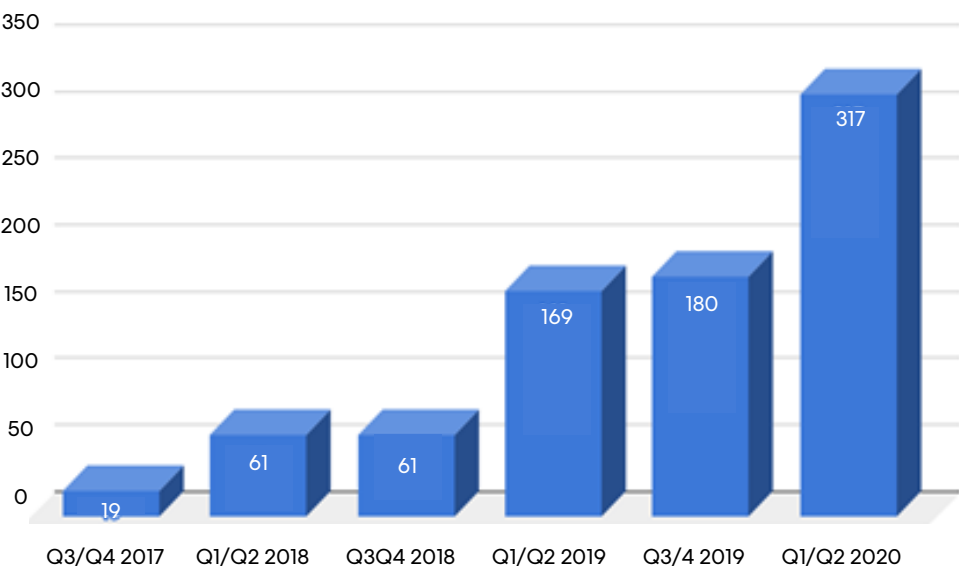
Asian consumers' shift towards plant-based diets is primarily driven by health reasons, with the exception of Singapore, where 63% of Singaporean consumers think their food and drink choices make a difference to the environment.



Plant-based food and drink landscape in Europe

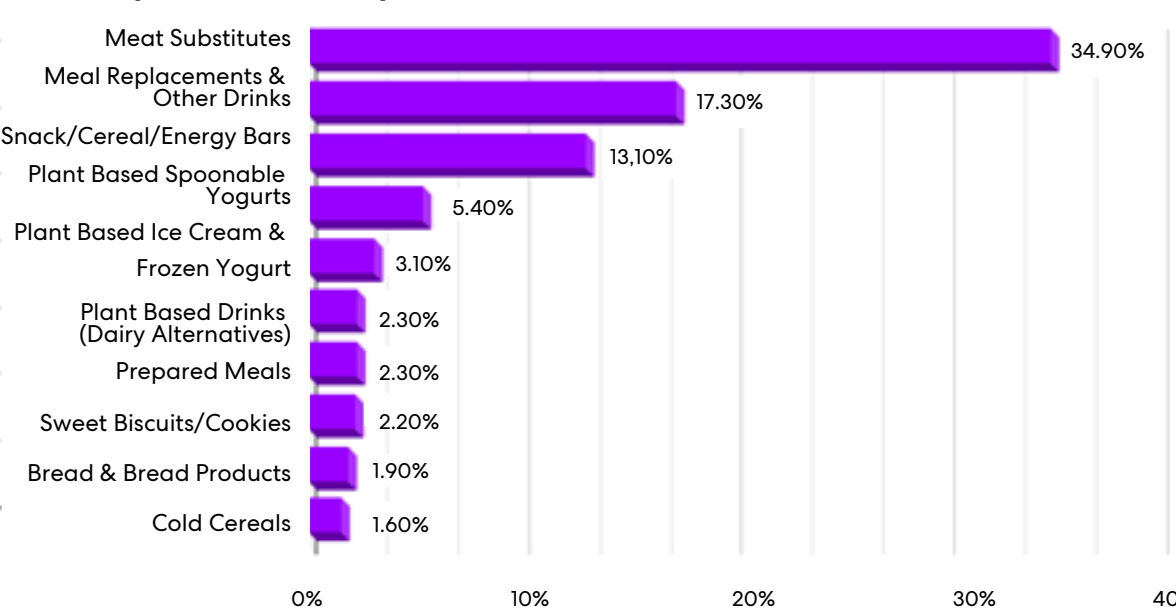
Plant-based products are rising, in food and drink launches in Europe, as manufactures react to increased demand. Meat substitutes as a sub-category sees the highest published products.

The number of food and drink launches with plant-based proteins in Europe



Source: Mintel GNPD

Top sub-categories in food and drink launches with plant-based proteins in Europe



Mintel Food and Drink expert's opinion on the plant-based category and plant-based protein in Europe



Emma Schofield, Mintel Senior Analyst - Global Food Science

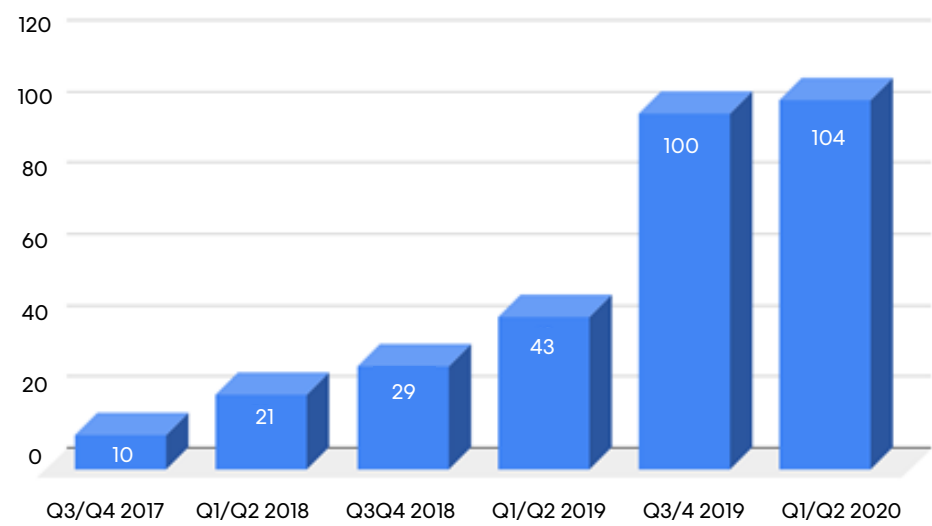
Plant-based is a significant trend in Europe and many major brands are launching meat and dairy alternative lines. However, there are some areas where meat and dairy alternatives fail to impress consumers, which may act as barriers to these products becoming mainstream. Consumers are often unsure about whether meat and dairy alternatives really are healthy and nutritious, and often have concerns about the naturalness of these products. Additionally, there is an opportunity to improve the eating experience of many products, delivering products that cater to consumers' needs across the full range of eating occasions. There is a need to build familiarity into plant-based alternatives, especially as COVID-19 is propelling interest in 'local', and many plant-based foods lack provenance and authenticity.



Plant-based food and drink landscape in APAC

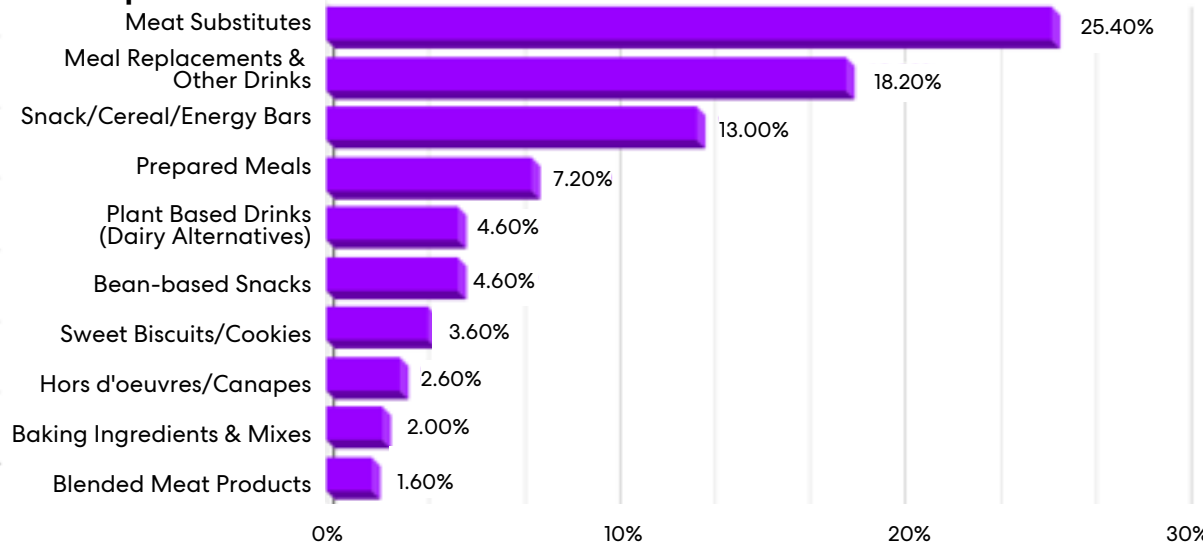
Similar to Europe, plant-based products are rising in food and drink launches in APAC. While meat substitutes remains a key sub-category, with the highest number of launches, bean-based snacks and prepared meals are emerging categories to watch out for. This presents good opportunities for cross-border knowledge sharing and co-innovation between the two regions.

The number of food and drink launches with plant-based proteins in APAC



Source: Mintel GNPD

Top sub-categories in food and drink launches with plant-based proteins in APAC



Mintel Food and Drink expert's opinion on the plant-based category and plant-based protein in APAC



Jolene Ng, Mintel Senior Food and Drink Analyst

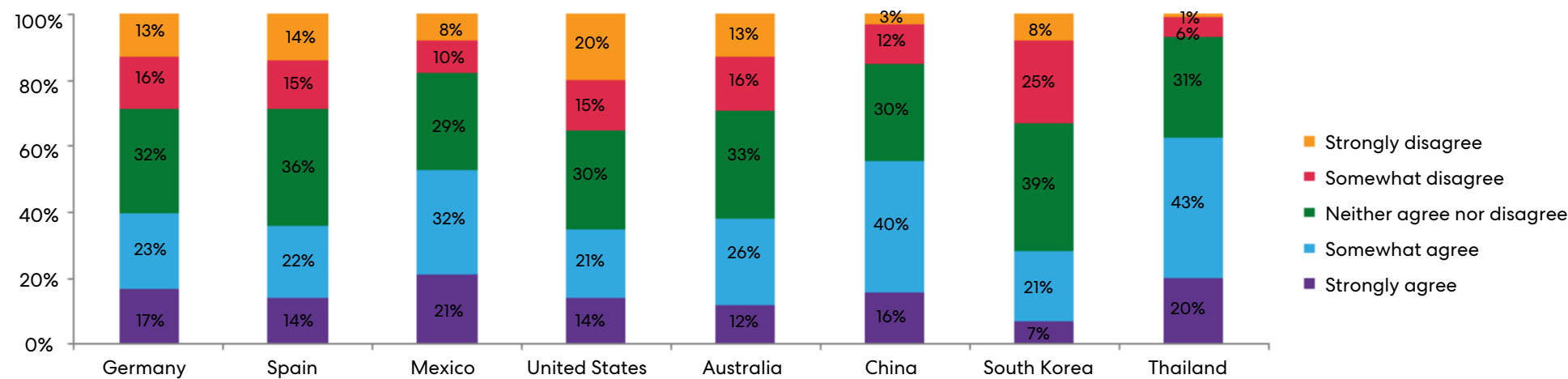
Many Asian cultures have culinary traditions that are vegetarian or primarily plant-based which from a dietary perspective is very much in line with modern veganism. Interestingly, the uptake in veganism is seen even with meat-eaters who want to incorporate more plant-based food into their diet. This is driven by the desire for a healthy lifestyle where consumers across all countries in APAC believe that taking care of their health is a top priority for them. In Southeast Asia, the interest in plant-based food will grow in parallel with continued meat consumption.



The impact of COVID-19

COVID-19 is giving consumers across the globe new reasons to cut back on foods of animal origin. The global health crisis has positioned plant-based (and cultured meat) to benefit not only from environmental appeal, but also hygiene and safety, and health and supply chain advantages. For example, in China 56% of consumers agree with the statement "the COVID-19/coronavirus pandemic proves that humans need to eat fewer animals".

