

Cerealier



No. 03/2024

A magazine from
Lantmännen
Research Foundation



NEW THESIS

**Health benefits
from oat lipids**

INNOVATION

**Platform for
future food**

HEALTH

**Hydrothermal
treatment helped
create a new
product**

THEME

FROM IDEA
TO FORK

Creating research-based food products



Helena Fredriksson From theory to practice

As always, I am even happier once the harvest is complete. Last year was a challenging year, so this year's harvest feels particularly important. We are now looking ahead, and our mills and bakeries are busy becoming familiar with the new harvest.

This issue is on the theme of 'From idea to fork' and highlights another crucial issue; we have interviewed researchers and innovators who have successfully taken ideas all the way from research to market. They have the drive, perseverance and the conviction that is necessary to get their idea across the finishing line. Collaboration is another important component for success, which is not least apparent in the strategic research initiative for Denmark's green transition. You can also read about Lantmännen's Greenhouse, a programme for open innovation that offers help with developing a business idea. We meet one of this year's participants, Volare, a start-up company from Finland.

IN THIS ISSUE, we also present a new ScanOats thesis. Its results are promising, and indicate that post-meal blood sugar responses can be reduced using less beta-glucan from oats than previously thought.

Finally, I would like to extend a warm welcome to our new editor-in-chief, Ingar Nilsson. Ingar is not only a talented journalist, but she is also an author with a special interest in food. For this issue, we have chosen a recipe from Ingar's book about brassica, a rich minestrone with Tuscan kale that is a wonderful autumn supper.

Enjoy!

Helena Fredriksson

Lantmännen Research Foundation

“...the conviction
that is necessary
to get their idea
across the
finishing line.”



PHOTO: JOHAN OLSSON / LANTMÄNNEN

The fruits of research

*This issue features researchers
and entrepreneurs who have
developed products based on
their ideas and knowledge.*

Pages 7–15

Cerealier

Responsible publisher

Helena Fredriksson
helena.fredriksson@
lantmannen.com

Editor-in-chief

Ingar Nilsson
ingarnilsson@hotmail.com

Scientific project manager

Karin Arkbåge

Editorial board

Karin Arkbåge
Helena Fredriksson
Lovisa Martin Marais
Ingar Nilsson
Camilla Telander Pulliam

Translation

Translation, Clare Barnes
Åre Translation

Art direction & layout

Alenäs Grafisk Form

Cover

Theme: From idea to fork.
Photo: Golden Retriever
(see also image on page 7).

Adress

Lantmännens
Forskningsstiftelse
Tidskriften Cerealier
Box 30 192
104 25 Stockholm

Telefon

+46 (0)10-556 00 00



PHOTO: LANTMÄNNEN



PHOTO: ISTOCK



PHOTO: EVA FINDER

Cerealier Regulars

- 4** News
- 22** Recipe
- 23** News from Lantmännen Research Foundation

Theme From idea to fork

- 8** Protein shift in Denmark
- 10** New products using traditional techniques
- 12** Prohibition that led to functional food
- 14** Side streams' potential for future protein production

In this issue

- 16** Lower risk of diabetes with more greens and high-quality carbohydrates
- 18** Innovation platform increases collaboration for future foods
- 20** Oat lipids reduce hunger

Subscribe for free

Fill in the form at www.lantmannen.com/cerealier. Cerealier is offered digitally and as a printed magazine in Swedish, and digitally in English.

Other questions about subscriptions?

Email tidskriftenc@lantmannen.com

Address Lantmännen Research Foundation
Tidskriften Cerealier
Box 30 192, 104 25 Stockholm, Sweden

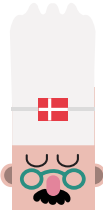
Your contact details are only used for Cerealier's subscription database and associated administration. Please contact us if you wish to cancel your subscription.

Cerealier is published by Lantmännen on behalf of Lantmännen Research Foundation. Its aim is to increase awareness about cereals (grains) and legumes, based on current research and debates on nutrition.



**LANTMÄNNEN
RESEARCH FOUNDATION**

Danish tips for tastier wording on menus



Replacing meat with more vegetables and legumes is desirable, but can be a challenge. This is particularly true for chefs in the public sector who, every day, encounter thousands of guests with varying attitudes towards plant-based food. The Danish Veterinary and Food Administration has published material with suggestions for how to make greener food more attractive. This not only involves the ingredients, preparation and seasoning, but also mouth-watering menu descriptions. ●

Read more (in Danish): www.foedevarestyrelsen.dk

Students develop an alternative to tofu



PHOTO: JM ARTS

During an innovation project on the Culinary Arts and Food Sciences programme at Kristianstad University, Maria Lindahl and Evelina Holmgren were tasked with creating a food product from hemp. After contact with hemp farmers at Mossagården, outside Lund, Sweden, and many experiments in the kitchen, a product and a company, Plantaste, were born.

The Krinova innovation hub helped them with product development and they are now considering more hemp-based products. ●

Read more: www.krinova.se



PHOTO: ISTOCK

New thesis examines the properties of pea protein

In a thesis from the University of Copenhagen, doctoral student Yuqi Zhang has investigated commercial ingredients made from pea protein and their molecular properties.

PEA PROTEIN HAS been gaining more attention in the development of alternatives to meat and dairy products.

In her research, Zhang performed a collective evaluation of how frothing and emulsifying properties differ.

BY CREATING AN analytical toolbox, Zhang has presented a holistic picture of the relationship between the molecular and functional properties of different pea proteins. This can be used to quickly predict stability in

ingredient emulsions and to more precisely determine the potential uses for ingredients in various foods and to develop new ingredients. ●

Thesis: Yuqi Zhang, 2024. *An Analytical Toolbox of the Relationship Between Molecular Characteristics and Functional Properties of Pea Protein Ingredients*. University of Copenhagen.

