By Denmark
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INGREDIENTS

LEADING INNOVATION TOWARDS SUSTAINABLE FEED AND FOOD

INSIDE THIS WHITE PAPER:

- **Innovative ingredients are made in partnership**
- **Enablers of global health and wellbeing**
- **Resourceful solutions for sustainable food**

FOOD NATION
Solutions of tomorrow
By Denmark

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Ingredients

Leading innovation towards sustainable feed and food
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EXECUTIVE SUMMARY

Denmark's ingredient sector is a one-stop shop for solutions to the challenges facing the global feed and food industry. As world demand grows for a safe and sustainable food supply, Danish ingredient companies enable feed and food manufacturers to make better use of resources, improve access to nutrition and support the health and wellbeing of livestock and consumers.

Through their bioscience capabilities and cross-sector collaboration, Danish ingredient companies have captured a large share of the world market for feed and food ingredients. Together, they are helping to set a new international agenda for food production. Case stories throughout the publication illustrate some of the recent solutions.

> This Danish way of working enables far-sighted research and development and the rapid implementation of results in innovative commercial products

World events are a regular reminder of the importance of safe, nutritious and good quality foods – and the risks to human health and the planet when standards are not met. In Denmark, ingredient companies partner with feed and food manufacturers, universities and government authorities to develop solutions that can prevent or minimise such risks. This Danish way of working enables far-sighted research and development and the rapid implementation of results in innovative commercial products.

The ingredient sector is a national priority area for the Danish government. A targeted ingredient strategy is today in place to support the growth of the sector and its contribution to the UN Sustainable Development Goals.

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INDEX

Foreword

Chapter 1 **Innovative ingredients are made in partnership**
Collaborative solutions to food supply challenges

Chapter 2 **Only the best quality from feed to food**
Driving international standards for superior feed and food safety

Chapter 3 **Enablers of global health and wellbeing**
The bioscience behind ingredient innovation

Chapter 4 **Resourceful solutions for sustainable food**
Important steps towards a circular economy

Chapter 5 **A step ahead of the world's changing needs**
The experience to guide the appliance of science

Chapter 6 **Investing in ingredients is a national priority**
Strategies for nourishing future generations

Supporting the SDGs
How does Denmark contribute?

With the 17 UN Sustainable Development Goals (SDGs), the UN has created a common framework for global challenges. The Danish ingredient industry has taken the SDGs on board, alongside many other stakeholders within the Danish food sector. Today, the SDGs serve as a guiding light for establishing the best food and feed production practices, prioritising research and development efforts and identifying innovation targets that will drive us towards a sustainable future.

An efficient and sustainable food sector will directly or indirectly contribute to all 17 goals. However, there are some goals where the strongholds of the Danish ingredient industry are expected to make a particular impact. These include **Goal 2** *End hunger, achieve food security and improved nutrition, and promote sustainable agriculture and* **Goal 3** *Ensure healthy lives and promote well-being for all at all ages* and **Goal 12** *Ensure sustainable consumption and production patterns.*

Achieving the ambitious goals of the 2030 agenda requires global support and partnerships. Extensive collaboration throughout the food value chain and between industry, academia, health NGOs and government is an outstanding characteristic of the Danish ingredient industry – accelerating progress with national and international initiatives and directly contributing to **Goal 17** *Strengthen the means of implementation and revitalize the global partnership for sustainable development.*

SUSTAINABLE DEVELOPMENT GOALS

FOREWORD

Photo: Keld Navntoft

The global food supply is full of challenges and opportunities. In Denmark, the ingredient industry has a track record for innovative and sustainable solutions.

Within the global feed and food industry, Denmark has earned a reputation as one of the absolute leaders for innovative ingredients. Today, Danish ingredient companies export 70% of their production and account for a significant share of the world market. That makes them well placed to help farmers, feed suppliers and food companies ensure a safe, nutritious and sustainable food supply to feed the growing global population.

In Denmark, you will find an ingredient industry skilled in developing solutions that improve the efficiency and quality of food production. Our ingredient professionals lead the development of enzymes, cultures, proteins and functional ingredients for nutritious and appealing foods. Many others focus on developing proteins, enzymes and vitamins for high-quality feed that supports animal growth and welfare – the essential starting point for high food safety standards in meat and dairy production.

These ingredient solutions not only deliver functional benefits to feed and food. In many cases, they also optimise the use of raw materials by reducing waste and extending shelf life. A number of ingredient manufacturers even base their production on leftover raw materials from other production plants. Innovative whey proteins, for example, make use of the whey from cheese production, while recycled trimmings from fish processing become nutrient-rich fishmeal for animal feed.

Our collaborative strategy

As in many other walks of Danish life, ingredient companies rely on cross-sector collaboration with relevant industry partners, academia, public authorities and government to maintain their competitive edge. Such mutual knowledge-sharing, research and development are all part of our cultural tradition in Denmark, rooted in our first farmer-owned cooperative more than 150 years ago.

The Danish government recognises the need to continue working closely with the ingredient industry, which we see as a key player in setting the future direction for feed and food production. This is why, in 2019, the government initiated a new ingredient strategy to support the industry's growth and promote the use of innovative ingredient solutions that enable improved health and sustainability.

A strong value proposition

For generations, the ingredient industry in Denmark has demonstrated its ability to respond to new challenges and opportunities in the farm to fork supply chain. In the current age, this is a powerful value proposition.

The commitment to continuous innovation has made Denmark a frontrunner for ingredient solutions that contribute to the UN Sustainable Development Goals (SDGs) – whether the aim is to reduce the climate impact of feed and food production, make safe and healthy food accessible to all or meet the nutritional needs of consumers throughout life.

This white paper provides an overview of the Danish ingredient industry and the solutions that we believe will play an important role in the green transition by contributing to a reliable and sustainable food supply for tomorrow. We hope to inspire you.

Mogens Jensen

Minister for Food, Fisheries, Equal Opportunities and Nordic Cooperation of Denmark

CHAPTER 1

INNOVATIVE INGREDIENTS ARE MADE IN PARTNERSHIP

COLLABORATIVE SOLUTIONS TO FOOD SUPPLY CHALLENGES

Photo: Food Nation

Denmark has built a reputation for ingredient solutions that make more with less in livestock farming and food production and improve consumer access to safe, nutritious and tasty foods

Global demand for a safe and reliable food supply puts increasing pressure on the planet's resources. The challenge for farmers and food companies is to produce enough food for the world's growing population in a sustainable way. Ingredients play a central role in many of the solutions.