Select countries: "the COVID-19/coronavirus pandemic proves that humans need to eat fewer animals",
% of consumers, July 2020



The COVID-19/coronavirus pandemic proves that humans need to eat fewer animals

Base: Germany, Spain: internet users age 16+, 1,000 in each country, Mexico, US, Australia, China, South Korea, Thailand: internet users age 18+ 1,000 in each country
Source: Germany, Spain, US: Lightspeed/Mintel; Mexico: Offerwise/Mintel; Australia, China, South Korea, Thailand: Dynata/Mintel.

In order to benefit from the window of opportunity for plant-based foods in a post-COVID-19 world, Mintel recommends to:

Promote plant-based foods as ethical and safe

Build familiarity into plant-based foods

Ensure plant-based foods deliver on 'health'



Promote plant-based foods as ethical and safe

The zoonotic origin of COVID-19 is drawing attention to the safety of livestock production systems and the role they might play in the emergence of zoonotic diseases. Such attention may encourage consumers to reconsider their protein choices in favor of plants, especially consumers who previously saw no reason to venture into the plant-based space.

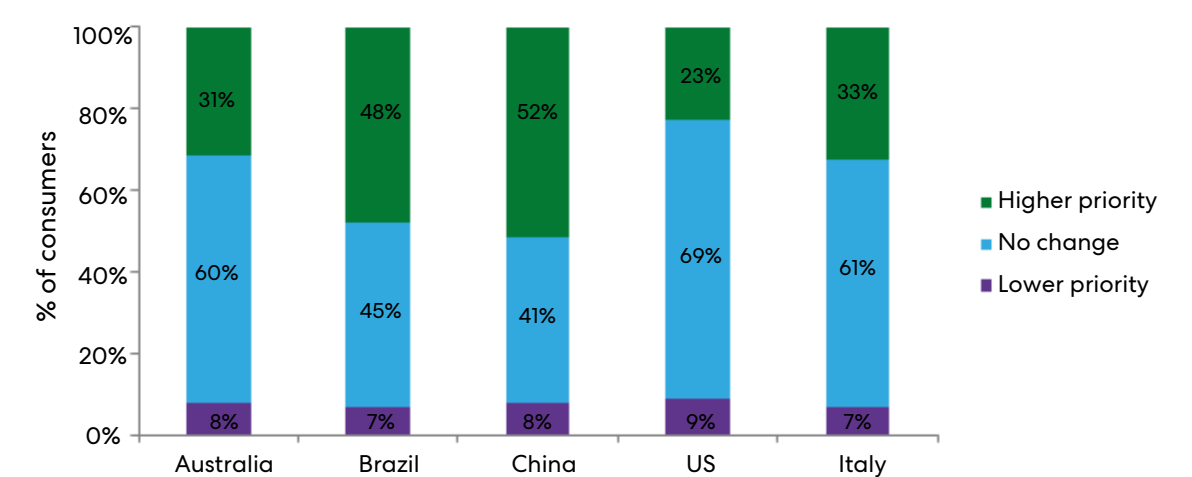
In addition, many consumers agree that 'the environment' has become a higher priority for them since COVID-19, which might encourage greater focus on eating for the health of the planet, suggesting an opportunity for plant-based foods that are promoted as being better for the environment than animal foods.

COVID-19's zoonotic origin might provoke concern about the safety of animal-derived foods



Base: 1,200 internet users aged 18-59, 26 Apr-2 May 2020
Source: KuRunData/Mintel; Mintel's Global COVID-19 Tracker

Global: how people's priorities have changed since the outbreak began - The Environment, % of consumers who agree, May 2020



Base: 500 Australian internet user aged 18-45+, 20 May 2020; 611 Brazilian internet user aged 16+, May 16-28 2020; 1,200 Chinese internet users aged 18-59, May 27-June 3 2020; 2,000 US internet users aged 18+, May 28-June 4 2020; 1,000 Italian internet user age 16+, 6-13 May 2020
Source: Lightspeed/Mintel (Italy, US, Brazil); Dynata/Mintel (Australia); Ku/Run/Data (China); Mintel's Global COVID-19 Tracker



Build familiarity into plant-based foods

During the initial weeks of the pandemic, consumers' desire for familiarity and comfort might have dampened their appetite for experimenting, thereby deterring them from venturing into the plant-based foods aisle - an area of the supermarket that is still uncharted for many. However, the threat of meat shortages caused by meat-processing plant closures could push new consumers into the plant-based meat substitutes sector.

To capture the attention of these 'new' consumers, brands must build an element of familiarity into plant-based foods, as during COVID-19 consumers will seek a degree of comfort and familiarity from food and drink.

To many consumers, plant-based meat/dairy alternatives are a 'new' type of food or drink. In uncertain times, building familiarity into these products could appeal to consumers. Building elements of 'local' into plant-based foods, such as the use of local ingredients or authentic traditional recipes, could also prove attractive to consumers.



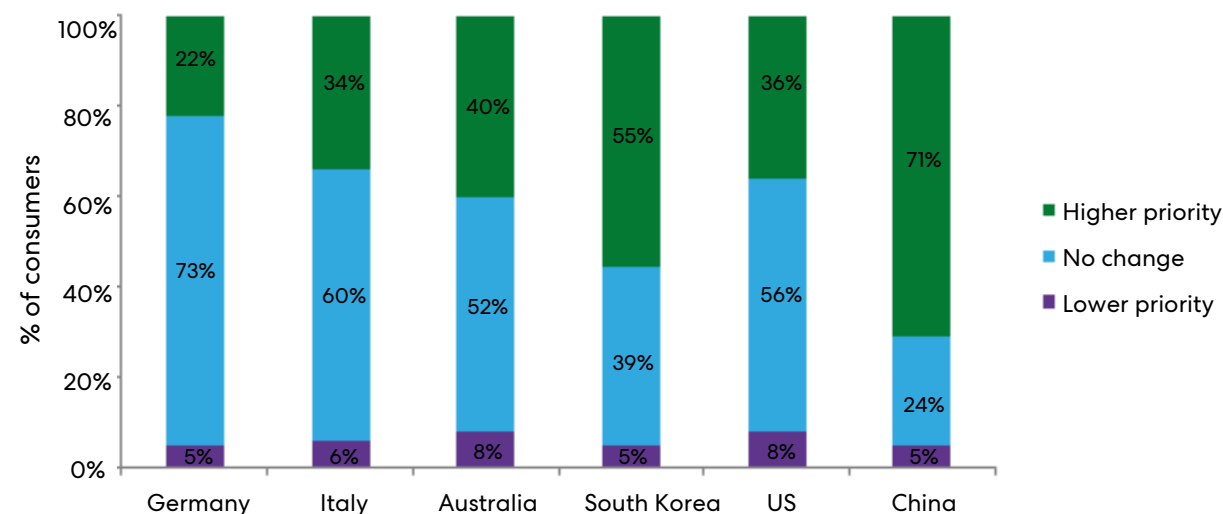
Base: internet users aged 16+, 2,000 in each country, May 2020
Source: Lightspeed/Mintel; Mintel's Impact of COVID-19 on Food & Drink 2020 research, May 2020

Ensure plant-based foods deliver on 'health'

Many consumers have prioritized health during COVID-19. While consumers understand the benefits of consuming more plants, they are less convinced of plant-based meat and dairy alternatives. Hence, plant-based meat and dairy alternatives can do more to address the perceived shortfalls of their products, to capture the attention of consumers who will otherwise prioritize 'real' or 'whole' plant foods such as fruits, vegetables, grains, seeds and nuts.

Interest in 'preventative health' could steer consumers towards healthy eating patterns such as plant-based dieting. Research indicates that the impact of COVID-19 is more severe in people with dietary-related diseases like diabetes and obesity, which has encouraged consumers to embrace eating patterns that support health for the longer term. Plant-based dieting underpins dietary guidelines such as the UK's Eatwell Guide and is regarded as a healthy diet for the longer term.

Global: how people's priorities have changed since the outbreak began
- Eating Healthily, % of consumers who agree, May 2020



Base: 1,000 internet users age 16+, in Germany and Italy, 6-13 May 2020; 500 internet users aged 18-45+ in Australia, 20 May 2020 and South Korea, 26-28 May 2020; 2,000 US internet users aged 18+, May 28-June 4; 1,200 Chinese internet users aged 18-59, May 27-June 3
Source: Lightspeed/Mintel (Germany, Italy, US); Dynata/Mintel (Australia, South Korea); Ku/Run/Data (China); Mintel's Global COVID-19 Tracker



Knowledge Providers

This section covers the key knowledge providers leading the way to a better understanding of the challenges and opportunities of alternative proteins.



Knowledge Providers



The **Singapore Institute of Food and Biotechnology Innovation (SIFBI)** is a research institute that brings the research capabilities of the Agency for Science, Technology and Research (A*STAR) in areas such as food, agri-food, nutrition, biotechnology, and safety under one roof. In doing so, it provides a single touchpoint for the F&B and consumer industry, as well as public institutions to connect with.

Through building strong regulatory and industry partnerships, SIFBI aims to support Singapore's local production capabilities, delivering sustainable and nutritious food for the modern consumer.

SIFBI steers multi-disciplinary expertise in food science & biotech; its key pillars of research are:

- Discovery & Biotransformation
- Fermentation
- Human Safety
- Nutrition

With a shared platform for a broad range of analytical support tools and access to A*STAR's Natural Product Library (NPL), SIFBI benefits from exceptional opportunities to develop novel products relevant to the personal care, flavors and fragrance industries.

Capabilities in Food Science and Biotechnology

Biotransformation

SIFBI's biotransformation and fermentation platform leverages micro-organisms as cell factories and can be used to produce a range of ingredients from small molecules to peptides and functional proteins. Both submerged and solid-state fermentations are deeply studied, and metabolic engineering, protein engineering and non-GM methods are also employed to improve product yields.

Nutrition

The nutrition team aims to provide state-of-the-art, evidence-based science to substantiate the philosophy that 'food is the new medicine'. The research emphasis is on developing a strong understanding of energy intake/expenditure and chronic disease conditions, and increasing the understanding of food forms, food textures, and food processing to enhance the technical and nutritional quality of foods as well as the sensory performance.

Human Safety

SIFBI's safety work extends from assessing protein allergenicity, a research collaboration with other A*STAR research institutes like the Bioinformatics Institute, all the way to understanding the interactions of food and food ingredients in the gastrointestinal tract. This is done through looking into the level of exposure and effects of chemicals within the body. By doing so, SIFBI also seeks to support the regulatory assessments of novel food products entering the Singapore and regional markets.

Knowledge Providers



Department of Food Science & Technology
Faculty of Science



The **Department of Food Science and Technology** at the **National University of Singapore (NUS FST)** is an internationally-renowned provider of education and research in food science, food technology and human nutrition. It is known for pioneering Singapore's university program in Food Science and Technology and offering the only degrees in Singapore that have obtained accreditation from the International Union of Food Science and Technology (IUFoST), the top global scientific organization in Food Science and Technology.

The campus is well equipped with the state-of-the-art laboratories and academic facilities that foster active and lifelong learning. The space dedicated for R&D is specially designed and built to stimulate and drive innovation and collaboration between the different stakeholders (i.e. academic, clinical, industry and regulatory partners) to solve national and industry challenges.

Underpinned by strong fundamental science and methodological foundations, the department's research efforts encompass four key themes:

- Functional Foods in Tropical Asia
- Novel Food Ingredients, Processes, Consumer Products and Emerging Food Technologies
- Food Safety and Preservation
- Human Nutritional Sciences

Future Sustainable Alternative Protein Sources

NUS FST actively promotes inter-disciplinary research, innovation, and enterprise across science, engineering and other disciplines to seek alternative, more-sustainable methods to produce protein-rich foods and beverages. Relevant topics include, but are not limited to, the four focus areas listed below:

Additive Manufacturing

3D food printing of reclaimed proteins from spent grains, leafy proteins and seafood mimics.

Cultured Meat

Clean meat culture (pork muscle cells) production using edible scaffolds and microbeads.

Plant-Based Alternatives to Animal Products

- Development of seafood analogues using plant-based proteins and seaweed
- Bioavailability assessment of plant-based proteins through a customized in-vitro digestion system
- Functionality characterization of plant-based proteins in liquid food systems
- Development of eggless cakes with plant-based proteins

Side Stream Valorization

Biotransformation of plant-based food processing side streams and market surplus food products into high-value food ingredients and beverages (such as probiotic-fermented beverages).