Less salt in bread and cured meats

One objective of the Swedish Food Agency's and the Public Health Agency of Sweden's work towards healthier eating is reducing the amount of dietary salt by 20 per cent by 2035 – and we seem to be well on the way.

Compared to the Swedish Food Agency's last shoppers' survey in 2015, salt has decreased by as much as 25 per cent in cured meats and by around 20 per cent in cereal products such as bread. ●

Read more (in Swedish): www.livsmedelsverket.se



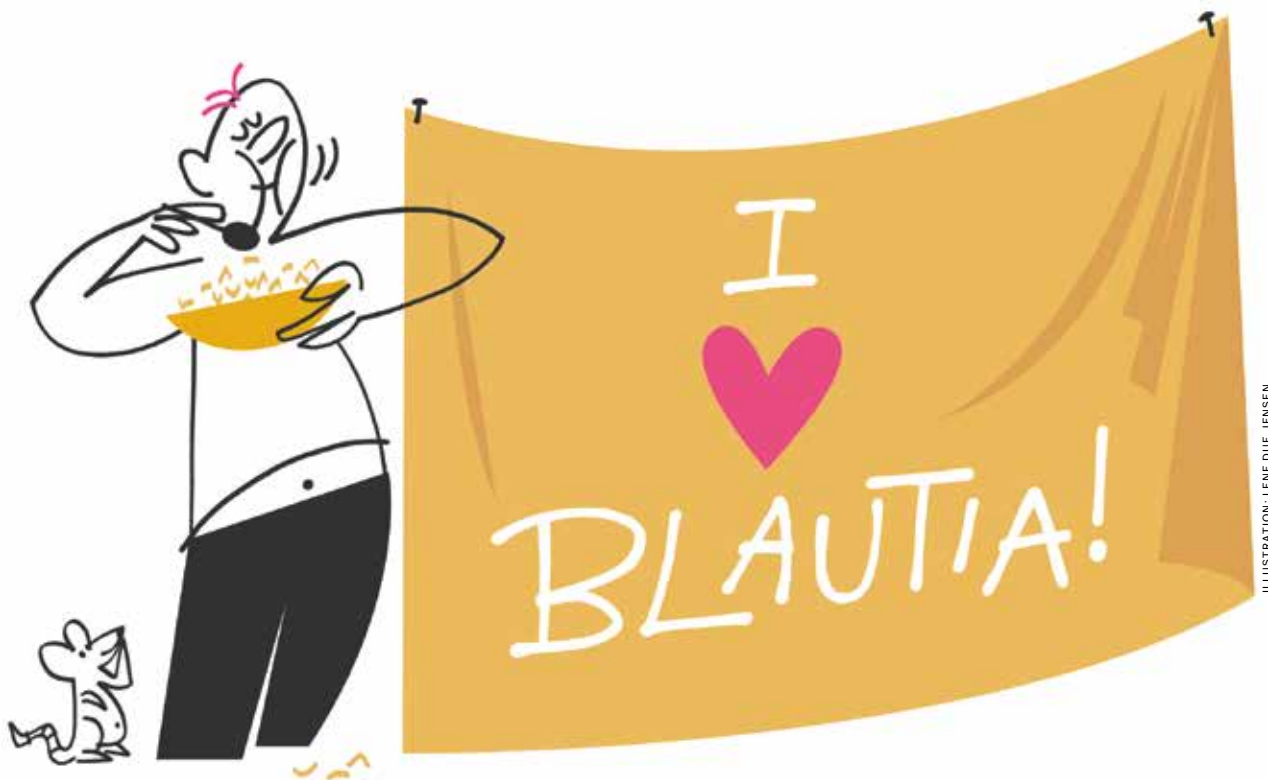
PHOTO: ISTOCK

Improved oat cultivation

The Interreg project Oat Frontiers will investigate how oat cultivation can be improved in Scandinavia and Ireland.

The project will evaluate which oat varieties are suitable for demanding weather and cultivation conditions, as well as how varieties can be developed through plant breeding and how increased cooperation can promote positive development in the oat sector. Lantmännen and Lund University are the Swedish participants. ●

Read more: www.interreg-npa.eu



Blautia bacterium may protect against gut infections

Our gut has a mucus barrier that protects the intestinal wall. This barrier can become damaged in people who eat a low-fibre diet, increasing the risk of inflammation in the gut. Researchers at Umeå University have found that a gut bacterium called *Blautia* may have a vital role in building and protecting the colon's mucus barrier in people who often eat a low-fibre Western diet.

This discovery came in a study where 74 people increased their intake of dietary fibre over a three-month period by 10 grams daily. This is equivalent to about 120 grams of oatmeal, for example. Gut flora samples were collected from the participants at the beginning and end of the study period. The gut flora was then transplanted into mice that had been

fed a low-fibre diet. In mice that received gut flora from the beginning of the study the mucus barrier was weakened, while it was strengthened in mice that received gut flora from the end of the study period.

WHEN THE RESEARCHERS then studied the gut flora's composition, they saw increased growth of *Blautia* after greater fibre intake, and that the bacterium's presence was associated with improvements to the mice's mucus barrier. The study then continued with the mice receiving a *Blautia* supplement with the low-fibre diet. This showed that the gut's

mucus barrier benefitted in a manner similar to when the mice received gut flora from study participants at the end of the fibre intervention.

THE BLAUTIA SUPPLEMENT also led to a reduction in infection with an unfavourable gut bacterium similar to *E. coli*. The researchers concluded that *Blautia* has the potential to provide direct protection against infection.