> By working across cultures, the Danish tradition for science-based innovation reaches far and wide

Around the world, Denmark is known for its high concentration of ingredient companies and expertise. Together, they make up an ecosystem of knowledge and innovation, delivering ingredients that boost the digestibility and efficiency of animal feed, for example, or bring a specific taste, texture or nutritional quality to food.

Danish ingredient companies make it possible for feed and food manufacturers to act on a fast-developing market trend, a change in legislation or consumer demand for more transparency in the supply chain. And, in the drive to produce more with less, ingredients create opportunities to cut back on waste while optimising food safety.

Over the years, Danish companies have captured a significant share of the global market for feed and food ingredients. A number of them are leaders in their field, with an already proven ability to boost the local and global food supply. Their approach to sustainability gets them noticed, too. In the Corporate Knights' 2020 ranking of the Global 100 Most Sustainable Corporations, Danish bioscience companies were listed among the top ten.

Collaboration-driven innovation

One of the biggest reason for Denmark's leading position in the global ingredient industry is the close collaboration that takes place across the food value chain. The Danish ingredient sector is dominated by partnerships where industry players work ambitiously with government authorities, scientific research institutions and other organisations to generate innovative technology and knowledge.

This includes collaborating with universities to develop new, climate-friendly protein sources from grass, for example, or with an NGO to investigate how whey ingredients can facilitate the production of affordable yoghurt for malnourished children in Ethiopia. Strong working relations with farmers are again key to developing and testing new feed ingredients, such as an enzyme that makes the potato pulp left over from starch extraction easier to digest as animal feed.

At government level, ingredient companies work with the Danish Food and Veterinary Administration to support the approval process of novel foods and feed additives. Cross-sector collaboration in a spirit of mutual trust and openness enables a faster response to each new challenge – and a shorter time to market for new ingredient solutions.

Made for many needs

Food manufacturers work continuously to meet the needs of specific consumer groups in their markets. To support regional food product development, many Danish ingredient companies have established international innovation centres. The objective is to develop ingredient solutions for foods that match local trends and preferences, often based on locally grown raw materials. By working across cultures in this way, the Danish tradition for science-based innovation reaches far and wide.

17 PARTNERSHIPS FOR THE GOALS

A successful sustainable development agenda requires inclusive partnerships between governments, the private sector and civil society. Common to each partnership are a shared vision, values and goals, where people and the planet are central. Through a long-standing commitment to such partnerships, the Danish ingredient industry contributes to for example:

17.17 Encourage and promote effective public, public-private and civil society partnerships, building on the experience and resourcing strategies of partnerships.

THE DANISH INGREDIENT INDUSTRY IN BRIEF

The Danish ingredient industry produces ingredients that are added to feed or food to obtain a specific functionality or nutritional profile.

Food ingredients are used to meet consumer expectations for convenience, appearance, taste, texture and nutritional properties, for example, or as processing aids in production.

Ingredients for feed meet the nutritional needs of animals while improving welfare and productivity and reducing the environmental impact of livestock production. As the illustration shows, ingredients are relevant to a wide range of products in addition to food and feed.

Raw materials

Plant-based raw materials
e.g. potatoes, rapeseed, cereals, peas, citrus fruits, soy beans

Animal raw materials
e.g. pigs, cattle, poultry, fish, larvae, insects

Ingredients

Macronutrients
e.g. proteins, starches, fat, oils, extracts, spices

Cultures and technical catalysts
e.g. enzymes, starter cultures, specific bacteria strains

Additives
e.g. emulsifiers, stabilisers, sweeteners, colourants, flavourings

Bioactive substances
e.g. antioxidants, vitamins, biocides

Products

Feed and food products
i.e. products for animal and human consumption

Other products
e.g. bioenergy, fertilisers, plant protection products, plastic, perfumes, pharmaceuticals, detergents, toothpaste, cosmetics

INNOVATIVE PARTNERS DEVELOP SUSTAINABLE LOCAL PROTEIN

Ambitions are high in Denmark when exploring new opportunities for local production of sustainable plant protein for feed and food. To speed up the development process, ingredient, feed and food companies joined forces with universities to establish the Danish Protein Innovation partnership in 2018.

Grass currently holds the biggest potential as a protein-source for feed. At Aarhus University, pilot production trials have demonstrated the suitability of concentrated, biorefined grass protein in feed for pigs and poultry, which are unable to digest grass directly from the field. With additional refining, the protein could also be fit for human consumption.

Photo: Food Nation

Ingredient, feed and food companies join forces with universities to develop local protein

Once the protein is extracted, the remaining grass components are suitable for cattle feed. The juice can be used in biogas production, so all parts of the grass are used.

In cooperation with other agricultural companies and with the support of a public grant, the farmer-owned agricultural supply company DLG is establishing Denmark's first commercial green biorefinery. The first priority is to produce organic protein feed for poultry and cattle from clover grass and alfalfa, which can be grown without pesticides and nitrogen addition. Initially grown on 2,000 hectares of land, these crops will provide the raw material for producing 4,000 tonnes of protein a year.

Looking ahead, green biorefining can pave the way to a partial conversion of corn crop production to grass crops. Great environmental benefits await due to the ability of grass to bind carbon into the soil, cutting emissions, and the reduction of nitrogen runoff into waterways. In addition, the pesticide-free grass production improves the soil's humus layer and strengthens biodiversity.

Case by Danish Protein Innovation

FAIR TRADE IS THE STARTING POINT FOR HIGH-QUALITY FATS

Photo: Charlotte Kropholler

Shea kernels are one of the most sustainable sources of vegetable oils

Thousands of West African women have gained a stable income and the opportunity to send their children to school since vegetable fats and oils company AAK launched its Kolo Nafaso programme.

The women make their living by collecting wild-growing shea kernels in the Sahel Belt. Today, through Kolo Nafaso, they are able to sell the kernels directly to AAK at a fair price.

The programme is not just about trade. AAK's local extension officers also train the women in good agricultural practices and other useful skills, such as building efficient rocket stoves for boiling the shea kernels. This is the important first step to ensure the high quality of AAK's speciality fats.

The benefit to AAK and its customers is a fully traceable, reliable supply of a key raw material, which goes into speciality fat solutions for chocolate confectionery and personal care products.