Knowledge Providers



The **Food Science and Technology Programme** at the **Nanyang Technological University (NTU FST)** was established in 2014 as an education partnership with Wageningen University & Research (the Netherlands).

Over the last few years, NTU FST has developed technology innovations of significant relevance to the Singapore food industry. Focusing on food waste valorization for zero waste processing, these simple and cost-effective innovations include sustainable fermentation, green processing and natural food preservatives. The university's innovations in biodegradable packaging materials contribute to the Circular Economy for Food.

NTU FST has evolved from an education programme into a vibrant and holistic initiative providing industry-relevant knowledge, cutting-edge food science research focusing on food waste valorization, a platform for academia/government/industry triple helix collaboration, and an engagement and community outreach unit.

The activity in R&D food science and technology has also helped to give the university a unique standing in the local and international community, and its opinions on food security and novel food technologies have been regularly featured on mainstream media.

Capabilities in Alternative Proteins

Microalgae

NTU FST has developed proprietary technology to culture protein-rich microalgae using fermented side streams. This has resulted in an industry partnership with Sophie's BioNutrients to develop microalgae as an alternative protein source. Microalgae rich in lipids and proteins are cultured with enhanced nutritional content and yield, in IP-protected novel bioreactors developed in-house at NTU. NTU is also devising effective methods for separating proteins, polysaccharides and oils from microalgae.

Cellular Agriculture

NTU FST is collaborating with A*STAR and New Zealand to develop new capabilities to create novel hybrid foods consisting of plant proteins and cultured livestock cells, with lower production costs, using NTU's fermentation technology. Such hybrid foods will help to broaden consumer appeal and improve the nutrition, taste and industrial processability of plant-protein foods.

Insects

NTU FST is also collaborating with a number of insect farms to develop insects as an alternative protein source. Black soldier fly larvae protein grown sustainably as alternative protein, and lipid sources for feeds and foods with enhanced bioavailability and superior amino acids profile are being developed. A metabolomics approach is being employed to identify the functional benefits of insect protein. Texture analysis and other relevant physical characterizations will demonstrate the potential downstream development of insect protein.

Knowledge Providers



The **Institute of Bioengineering & Nanotechnology (IBN)** of A*STAR has a proven scientific track record in developing microcarriers, edible plant-based scaffolds and culturing fish fat-derived stem cell lines to be used for cell-based meat components.

With an integrated approach across the relevant labs, IBN has built-up robust capabilities in precision tissue engineering technology to advance plant-based and cultured meat research. This is achieved through fish and farm-derived cell line development, adipocyte differentiation, optimizing serum-free media components and lipid formulation, microcarriers, edible scaffolds and 3D printing micropatterns. In addition, IBN offers platforms for structuring of proteins from alternative sources, engineered microgels for optimal differentiation of bovine stem cells, and developing non-toxic, inorganic, antimicrobial technologies for food-safety applications.

IBN works alongside other institutions including the Bioprocessing Technology Institute, National Technological University and the University of Auckland, to leverage their expertise in bioreactors for scalability of production and livestock cell-banking. Concurrently, work has been initiated between IBN and local and international cultured-meat companies to co-develop novel cell-based technologies.



With 30 years of experience leveraging cell culture to manufacture recombinant proteins and cellular products, the **Bioprocessing Technology Institute (BTI)** of A*STAR has amassed research capabilities that can readily be repurposed to advance our understanding of alternative proteins.

BTI has begun to work with cultured-meat companies to co-develop technologies. Relevant intellectual property at BTI includes scalable platforms for producing stem cells, serum-free media formulations, vectors for cell-line development, novel bioreactors, protein purification, multi-omics analysis, process analytical technologies, and bioprinting. BTI is able to process up to 50 liters of biological material, in a single run, at research grade.

With plant-based and microbial-protein companies, BTI offers its multi-omics and semi-automated sample preparation platforms to analyze food ingredients and products. In partnership with SIFBI and other public institutions, BTI is upgrading these platforms to benefit more companies.

Knowledge Providers



The **Food Technology Programme** at **Singapore Institute of Technology (SIT)** was established in 2016, in partnership with Massey University from New Zealand.

It is currently focusing on plant-protein product development and scaling up, through close collaborations with food companies. Being situated in Asia, Singapore has the competitive advantage to work with emerging companies in the region to explore applications for meat analogues in Asian cuisine.

In 2021, SIT will be operating FoodPlant, a small batch food processing facility, that will provide comprehensive support in equipping companies with knowledge and skills and renting-out cutting-edge equipment to accelerate the development of meat analogues. This facility will also have analysis capabilities to study the texture profiles of cooked meat and meat analogues from high-moisture extrusion cooking, and compare and quantify their differences. This facility is aimed at enabling more companies to industrialize their innovations and increase their speed to market, targeting different plant-protein food applications for all consumer segments, including food for the elderly.



To meet the increasing demand for alternative protein foods, the **Food Innovation & Resource Centre (FIRC)** has assembled a team of food scientists, nutritionists, food technologists, packaging technologists and sensory analysts, to examine different aspects of product and process development to develop holistic solutions for the food industry.

The team applies plant, fungi and insect-based protein sources to develop meat and dairy alternatives, vegan and protein-enriched food products. Working closely with research institutes and ingredient houses, the team is researching the functions and interactions of ingredients to achieve optimum appearance, flavor, texture and nutrition in alternative protein products.

FIRC also continuously explores different processing technologies to improve the textural quality of plant-based foods. One of the research projects studies the effect of High Pressure Processing (HPP) on improving the functionality of pulses (e.g. foaming capacity) which can be applied as an alternative to egg ingredients in bakery products. The team is also looking at adopting extrusion technology to create a greater range of texturized protein suitable for Asian-based meat alternatives.

Knowledge Providers



Wageningen University & Research (WUR) is internationally renowned for its excellent independent research, and education provision related to its five key areas of focus: Agrotechnology and Food Sciences, Plant Sciences, Animal Sciences, Social Sciences and Environmental Sciences.

Under the banner of Wageningen University & Research, Wageningen University and the specialized research institutes of the Wageningen Research Foundation have joined forces to find solutions to important questions in the domain of healthy food and living environment. The strength of WUR lies in the collaboration between its specialized research institutes and the university, across various natural, technological and social-science disciplines. This means that scientific breakthroughs can be translated quickly into practice and into education.

The Protein Transition is one of the three investment themes in the WUR Strategic Plan 2019-2022. To achieve this transition, it is essential that technology, production and consumption developments align. In addition to technology advances that can increase protein availability, a redesign of production systems and a shift in consumption patterns are necessary. WUR is undertaking a wide variety of fundamental and applied research activities related to these areas.

Research enabling the Protein Transition

Wageningen University & Research is looking at four different technology routes to increase protein availability.

Improved crops

Only a few of the world's breeding initiatives have focused specifically on protein. Collaboration between food technology and plant breeding presents an opportunity. Pulses such as fava beans, lentils, and chickpeas are an efficient protein source for European cultivation.

Innovative aquatic production systems

Smart organic farms could, for example, combine wind farms with food production systems based on aquatic crops. Technology breakthroughs are needed to reach the full potential of aquatic protein crops such as seaweed and microalgae.

Biosynthesis and recombinant proteins

Protein sources from fungi, bacteria and yeast can decouple production from land and sea resources. Improvements in production yield and purification efficiency can improve the economic feasibility of recombinant proteins.

Reduced food loss and waste

Upcycling of waste and improving the yield of agricultural side streams offer solutions in regions where food waste is a primary challenge.

Knowledge Providers



NIZO is a Dutch contract research organization focusing on the development and application of innovations for the global food and health industry. A key area of expertise is the extraction and application of proteins, with the ability to scale extraction protocols from the laboratory through to full commercial scale using their food-grade processing centre. NIZO has developed a series of techniques to increase the solubility of plant proteins and methods to work around the negative off-flavors often associated with them.

NIZO's experience in applied protein technology originates from its heritage in dairy technology. In the last 20 years NIZO has expanded its expertise, to include native proteins, to meet the growing demand for proteins. Today NIZO supports the industry with knowledge about dairy proteins and animal proteins and plant proteins, including soy, corn, pea, rice, lupin and duckweed.

NIZO is collaborating in the consortium PULSE (Protein Utilization from Legumes for a Sustainable European crop) that focuses on developing high-quality protein ingredients from legumes. This consortium is a collaboration with the HAS University of Applied Sciences, and companies that cover the entire supply chain from seed breeding to consumer products: Limagrains, GEA, Cosucra, Frank Food Products, MFH Pulses, Ruitenberg Ingredients and SoFine Foods.



The **Louis Bolk Institute** is developing knowledge for sustainable agriculture, nutrition and health care. Researchers at The Louis Bolk Institute have expertise across the entire plant-protein production chain, from crop breeding through to consumer products.

The Louis Bolk Institute was one of 19 partners in the PROTEIN2FOOD project, which aimed to develop high-quality food protein through optimized, sustainable production and processing methods. The project focused on multi-purpose high-protein seed crops (quinoa, amaranth and buckwheat) and grain legumes (lupin, fava bean, chickpea and lentil).



Delphy is a leading international agricultural consultancy organization, based in the Netherlands. At the core of Delphy is the development of knowledge about the cultivation of crops and the optimization of the cultivation conditions. Delphy is part of the EU project Smart Protein, which builds on the key scientific findings from the previous PROTEIN2FOOD project. The project is a partnership between more than 30 external partners, including universities, research institutions, corporations, SMEs and NGOs.

Knowledge Providers



Utrecht University



Future Food Utrecht is a hub within Pathways to Sustainability, one of four strategic themes of **Utrecht University**. It serves as a platform for the discovery and implementation of new concepts that contribute to a food system that is healthy, available and reliable for a growing world population and, at the same time, sustainable.

Utrecht University is collaborating with Delft University of Technology and Wageningen University & Research and commercial parties including Unilever and Danone Nutricia Research to identify what is needed to convince consumers to switch to plant-based alternatives to meat and dairy products.

This research program will focus on four topics:

- the motives of consumers to make a dietary shift and implications for reframing strategies
- using categorization theory to shed light on how meat and dairy alternatives are perceived by consumers and what the consequences are for adoption
- study the complete innovation system and analyze what elements of the system are driving or hampering the protein shift
- using a design perspective to examine the effects of various approaches on strategies and system interventions employed to accelerate the transition



The **Protein Competence Center (PCC)** is an initiative, in the Netherlands, to bundle the research and knowledge of companies and research institutes in the field of proteins in food and feed. A main strength of the PCC is the collective technical and scientific coverage of the protein-research field by the knowledge partners and the partner companies. Collectively, PCC has access to expertise ranging from agricultural production to processing technology to health claim validation and market research.

The protein research at PCC comprises the whole food chain, from primary plant and animal production to end-user aspect. The four major research themes of PCC are:

- Bio-refinery and processing - protein sources and their primary processing
- Proteins as ingredients - how proteins find their way into feed and food
- Protein functionality - proteins in consumer/animal products and their biofunctionality
- Chain aspects of new protein sources - using fewer traditional protein sources in feed and food

Knowledge Providers



KeyGene is a Dutch molecular genetics R&D company with a track record in proprietary breakthrough technology and trait innovations. It aims to support its partners to further innovate in plant breeding and research in order to improve yield and quality. KeyGene focuses primarily on the development of high quality genome assemblies of 6F crops (Food, Feed, Fiber, Fuel, Flowers and Fun).

KeyGene's crop innovation activities centre around six innovation platforms: Genome Insights; Trait Discovery; Digital Phenotyping; Precision Breeding; Cell & Tissue Design and Genomic Breeding.



Triskelion is a contract research organization that offers a range of analyses to provide assurances regarding the authenticity of food products, including the discrimination of ingredients derived from plant and non-plant sources.

Triskelion supports industrial partners in delivering products that meet specific consumer requirements, such as GM free, and to comply with legislation regarding food labeling requirements around issues such as allergens.



**Sustainable
Food
Initiative**



The **Sustainable Food Initiative** foundation is a network organization, bringing together industry, academia, research organizations, field labs, living labs and government in order to achieve its mission of zero footprint and zero hunger in 2050. The Sustainable Food Initiative combines fundamental research with fast innovation by creating a community of industrialists, scientists, entrepreneurs, students, experts and consumers.