The results of the study increase understanding of the importance of high-fibre diets for gut health. According to the researchers, the results could also lead to better treatments for conditions such as ulcerative colitis.

Text Linda Swartz

BLAUTIA

Blautia is an anaerobic bacterium in the *Lachnospiraceae* family.

Source: Holmberg *et al. Nature Communications*, 2024.

The world's best porridge is in Carrbridge

On the first Saturday in October, the small village of Carrbridge in the Scottish Highlands fills with porridge lovers from around the globe. Since 1994, it has hosted the World Porridge Making Championship, held to select the recipient of the coveted Golden Spurtle®.

The lucky 24 finalists have less than thirty minutes to produce just over a litre of porridge (two pints) from oatmeal, salt and water, as well as a specially composed porridge using their own recipe.

This year's winners will feature in the next issue of *Cerealier*. ●

Read more:
www.goldenspurtle.com

PhD thesis



PHOTO: PRIVATE

On 13 December 2024, Solja Pietiäinen will defend her doctoral thesis on *Fractionation of Wheat Bran to Create functional Ingredients* at the Swedish University of Agricultural Sciences. ●

Cerealier nominated



Cerealier has been nominated for the Swedish Publishing Prize. All aspects of the journal will be assessed: textual content, visual elements, form, usability and print quality. We're thrilled! ●



ILLUSTRATION: LENE DUE JENSEN

Buckwheat good for health and the environment

Increased cultivation of buckwheat, a pseudocereal, could benefit biodiversity. It is also rich in dietary fibre, protein, vitamins and minerals, and is naturally gluten-free. These are properties that could be used in many food

products, according to a scientific article by researchers from Kristianstad University.

BUCKWHEAT CULTIVATION started in China around 4,000 years ago. Historically, it has been a valuable crop, particularly because it adapts quickly

to different growing conditions and matures quickly. It is also heat tolerant, so is suitable for increasingly hot climates. ●

Source: Zamaratskaia *et al.* *Critical Reviews in Food Science and Nutrition*, 2023.

The path to sustainable starches

Starch is found in many foods, but is also used in industry as a binding agent, such as in pharmaceuticals and in films on food packaging. Starch is often modified to give it the necessary properties for its intended use.

In a new thesis from the Swedish University of Agricultural Sciences in Uppsala, doctoral student Shishanthi Jayarathna has studied how starch can be modified in a more sustainable way, using biotechnological methods.

In her thesis, she describes different modified starches and how to tailor plant starches through genetic modification and using conventional crossing methods. ●

Thesis: Shishanthi Jayarathna, 2024. *Novel Starch Types: Molecular Diversity for Future Applications*. Swedish University of Agricultural Sciences.

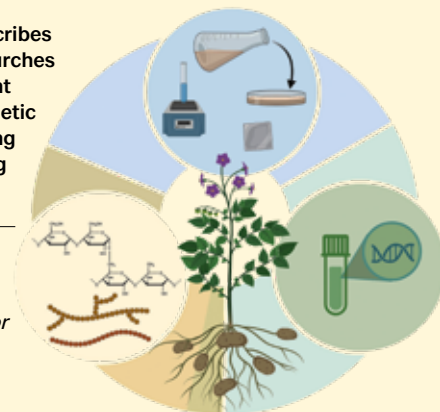


ILLUSTRATION: SHISHANTHI JAYARATHNA

THEME

FROM IDEA

Moving from idea to product can take decades of research.

Two examples featured in this issue are among those where preparatory work has taken a long time. In Denmark, politicians and the business community have stepped up the pace of knowledge and product development through generous investment in research that brings together farmers, producers, wholesalers and retailers. ►

Photo Golden Retriever



TO FORK

FROM IDEA TO FORK



PHOTO: INGÅR NILSSON

➤ Iben Lykke Petersen is an associate professor in the Department of Food Science at the University of Copenhagen.

PROTEIN SHIFT

The Green Development and Demonstration Programme was launched with the aim of encouraging a protein shift in Denmark. Over 600 projects have been funded through the programme so far. For maximum impact, collaboration is required with partners throughout the food chain, in farming, higher education, food companies, culinary colleges, large wholesalers and catering companies.

Text Ingar Nilsson

Iben Lykke Petersen, associate professor at the Department of Food Science at the University of Copenhagen is deeply involved in the transition. When we meet in her office, she starts by telling us about the strong focus on plant-based foods.

"I think almost everyone who conducts research here is working on a project that is part of the green transition," she says.

The department's mission is to be a vital element of work towards a more sustainable food chain and an important knowledge broker regarding alternative protein sources.

SHE HAS BEEN involved in several recent projects that have resulted in new plant-based and protein-rich products. One project, Dansk BÆlg, which started this year and in which she is involved, aims to get more legumes on the dinner table by expanding Denmark's cultivation of ingredients, creating tasty products and inspiring the market to use them.

"In another project, Tempeh, which started in 2021 and ends this year, a company called Contempehry developed a new type of tempeh. This is traditionally made from fermented soya, but they have replaced this with fermented beans from Denmark. My contribution has been to investigate

how well the body can break down and absorb the proteins in food during digestion. We have investigated this *in vitro* by simulating what happens in the stomach and intestine."

University College Absalon then worked on the sensory aspects to guarantee the quality of the product's taste and structure. Other partners have found ways to package it and a recipe bank has been created to inspire caterers and consumers to use the new tempeh.

SEVERAL VARIETIES AND FLAVOURS of Contempehry are now available online and in specialty stores.