Requiring no land clearing or plantations, shea kernels are one of the most sustainable sources of vegetable oils on the planet. Every year, a significant share of the exported kernels arrives for processing in the large AAK plant. Around 10% come from the more than 230,000 women in the Kolo Nafaso programme.

Case by AAK

CROSS-BORDER TEAM CREATES A LEADING CAKE BRAND

International collaboration was at the highest level when a large manufacturer of dried noodles and biscuits in the Philippines decided to make the move into the soft cake category. The manufacturer contacted the regional office of Danish emulsifier and stabiliser producer Palsgaard to help with the product development.

Palsgaard pooled the expertise of the technical specialists working in its application centres in Singapore and Denmark. The team then worked with the manufacturer's product development team to create a new line of Filipino mamon cakes. Palsgaard also helped out with the choice of equipment for the production line and the running of production trials.

Photo: Palsgaard

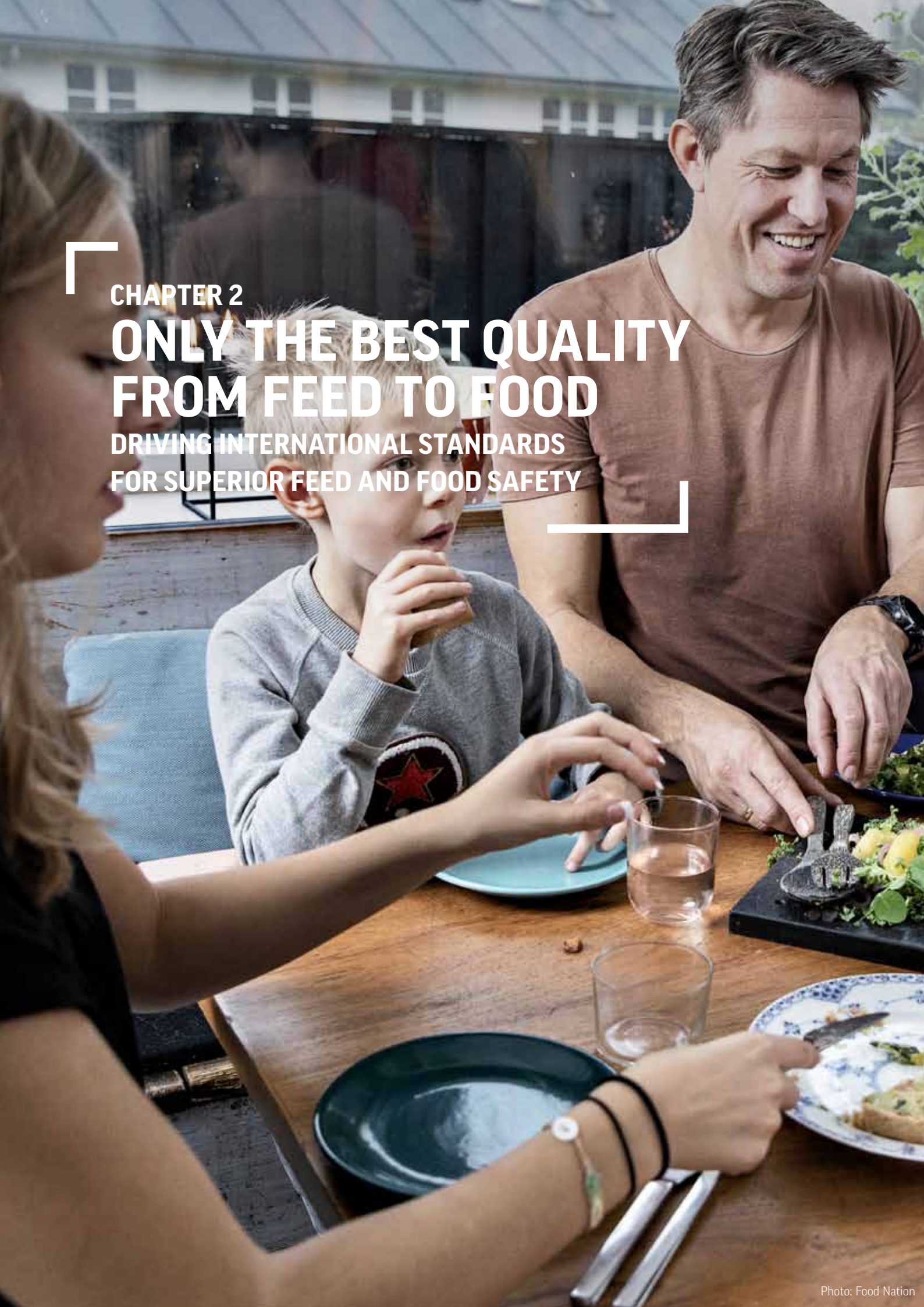
Technical specialists worked closely with the manufacturer's product development team

Today, the cake brand has become one of the manufacturer's most popular lines – exported all over the world.

Strong development partnerships are just one reason for choosing Palsgaard. Another has to do with the increasing global focus on minimising carbon footprint.

Since 2018, Palsgaard has been able to write 'produced in CO_2-neutral factories' on the label of all the ingredient solutions it supplies. After years of continuous investment in wind energy, solar panels, biogas and other initiatives, the company reached its carbon-neutral production target two years earlier than planned.

Case by Palsgaard



CHAPTER 2

ONLY THE BEST QUALITY FROM FEED TO FOOD

DRIVING INTERNATIONAL STANDARDS FOR SUPERIOR FEED AND FOOD SAFETY

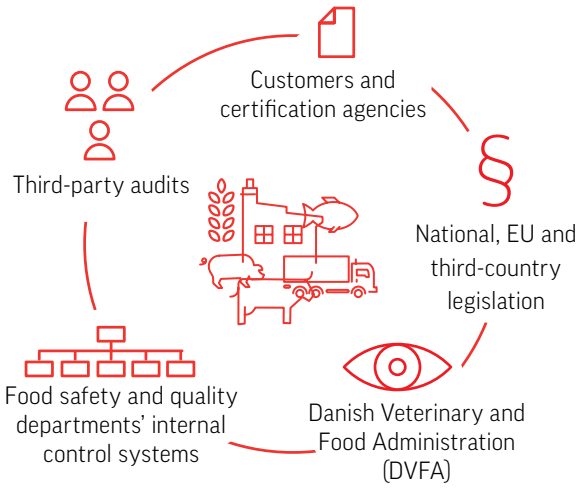
Photo: Food Nation

Ingredient technology from Denmark sets the highest standards for quality and food safety – earning the trust of feed and food manufacturers everywhere.