The Sustainable Food Initiative is conducting research to meet future demands for sustainable, healthy and safe food. This includes research on, for example, reducing footprint, circular food production, reducing waste in the chain and supporting consumers to make healthy and sustainable choices.

One of the projects in the field of the protein transition focuses on the development of digital tools to analyze and archive the properties and sustainability information of proteins, including protein concentrates and protein-enriched fractions, as well as emerging protein sources. Modeling will be used to predict the functional properties of the protein-rich materials based on composition, structure and process history of the proteinaceous materials. The aim of this research is understanding the importance of composition and structure of proteins and to develop an easily-accessible database containing all the properties of different kinds of proteins.

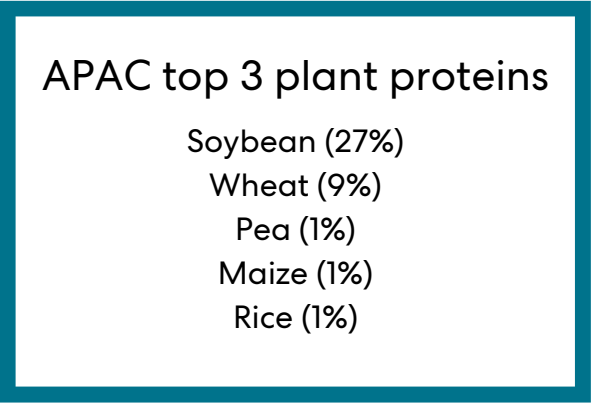
Plant-based Protein Sources

This section covers various plant-based protein sources and technological innovations to develop new sources of plant-based protein.

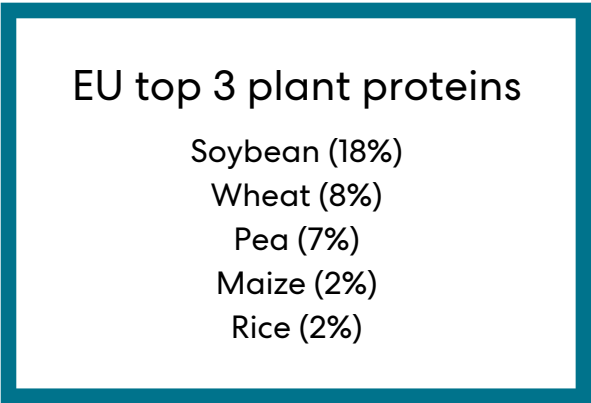


Plant-based Protein Sources

In both APAC and Europe, the most dominant plant protein source at present is soy. However, there is a drive for other plants and seeds as protein sources. Looking at both regions as a whole, there has been over 100% growth in rice protein, potato protein and pea protein over the past five years. Bean and broad bean proteins have grown from almost zero to having a significant market share today. Other plant-based proteins that have also grown significantly include hemp, oat and sunflower protein.

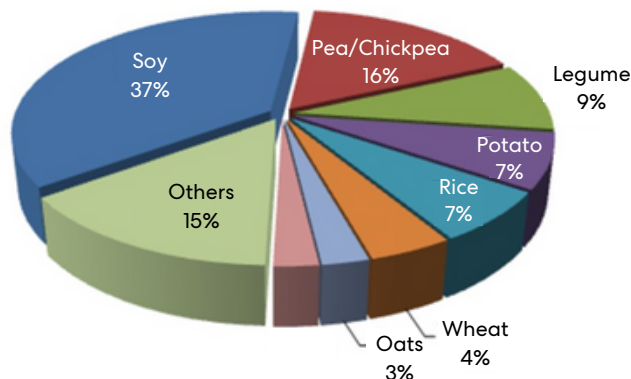


Source: Mintel GNPD



Source: Mintel GNPD

Global: % distribution of active* patents for food & drink, disclosing plant-based protein source, December 2019



Besides soy, global distribution of active patents for food & drink, disclosing plant-based protein source, shows that proteins from pea/chickpea, potato, legume and cereals, are being increasingly explored in recent years. Additionally, 15% of the patents disclose plant-derived protein from 'other' sources including hemp, oil-seed meals, weeds and marine plants.

Base: * active patents refers to granted or pending patents; excludes patents filed only in China
Source: Cipher/Mintel



Pulses

Pulses are suitable for direct human consumption and have been consumed for thousands of years. The exploration of alternative sources of protein ingredients has resulted in a renewed interest in pulses due to their relative high protein content. Pulse-seed proteins are separated using dry or wet fractionation technologies based on the desired protein content and functionality. Protein products, such as concentrates and isolates, are applied in food products such as meat and dairy substitutes.

Peas



Herba Ingredients has developed several textured vegetable proteins based on pea protein. Recently, Herba Ingredients opened a new state-of-the-art production line for protein and starch concentrates. With this new production line, Herba Ingredients is looking to increase its production capacity of pea and fava bean concentrates and to expand its pulse-flours portfolio.



Fava beans



Dutch companies Multiflour and MFH Pulses have jointly developed a textured fava-bean protein. FabaTex®60, is dry-extruded (no water loss) and contains 60% protein. This new plant protein is produced without additives. All these qualities make FabaTex®60 perfectly suitable as a protein source for meat substitutes and as an adequate alternative to soy.



Chickpeas



Growthwell, a Singapore plant-based food company plans to launch a new alternative seafood product line in collaboration with the Israeli startup, ChickP, which has developed an IP-protected extraction process to produce chickpea protein isolate with 90% protein. The protein isolate is neutral in taste and is suitable for plant-based dairy and meat applications.



Industry By-products

By-products from the manufacturing of food ingredients can provide useful sources of proteins. New initiatives are focusing on extracting protein from side streams arising from the production of starch, bioethanol, plant oils and food. Extracting and isolating protein from these side streams can have positive impacts on environmental and financial sustainability and make a significant contribution to global food security.

Rapeseed

Rapeseed is a crop grown worldwide in large volumes for oil production. To extract the oil, the seeds are usually treated with hexane and the process takes place at high temperatures, resulting in denaturation of proteins. This creates challenges with residue solvents and limits their functional properties and thus opportunities for their subsequent use.

The Dutch multinational **DSM** has developed a process to ensure that the proteins remain intact and unwanted components are removed, resulting in a high-quality protein containing all essential amino acids. DSM is collaborating with the Avril Group to develop an industrial production, facility utilizing this approach, in France.



Okara

Okara is a by-product generated during the production of soybean products such as soy milk and tofu. It is rich in protein, fiber and vitamins. Traditionally, food manufacturers discard this side stream as it turns rancid quickly due to the high moisture content. In recent years, research institutes have discovered new ways to improve the palatability and nutritional value of okara through fermentation.

For example, the **National University of Singapore** has developed a probiotic beverage and high-protein okara flour using fermentation technology. Scientists at **Nanyang Technological University** have also uncovered a new way to cultivate microalgae in a fermenter using okara as an effective culture medium.



Aquatic Plants

Aquatic crops are promising protein sources due to their high protein quality and yield. In many instances they can grow in a variety of water environments, including open water or covered man-made ponds located on land not suitable for other methods of food production. Microalgae and duckweed are among the most common aquatic crops currently being utilized or researched for protein production.

Algae



Duckweed



Sophie's BioNutrients is using food manufacturing side streams such as okara, spent brewer grains and molasses to feed microalgae in a fermenter to produce sustainable alternative protein sources in just three days.

While contributing to a circular economy, this also helps to lower the cost of production compared to commercial microalgae growing methods. The end product is a 90% protein isolate from the harvest, which can be turned into protein flour to produce food products.

Duplaco is a Dutch producer of heterotrophically-cultured *Chlorella* microalgae. Using this unique, sustainable, production method, the *Chlorella* produced is completely sterile and fully controlled, which ensures high quality and a good, mild taste.

Duplaco's *Chlorella* is suitable for inclusion in products such as smoothies, algae burgers or pasta, but can also be consumed in its natural form or served as a condiment. It has a high protein content, contains all essential amino acids and is rich in other important nutrients and antioxidants.

NL company **Phycom** has one of the largest microalgae production facilities in Europe. It grows algae in a completely closed system so that the growth can be fully controlled from start to finish. Phycom's biotech system is modular, scalable and sustainable, with the system designed to be circular wherever possible.

Phycom works closely with the food industry to identify and implement food product applications for their microalgae range.

Rubisco Foods (the new trade name of the company ABC Kroos) has developed a patented technology to produce high-protein ingredients, such as powders and gels, from plants. It produces ingredients from duckweed, that has been cultivated in a controlled environment, and other plants such as alfalfa.

These ingredients are designed to enable food manufacturers to meet consumer demands for natural, clean label and allergen-free products.

Other Emerging Plant-Protein Sources

Various novel plant-based protein sources are beginning to emerge propelled by advances in technology. For example, the high protein content in some green leaves makes them promising alternative protein sources. By pioneering new technologies, novel protein ingredients can add to the diversity of alternative protein sources and provide more choices for consumers.

Sunflower seeds

**TIME-TRAVELLING
MILKMAN**



Time-travelling Milkman (TTM) is a B2B company that will produce and sell stable plant-based fat ingredients for sustainable and appetizing dairy alternatives. TTM focuses on ingredients extracted from sustainable sources such as sunflower, rapeseed and European soy. The startup has developed food-processing designs based on the preservation of the naturally occurring fat droplets inside the plants, called oleosomes.



Moringa

AnuLife



AnuLife, using elements from the leaves of the Moringa tree, is developing technologies to increase its bioavailability and improve the flavor profile in order to create high-protein, nutrient dense plant-based ingredients. By working with an established global network of small-holder farmers, utilizing a regenerative system of agriculture, AnuLife is able to source the highest quality products for the optimal benefit of people and the planet.



Sugar-beet foliage

 **Cosun Beet
COMPANY**



In December 2018, **Cosun Beet Company** acquired the Dutch start-up GreenProtein and their process to extract the protein RuBisCo from green leaves. Cosun Beet Company, a Royal Cosun company, is utilizing this technology to extract protein from sugar beet foliage. In October 2019, it opened a Green Protein Demo Plant to improve process efficiency and to allow for fine-tuning of the extraction process at industrial scale.



Plant-based Product Innovation

This section highlights examples of innovative consumer products utilizing plant-based protein sources.



Meat Analogues

KARANA



Karana is a whole-plant 'meat' company that envisions a world where plants dominate the plates. Karana takes natural, whole-plant ingredients and creates minimally-processed meat-like products. Its first range of products are made from Jackfruit, an abundant, sustainable ingredient with natural meat-like qualities.



Karana transforms the fruit, using its proprietary process, to create Jackfruit-meat from the whole-plant. The Karana range will begin with a pork alternative for food service before expanding into ready-to-cook Asian Dim Sum.



The Vegetarian Butcher was founded by a ninth generation farmer with an ambition to become the biggest butcher in the world by selling only meat-free products. The company offers a wide variety of products as alternatives to classic meat and fish products such as veggie meat balls, minced meat, bacon, chicken, sausages and tuna.



In 2018, Unilever acquired The Vegetarian Butcher. The acquisition aligns with Unilever's strategy to expand its portfolio into plant-based foods. For The Vegetarian Butcher, the acquisition is the next step in its ambition to grow into the largest butcher in the world.



Rival Foods has developed a novel shear-cell technology to create plant-based whole-cuts using minimal ingredients. With this technology it can transform plant proteins into food products with a pronounced fibrous meat-like texture. The company spun out of Wageningen University & Research in 2019.



Rival Foods aims to imitate three product categories using the shear-cell technology: Rival At Sea, a layered product resembling fish; Rival On Land, a heterogeneous fibrous structure resembling red meat and Rival With Wings, a more homogeneous, finer, soft fibrous structure resembling poultry.

Meat Analogues



Ojah uses a proprietary process based on High Moisture Extrusion (HME) to produce plant-based products. The result is a meat-free product with a fleshy texture, unique bite and tenderness. Ojah operates as a business-to-business company.



Ojah is known for its plant-based meat alternative Plenti®. Because the tenderness, shape and texture can be regulated, this meat alternative can be processed into countless types of end product. In December 2019, Ojah launched the world's first vegan ribs. Heppi® Ribs are made from yellow-pea flour, water and seasoning, via its HME technology.