Another project that Lykke Petersen was involved with focused on improving techniques and processes for increased efficiency and quality in the production of protein-rich plant-based products.

DANISH FUNDING

The Green Development and Demonstration Programme started in 2009 and is administered by the Danish Veterinary and Food Administration. So far, DKK 3.2 billion has been awarded to a range of projects.

In 2021, a majority of Denmark's parliamentary parties signed an agreement on a green transition in Danish agriculture to reduce carbon emissions. The Plant-Based Food Grant was created to help with this and encourage domestic crop cultivation; it has DKK 675 million to distribute.

The Novo Nordisk Foundation has committed DKK 200 million to an open innovation platform, Plant2Food, where research institutions and other organisations can work together to solve the complex questions on plant properties and functions that arise in the Danish protein shift.

The Independent Research Fund Denmark also provides grants for research projects as part of the green transition.

One participant was a pork producer, Hanegal, which make a product from ground faba beans and peas that are extruded as protein-rich meat and fish substitutes, but under a different brand name. Lykke Petersen's task was to investigate the product's amino acid composition and its protein quality, as well as how to maximise protein uptake once it has passed through the digestive system.

"This is important for ensuring that vegans and other people on a plant-only diet get the necessary amount of protein and amino acids."

IN MARCH THIS YEAR, the department launched a project – led by Lykke Petersen – to investigate the immunoregulatory potential of legumes. The project has been funded by an open innovation platform, Plant2Food, and the Independent Research Fund Denmark. Lykke Petersen and her research colleagues want to discover how processing can deactivate trypsin inhibitors – trypsin is an enzyme that naturally occurs in cereals and legumes and usually prevents protein uptake from them – as well as how they could be used to reverse inflammation in the gut.

"Starting with faba beans, peas and lupins, we will study whether the levels of trypsin inhibitors vary from year to year depending on the weather, location and other factors. We will ferment some of the crops and then make *in vitro* models to see how the trypsin inhibitors react with our bodies and digestive systems," concludes Lykke Petersen. ●

Read more (in Danish): www.food.ku.dk/nyheder/2024/nu-skal-baelgfrugters-sundhedsfremmende-egenskaber-udforskes/

IN DENMARK

New products using traditional techniques

When Kerstin Fredlund, a physician, had her first child, she started questioning a commonly accepted truth: that young children need a special, iron-fortified diet. Forty years later, she has challenged this idea and created new products. **Text Ingar Nilsson**

“My first report on how young children are perfectly able to eat a complete diet came out in the late 1970s. In 1984, when I published a book on making your own baby food, I was praised but also criticised, and decided to start doing some research.”

FREDLUND FOUND HER first clues in publications by ethnologist Anni Gamerith, who described how people traditionally never used raw cereals; instead, there were several stages of processing, such as soaking and drying. Her encounter with the doyen of soured milk and sourdough baking, Annelies Schöneck, was also eye opening. Fredlund realised that these traditional techniques reduce the amount of an antinutrient, phytic acid, which inhibits nutrient uptake and therefore increase the chances of absorbing the important minerals in cereals.

“In 1990, I received SEK 100,000 from Skånska Lantmännen for a study on how traditional techniques affected the phytic acid content of cereals. I soaked different types of grain and regulated their pH, which gave interesting results,” says Fredlund.

By then, she had made important

contacts in the food industry who supported further research, including Semper, Svenska Malt – now Viking Malt, and Lantmännen. As part of a three-year research project, barley, rye and wheat were soaked and dried using traditional treatment techniques, and the process was then optimised for industrial application. The hydrothermal technique was investigated as regards phytic acid, inositol, drying methods, storability and sensory properties.

IN 2002, KERSTIN FREDLUND received her doctorate from Chalmers University of Technology in Gothenburg. Her thesis dealt with hydrothermal technology’s effect on phytic acid and the bioavailability of zinc and calcium in barley, rye and oats. Human studies in which participants were given barley flakes and

porridge showed that zinc absorption increased significantly after hydrothermal treatment.

Ten years ago, Kerstin decided to start a company to develop and produce hydrothermally treated cereal products. She founded the company Hidden in Grains with Annette Almgren, a research engineer and biomedical analyst at the Division of Food and Nutrition Science, also Chalmers.

“The times have caught up with us,” says Fredlund. “With a shift to a more plant-based diet, there is a significant risk that requirements for essential minerals will not be met. A recently completed project, Mineral Shift, tested and developed several new cereal-based products that had been treated for increased mineral availability.”

FREDLUND HIGHLIGHTS the importance of heritage cultivars for this shift, because some varieties have a high nutrient density and there are advantages to growing these in organic systems.

Hidden in Grain’s first product was tested during the spring. In collaboration with Warbro Kvarn, a Swedish organic bulgur is being produced from barley that has been treated to increase mineral availability. It is primarily sold to schools, preschools and catering kitchens via wholesalers. ●

Read more: Projects in Vinnova’s call for “The good and sustainable everyday food of the future – Innovations for support for Swedish processing of plant-based raw materials”. Project title: The Mineral Shift – unlocking the potential of mineral absorption from wholegrain.



PHOTO: EVA FINDER

“The times have caught up with us.”

Kerstin Fredlund
MD

Step by step Hydrothermal treatment of grains

Choose the raw material carefully

1 Starting with a high-quality raw material is important: wheat, barley, rye or oats that have not been heat treated.



PHOTO ON PAGE: ISTOCK

Hydrothermal treatment

2 Moisture and heat are added in several steps through wet steeping, which activates a natural enzyme, phytase, in the grain kernels. Time and some acid are also needed to create optimal conditions. Phytic acid complexes that bind the minerals are then broken down by phytase, which cleaves the complex and releases the minerals.