Foodborne diseases and food adulteration are a huge health burden, a barrier to trade and an area of immense concern. Among consumers, media reports of food fraud are driving a growing desire to know where food comes from, what the food products contain and what is written on the label.

First-class quality and food safety standards are a hallmark of the Danish ingredient industry – a reputation that has opened the door to global markets and built trust. Today, these reliably high standards are the reason why Danish companies can supply ingredients for products that satisfy the requirements of the most demanding food safety authorities in the world.

The 360° quality and safety system of the Danish food value chain



Convenient and authentic food

As urbanisation brings more people to the cities, demand for convenient, processed foods that are either ready to eat or can be prepared in minutes is exploding all over the world. At the same time, consumers want to buy authentic food that is as natural as possible. Ingredient lists on food packaging must be short and include familiar raw materials.

Danish ingredient companies develop solutions that, with minimum addition or change, can protect foods from spoilage during shelf life while maintaining the sensory and nutritional quality that consumers look for. That could be a natural rosemary extract that acts as an antioxidant in meat products, for example, or a natural flavor enhancer made from beef or chicken stock to give ready meals a taste of home.

Efficient own-check programme

To maximise food safety from farm to fork, feed ingredients are subject to stringent standards for hygiene and quality control to eliminate risks to animal health. For this reason, all companies responsible for producing, handling or selling feed ingredients must be registered or approved by the Danish Veterinary and Food Administration.

Collaboration between supervising authorities, farmers, feed and food producers and ingredient manufacturers ensures these high standards are maintained throughout the feed and food value chain. This includes an efficient own-check programme, whereby suppliers are responsible for identifying risks and assuring the quality of their products in line with current legislation. In this way, the ingredient industry helps push back the boundaries for safe feed and food production and contributes to the development of ever-higher international standards for food safety, hygiene and quality. This is critical to maintaining the high credibility and reliability of the Danish veterinary health certificates that accompany consignments of goods to more than 190 countries around the world.

> First-class quality and food safety standards are a hallmark of the Danish ingredient industry

Within Danish ingredient companies, extensive research and development continues to result in new solutions to ongoing challenges for feed and food. Using these innovative ingredient technologies, manufacturers can satisfy the quality demands of consumers and strengthen their food safety efforts.

2 ZERO HUNGER

The global food and agriculture system must be transformed to provide safe, nutritious and sufficient food for the more than 820 million people who are hungry today and the additional 2 billion people expected to be undernourished by 2050. By providing solutions for enhanced food quality and safety and better utilisation of local produce, the Danish ingredient industry contributes to for example:

2.1 End hunger and ensure access by all people to safe, nutritious and sufficient food all year round.

2.4 Ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production.

RICH INGREDIENTS FRESH FROM THE SEA

Photo: Mai Mortensen

Fishmeal and fish oil rank among the most valuable ingredients in feed for aquaculture and livestock on land. Their composition of amino acids, vitamins and minerals is indispensable to growth and physiological function. So, securing high nutritional quality and safety throughout production is paramount.

With total exports of around US$ 556 million, Denmark is Europe's leading producer of fishmeal and fish oil by far. The two largest Danish producers – TripleNine and FF Skagen – deliver to the feed and pet food industry all over the world.

The primary raw materials for both companies are either small, short-lived fish with little or no potential for use in direct food production or upcycled trimmings from fish processing. Used in the production of fishmeal and fish oil, these valuable resources deliver essential nutrients to the fast-growing global aquaculture sector in particular.

> Continuous quality control ensures all raw materials are fresh and traceable back to origin

Continuous quality control ensures all raw materials are fresh and traceable back to origin. In this way, the highest quality and safety standards are always met. Responsible sourcing with minimal impact on marine ecosystems is all part of that quality hallmark. This is whyTripleNine and FF Skagen strive to use fish stocks that either comply with the Global Standard for Responsible Supply of Marine Ingredients (IFFO RS) or are certified by the Marine Stewardship Council (MSC).

Case by Marine Ingredients Denmark

PROTECTIVE BACTERIA FIGHT PATHOGENS IN MEAT

Sometimes the best strategy for eliminating pathogenic bacteria is to fight them with other bacteria. Called bioprotection, it's a strategy that Danish ingredient company Chr. Hansen has refined over the past two decades, specifically to protect against harmful contaminants in bacon and fermented meats.

Research at the University of Copenhagen was the initial inspiration. In collaboration with the Danish Technological Institute and the meat industry, a study found antimicrobial activity in some of the lactic acid bacteria already naturally present in meat products.

> Lactic acid bacteria cultures inhibit food spoilage and protect against harmful contaminants

The findings led to the identification and development of specific lactic acid bacteria for effective elimination for Listeria monocytogenes – a pathogen of risk to human health and capable of surviving in conditions where other bacteria do not.

As a result, Chr. Hansen now offers an extensive portfolio of lactic acid bacteria cultures that both inhibit food spoilage and protect against harmful contaminants. Used in bacon or salami, for example, they improve colour, flavour and texture development at the same time – completely naturally and without need of other additives.

Meat manufacturers cannot afford to leave anything to chance. Bioprotection has become an important tool for ensuring a uniform high standard of food safety and quality with every batch.

Case by Chr. Hansen

Photo: Chr. Hansen

CHAPTER 3

ENABLERS OF GLOBAL HEALTH AND WELLBEING

THE BIOSCIENCE BEHIND INGREDIENT INNOVATION

Photo: Food Nation

From improved welfare in livestock production to nutritious and appealing foods for consumer needs, the Danish ingredient industry provides solutions for all.

Consumers worldwide are increasingly aware of the diet's importance to health and well-being and to the prevention of lifestyle-related conditions, such as obesity, cardiovascular disease, type 2 diabetes and certain cancers. Today, there is a growing trend towards foods that can support specific nutritional needs throughout life, from childhood to old age. As more foods with nutrition or health claims are launched on the market, there are now clear signs that many consumers prefer them to dietary supplements.

The Danish ingredient industry is an essential enabler of foods with an improved nutritional profile. This includes supporting food manufacturers with solutions that allow them to reduce the salt and sugar content of their brands without sacrificing consumer enjoyment. In recent years, new ingredient technology has emerged for high quality gluten-free bread or lactose-free dairy products, broadening the choices available to consumers with food allergies and intolerances.