BeefyGreen is using oyster mushrooms to create the flavor, texture and juiciness of meat products. Unlike white button mushrooms, oyster mushrooms are grown in a substrate of natural straw. BeefyGreen hand-selects the hearts of oyster mushrooms, ensuring the highest quality.



One of the examples of a traditional recipe made with BeefyGreen is its tartare blend. The BeefyGreen Tartare can be used as a vegan meat substitute or it can be blended with ground or minced meat to add flavor and reduce calories in burgers, meatballs, sausages and other hybrid products.



Phuture Foods is a plant-based food company pioneering meat substitutes to cater to the diverse needs of the Asian market. Its flagship product, Phuture Mince, is a substitute for ground pork made with a variety of plant-based ingredients which include non-GMO soy protein, pea protein, chickpea protein and rice.



Phuture Mince has recently been soft launched in Singapore and is working with local chefs to showcase the ease and versatility with which the product can be incorporated into Asian cuisine. Phuture Foods aims to address the long-term sustainability and security of pork supply, as pork is the most common meat consumed in Asia, yet very susceptible to disruptions such as African Swine Flu.

Meat Analogues

schouten



Schouten Europe is a specialist in the development and production of plant-based protein products for retail, foodservice and the food industry. The Dutch family business has 30 years experience in the field of plant-based protein.



The product portfolio of Schouten includes a large number of plant-based products that can be delivered either as a brand or under a private label. In addition to the standard product range, they develop tailor-made products.

ME•AT
THE ALTERNATIVE



In 2019, Dutch meat processor Vion launched the startup ME-AT to develop plant-based meat alternatives. Vion's slaughterhouse and meat processing plant in Leeuwarden will become a plant-based site.



With ME-AT, Vion is focusing on products that are meat-like in their flavor and appearance. Its range consists of five meat alternatives that are 100% plant-based aimed at international retail and foodservice.

THE BLUE BUTCHER
NO MEAT TODAY



With The Blue Butcher, the Dutch meat processor Van Loon Group entered the meat alternative market in 2019. The Blue Butcher is a range of meat-identical products including a burger, mince, sausages, no-meat balls, nuggets and two types of schnitzels.



The main ingredients of The Blue Butcher products are a combination of soy and wheat. With the blue color code, The Blue Butcher aims to differentiate itself. The products are targeted at the retail and foodservice market.

Meat Analogues



Life3 Biotech is a Singapore startup that develops sustainable food products to meet the rising demand for healthy alternatives to meat. The company's flagship product is a plant-based protein called Veego, made from a blend of legumes, grains, fungi and other whole foods.



Veego was developed in collaboration with the National University of Singapore and bagged the 1st runner-up prize at the Food Innovation Product Award in 2016. The company is in the process of setting up its first integrated agri-food pilot facility in Singapore.



Ruitenberg Ingredients is a family firm and pioneer in finding innovative ingredient solutions for the food industry. It makes a wide range of products, including egg replacers, smoke flavors, fillings and meat alternatives. One of its key innovations is Rudin@ProVega, a protein technology that imitates real meat structure.



Rudin@ProVega can be created from various protein sources such as pea, soy and lupin and is suitable for vegetarian and vegan applications. It can be used to develop meat substitutes for products like nuggets, hamburgers, kebab and pulled pork. It can also be used to make vegetarian fillings for sausage rolls or other snacks.



Evolution Meats is a startup that is developing and producing plant-based products for foodservice. Evolution Meats (formerly Green Meat Products) was founded in March 2018. It focuses on flexitarians who alternate meat consumption with the consumption of plant-based meat substitutes.



The company's first product was a vegan doner kebab based on non-GMO European soybeans. It has expanded its product portfolio to include gyros, shawarma and a range of satay and sausage products. Furthermore, Evolution Meats launched vegan sauces which can be combined with meat alternatives.

Fish Analogues



SoFine Foods is a social enterprise that aims to promote the consumption of healthy, sustainable and environmentally friendly plant-based foods. In 2019, SoFine Foods launched plant-based fish fillets and nuggets. The products are made with organic non-GMO soy beans.



SoFine Foods started in 1963 making tofu for Indonesian emigrants to the Netherlands. This makes them a pioneer in plant-based food in this part of the world. Nowadays SoFine Foods offers a wide assortment of plant-based products including meat alternatives, cheese alternatives, tofu and vegetable products.



Growthwell is a plant-based food company. Some of its flagship products include Asian easy-to-cook and ready-to-eat dishes and egg-free sauces made with soy, mushroom, and konnyaku. Besides making plant-based products, Growthwell provides services such as sourcing, R&D, and contract manufacturing.



Growthwell recently clinched US\$8 million in a funding round led by Temasek. The company plans to use the fresh funds to set up an end-to-end technology centre in Singapore focused on R&D and manufacturing, targeted for completion by 2021. It also plans to launch a new alternative seafood product line in collaboration with Israeli startup ChickP.



Novish is a newly established company focusing on the market for plant-based products. Their products are 100% vegan, produced without using soy. Novish is focusing on seafood products made from plant-based proteins. The first range of products include fish nuggets, fish burgers and fish sticks.



New products in the Novish pipeline include salmon burgers and tuna steaks. The products will be sold in the European retail and foodservice markets in both the chilled and frozen counters. Novish was founded in 2019 by three food industry veterans.

Fish Analogues



Meatless is producing textured vegetable products which can be used in a large variety of processed food products. Its products are used as a raw material or ingredient in the production of vegetarian and vegan food. Meatless has developed fish analog textures based on natural whole food rice.



Meatless also supplies the meat and fish processing industries with ingredients to help improve the eating quality of products or to enable the manufacture of blended animal-plant protein products. Meatless is currently scaling up its production capacity in a two-year major investment scheme (2019-2020).



Vegan ZeaStar is a partnership between the Dutch vegan-product commercial agent VeganXL and comfort food restaurant Vegan Junk Food Bar. It has developed a plant-based alternative to traditional sashimi. Recently Vegan ZeaStar also launched plant-based versions of shrimp and calamari.



Vegan ZeaStar's mission is to put delicious and exclusive plant-based fish products on the market with the same taste and texture as real fish. The plant-based fish alternatives are made with potato starch and/or tapioca starch. Seaweed extract is used to mimic the flavor of fish.



Bobeldijk Food Group has 20 years know-how in development, production, packaging and sales of vegetarian and vegan products. Vegafit is the brand name of their plant-based products. The brand includes products like fish sticks, burgers, nuggets, schnitzels, and steaks.



Vegafit uses wheat or soy protein grown by European farmers. In addition to its own brand, Bobeldijk Food Group produces for private label. In June 2020 Dutch fish processor Kennemervis Groep acquired the Bobeldijk Food Group.

Dairy Alternatives



As part of **Lam Soon's** ongoing initiatives towards sustainability, it launched a series of plant-based milk alternatives under the brand UFC Velvet. The range includes Almond Milk, Coconut Milk and Oat Milk.



These beverages are made from 100% plant-based ingredients; cholesterol and trans-fat free, with no added artificial flavor, color or preservatives. UFC Velvet range is suitable for all consumers including vegans, as a healthy beverage or milk substitute in coffee, tea and cereals. It can also be used as a healthy ingredient in cooked dishes and desserts.



DE NIEUWE MELKBOER



The New Milkman (De Nieuwe Melkboer) is revolutionizing the alternative dairy sector by creating the first Dutch, plant-based, seed-to-product 'milk' supply chain. The New Milkman is harvesting locally-cultivated soy to produce plant-based milk.



The founders come from an established farming family with a long history of dairy farming. They saw that soy could be successfully grown in the Netherlands and that there was increasing demand from local consumers for plant-based milks, and that existing suppliers were importing their soy from other continents.



Gorilla Press is a plant-based functional beverage brand established in 2013. The company uses mainly almond, cashew, oat and coconut to produce alternative milks, and strongly believes in using only natural and sustainable ingredients.



Driven by its motto of mindful indulgence, Gorilla Press uses traditional Asian superfoods such as matcha, black sesame and turmeric to create special blends: classics reinvented as nutritional on-the-go beverages. Its customers are high performers and dessert lovers looking for great taste, convenience and nourishment.

Dairy Alternatives



First Brew focuses on delivering nutritious, healthy and tasty beverages. Its flagship AlmondPlus plant-based milk is formulated based on its proprietary almond blend and is rich in Omega 3, 6 and 9.

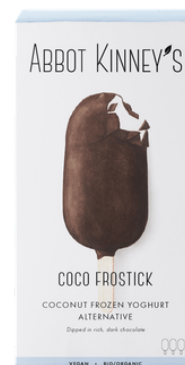


The AlmondPlus series is packed with nutrients and superfoods such as quinoa, chia seeds and black sesame for even more health benefits. The company also developed the innovative Almond Culture series, fortified with probiotic Lac-shield strain and prebiotic Inulin to help lactose-intolerant consumers boost their immunity and gut health.

ABBOT KINNEY'S



Abbot Kinney's is a plant-based dairy brand that offers a wide range of yoghurts and ice creams. Its products are made from either organic coconut milk or organic almonds and are 100% plant-based.



Since 2014, Abbot Kinney's has been working on the transition toward a sustainable food system. After four years, Abbot Kinney's was acquired by the Dutch health-food company Royal Wessanen. Currently, Abbot Kinney's products are available in more than 1900 stores across Europe.



In the first quarter of 2020, **Danone** introduced new plant-based products in the Netherlands. For its Danio brands, Danone introduced coconut-based products in three flavors. Its Activia brand introduced soy-based products with exclusive vegan cultures.



With this launch Danone is responding to the needs of the growing group of flexitarians who want to eat more-varied and therefore more plant-based. This launch was unique for Danone it was the first time the brand focused on 100% plant-based products.

Dairy Alternatives



Upfield is a plant-based butter and spread producer, active since 1871. The company became known as Unilever in 1930 following a merger between Margarine Unie and Lever Brothers. In 2017, the business was sold and relaunched as Upfield.



In January 2020, Upfield Group completed the acquisition of **Arivia**, the owner of the plant-based cheese brand VIOLIFE. VIOLIFE offers a range of plant-based cheese products primarily made with coconut oil. It avoids the use of nut, soy and gluten-containing ingredients.



Willicroft has created plant-based cheeses using a variety of nut and tofu based recipes. The Dutch startup was founded in 2018 by the grandson of a dairy farmer. Willicroft products include plant-based cheese fondue, cheese sauce, parmesan and cream cheese.



In December 2019, Willicroft opened a plant-based cheese store in Amsterdam, offering plant-based cheeses from Willicroft and other plant-cheese producers. Willicroft received the Consumer Impact Award during the European Plant-Based Protein Awards for Startups 2019.



Co+Nut+ink has been producing refreshing coconut ice cream, 100% vegan, dairy-free and gluten free, since 2013. Starting out as an F&B outdoor lifestyle concept, the company has expanded into retailing its signature coconut ice cream in tub format to reach more consumers.



The founder of Co+Nut+ink is a strong believer in improving the livelihoods of smallholder farmers and educating customers via its own ecosystem program. All its coconuts are consciously sourced with the Fair Trade Program.

Dairy Alternatives



Mr Bean, Singapore's largest soy F&B retailer collaborated with Udders, Singapore's largest homegrown ice cream brand to launch a series of soy ice creams for vegans and lactose-intolerant consumers. Dairy-free and egg-free, the soy ice cream is made using non-genetically modified soy beans and is certified as Healthier Choice Ice Cream by Singapore's Health Promotion Board.



the ice cream & cookie co.



The Ice Cream & Cookie Co created a series of dairy-free ice creams made with avocado and a coconut milk base. These creations are inspired by Singapore heritage and classic Singaporean desserts such as Chendol, Onde Onde and Avocado & Gula Melaka smoothie. The dairy-free ice creams are vegan, 100% plant-based and all-natural with no artificial coloring or additives.



Smoocht is a fully plant-based dessert maker in Singapore on a mission to nudge people towards a better world of eating, living and thinking. Its R'ice Cream is a pioneer in Asia and its first proprietary product. Created using organic brown rice milk and all-natural plant-based ingredients with no added artificial colors or preservatives.



Snacks & Meal Components



WhatIF Foods is a social enterprise aiming to re-introduce biodiversity in the food ecosystem by incorporating Future Fit crops into tasty and healthy convenience foods. These crops are rich in fiber, plant-based proteins and micronutrients, can grow in poor soils and withstand the dry and volatile climates predicted for the future.