Drying

3 After about 12–15 hours, almost all the phytic acid has been broken down and the minerals are free. The whole kernel is then dried. Different temperatures are used depending on the properties required in the final product.

Mill processing

4 The whole dried kernels are processed in a mill to become food products, by being ground into flour, flaked or cut into bulgur. ●



SOURCE: HIDDEN IN GRAINS

Prohibition that led to functional food

When rearing piglets, diarrhoea is a common problem during weaning and the transition to regular feed. To avoid this, antibiotics were added to piglet feed until they were banned in 1986. Fears of a rapid increase in diarrhoea among piglets led to an intense search for an effective replacement. This resulted in the discovery of a new protein, which became the basis of SPC-Flakes, a food product for specific medical purposes that improves quality of life for people with illnesses such as inflammatory bowel disease and Meniere's disease.

Text Ingar Nilsson

For 25 years, Carola Lindholm worked as a development manager at Lantmännen, in the company that conducts research and development of products such as food for specific medical purposes. Throughout her employment, she was deeply involved in what would become the specially processed oat flakes, SPC-Flakes.

"When the ban on antibiotics arrived, a multidisciplinary research group was quickly established to solve the problem of diarrhoea in piglets," says Lindholm.

AT SAHLGRENSKA UNIVERSITY HOSPITAL, Gothenburg, researchers specialising in diarrhoea and cholera became involved; they discovered that pigs with severe diarrhoea had low levels of a protein called antisecretory factor (Protein-AF).

PHOTO: LANTMÄNNEN



"The Swedish Medical Products Agency decided that SPC-Flakes could be prescribed by doctors and dietitians using a dietary prescription."

Carola Lindholm

One function of this protein, which is found in the gut mucosa, is to regulate the absorption and flow of fluid through the gut wall.

If the pigs were fed a specially processed oat, they were able to produce Protein-AF themselves (see fact box).

The problem was that researchers did not initially understand why it worked.

"The analysis methods then available were not as developed as those we have now," explains Lindholm. "And while there were no studies explaining why the piglets got better, it was difficult to convince people that this protein could also be used to treat humans."

IN THE 1990S, basic research was conducted to describe why and how Protein-AF works. In 1997, a research team at Sahlgrenska in Gothenburg started a large-scale human study. Patients

with inflammatory bowel disease who participated no longer had symptoms, and said they could start living a more normal life, without the fear of not being able to get to a toilet in time.

In 2000, the research team published the results of the human study in a scientific article, by which time a new European law on food for special medical purposes had been introduced.

"SPC-Flakes were suitable for this and the Swedish Medical Products Agency decided that they could be prescribed by doctors and dietitians using a dietary prescription. Most regions in Sweden also started subsidising SPC-Flakes," says Lindholm.

THE PRODUCT IS NOW prescribed for both inflammatory bowel disease and Meniere's disease and its medical efficacy is described in many scientific studies. Several clinical studies that have been initiated by academic and healthcare researchers are now investigating the product's effect on other target groups.

Salovum is another medicinal food for inflammatory bowel disease. Hens are fed a special feed so they develop Protein-AF; this is concentrated in the egg yolk, which is then dried. This allows humans and animals to consume concentrated Protein-AF for a more rapid effect. ●

You can find out more about Protein-AF and the studies that have been conducted at www.functionalfoods.com.



HOW PROTEIN-AF WORKS

Protein-AF is produced by the body and is present in varying amounts in all animal and human cells. It helps regulate the flow of fluids and ions across cell membranes. For diarrhoea, it is used when you want to or need to avoid agents that prevent bowel movements.

SPC-Flakes are specially treated flakes that stimulate the body's production of Protein-AF. Research shows that many patients suffering from inflammatory bowel disease

or Meniere's disease benefit from consuming SPC-Flakes. Lantmännen Functional Foods has also launched a sister product, Salovum. This is based on spray-dried egg yolk from hens fed a special feed, resulting in a product with high levels of Protein-AF. Salovum stops diarrhoea quickly and effectively in humans.

Knowledge surrounding protein antisecretory factor, Protein-AF, and SPC-Flakes, Specially Processed Flakes, is patented by Lantmännen Functional Foods.



PHOTO: ADOBE STOCK



Nina Tuomikangas,
responsible for
the Greenhouse.



↑↑ The black soldier fly can be-
come protein-rich animal feed.

↑ The fly larvae grow quickly and
can be harvested after just
a couple of weeks.

← Team Volare-Lantmännen in
the Hackathon, from left: Sofia
Siljama, Lantmännen Cerealia,
Tuure Parviainen and Jarna
Hyvönen, Volare, Tapio Lahti,
Lantmännen Agro and Kirsi
Vesterinen, Lantmännen Cerealia.

Side streams' potential for future protein production

Cereal processing generates significant side streams, and there is potential to develop them further. For example, so far oat husks have mainly been used as a raw fuel for heating. However, Finnish Volare, supported by Lantmännen, has now developed a business model in which black soldier flies that are fed with side streams become protein-rich animal feed.

Text Marina Nilsson

"Insects may seem new and exotic, but for many animal species they are a natural source of food. Black soldier flies have an amazing ability to survive by eating almost any type of biomass. We feed them wheat bran and oat husks, but they can also eat grains that have been rejected due to their size, or side streams from bakeries. Their larvae also grow extremely quickly and their faeces can be used as fertilizer. The environmental benefits are obvious, but there is also growing research evidence about health benefits for the animals that eat the protein meal," says Tuure Parviainen, co-founder and CEO of Volare.