Many companies use bioscience to develop ingredients with direct benefits for consumer health. For this reason, clinical studies are often conducted in collaboration with external research partners, for example to document the effects of special whey proteins, dietary fibres or cultures for the world's growing food ingredient market. Essential vitamins and minerals are also among the many opportunities for food and beverage enrichment.

Nutrients for healthy livestock

Health and wellbeing are similarly top of mind for livestock farmers. In recent decades, new regulations regarding the use of antibiotics and increased global understanding of the threat of antibiotic resistance have driven changes in farming practices. In Denmark, pig farmers have cut their use of antibiotics by more than 30% over the past ten years without compromising animal health. This is the result of gradual reductions in line with the implementation of new regulations. As a result, antibiotic consumption in Danish livestock production is now among the lowest in Europe.

> Many companies use bioscience to develop ingredients with direct benefits for consumer and animal health

Danish ingredient companies continue to play an important role in this shift by supplying feed ingredients that are easy for young animals to digest and contribute to increased growth and an overall improvement in animal performance.

As Europe's largest exporter of fishmeal and fish oil, Denmark is a reliable source of essential nutrients for land-based livestock and aquaculture. Piglets, in particular, benefit from the highly digestible amino acids, minerals and other nutrients in fishmeal. Research suggests that fishmeal and fish oil nutrients in feed are later transferred to humans via their meat consumption.

> Denmark supplies 30% of the vitamin and mineral blends used for livestock feed in Europe

3 GOOD HEALTH AND WELL-BEING

Significant strides have been made to address nutrition-related, lifestyle diseases, reduce child mortality and increase life expectancy, but there is still much to be done to improve the health of the world's growing population. By providing solutions for nutritious foods, the Danish ingredient industry contributes to for example:

3.2 End preventable deaths of newborns and children under 5 years of age.
3.4 Reduce by one third premature mortality from non-communicable diseases through prevention and treatment.

DANISH INGREDIENTS ARE ENABLERS OF FOODS FOR NUTRITIONAL NEEDS THROUGHOUT LIFE

SOLUTIONS FOR SPECIAL NUTRITION

Weight management
People who are overweight or obese can benefit from foods that are low in fat and sugar and which promote satiety. Danish ingredient companies supply solutions for foods that meet these demands while maintaining their sensory appeal. Certain ingredients may also support blood sugar control.

Nutrition for sportspeople
Athletes rely on their diet to support muscle recovery and growth for a top sports performance. Danish ingredient companies can deliver solutions for protein-rich nutrition.

Food for special medical purposes
Malnourishment is a major risk for some population groups. Danish companies supply vitamins, minerals and proteins for nutritionally enriched diets. Flavours and texturants play an important role in making foods appealing.

Malnutrition prevention
Malnutrition is a frequent cause of wasting and stunting among children in developing countries. The Danish ingredient industry shares expertise with local food producers and delivers bioavailable proteins, energy-dense carbohydrates, vitamins and minerals for appropriate food solutions.

INNOVATIVE ENZYMES OVERCOME THE TRANS FAT RISK

Trans fats have long been linked to cardiovascular disease. According to the World Health Organization, an estimated half a million deaths could be prevented each year by reducing trans fats in everyday food products, including margarine, cakes, fried foods and salad dressings.

The problem of trans fats arises when margarine and other vegetable fats and oils are subjected to a partial hydrogenation process to obtain the right melting properties and shelf stability. Today, that process is no longer necessary. Using a ground-breaking enzyme from Danish Novozymes, it is possible to produce margarine with all the desired qualities while avoiding trans fats altogether.

Novozymes is always looking for ways to develop better, more environmentally-friendly products. In addition to eliminating trans fats, its special enzyme removes the need for chemicals, washing and post-bleaching processes, so no wastewater is produced. Due to the reduced number of processing steps, manufacturers save on energy and water consumption overall.

Innovation like this helps food manufacturers keep pace with international consumer demands and changes in legislation, whether the aim is to limit harmful trans fats in food or overcome new taxes on sugar.

Photo: Novozymes

A ground-breaking enzyme can avoid trans fats in margarine

For sugar reduction purposes, Novozymes has also developed an enzyme solution that makes it possible for bakers to cut sugar addition in bread without compromising quality. The knock-on benefit is an up to 20% saving on sugar expenses.

Case by Novozymes

PIGLETS THRIVE ON THE SMALLEST INGREDIENTS

Photo: DVSA

Feed mix help build muscle tissue in piglets

Carefully formulated feed mix is vital to healthy piglet growth from just a few days after birth. Even though vitamins and minerals are only a small part of the mix, they contribute to as much as 80% of a pig farm's productivity – by stimulating biological processes and helping to build muscle tissue.

Danish Vilofoss is a specialist in vitamins and minerals for piglet feed and an expert in formulating customised premixes for pig production. It's also a company that understands the importance of early feed intake for getting piglets off to the very best start.

If piglets increase their feed intake by 100g during the first week after weaning, then they will weigh a full kilo more at the age of 42 days. That's a sign of good health – both for the piglets and for the farmer's business.

The key to success is to keep the digestive tract in balance without using high levels of zinc, which will be subject to an EU ban from June 2022. This is why Vilofoss weaner blends are based on highly digestible raw materials with plenty of flavour and aroma to encourage a healthy appetite.

Multiple trials in a Danish commercial piglet unit and independent scientific testing confirm that, by using tailored Vilofoss products, it is possible to achieve optimal piglet performance without zinc oxide or increased antibiotic use.

Case by Vilofoss

NUTRITION FOR LIFE – ALL IN A WHEY PROTEIN

People are living longer all over the world. This makes it more important than ever to focus on helping the elderly maintain an active and independent life for as long as possible.

One of the biggest challenges is to maintain muscle mass throughout all stages of life. This is where protein makes a major contribution. Farmer-owned ingredients supplier, Arla Foods Ingredients has built a business on developing speciality whey proteins and exploring the opportunities to incorporate them in everyday diets. The proteins are now widely used for their functional and nutritious benefits in a wide range of foods – including early life nutrition, sports nutrition and health foods.

Just a few decades ago, whey was regarded as nothing more than a low-value sidestream of cheese production. The pioneers behind Arla Foods Ingredients were the first to see the potential and drive the development of a whole new ingredient category. Today, they continue to uncover the value of whey.