One such crop is the Bambara groundnut, which has been included in their soups, shakes and noodles, to create plant-based high protein products – offering the growing urban working population a nutritious and guilt-free food experience.



Uncle Saba's Poppadoms was founded in 2015 to transform the ethnic poppadom into a healthier snack. Made of lentils, these crunchy chips are packed with plant-based goodness: high protein, high fiber, gluten free, vegan and non-GMO.



Uncle Saba's also works with leading brands to create new plant-based snacks such as hummus chips, quinoa chips, protein chips etc., all of which use a lentil base and are free of corn or potato. The company is currently exporting to more than 25 countries.



Seamore is turning seaweed into an everyday food. It wants to provide an easy way to eat healthy and more sustainably. Seamore introduced an alternative for tagliatelle made from 100% wild, seaweed handpicked in Connemara, Ireland.



Its product portfolio includes an alternative to bacon made from 100% organic, unprocessed seaweed, which can be fried, dried or smoked. Seamore also develops seaweed-enriched products such as wraps, bread and tortilla chips.

Cellular Agriculture

This section covers innovations in cellular agriculture, the emerging field of producing animal products from cell cultures, rather than animals.



Cellular Agriculture

Cell-cultured meat is produced from animal cells using a combination of biotechnology, tissue engineering, molecular biology and synthetic processes. Cell-culture technology does not reproduce the animal itself, but produces a product that is intended to resemble traditional animal meat. Technology has advanced to a stage where this is possible, so companies are increasingly exploring cell-based meat options as an alternative to farmed meat.



In 2013, Professor Mark Post, of Maastricht University, presented the world's first slaughter-free hamburger. After years of research, Mark Post co-founded **Mosa Meat** to commercialize cell-cultured meat, revolutionizing the way meat is produced.

Since that first hamburger, Mosa Meat has been working in four main areas:

- Improving the protein content of cell-cultured meat.
- Culturing fat tissue to improve the taste and texture of the resulting meat products.
- Developing a culture medium that is free of fetal bovine serum.
- Designing and optimizing culture methods that are scalable to industrial volumes.

Mosa Meat reached critical technical milestones in 2019 and 2020 including an 88x cost reduction in growth-medium cost. After a successful Series A funding round in 2018, Mosa Meat recently announced the first closing of US\$55 million as part of larger Series B funding. The B round was led by Blue Horizon Ventures and joined by investors such as the Bell Food Group and M Ventures.



Founded in 2018, **Shiok Meats** is a cell-based clean-meat company, the first of its kind in Singapore and Southeast Asia. The company's mission is to offer delicious, clean and healthy crustacean meats (shrimp, crab, lobster etc.) harvested from cells instead of animals. Shiok Meats' clean meat is grown under controlled and clean conditions, eliminating the potential for food-borne diseases, bacterial/antibiotic resistance and harmful chemicals. In March 2019, the company unveiled its first ever cell-based dumpling (Shiok Shrimp Dumpling) at the Disruption in Food and Sustainability Summit.

The startup recently raised US\$12.6 million in a Series A funding round from the Netherlands-based investment fund Aqua-Spark and SEEDS Capital, the investment arm of Enterprise Singapore. This will finance research, development and its first plant in Singapore. Shiok Meats has raised US\$20.2 million in total funding.



Cellular Agriculture



Founded in 2019, **TurtleTree Labs** offers patent-protected cell-based technology to make full-composition, full-functionality, full-flavor milk, referencing humanely-selected dairy cow cells. The approach involves working with mammalian cells so they can be cultured, differentiated and induced to lactate. This method of producing milk is 95% less resource consumptive when compared to regular dairy milk production.

TurtleTree Labs has recently secured US\$3.2 million in seed funding to scale up operations and move towards commercialization of lab-produced cow milk and human breast milk from stem cells. Investors include Green Monday Ventures, KBW Ventures, CPT Capital, Artesian, and New Luna Ventures. Most of them were also involved in TurtleTree's pre-seed round. With the latest funding, the startup is working towards upscaling its production, targeting production of 50,000 liters of milk by the end of 2021.

Additionally, the startup recently won the Liveability Challenge 2020, a global platform which calls for companies to present innovative solutions, for sustainability in tropical cities.

The logo for Meatable consists of the word "MEATABLE" in white, uppercase, sans-serif font, centered within a black rectangular box.

MEATABLE



The Dutch startup **Meatable** was founded in 2018 and uses a proprietary stem-cell technology to make cell-cultured meat. The technology is based on a study on manipulating living cells that won a Nobel Prize in 2012 and has been optimized by Stanford and Cambridge scientists. Meatable's proprietary OPTI-OX technology removes one of the biggest barriers to cell-cultured meat, the use of fetal bovine serum. Instead the company is using pluripotent stem cells that can grow without serum, which makes its products completely slaughter-free.

In December 2019, Meatable announced it had secured an additional US\$10 million in seed funding bringing its total funding to US\$13 million. The funding round was led by its existing investor base including BlueYard Capital, supplemented by angel investors including Taavet Hinrikus, CEO and co-founder of TransferWise, and Albert Wenger, Managing Partner at Union Square Ventures. The European Commission also contributed funds through its Eurostars Program. The additional funding will be used to accelerate the development of the first pork prototype.

Cellular Agriculture



Gaia Foods is the first biotech startup in Southeast Asia to aim at producing cultivated red meat specifically for Asian consumers. Unlike other startups in the region that are producing cell-based ground meat, Gaia Foods differentiates itself by developing structured meat. The startup aims to make this process cost-effective through its proprietary 3D scaffold. Within 3 months of operation, Gaia Foods has isolated bovine stem cells and successfully grown structured muscle tissue using 3D scaffolds. The company is now growing the pilot meat product for investor demonstration.



Founded in 2019, **Cellivate Technologies** has developed a patented nanotech cell culture technology that enables cells to adhere better and accelerate their growth, while maintaining vital cellular markers for the development of clean meat. The product portfolio includes coverslips, microcarriers and other cell-culture vessels, which fit into the value chain of clean meat companies and will accelerate the development of clean meat solutions. The company was identified as one of the 100 top players in Asia's alternative protein industry, in the inaugural "2020 Asia Alt 100" list published by Good Food Institute APAC. The company was also merited by Mitsui Chemicals in recognition of its mission.



SingCell is a Singapore-based contract development and manufacturing organization (CDMO). The company provides process development and contract manufacturing services to cultured meat companies. SingCell has a proprietary, scalable bioprocessing platform for manufacturing animal cells at significantly lower cost with accelerated time to market. The company has experience with various cell types, including myoblasts, fibroblasts, mesenchymal stem cells, and adipose progenitor cells.

Fermentation



This section covers examples of alternative protein sources derived from biotransformation processes.

Fermentation

Fermentation is the process of converting carbohydrates and proteins into other molecules under a controlled environment. These molecules include organic acids, alcohol, fatty acids and proteins, which can then be extracted and used as ingredients for other food products. The specific molecules produced are a result of complex interactions between the substrate (what the organisms are given to use as food), the microorganism (both the general category such as yeast but also the specific variant) and the environmental conditions used for the fermentation.



The Dutch startup **FUMI Ingredients** develops biorefinery platforms to produce animal-free food ingredients. The Wageningen University & Research spin-off was founded in 2019 as a response to the need to provide sustainable high-value proteins. It has developed a scalable process for the production of a highly functional vegan non-GMO egg-white replacer from organisms such as baker's and brewer's yeast and microalgae. FUMI Ingredients uses a unique proprietary approach to transform naturally occurring micro-organisms into highly functional fractions containing polysaccharides, proteins and peptides. These ingredients show superior techno-functional properties compared to other animal and plant-based proteins.

FUMI Ingredients raised €500,000 from Innovation Industries and SHIFT Invest. This capital will be used to realize their scale-up ambitions and to accelerate market entry. FUMI has been awarded prizes including the Rabobank Sustainable Innovation Prize - in the category Food & Agri - and the Most Innovative Alternative Food or Beverage Ingredient Award at Food Ingredients Europe 2019.



The **Protein Brewery** was founded in 2020 to commercialize products developed by the Dutch company BioscienZ and offer R&D and scale-up services to companies developing protein-rich foods and ingredients utilizing fermentation technology.

Its brewed Fermotein™ products are based on natural organisms. Fermotein™ will become available as a staple food ingredient, capable of replacing animal protein in any diet without compromising on nutritional value. In other applications it will be capable of replacing carbohydrates with proteins and fibers.

Alongside using natural organisms, The Protein Brewery has the toolbox to engineer designer proteins and express proteins of interest using its proprietary fungal-expression technologies based on fungi generally regarded as safe. Proteins of interest can be of any source; microbial, but also plant derived or animal derived. Using this expertise and these technologies, The Protein Brewery is developing a platform to produce an egg white protein without the use of any animal.

Fermentation



Sophie's BioNutrients is a Singapore-based company producing food-grade protein flour using microalgae, as an alternative to animal or plant protein. The company grows microalgae through a fermentation process fueled with nutrient-rich food waste such as spent grains from breweries, okara from tofu makers and even molasses from sugar refineries. It then extracts a 90% protein isolate, which can be turned into protein flour to produce food products such as tofu, seafood or meat alternatives.

The company has successfully grown its production of microalgae-based protein to the 10-tonne scale now. This has allowed the company to lower production costs significantly, and it hopes to further sharpen its competitive edge by cutting the selling price to just under US\$2 per kilogram.



Soynergy, a spin-off from the National University of Singapore, has developed a biotechnology platform to transform food by-products into high value functional food. For their first product, Soynergy is working on converting okara, a by-product from soy milk and tofu production, into a non-dairy probiotic beverage. This probiotic beverage contains high cell counts of live probiotics, easily absorbed free amino acids and free isoflavones with a fruity aroma.



Insects

This section highlights innovative companies utilizing insects as a protein source.



Insects

Insects represent another alternative protein source, since they are rich in proteins and have high reproduction rates. Insects are extremely effective in converting organic waste (such as by-products from food production or food waste) into high-quality proteins. Insects are not commonly eaten whole in the western diet. However, the demand for sustainable proteins offers opportunities for insect-producing companies that make products for animal and human consumption, many of which are processing insects into food and food ingredients.



Protix is a highly technological and data driven insect producer based in the Netherlands. Protix produces insects for sustainable proteins by using plant waste from the environment as feed for insects.

High-quality proteins and fats are extracted from the insects and processed into raw materials used primarily in fish feed, animal feed and pet food. Protix owns the brands Friendly Fish (farmed fish fed with insect proteins instead of fish meal), OERei™ (eggs from chickens that eat live insects) and Bloosom (an organic soil improver).

In July 2019, the company opened the world's largest insect factory in Bergen op Zoom. This state-of-the-art facility is able to produce protein to provide feed for more than 5 million salmon, and 250 million eggs laid by hens fed with soy-free feed.



Protifarm is a large-scale producer of insects for human nutrition. In controlled and fully automated facilities, insects are bred combining the latest technologies with optimized feed composition to maximize efficiency.

Throughout the automated production system, the insects are bred, fed, harvested and processed to final delivery with minimal manual intervention. This minimizes health risks while guaranteeing an unparalleled level of safety and traceability for each batch. These innovations enable Protifarm to cost-effectively produce insects and make them a viable ingredient for a wide variety of food formulations.

Protifarm's main product is a 100% pure buffalo-beetle insect powder, which can serve as nutritional enhancement in existing food or as the basis for new food products.

Insects



Asia Insect Farm Solutions (AIFS) is a Singapore-based agritech company that specializes in the production and supply of cricket powder as an alternative protein for food applications. The company uses a customized and proprietary system of processes to breed crickets in a climate-resilient and resource-efficient way. The end-product is cricket powder: a nutritionally dense and minimally processed whole foods protein ingredient that has a mild taste and aroma and is free of any chemical processing.

The company is also working with food manufacturers who are looking to incorporate alternative proteins in their existing range of products to cater to the growing group of health- and wellness-conscious consumers. Over the next 12 months, AIFS and its partners will be launching a range of edible-insect products, focusing on health and nutrition, for consumer markets in the Asian region.



Insectta is the first black soldier fly biotech company in Singapore, taking food waste, and returning it into the economy as valuable biomaterials for the pharmaceutical and cosmetics industries.