THE FLY LARVAE ARE HARVESTED when they are barely two weeks old, and one result is a protein meal that contains as much as 52 per cent protein and 14 per cent fat. The fat is rich in lauric acid, which is also found in breast milk and thought to have protective properties, for example for gut flora.

Parviainen and Matti Tähtinen, the chief technical officer, met as research

colleagues at VTT Technical Research Centre of Finland in 2018. They had both come to the same conclusion: that black soldier flies, combined with cutting-edge technology, could provide efficient protein production. This could reduce the use of soya meal and fishmeal in animal feed and thus increase Europe's level of self-sufficiency.

They soon realised that a start-up was necessary if they were to scale up, so they also brought in Jarna Hyvönen, now chief commercial officer. Her background was in circular business economics.

"When you build a circular business, partnerships are essential to making the model work. For us, Lantmännen's innovation programme – the Greenhouse – was thus an excellent way to gain insight into what the industry needs, so that we can meet these needs even more successfully," she explains.

"Volare already has a small demo plant in Finland, where it has produced protein-rich feed for dogs and cats, as well as for production animals such as laying hens, piglets and salmon, for 2.5 years. However, the plan is for a large-scale industry. Lantmännen is a partner we are delighted to work with. The side streams from their production are very interesting for feeding soldier flies."

"AT THE GREENHOUSE, we test out wild ideas to see if they bear fruit," says Nina Tuomikangas, who works with innovation and is responsible for the Greenhouse. This has been Lantmännen's open innovation programme since 2014, and

its management act as a 'dragon's den' to find the most promising ideas.

"This year we received 170 ideas in the Greenhouse's open call, and Volare was one of the companies that went on to participate in our Hackathon," she says.

There, over several days, the innovative ideas are subjected to an intensive workshop.

"Taking care of 'wild ideas' in this way, really testing their potential, is not something that large companies are otherwise able to do," Tuomikangas continues.

LANTMÄNNEN'S SUCCESS FACTOR as an innovation partner includes being able to offer participants access to the entire value chain for cereals, from plant breeding, through farming to milling and baking processes.

"As a raw material, cereals are a great starting point in terms of both health and sustainability, but achieving our ambitious climate targets will require innovation throughout the chain, including finding more uses for our side streams," says Tuomikangas.

Volare's business model thus involves building a large-scale plant, but Tuomikangas also sees a future in which innovative work with flies and their larvae can be done at farm level.

"In the future, cereal farms could also have a small insect farm so they can utilise their own side streams," she concludes. ●

Read more: www.volare.fi
<https://www.lantmannen.com/research-and-innovation/the-greenhouse/>

A thesis from Lund University provides further evidence that a diet rich in vegetables, fruits and fibre can reduce the risk of type 2 diabetes. But for some food types, the effect differs between men and women. **Text** Linda Swartz

Lower risk of diabetes

with more greens and high-quality carbohydrates

The main aim of the thesis was to look at the relationship between different types of carbohydrate and the risk of developing type 2 diabetes. The underlying data came from the extensive Malmö Diet and Cancer Study that was conducted in the 1990s, which also recorded dietary intake. Since then, the 30,000 people included in the study have been tracked in various health registries, allowing researchers to identify which individuals have developed type 2 diabetes.

“What we found was that a higher intake of fruit and monosaccharides can be linked to a lower risk of being affected and that a higher intake of sweets and disaccharides was associated with increased risk,” says Kjell Olsson, a researcher at Lund University.

He is a dietitian and has now completed his PhD in public health science with a focus on nutritional epidemiology. Alongside his research, he works as a health care strategist for Region Skåne.

HIS THESIS ALSO INVESTIGATED whether and, if so, how the quality of dietary carbohydrates influences the risk of developing type 2 diabetes. Four previously developed indices were used to identify healthy foods. The results were not clear-cut, but provided some support for a relatively high proportion of dietary fibre in relation to other carbohydrates and free sugars reducing the risk of type 2 diabetes.

Olsson and his research colleagues were also curious about whether the degree of adherence to the EAT-Lancet diet affected the risk of disease. The EAT-Lancet advocates a mainly plant-based diet, with fruits, vegetables, wholegrains, nuts and legumes as important components. The individuals

in the study who followed the diet most strictly also had a lower risk of diabetes, explains Olsson.

“The overall conclusion, supported by previous research, is that a plant-based dietary pattern that focuses on carbohydrate quality, with a higher proportion of fibre and wholegrains and less sugar, reduces the risk of type 2 diabetes.”

WHEN OLSSON LOOKED more closely at how different types of fruit and vegetables affect disease risk, some of the findings turned out to be gender-specific. For example, the men who ate more vegetables, root vegetables and jams had a lower risk of disease, while women with a higher intake of berries and chocolate had an increased risk. Leafy vegetables and dried fruit were protective for everyone.

“These findings can probably be explained by differences in dietary patterns, where higher intakes of these foods correlate with higher and lower intakes of other foods,” says Olsson. ●

Thesis: Kjell Olsson, 2024. *Quality and Type 2 Diabetes Risk – With a Focus on Intake of Carbohydrates and Carbohydrate Rich Foods*. Lund University.

“...a plant-based dietary pattern with a focus on carbohydrate quality, with a higher proportion of fibre and wholegrains and less sugar, reduces the risk of type 2 diabetes.”

Kjell Olsson Researcher, Lund University



↓ Kjell Olsson's research shows that a diet rich in fruits, vegetables and fibre has many health benefits. Möllevångstorget in Malmö has a large selection of fruit and vegetables all year round.



PHOTO: INGEMAR NILSSON

Innovation platform increases collaboration for future foods

Eight platforms will help create an innovative and sustainable food system in Sweden. One of these is Biotech Heights in Lund, which was launched at the beginning of the year. Work is now underway to mobilise the industry around the mission to have everyone eating new fermented foods by 2035.