Case by Arla Foods Ingredients

Speciality whey proteins are widely used for everyday diets

Photo: Arla Foods Ingredients

‘SWEET’ CULTURE REDUCES ADDED SUGAR IN YOGHURT

Photo: Chr. Hansen

New yoghurt culture increases the sweetness of yoghurts while reducing the need for added sugar

In today’s market for fermented dairy products, the pressure is on for dairy manufacturers to reduce added sugar, especially in yoghurt. Health organisations, governments and retailers are setting targets for sugar reduction in foods, while consumers increasingly look for naturally healthy products with a great taste.

Danish bioscience company Chr. Hansen has developed the first yoghurt culture in the world that allows dairy manufacturers to increase the sweetness of yoghurts while reducing the need for added sugar or artificial sweeteners by up to 25%.

The new culture is called Sweety® and converts milk’s own sugar resource – lactose – into high-sweetness glucose. This reduces the need for adding extra sugar to obtain the desired sweetness. At the same time, it ensures the yoghurt keeps its mild and appealing flavour throughout shelf life.

The innovative culture has attracted international attention. At Food Ingredients Europe 2019, Sweety® won the Reformulation Innovation Award as the best solution for improving the nutritional profile of a food product while maintaining sensory and physical properties at no extra cost.

Case by Chr. Hansen

REDUCING SUGAR CONTENT IN FRUIT-FLAVOURED DRINKS

Levels of childhood obesity are rising in many countries round the world – and consumption of sugar-sweetened beverages is believed to be a contributing factor.

CP Kelco, a global nature-based ingredient company with operations in Denmark, has found a solution in pectin, derived from sustainable sources of citrus peel. Using this consumer-friendly ingredient, they developed an opportunity to produce a fruit-flavoured drink with less sugar, without sacrificing taste and texture.

Although consumers increasingly demand healthier products, they still expect a familiar taste and texture. This is what often makes product reformulation a challenge.

By analysing the sensory profile of fruit-flavoured drinks, CP Kelco figured out the key sensory aspects to meet consumer expectations. This then became the basis for creating an alternative formulation for soft drinks that deliver all the taste and texture of sugar with less sugar addition.

Case by CP Kelco

Reduced sugar soft drinks with the taste and texture that consumers expect

CHAPTER 4

RESOURCEFUL SOLUTIONS FOR SUSTAINABLE FOOD

IMPORTANT STEPS TOWARDS A CIRCULAR ECONOMY

Photo: Novozymes

The Danish ingredient industry enables farmers and food manufacturers to produce more with less, reduce their environmental impact and cut down on waste.

Ingredients that optimise processing efficiency and maximise raw material yield are already making a difference in the effort to secure the global food supply. Such solutions will become even more important in the years ahead. As statistics show around a third of global production goes to waste, there is still much to be done.

A number of Danish ingredient manufacturers have built a business on the reduction of food waste. These are companies that find their key raw materials in the side streams from food production, such as orange peel from juice production, whey from cheese processing or in animal by-products from fish and meat production.

By upgrading side streams to high-value ingredients for feed and food, they make their own special contribution to a circular economy.

> Better feed efficiency means lower environmental impact per animal produced

Resource-efficient feed for meat production is another area where Danish ingredient suppliers can make a noticeable impact. As demand grows for animal-derived foods, livestock producers face the challenge of increasing their production of healthy animals, while minimising their environmental footprint. Arable farmers, on the other hand, need natural solutions that can protect plants from drought, heat and disease. Well-aimed ingredient solutions make that possible.

Healthy animals with less feed

Denmark leads the way in the research and development of ingredients for efficient poultry, fish and pig feed. The goal is to ensure the highest possible bioavailability of the feed, supporting healthy animal growth. So, by the time animals reach their slaughter weight, they are likely to have consumed less feed to get there.

The use of ingredients for better feed efficiency means that the environmental impact per animal produced is lower on Danish farms than in many other countries. In other words, energy and water consumption, land use requirements and the nutrient content of manure are all reduced.

One good example is a feed enzyme developed by the biotechnology company Novozymes in partnership with DSM, a producer of science-based nutrition and health solutions. The enzyme works by improving the functionality of the gut in broiler chickens – enabling farmers to produce 3% more meat from the same amount of feed, reducing CO_2 emissions at the same time. Denmark is also one of the first countries to use phytase enzymes to increase the bioavailability of phosphor in feed, reducing the need for phosphorus addition and lowering phosphorous emissions to the environment.

Minimising food waste

Another way to tackle the growing demand for food is to ensure that consumers eat more of the food that is produced instead of wasting it. In the EU, 70% of all food waste occurs in households, retail outlets or in the food service sector. Much of this waste is because the sell-by date has expired.

This is where ingredient companies help food products stay on the shelf for longer. Bakery enzymes, for example, can slow the staling process, so bread keeps its soft, fresh feel right down to the last slice. Natural cultures can increase yoghurt shelf life by at least seven days by reducing the risk of yeast and mould spoilage – a solution with the potential to reduce yoghurt waste by 30% in Europe alone. Antioxidants can delay the onset of rancidity in products such as cooking oil, margarine and snacks. And emulsifiers can act as anti-fogging agents in polyethylene film so chilled food products in trays maintain their quality and appeal for longer.

The quality of foods exported to consumers around the world is often challenged by long transport times. Here, again, the Danish ingredient industry can support the production of foods with an extended shelf life, giving manufacturers a wider geographical reach.

12 RESPONSIBLE CONSUMPTION AND PRODUCTION

Worldwide demand for food is growing fast, increasing the pressure on natural resources and ecosystems. Sustainable consumption and production entails involving everyone in the supply chain from producer to consumer. By providing solutions that optimise the use of resources in feed and food production and reduce food waste, the Danish ingredient industry contributes to for example:

12.2 Achieve the sustainable management and efficient use of natural resources.
12.3 Halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains.

PURE PROTEIN FROM A HUMBLE SOURCE

World population growth has created an urgent need for new sustainable sources of protein. As the search goes on, there is one source that has long gone under the radar – the humble potato. KMC, a Danish ingredient company owned by potato farmers, recognised the potential.

KMC has specialised in producing functional ingredients from potato starch for a wide range of food products since 1933. During that time, the company has mainly sold the protein-containing side stream from starch production for feed.

Today, following intense product development and a major investment in processing technology, the company has launched its first commercial potato protein for food on the market – a development that both maximises the utilisation and value of the potato harvest and helps food manufacturers meet rising protein demands.