While most insect farming companies harvest their insects whole and sell them to customers, Insectta has discovered a way to separate the black soldier fly larvae into different parts through a biorefinery process to produce black soldier fly-derived chitosan, organic semiconductors, and protein and probiotic products - an industry model which is estimated to triple the final larvae product's value.

The company holds the knowledge to farm, process, and extract high-value biomaterials from the black soldier fly, using proprietary extraction methods that result in higher grade biomaterials than current industry standards.

Insectta has recently received seed round funding from the Trendlines Agrifood Fund to fuel the work on the extraction of valuable insect-derived biomaterials and to bring the applications of its chitosan, organic semiconductors, and protein and probiotics from lab to market.

Insects



Headquartered in Singapore, **Nutrition Technologies** manufactures sustainable insect proteins and oils for the aquaculture, pet food and animal feed industries, using a unique combination of bacteria and black soldier fly larvae to upcycle nutrients from agricultural and food processing by-products. The company is already selling its flagship products, made from powdered and dried black soldier fly larvae, to pet food companies and animal feed manufacturers.

Nutrition Technologies closed a Series A funding round in July 2019, with US\$8.5 million raised from a consortium of investors led by Openspace Ventures and SEEDS Capital, the investment arm of Enterprise Singapore. The company is investing the money to build the largest high-tech insect protein production facility in Southeast Asia able to produce over 18,000 tonnes of insect-based protein products and organic fertilizers annually.



Protenga is an insect technology company with a proprietary turnkey hardware and software system that enables decentralization and consistency in the bioconversion process and black soldier fly production. The company produces sustainable and high-quality protein, oil and frass products for animal feed and fertilizer under the Hermet brand.

Protenga recently raised US\$1.6 million in seed funding from UK agritech firm Roslin Technologies and SEEDS Capital, the investment arm of Enterprise Singapore, to support the company's ambition to develop sustainable innovative businesses in new fast growth markets.

It is ramping up production of its insect-based products, conducting genetic research, and taking its Smart Insect Farm model, which transforms agricultural and food waste into valuable products, to waste business around Asia.

Accelerators and Incubators

This section highlights the accelerators and incubators currently operating in the alternative protein space in the Netherlands and Singapore.



Accelerators and Incubators



StartLife supports agrifood startups in the pre-seed stage. StartLife Accelerate is a 12-week pressure-cooker program for ambitious, early-stage food and agtech startups. The program provides a loan, allowing the startups to take their first steps toward developing their business. In addition to funding, the program offers training in various areas of business development such as building a team, financial modelling and market validation.



ScaleUpFood is a comprehensive support program dedicated to scaling entrepreneurial ventures in food and agriculture. The program addresses areas specific to food and agri scaleups like strategic selling to large corporates, specialized finance, and data-driven business models.

The program engages top Dutch corporates and innovative midcaps for collaboration with the scaleups. After the program, qualified ventures will be invited for longer-term tailored support, collaboration opportunities and access to series B funding.



BOX (Blue Ocean Xlerator) is an accelerator for startups in agri, food and life sciences. Focused on sustainable breakthrough technologies, BOX is run by entrepreneurs for entrepreneurs. It aims to help build companies from the ground up, including putting together a team and scaling up any technology needed to speed company growth. Box has its own research and development firms, TDI and TOP, that provide tailored expertise, from research and advisory work to factory design.



Innovate 360 is Singapore's first food incubator with shared facilities including co-working space, test kitchen, R&D laboratories and food production space. It provides 1-to-1 industry mentor matching, funding, and expertise to help startups develop, scale up and access markets, distribution and industry.

Startups that Innovate 360 incubates include Shiok Meats, TurtleTree Labs and Asia Insect Farm Solutions. It is also an Accredited Mentor Partner of Enterprise Singapore, to assist startups with advice, learning programs and networking contacts.

Accelerators and Incubators



Big Idea Ventures Asia invests, accelerates and supports the world's most compelling and innovative alternative protein companies, with the potential to disrupt the global food industry. The BIV accelerator is a 5-month program for start-up companies, providing strategic guidance from experts in core business areas, including product development, manufacturing, sales and distribution, marketing, business development and fundraising. The accelerator program runs twice per year in Singapore and New York, respectively.

In addition, BIV also invests US\$125K and provides another US\$75K of in-kind services to help each startup expand and grow in the Asia-Pacific region, and in North America with its New York program.



The **Impact the Food Chain Accelerator**, is a 4-month accelerator program supporting entrepreneurs working on the transition to a more sustainable food system. Under guidance from experts, mentors, financiers and strategic partners, startups and SMEs will strengthen their revenue model, growth strategy and impact.

The program is part of the Food Ecosystem of Impact Hub Amsterdam. With a series of events, a community, publications and accelerator programs, Impact Hub Amsterdam brings together entrepreneurs, investors, consumers, government, corporates, and other organizations to accelerate positive change in the food sector.



Trendlines Agrifood Innovation Centre (AFIC) is a Singapore-based incubator and fund manager for early-stage and late-stage agrifood technology startups. It is a wholly-owned subsidiary of The Trendlines Group Ltd, a leading medical device and agrifood investor in Israel.

Trendlines AFIC team provides its portfolio companies with business and technology development, finance, marketing communications, administrative support and access to a global network of investors and strategic partners.



Founded in 2017, **HATCH** is an accelerator and venture platform launched to fuel innovation in the alternative seafood and aquaculture industry. HATCH bridges the gap between innovative ideas and their commercialization by helping pre-seed and seed-stage startups become investment and market ready, and by catalyzing their aquaculture market-entry ideas and their commercialization.

HATCH's mission is to catalyze farmed and alternative seafood innovation through responsible investment, expertise and insights, supported by a strong, committed community.

Accelerators and Incubators



GROW is an agrifood tech impact accelerator backed by AgFunder. It is the first dedicated agrifood tech accelerator in Southeast Asia and is set to shape the agrifood startup ecosystem across the Asia Pacific. GROW's value proposition is to help startups achieve global growth – both for international startups to launch into Asia and for local and regional startups to capture new international markets.

Through its portfolio of programs, it invests in and/or accelerates extraordinary founders developing transformative technologies for positive impact across the Asia food system and beyond. GROW explores new frontiers across the whole agrifood value chain. This includes but is not limited to alternative protein (plant and cell-based), urban farming, food waste, digital supply chain innovation, traceability, IoT sensing technologies, aquaculture, functional foods/ingredients, sustainable packaging and more.



Kitchen Republic is an incubator for businesses in Amsterdam's food industry. Its 12-month incubator program is designed for food entrepreneurs with a sustainable and social focus. The program is geared towards food makers, producers and caterers in the Netherlands who are in the very early startup phase.



The Yield Lab is an agtech focused fund and accelerator and part of the global The Yield Lab federation of funds currently present in North America, Latam, Europe and Asia Pacific. It stimulates, accelerates, invests and scales sustainable and impactful agtech innovations.

Its non-residential accelerator program involves bespoke mentorship provided by subject matter experts with 20-30 years relevant technology and commercial experience. The program is held over a 12-month period to allow sufficient time for the mentoring to be provided over the produce growth cycle. With access to over 75 expert mentors and advisors within Asia Pacific (on top of several hundred experts globally), The Yield Lab is able to rapidly help move its portfolio companies into their highest addressable market to achieve maximum value market impact. Its regional accelerator will accept 6-8 companies into its cohort annually.



BLINC is the startup accelerator of Brightlands Campus, Greenport Venlo. The 3-month program supports food entrepreneurs wishing to innovate healthy and safe nutrition, agriculture/horticulture, or towards a bio-circular economy. In addition to workshops, expert sessions, coaching and guidance, the program offers access to the Brightlands campus network and work space at the campus.

Investors

This section provides a brief insight into those investing in Dutch or Singapore agrifood companies and active investors in the alternative protein space.



Investors



SEEDS Capital, the investment arm of Enterprise Singapore, catalyzes smart investments into innovative Singapore-based startups with strong intellectual content and global market potential. SEEDS Capital has appointed seven co-investment partners to catalyze over S\$90 million worth of investments into early-stage Singapore-based food and agri-tech startups. SEEDS Capital will co-invest with partners in specific ratios, up to S\$4 million for each deep-tech startup.



New Crop Capital invests in companies developing meat, dairy, eggs and seafood with plant-based ingredients or through cellular agriculture, as well as companies that promote and distribute these products. It provides angel, seed and series A funding to early stage companies. New Crop Capital is a privately held, specialized venture capital fund managed by Unovis Asset Management.



Pioneers in deploying venture capital into 'New Protein', **Visvires New Protein** (VVNP) backs ambitious teams who are developing transformative solutions for a healthier, safer and more sustainable agrifood system. Since its inception, in 2014, VVNP has helped to germinate and grow startup companies all over the world. The firm manages two funds with a global portfolio in the alternative protein space that includes Ynsect (France), Aleph Farms (Israel) and Mushlabs (Germany).

TEMASEK

Temasek is a global investment company headquartered in Singapore. It has been actively investing in promising foodtech and agritech companies, globally, over the last five years. Temasek is an early investor of startups including Impossible Foods, Perfect Day and InnovaFeed, and recently led an investment into Growthwell Group, a Singapore-headquartered plant-based meat alternatives company.



Big Idea Ventures (BIV) is a global venture capital firm with a US\$50 million fund, the New Protein Fund, that is backed by Temasek, Tyson Ventures and Buhler. This fund is used to invest in innovative startups working on plant-based food or ingredients, food technology and cellular agriculture technology. It made its first investment - in ShioK Meats - and currently has a total of 26 companies in its portfolio. BIV aims to invest in and accelerate up to 100 startups.



SHIFT Invest provides an early stage venture capital fund that invests in innovations that create an environmental or health impact alongside financial return. It focuses on four investment themes: Agriculture & Nutrients, Food & Health, Biobased Technologies and Water & Clean Technologies. SHIFT Invest is managed by New Balance Impact Investors. It has invested, among others, in Meatless, Protix and FUMI Ingredients.

Investors



Trendlines Agrifood Fund is a Singapore-based agrifood investment fund that takes on a blended early/late stage investment strategy. It invests in innovation-based early-stage agrifood tech companies in Singapore and, globally, in commercially-ready agrifood tech companies, looking to establish their Asia-Pacific headquarters in Singapore. Since the first closing of its Trendlines Agrifood Fund in Nov 2019, it has made 3 investments, which include a seed investment into Insectta.



ID Capital is an investment company headquartered in Singapore that invests in foodtech and agritech startups who are bringing more sustainability to the food chain, with a focus on Asia Pacific. It invests in Series A rounds and post-proof-of-concept startups. Its portfolio includes Ynsect (France) and InnovoPro (Israel).



CPT Capital is an investor in the alternative protein space with a mission to drive the food and materials technology revolution by replacing animals in the supply chain. It focuses on three areas within the alternative protein space: plant-based proteins, recombinant proteins and cell cultures. CPT Capital invests from pre-seed onwards with a view to backing the company all the way - be that to a sale, an IPO or longer term.



With **Capital V**, former tech entrepreneur Michiel van Deursen is investing in plant-based ventures. The portfolio includes companies focusing on meat alternatives, plant-based dairy, plant-based textile and materials, retail and direct to consumer, tech, cultured meat and additives. Michiel van Deursen was an early investor in The Vegetarian Butcher.



GROW Impact Fund, managed by **AgFunder**, invests in early stage companies, from pre-seed to Series A, developing technologies that deliver positive, material impact to the global food system. The AgFunder GROW Impact Fund invests across the entire agrifood value chain from upstream to downstream, including Future Fields (Canada) and Back of the Yard Algae Sciences (US) in the alternative protein space.



Blue Horizon is a venture capital firm that is aiming to support the movement toward a more sustainable food system through innovation, technology and entrepreneurship. Blue Horizon is investing in businesses along the value chain of plant-based food. Its portfolio also includes cellular-agriculture businesses, such as Mosa Meat.

Investors



The **HATCH Fund** is an aquaculture venture fund focused on investment into technology companies with an aquaculture or alternative seafood (plant-based and cell-based) focus as their main or initial market. HATCH raised US\$8.4 million in 2020 for investment, and its portfolio companies include Finless Foods (US) and Montana Microbial (US).



