Cerealier

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A magazine from
Lantmännen
Research Foundation

RECIPE
Make porridge like a champion!

THE PROTEIN OF THE FUTURE
Project searching for the perfect pea

HEARING
More legumes and wholegrains in new dietary guidelines

#04

Research for future food systems

THEME

FOUR THAT ARE FORMING THE FUTURE

Helena Fredriksson
Porridge perfection!

In this issue, which has the theme "Four that are forming the future", we return to a major Swedish research initiative that we first wrote about in the spring of 2021. That was when centres that promote sustainability and competitiveness in the Swedish food system were awarded around SEK 120 million to conduct four years of research. Then, our theme was blue, red and green proteins. Now we caught up with researchers at the centres, to learn about their achievements during the first project period and what their plans are for the future.

YOU CAN ALSO read about a project where researchers at the Swedish University of Agricultural Sciences have collected 300 pea varieties from around the globe, and are investigating which ones have the potential to be the protein crop of the future. Properties such as protein content, taste and, not least, cookability are vital.

"... tips for successful porridge-making."

On page 23, we tell you about work being conducted by our Research Foundation, which is currently at full speed, as we are reading all the applications in this year's call. Once assessments are completed, about 20 projects will receive funding.

Finally, I want to highlight the article about the World Porridge Making Championship, held in Scotland, which has tips for successful porridge-making. I will never forget the perfect texture and taste of a porridge served at a B&B in the Scottish islands many years ago. The recipe for one of the previous entries is on page 21, and is based on oats, plums and spices.

Enjoy!

Helena Fredriksson
Lantmännen Research Foundation

PHOTO: ISTOCK

↖ Cerealier wishes you a deliciously, happy and healthy Christmas.

Sustainable food

Four research centres – building the food system of the future on legumes, meat, seafood and berries.
Pages 6–15

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
Clare Barnes
Åre Translation

Art direction & layout
Alenäs Grafisk Form

Cover
Theme: Four that are forming the future.
Photo: Golden Retriever (see also image on page 6).

Adress
Lantmännens Forskningsstiftelse
Tidskriften Cerealier
Box 30 192
104 25 Stockholm

Telefon
+46 (0)10-556 00 00

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PHOTO: REBECCA GUSTAFSSON

PHOTO: JULIA LOHMAN

PHOTO: FOOD&FRIENDS / LANTMÄNNEN

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Other questions about subscriptions?
Email tidskriftenc@lantmannen.com
Adress Lantmännen Research Foundation
Tidskriften Cerealier
Box 30192, 104 25 Stockholm, Sweden

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LANTMÄNNEN
RESEARCH FOUNDATION

Consumer scepticism about high-protein beans

The protein-rich faba bean could play an important role in new plant-based foods, but consumers need to choose products that contain it. A research team from the University of Helsinki studied the reactions of 264 subjects during testing of faba bean spreads.

Despite differences between the spreads, the general opinion of the test group was that they tasted too bitter. The researchers conclusion is that bitterness is something that needs to be considered during the introduction of new plant-based foods. ●

Read more: Tuccillo *et al. Food Quality and Preference.* 2024

Development of hybrid cheese

PHOTO: ISTOCK

Every year, Danish dairies produce 400,000 tons of cheese. Cheese manufacturing has a carbon footprint, which researchers at the University of Copenhagen will try to reduce. The HYCheese project aims to create a more environmentally friendly hybrid cheese.

It runs until 2028 and will develop a sliceable cheese by combining milk and plant proteins. Obtain the protein structure of cheese with other types of protein is difficult, so the first stage of the project will investigate the protein structures of milk and plants to find synergies. ●

Read more: https://food.ku.dk/english/news/2024/hycheese/

PHOTO: ISTOCK

Studying attitudes to sustainable lifestyles

The green transition requires that we change our attitudes to what we eat and the foods we identify ourselves with.

Jonatan Leer, new professor of food science at Örebro University, is leading a project that examines people who are reluctant and people who do adopt a more sustainable lifestyle.

"We know that those who are most enthusiastic about sustainable eating live in cities, but their lifestyle also has the biggest climate impact," Leer says.

Other such paradoxes that will be studied are why people who live in areas affected by storms and flooding do not change their habits to a greater extent. At the other end of the spectrum are the climate dads, men who, once they have children, also become more climate aware. They live in eco-villages where an alternative form of masculinity is more accepted.

There is quite significant discussion among the research community about how to make healthy and sustainable products more attractive to sceptics. ●

Read more: Leer. *Anthropology of Food.* 2020

New discovery in a Nobel Prize-winning field

By identifying mRNA molecules, researchers at the Swedish University of Agricultural Sciences have been able to observe how fungi and plants communicate.

They studied how a specific parasitic fungus on wheat uses mRNA molecules to communicate with the plant. This allows the parasite to attack pathogenic fungi. This means it could act as a biological and environmentally friendly pesticide in agriculture. ●

Read more: Piombo *et al. BMC Biology.* 2024

ILLUSTRATION: LENE DUE JENSEN

ILLUSTRATION: LENE DUE JENSEN

Dietary fibre affects the activity of gut bacteria

We have known for many years that dietary fibre from fruits, vegetables and wholegrains is good for us, and a Danish research group has studied this in depth. They found that the right amount of fibre in the diet can have a positive effect on gut bacteria. However, if a diet has too little fibre, bacterial activity can lead to illness.