The side stream of starch production is a new sustainable source of protein

Now, only the mineral-containing potato juice remains at the end of the KMC production line. KMC sends this back to the fields to nourish the next season's crops – completing a circular supply chain, where nothing goes to waste.

Case by KMC

LONG-LASTING APPEAL CUTS MEAT WASTE

Photo: Essentia

Appearance is everything when consumers buy fresh meat and poultry. So, if a product loses colour or liquid seeps into the packaging, consumers will believe it to be poor quality or spoiled – and it will probably never be sold.

A global ingredient producer based in Denmark, Essentia Protein Solutions has developed a natural ingredient range to help manufacturers maximise their products' appeal throughout shelf life.

Essentia's functional meat proteins, for example, minimise liquid seepage and keep pre-shaped products like patties and meatballs in shape. Micro-granulated meat pigment is available to give meat products a stable colour without need of further additives.

In years gone by, slaughterhouses struggled to find an outlet for meat by-products like pork rind and greaves. Today, these by-products are the raw material for Essentia's functional ingredient production. In other words, former waste products are now being used to reduce meat waste in the chilled counter.

Functional meat ingredients give a better shelf life

The multi-functional proteins provide other benefits too. These include improving meat texture and structure and speeding up the drying process of dried and fermented meat products.

Case by Essentia Protein Solutions

MAKING PLANT-BASED YOGHURTS TASTE GREAT – AND LAST LONGER

Plant-based yoghurts have captured attention all over the world. Previously targeted at a small vegan minority, the growing consumer desire to eat more sustainable food has driven dairy alternatives into the mainstream.

DuPont Nutrition & Biosciences supports manufacturers with innovative solutions all the way. This includes delivering efficient starter cultures that unlock each plant base, optimise the fermentation process and ensure the appealing taste and texture of each new product.

Drawing on long experience with yoghurt cultures and plant-based proteins, DuPont has also introduced HOLDBAC® YM VEGE cultures, which are designed to protect plant-based yoghurts against spoilage by yeasts and moulds – extending shelf life by up to 10 days.

Studies estimate that 15-17% of all yoghurt in the EU is thrown away. By giving plant-based yoghurts a longer shelf life, DuPont protective cultures have the potential to cut waste-related carbon emissions by 1.2 million tons a year.

Cultures optimise the fermentation, taste and texture of plant-based yoghurts

Case by DuPont Nutrition & Biosciences

INNOVATIVE PROCESS LEADS TO LIFELONG BENEFITS

Piglets and other young animals have an immature gut with a limited ability to absorb nutrients. So, if their feed is hard to digest, the consequences can be severe for health, growth and feed utilisation – serious risks for farmers who need to produce high-yield livestock with fewer resources and full consideration for animal welfare.

Danish supplier of speciality feed proteins, Hamlet Protein began working on a solution to the problem three decades ago. Their first innovation became the benchmark for a whole new category of easily digestible, premium soy bean proteins for piglet weaning feed.

Hamlet Protein's success is rooted in its customised bio-conversion process, which minimises the anti-nutritional factors that make soy bean proteins hard for young animals to digest – while keeping the amino acid profile intact.

International feeding trials have documented lifelong benefits for animal welfare, growth and performance that at least match the benefits of animal-derived proteins. In terms of feed efficiency, the speciality proteins give farmers an optimum return on investment.

Case by Hamlet Protein

Photo: Hamlet Protein

Speciality proteins give farmers an optimum return on investment

CHAPTER 5

A STEP AHEAD OF THE WORLD'S CHANGING NEEDS

THE EXPERIENCE TO GUIDE THE APPLIANCE OF SCIENCE

Photo: Chr. Hansen

Flexible and forward-thinking, Danish ingredient companies are equipped to respond quickly to market needs. Scientific research keeps their finger on the pulse.

The Danish ingredient industry is a flexible partner. Over the years, innovations in ingredient technology have continued to meet the growing demand for healthier, more natural foods and improved sustainability in food production, including better animal welfare.

Collaboration between companies, government, authorities, universities and other research institutes is essential to this innovative strength. As close to 4% of employees in the ingredient industry have PhDs – almost ten times more than in the rest of the Danish private sector – there are plenty of highly qualified experts to draw on.

Danish ingredient specialists are known for their prompt responses to new market trends and challenges. The fast-growing plant-based category is a case in point. Here, a strong research and development focus is unlocking alternative, local sources of plant-based proteins for use in food production. Climate-friendly proteins from potatoes, seaweed, algae and grass are on their way into food production as a result – soon to be part of the solution to the world's growing need for nutrition. Test cultivation of quinoa and other ancient crops is also underway.

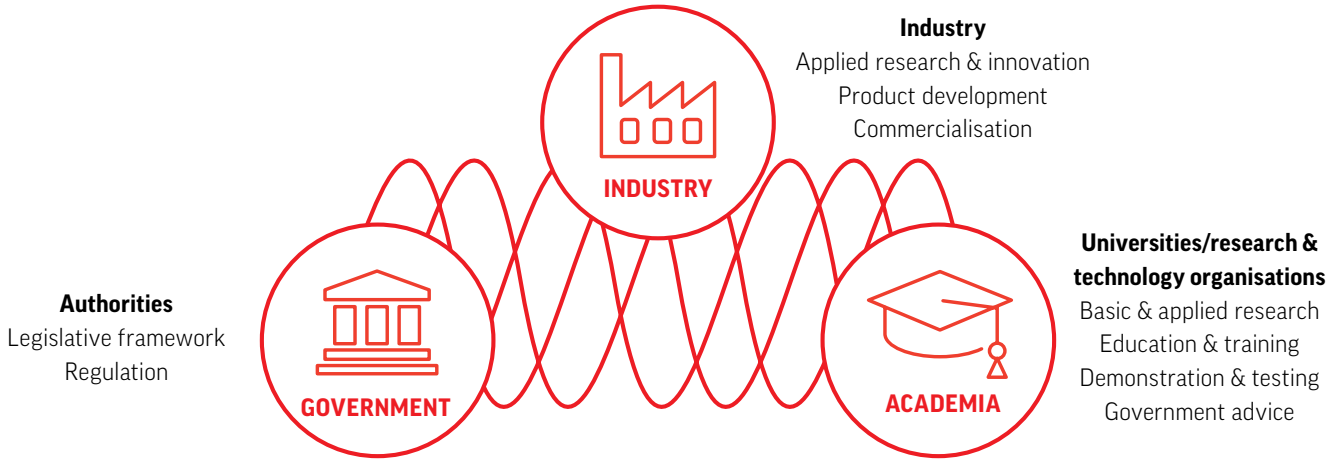
Within agriculture, opportunities to produce feed with locally grown sources of sustainable proteins are capturing attention. Danish research & technology organisations, for example, are involved in several projects with ingredient entrepreneurs to utilise the nutritional potential of insects.