Text Ingar Nilsson

Biotech Heights is built around Lund University, Tetra Pak and Future by Lund. This spring, 100 people gathered at a workshop to learn more about the platform and the test facility at Kemicentrum in Lund.

"The aim is for us to create a platform for collaboration, and better utilise existing resources for companies to use and scale up their pilot projects," says Emma Nordell, the platform's project manager.

SHE SAYS THAT THEY have identified a lack of facilities for companies that want to scale up. Another challenge is cooperation between academia and industry, and current food legislation can be regarded as another. However, there are already many resources in place: all the knowledge and staff at Kemicentrum, and the building's existing pilot halls with processing equipment – the

processing hall, the food hall and a separate biotechnology hall.

TETRA PAK IS ALSO building a hall for industrial-scale trials in Karlshamn.

"We are looking at two raw materials, potatoes and seaweed, in our initial projects," says Eva Nordberg Karlsson, professor of biotechnology at Lund University.

Many chemical and packaging companies are interested in looking at agricultural side streams and what they can be used for. Another possibility is scaling up microbial production of a polymer that retains water and could be used in plant-based steaks.

"Potatoes are a commodity with side streams that are likely to be more useful

than using them to produce biogas. We must try to maximise the use of the planet's resources. Seaweed could be given a longer shelf life through fermentation. Also, this can remove the metals such as iodine, cadmium and arsenic that accumulate in seaweed."

NORDBERG KARLSSON STATES that the new ingredients require thorough investigation and development of sensory properties so they are tasty, has a pleasant texture and can be an attractive option.

"We are currently working with a company to mix raw material from seaweed in a biscuit filling," she says.

Nordell emphasises how one element of Biotech Heights' activities is to educate the public, so they are better informed about future foods.

"Part of this initiative includes making a radio programme about the future of cooking."

Networking is another component in their work. Membership of clusters such as Sweden Food Arena and the Food and Bio Cluster Denmark allows mutual learning and the establishment of interesting contacts and partnerships. ●

Read more: www.biotechheights.com, <https://www.vinnova.se/en/news/2023/11/eight-innovation-platforms-for-sustainable-food-systems/>

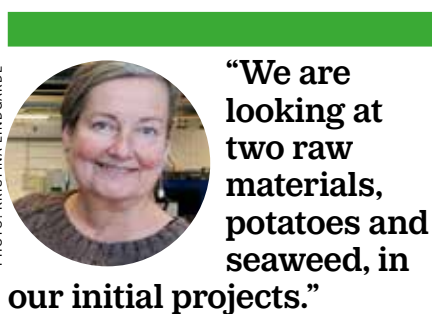


PHOTO: KRISTINA LINDGÄRDE

Eva Nordberg Karlsson Professor of Biotechnology, Lund University



➤ The shelf life of seaweed can be extended through fermentation.

Foods containing polar lipids from oat oil help regulate blood sugar levels and lessen appetite, according to research results in a recently published doctoral thesis from Lund University, as part of ScanOats.

Text Ylva Carlsson **Illustration** Lene Due Jensen



OAT LIPIDS REDUCE

The author of the thesis is Mukul Hossain, whose background is in nutrition. He has focused on the health benefits of two bioactive substances in oats – beta-glucans and polar lipids.

Previous studies have shown that beta-glucan, a dietary fibre, has positive health effects as it lowers cholesterol and blood sugar.

"My research shows that polar lipids in oat oil have a similar effect on blood sugar to that of beta-glucans. Values remain at a low and steady level," says Hossain.

FOUR INTERVENTION STUDIES were carried out, involving around 80 healthy young adults aged between 20 and 40. In one of the studies, participants ate a breakfast that included



"...polar lipids in oat oil have a similar effect on blood sugar to that of beta-glucans."

Mukul Hossain
Lund University

bread with toppings that contained polar lipids from oats, with a meatball sandwich as a standardised lunch. In another study, they were given a meal of strawberry kissel with oat beta-glucans.

BLOOD SAMPLES WERE TAKEN after both breakfast and lunch. In addition to blood glucose, free fatty acids, triglycerides and the hunger and satiety hormones GLP-1, PYY and ghrelin were measured in the blood. The results showed that the participants' blood sugar levels remained stable after both breakfast and lunch when they were given oat lipids, compared to products without them. In addition, polar lipids helped lower the levels of circulating free fatty acids and triglycerides in the blood after meals.

"It was also interesting to see that the



HUNGER

polar lipids helped increase the release of GLP-1, which then reduces both blood sugar and appetite. Because GLP-1 is used as a drug to treat diabetes and obesity, this discovery is particularly significant,” says Hossain.

ANOTHER FINDING IN THE THESIS is that the post-meal blood sugar response can be reduced with

relatively low amounts of oat beta-glucans.

The results thus show positive effects at amounts below those currently required to use the EU-approved health claim of reduced blood glucose response after meals.

“Both texture and taste are better with less beta-glucan,” says Hossain. “This is a great benefit in the development of new oat products, such as puddings and energy bars.”

HOSSAIN HOPES HIS RESEARCH can help reduce the risk of developing type 2 diabetes, in which lifestyle factors such as diet and physical activity play a major role. ●



MUKUL HOSSAIN

Mukul Hossain defended his thesis on 13 June this year. He previously studied food technology at Bangladesh Agricultural University and received his master's degree from Lund University.

Thesis: Mukul Hossain, 2024. *Health Benefits of Oat (Avena sativa) Bioactives. Acute and Second-meal Effects of Oat Polar Lipids and Beta-glucans*, Lund University.