The East Netherlands Development Agency **Oost NL** focuses on strengthening and stimulating the economy of the provinces Gelderland and Overijssel. Oost NL invests in companies with solutions to major social issues and recognizes the protein transition as one of the world's greatest current challenges. Oost NL has invested in Protifarm.



Atlantic Food Labs is a launchpad for startups shaping the future of health and nutrition. It invests at the (pre)seed stage and builds companies from scratch within the food industry. The portfolio covers the entire value chain – from agtech, alternative protein sources, water supply, food security, decentralized food production, vertical farming, personalized nutrition, food waste, and carbon reduction.



In 2016, **Corpeq**, a family-owned investment and holding company, set up a fund to invest in companies contributing to more-sustainable protein use in the food or feed chain. With the CQ Green Protein Fund, it is investing in Benelux and German startups and scaleups. Its portfolio includes The Dutch Weedburger and Duplaco.



Food Ventures is a Singapore-based investment company. It partners, mentors and invests in promising food science and technology startups that have the potential to create new market spaces in Asia. It is open to investing in foodtech companies all around the world which offer products or solutions relevant to the Asian demographic. Startups that it has invested in include ChickP Protein (Israel).



VegInvest is an investment fund for early stage companies replacing the use of animals in the food industry. The venture capital firm invests in plant-based food companies, food technology companies driving innovations in synthetic biology and plant-based restaurant chains. VegInvest has, among others, invested in Mosa Meat and Shiok Meats.

Investors



The Yield Lab Fund is an agtech focused fund and part of the global The Yield Lab federation of funds. It has a portfolio of more than 42 agtech companies globally and has achieved successful exit with companies moving into Series A and B with one in Series E valued over \$150 million. Companies in the alternative protein sector include Kaffe Bueno (Denmark), Planetarians (US) and TerViva (US).



StrayDogCapital

Stray Dog Capital is a venture capital firm investing in innovative, early stage companies across the food, beverage, and biotechnology sectors that are driving a healthier, humane and more-sustainable future. It is investing in plant-based food and beverage startups and novel companies driving production of food using tissue engineering, fermentation and other biotechnology processes.



Evolv Ventures is a \$100 million venture fund backed by Kraft Heinz to invest in early stage technology companies disrupting the food industry. Its investment areas include four main categories: Food Tech (including protein alternatives), Industrial (including warehouse optimization), Retail Tech (including trade optimization), and Consumer Tech & Insights (including ecommerce platforms).

Plantbase

The Plantbase Foundation supports mission-driven entrepreneurs to accelerate the transition from animal protein to plant-based protein. Plantbase supports these entrepreneurs by either investing in the company or by making a donation. The Plantbase Foundation is financially supported by Willem Blom, entrepreneur and impact investor.



FIVE SEASONS
VENTURES

Five Seasons Ventures is a venture capital firm focused on innovative companies along the food and agriculture supply chain. New protein sources is one of its investment themes. The firm is making seed, series A, and series B investments for a healthier, more-sustainable and more-efficient food system.



Nutraeco NuFrontiers is the strategic innovation and investment department of Nutreco, a global leader in animal nutrition. NuFrontiers invests in startups and scaleups, partnerships and joint ventures with innovative companies. Alternative proteins is one of the key investments themes of NuFrontiers. Portfolio with companies including Mosa Meat and BlueNalu.

Investors



Finistere Ventures is a leading agrifood technology venture capital investor. The company partners with entrepreneurs and creative thinkers to build innovative companies that have the potential to transform modern agriculture, increase food security, improve nutrition and enhance sustainability. Finistere raised USD \$150 million for their agtech fund Finistere II.



KALE UNITED
THE FUTURE IS PLANT-BASED

Kale United is investing in plant-based companies that are actively engaged in making the world a better place by reducing their carbon footprint and improving the health of humans and animals. The Scandinavian hub for plant-based business growth is on a mission to increase awareness and availability of plant-based products globally.



Anterra Capital is an independent growth capital fund. It invests in fast growing companies that are working to make the global food supply chain safer, more efficient and more sustainable. Its focus is on supporting the growth of companies that are commercializing novel technologies and services. Anterra Capital operates out of Amsterdam, Boston and London with a global perspective.



Agronomics Limited invests in opportunities within the Life Sciences sector, concentrating on, but not limited to, environmentally-friendly alternatives to the traditional production of meat, and plant-based nutrition sources such as cellular agriculture, cellular aquaculture and the alternative protein space. Portfolio companies include ShioK Meats, Meatable and Mosa Meat.



Aqua-Spark is a global investment fund based in the Netherlands that makes investments in sustainable aquaculture businesses. The fund invests in SMEs working towards the production of safe, accessible aquatic life, in a way that does not harm the health of the planet. Recently, Aqua-Spark made its first investment in the cell-based industry, leading the series A round for Singapore's ShioK Meats.



Vevolution is a global movement for plant-powered positive change in the world. Vevolution is developing a new digital platform that will serve as a hub for the plant-based business community of entrepreneurs and investors. This platform will enable startups to meet investors, get funding quicker and accelerate their business.

Shared Facilities & Pilot Plants

This section gives an overview of shared facilities from pilot to industrial scale for the production of plant-protein ingredients, semi-finished products and consumer products.



Shared Facilities & Pilot Plants



FoodInnovate is a multi-agency initiative to grow Singapore's food manufacturing industry through innovation, with the vision to position Singapore as the leading food and nutrition hub in Asia.

Under FoodInnovate, Enterprise Singapore (ESG) collaborates with the Agency for Science, Technology and Research (A*STAR), the Economic Development Board (EDB), Intellectual Property Intermediary (IPI), JTC Corporation (JTC) and the Singapore Food Agency (SFA) to bring a suite of resources to food companies, enabling them to create and commercialize food products faster, and sell to a larger market.

FoodInnovate provides companies with access to shared facilities to trial new ideas and bring new products to market faster without investing in expensive equipment. Some of FoodInnovate's network of shared facilities are highlighted in the panel on the right.

Interested companies may refer to FoodInnovate's [web page](#) for a complete list of resource partners and their relevant capabilities. The list will be updated as and when new partners and facilities are added to the network.

FoodInnovate Network of Shared Facilities

Food Innovation & Resource Centre (FIRC)

Jointly set up by Singapore Polytechnic and ESG, FIRC is equipped with a range of application laboratories, test kitchens, pilot-plant-scale processing equipment and sensory suites, to conduct trials and turn ideas into innovative products. The Centre also provides technical expertise on new product and process development, including packaging, shelf-life sensory evaluation, automation and market testing. In addition, FIRC is building up its technical capability in plant-based food and will soon add an extruder to its pilot plant.

High Pressure Processing (HPP) Resource Sharing Facility

HPP technology can extend a food product's shelf-life while preserving its nutritional value and quality. This technology is suitable for products such as beverages and pastes, as well as ready-to-eat and ready-to-cook items. Companies may access the HPP machine at the Resource Sharing Facility - jointly set up by ESG, FIRC and Warehouse Logistics Net Asia (WLNA), on a pay-per-use basis, without the need to invest in the equipment.

Shared Production Facility

ESG, JTC and the Singapore Institute of Technology (SIT) are collaborating to set up a shared production facility (with a food processing license) where companies can rent industrial-scale equipment to produce small batches for market testing. Equipment that will be made available include a twin screw extruder, spray dryer, retort and other ancillary equipment such as packaging machines to complete the production process. This new 1,130 sqm shared food-production facility at JTC Food Hub @ Senoko will be ready by end 2021.

Shared Facilities & Pilot Plants



Bühler, the leading food technology provider and Givaudan, the global leader in flavors and fragrances, are bringing their global partnership to Asia to build an Innovation Center dedicated to plant-based food.

The new facility is planned to open in Singapore early next year and will be jointly run by the two companies, bringing together a pilot plant featuring Bühler extrusion and processing equipment and a kitchen and flavor laboratory by Givaudan. The facility will be supported by experts from both companies.

The Innovation Center will welcome food processing companies, startups and university researchers looking to develop novel plant-based food products that cater to Asian tastes, texture expectations and cooking techniques. The Innovation Centre is part of a wider global innovation network with pilot plants in Europe, the USA and China and is currently under construction at the Givaudan Woodlands site in Singapore. It is scheduled to open in early 2021.



Wageningen University & Research (WUR) – Shared Research Facilities (SRF) is closely collaborating with Foodvalley NL and working on bringing innovation to life by creating a platform of facilities that are shared within the ecosystem. The Foodvalley Facilities Team helps companies, knowledge providers and academia to find the right facility to accelerate their particular innovations. Sharing facilities is an elegant solution: research equipment, laboratories and production facilities are usually highly expensive. By creating a network of shareable facilities, wherein each user pays only for what they use, Foodvalley NL is offering a unique tool.

WUR is leading the way by sharing advanced research equipment and facilities. These are open to use for researchers from universities, research institutes and companies on a pay-per-use basis. By using a search-tool users can browse through >300 available devices. The team is also encouraging the shared use of equipment by offering investment support and subsidy for any shareable device that is not yet available in the ecosystem.

For research into plant-based protein various devices are available. Equipment for sequencing for crop selection, to measurements on composition and flavors includes various Mass Spectrometers, NMR, MRI, Infrared Spectroscopy, and high-end microscopes (TEM, SEM). Structural analysis with measurements on rheology is also possible. A specific example is the XRT scanner, which is suitable for measuring structures in 3D, with high spatial resolution of a broad range of products. Developing a proper understanding of the microstructure, particularly the spatial distribution and interaction of food components, is a key tool in developing products with desired mechanical and organoleptic properties. The scanner was bought with the support of SRF and is available for use by others.

Shared Facilities & Pilot Plants



Foodvalley Protein Facility Map The Netherlands

The Foodvalley Protein Facility Map helps companies to find facilities at pilot to industrial scale. Various facilities are available for research on and into the production of plant-based ingredients, semi-finished products and consumer-ready products.

A complete list of facilities throughout the plant protein chain is available via The Protein Cluster [web page](#). Facilities vary from contract research institutes to test kitchens to pilot & production scale partners. Two examples from the facility map are highlighted below:



The Bioprocess Pilot Facility (BPF) is a unique and open-access facility in the Biotech Campus Delft (NL) ecosystem. Together with Planetb.io, an environment is created where partners, companies and knowledge institutes can work together on developing and commercializing new circular products and production processes, in the biotechnology, domain that address pressing global societal challenges, such as the protein shift.

BPF has facilities to scale up and validate biomass pre-treatment and hydrolysis, and fermentation and purification processes. A great example is the development of plant-based protein from rapeseed by DSM (CanolaPRO™). A process which has been developed and scaled up to pre-commercial scale at BPF with specific downstream processing equipment installed at, and operated by, BPF in a certified food-grade facility.



TOP in Wageningen has assembled a pilot production plant that can be used to produce a wide range of meat analogues. The production line is

made up of several interchangeable modules, enabling us to produce almost all common vegetarian products, such as burgers, balls, sausages, minced meat, cubes, strips and nuggets. TOP opens up its pilot plant to small-scale producers, starting entrepreneurs and researchers for scale-up tests, pilot productions and small-scale co-productions. In this way, TOP wants to contribute to accelerating innovations in the development of meat substitutes and lowering the cost price across the entire breadth of the market.



FUTURE POTENTIAL

Companies and research institutes in the Netherlands and Singapore will continue to develop rapidly in areas related to the protein transition, including plant-based, cellular agriculture, fermentation and insect protein. The alternative protein market is still developing rapidly with plenty of scope for new entrants who have the knowledge and insight to unlock technical opportunities and develop products that resonate deeply with consumers.

We hope that this Innovation Scan will provide food innovators in the Netherlands and Singapore with a better understanding of the capabilities of their counterparts in both countries and inspire all parties to collaborate and co-innovate to bring new products to the EU and APAC markets, and to the rest of the world.

We would encourage you to pause here and consider how much further, faster and better your businesses could go with a little more collaboration. Do get in touch with us if you wish to know more about any of the companies, research institutes or organizations featured in this Scan and we will be happy to facilitate an introduction where possible.

Miranda van Dijck
Innovation Analyst, Foodvalley NL

Angelin Yeo
Senior Development Partner, Enterprise Singapore



Miranda van Dijck
Innovation Analyst
Foodvalley NL
miranda.vandijck@foodvalley.nl



Angelin Yeo
Senior Development Partner
Enterprise Singapore
angelin_yeo@enterprisesg.gov.sg

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