Collaboration with universities and other research organisations is essential to develop innovative solutions

The road to personalised nutrition

Nutrigenomic science is another exciting area of development that is providing insights into the nutritional needs of individual consumers at each stage of life. This is accompanied by a growing knowledge of the link between human gut bacteria and a healthy immune system and cognitive abilities. Danish ingredient companies are actively involved in research of this kind, paving the way to new solutions for personalised nutrition. Clinical studies are an increasingly used tool for documenting the health benefits that ingredients can provide.

Ingredient innovation always starts with science. In collaboration with farmers, feed suppliers and food manufacturers, Danish ingredient companies put the science to use.



NEW METHOD REVEALS THE BUSINESS POTENTIAL IN LEFTOVERS

Photo: DTU

Apart from optimising raw material utilisation, protein extraction makes excellent business sense

There is always something that goes to waste when potatoes and seaweed are used as raw materials for food ingredients such as starch, alginate and carrageenan. Until recently, these so-called side streams were either sold off for animal feed or used as an agricultural fertiliser.

But now scientists from the Technical University of Denmark (DTU) and Aalborg University are working with five Danish companies on a new method that can scan side streams for valuable proteins and clip them into functional peptides.

Based on modern bioinformatics, the method has already identified useful peptide emulsifiers in potato protein. Tests show that these peptides are suitable for encapsulating fish oil, which is particularly sensitive to oxidation, extending its shelf life. Many other opportunities exist to obtain flavourings and preservatives from protein-containing waste materials.

Apart from optimising raw material utilisation, protein extraction makes excellent business sense – increasing the value of side streams a thousand-fold. The fact that the new additives come from proteins which have been in the food chain for centuries also meets the growing consumer demand for natural functional ingredients.

The method is not limited to potatoes and seaweed but can be used to scan any protein-containing crop or side stream, such as the wastewater from fish processing.

Case by DTU and Aalborg University

CULTIVATING PLANTS TO PRODUCE NATURAL ADDITIVES

Plants contain a fascinating variety of functional components and flavourings, but often at a level too low for commercial extraction. Now a Danish innovation project – BioFactory – has used advanced biotechnology to grow plants with a higher concentration of these valuable natural ingredients.

> Functional substances increased by up to three times their original concentration

Photo: Chr. Hansen

Led by Danish Technological Institute, the project involved ingredient producer Chr. Hansen, the universities of Copenhagen and Southern Denmark and many other representatives from the food value chain.

Inspiration came from consumers who choose to avoid foods with artificial additives. Many natural alternatives currently exist – such as colourings in carrots and beetroot – but at a level too low to make good business sense.

During the BioFactory project, scientists successfully developed new methods for identifying and growing plant varieties with a high content of specific functional substances. One approach is to stress the plants during growth by subjecting them to excessive light or drought, for example. This stimulates the plant's natural defence system, so more of the substances are produced.

Functional substances increased by up to three times their original concentration during BioFactory's breeding and cultivation experiments.

In addition to breeding carrots rich in carotene and anthocyanins, scientists investigated other plants of potential value to food, including red clover, roseroot and hemp.

Case by Danish Technological Institute

CHAPTER 6

INVESTING IN INGREDIENTS IS A NATIONAL PRIORITY

STRATEGIES FOR NOURISHING FUTURE GENERATIONS

Photo: Novozymes

The Danish ingredient industry has recognised the potential to contribute to the UN sustainable development goals.

The ingredient industry continues to develop new opportunities to secure the global food supply for future generations.

The ingredient industry is a national priority area in Denmark. In 2019, the Danish government launched an ingredient strategy to provide the very best conditions for growth, while investing in the industry's strong potential to contribute to the UN sustainable development goals. The Confederation of Danish Industry, the Danish Agriculture & Food Council and industry representatives are closely involved in implementing the strategy. In the coming years, the ingredient strategy will promote the use of innovative ingredient solutions in the production of healthy and sustainable feed and food.

As a frontrunner within sustainable solutions, the ingredient industry continues to develop new opportunities to secure the global food supply for future generations. Functional ingredients that extend the shelf life of foods, secure sensory appeal and optimise the use of raw materials are already contributing to a more sustainable food value chain. In the years ahead, ongoing research and development will maintain the steady flow of solutions to improve the safety, efficiency and nutritious quality of food and feed.

Food Nation

Food Nation is a non-profit partnership established by the Danish government and leading private organisations and companies. It is your gateway to information about the Danish food cluster and knowhow that can accelerate the growth of international businesses through better solutions, innovative products and trusting cooperation.

The Danish food cluster encompasses everything from primary production in agriculture and the fishing industry to the food products consumers buy in stores. Companies, universities, research institutes, local and national authorities and other private and public organisations belong to the extensive, collaborative network. Together, they work hand-in-hand with international partners to maintain and improve food quality and safety along the value chain.

Take an interactive tour

Food Nation's Visitor Centre welcomes international delegations, providing them with an introduction to Danish capabilities within food and agriculture. An interactive installation at the centre gives visitors an up-to-date overview of the food value chain based on their individual interests. It is the ideal starting point before visiting Danish food producers and production facilities.

Food Nation is a great place to start learning about how Denmark can support sustainable development through collaboration and how you can benefit from the Danish food cluster.

Find out more about Food Nation's services and arrange a visit to the Food Nation Visitor Centre at foodnationdenmark.com

INGREDIENTS INDUSTRY

Producers of enzymes, cultures and other ingredients

PRIMARY PRODUCTION

Agriculture, fishing & horticulture

PROCESSING INDUSTRY

Producers of food, beverages & animal feed

The Danish food cluster

Denmark is home to countless large, medium-sized and small companies, research institutes and other organisations that make the country a European hotspot for innovative food products, services and technology.

RESEARCH & INNOVATION

Research, education & counselling institutions

FOOD TECHNOLOGY

Producers of machines, technology & equipment

GASTRONOMY & THE CONSUMER

Retail, consumers, restaurant, authorities, tourism & other related industries

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