RECIPE

An Italian classic

A perfect autumn dish, bringing warmth to the dark evenings.

Recipe Ingar Nilsson Photo Charlotte Gawell

Minestrone with Tuscan kale

Serves: 8

Time: 60 min (with ready-cooked beans)

- 1 packet ready-cooked haricot beans or 100 g dried beans
- 3 tbsp olive oil
- 2 onions
- 2 garlic cloves
- 2–3 slices of bacon or pancetta
- 4 tomatoes
- 1.8 l water

Fresh marjoram, thyme or oregano
2 carrots, diced
2 celery sticks
250 g Tuscan kale
Small macaroni or other pasta
Salt, black pepper
Parmesan

INSTRUCTIONS:

1. If you are using dried beans, soak them overnight.
2. Heat the oil in a saucepan and fry the chopped onion, finely chopped garlic and sliced bacon until the onion is translucent.
3. Scald the tomatoes, peel and deseed them, then chop them finely.
4. Add the tomatoes and the soaked beans, then the water and seasoning. Cover and simmer for two hours. Simmer for 30 minutes if you will use ready-cooked beans.
5. Dice the carrots and cut the celery stalks into thin slices. Add them to the soup and cook for another 8–10 minutes.
6. Add the shredded kale and pasta and cook for a few more minutes.
7. Add the ready-cooked beans and season with salt and pepper. Sprinkle with grated parmesan. ●



PHOTO: WOLFGANG KLEINSCHMIDT / LANTMÄNNEN

↑ Veggie balls, where extrusion technology has been used to texturise pea protein.

Focus on freezing, extrusion and fermentation

Food processing has two main purposes: refining and preserving. It is an important area and Lantmännen Research Foundation has supported numerous projects over the years.

Text Sophia Wassén, Lantmännen R&D

The scale of the food industry is larger than our domestic kitchens, but the processes are often the same. Food is processed by removing parts, such as husk and peel. At home, potatoes are peeled before they are boiled and, in the milling industry, the husk is removed from oats before they are rolled into groats. The mill then produces flours with different compositions and properties that are adapted for different products.

THE FOUNDATION IS FUNDING a project at RISE that aims to increase understanding of how components in flour contribute to the properties of bread. Flour is broken down into its constituent parts, such as starch, protein and fibre, and

then recreated using compositions that are evaluated through baking tests.

Food is also processed so that it can be preserved for a long time. Freezing is a common technique that can be quite complicated. For example, boiled potatoes decline in quality when frozen and thawed. Industrially, similar challenges exist with products that decrease in volume when frozen, which can lead to consumers to perceive that they are getting less for their money. Recently, our foundation funded a project that will study how volume losses can be reduced during the freezing of bake-off products.

ANOTHER WAY TO PRESERVE food is fermentation, which lowers pH and thus extends products' shelf life. Fermentation can also improve the taste and nutritional value of a product. Dutch researchers are currently studying how different microorganisms can improve the taste of peas and faba beans through fermentation. In another project, researchers at Chalmers University of Technology are investigating whether the content

of phytic acid in yellow peas can be reduced, as this substance interferes with the absorption of iron in the body.

In many cases, the purpose of food processing is to create pleasant textures and flavours. Breakfast cereals and meat substitutes are examples of products made using extrusion, a process where flour from cereals or legumes and water is kneaded at a high temperature and pressure, before being pressed through a nozzle into the desired shape and texture. This is how breakfast cereals are puffed and meat-like fibre textures are made in plant-based burgers.

Researchers at RISE have studied exactly how these meat-like fibre structures are formed. This knowledge is necessary for developing innovative products from legumes.

FOOD PROCESSING AND preservation is a complex area, where detailed knowledge and understanding are needed to harness the strengths of the ingredients. Research on food processing will remain vital. ●



PHOTO: ISTOCK

↑ Pea starch is used in Asia as an important ingredient in noodles.

Recently granted projects



Pea starch for foodstuffs

Pea starch is used in Asia as an important ingredient in foods such as noodles. In Europe, pea starch is often a side stream from the production of pea protein. In this project, researchers at Swedish University of Agricultural Science will study the relationship between the pea starch's structure and its functional properties, with the aim of supporting its use in future foods. ●



Wholegrain breakfast

Wholegrains are part of the SCAP-IS2 study, where researchers at Chalmers University of Technology investigate the effects of the one breakfast on different people. The relationship between individual blood glucose responses and other parameters linked to health will be studied. The results may provide insights into what type of breakfast is best for different people. ●



Increased oat protein content

Concentrated oat protein has a strong tendency to aggregate, clump together, which can result in a sandy mouthfeel. Many dairy analogues with oats are therefore low in protein. In one project, researchers at Chalmers and Aarhus University will investigate whether adding dietary fibre can reduce clumping. Success could lead to dairy analogues with higher protein content. ●

About the research foundation

Lantmännen Research Foundation supports research in the entire chain, from field to fork. It grants SEK 25 million to research annually, focusing on three areas:

- Agriculture and machinery
- Bioenergy and green materials
- Food and health

The goals of this research funding include increased agricultural production with minimised

environmental impact, and establishing how agriculture can contribute to the development of a biobased society. In the area of food, we want to increase knowledge of grains and legumes as a natural element of sustainable future food.

The foundation has an open call for proposals every year. Applications are assessed on their newsworthiness, scientific quality and business potential. ●

See: www.lantmannen.com/researchfoundation

For more information:

Helena Fredriksson

Telephone: +46(0)10-556 00 00

Email: helena.fredriksson@lantmannen.com



LANTMÄNNEN
RESEARCH FOUNDATION