The research team comprises people from Denmark's National Food Institute (DTU) and the Faculty of Nutrition, Exercise and Sports at the University of Copenhagen. So far, research about the gut has focused on measuring the amount of desirable and undesirable bacteria. What the researchers discovered was that dietary fibre not only helps gut bacteria to form short-chain fatty acids, but it also influences the bacteria so they protect the gut from the potentially negative effects of amino acids that are present.

VARIOUS GUT BACTERIA compete to utilise tryptophan, an amino acid found in protein-rich foods such as legumes, nuts, seeds, chicken and salmon. When we eat a lot of dietary fibre, the gut bacteria convert tryptophan into healthy substances. If we eat too little fibre, bacteria can instead convert this amino acid into harmful compounds.

"The gut bacterium *E. coli* can convert tryptophan into indole, a harmful compound, which can contribute to chronic kidney disease. However, another gut bacteria, *C. sprogenes*, converts tryptophan into healthier substances, which protect against inflammatory diseases in the gut, type 2 diabetes, cardiovascular and neurological diseases," says Anurag Kumar Sinha, a researcher at DTU.

USING MANY EXPERIMENTS, researchers have demonstrated how bacteria that break down dietary fibre regulate the production of indole.

"These results highlight how much of an impact our dietary habits have on how gut bacteria behave, creating a delicate balance between health-promoting and disease-related activities. In the long term, these results could help us design dietary recommendations to prevent a range of diseases," says Professor Tine Rask Licht, from DTU.

Ingar Nilsson

Source: Sinha *et al. Nature Microbiology.* 2024.

THEME

FOUR THAT ARE FORMING THE FUTURE

In 2021, four interdisciplinary research centres started work on increasing the Swedish food system's sustainability and competitiveness. Cerealier has taken a closer look at what they have achieved in their first four years and can say that it's a great deal. But much remains to be done if we are to make our seafood and animal husbandry more sustainable, bring alternative proteins to market and make our food sector more innovative. ▶

Photo **Golden Retriever**

Research centres showing the way forward

The first programme period is over for the research centres that will provide solutions which could result in a more sustainable and competitive food system. They have identified the current system's weaknesses in each sector, and also show how they can be changed, to improve the potential for Swedish foods.

Text **Ingar Nilsson**

Jessica Ekström is a research officer at FORMAS, and is responsible for the areas of food, agriculture and livestock. She has just finished her work on guiding the international panel that has evaluated the centres' activities and assessed their applications for the next four years. This evaluation and assessment led to one centre losing continuing funding and receiving a closure grant instead.

During a hearing this autumn, the heads of the centres presented their findings to the panel. In their applications for the next period, they described their experiences so far and what they want to work on next. They also each had to reflect on what will happen to their centre when the funding from FORMAS ends.

The food sector is strongly associated with several of the UN's Sustainable Development Goals and a sustainable food system can make many contributions to Sweden's efforts to meet them. The centres are working towards a total of seven of these goals. Jessica Ekström says that additional research centres may need creating to achieve more goals.

"We are currently evaluating applications within a call that addresses food preparedness, which we hope will contribute. In terms of economics and business models, efforts are certainly needed to make the food system economically sustainable too," she continues. "Profitability must be improved in primary production and for small processing companies."

LOOKING AT THE WAY that other countries work, Jessica Ekström highlights Finland, which has its own food programme and is good at food contingency planning. The Netherlands can also provide a positive example, especially in food innovation.

"In general, countries where agriculture is a political priority are good at generating new ideas and solutions to problems in the sector. And we see that there is increasing interest and understanding for the food sector among Swedish politicians too," she concludes.

PHOTO: ELISABETH OHLSON WALLIN

"... there is increasing interest and understanding for the food sector among Swedish politicians ..."

Jessica Ekström
Research Officer, FORMAS

FORMAS AND THE RESEARCH CENTRES

The Swedish national research programme for food, which was launched in 2017, will help develop a sustainable food system. Every year, it distributes SEK 150 million to various projects and research centres. FORMAS is a government research council for sustainable development and runs the programme as part of the national food strategy.

In 2020, FORMAS announced funding for centres that promote sustainability and competitiveness in the food system. Four were granted funding: Blue Food, PAN Sweden, FINEST and SustAinimal. Following the evaluation of the first programme period, three of these programmes have received another four years of funding. The centres share around SEK 120 million in total.

Dietary recommendations can be personalised

During the next programme period, one focus for the PAN Sweden research centre will be developing personalised dietary recommendations for individuals or groups.

Text **Ingar Nilsson**

Personalised recommendations are possible thanks to new methods that measure the effect that different types of food have in the gut.

"So far, we have mainly looked at the possibility of combining plant-based proteins with dietary fibre. Our results show that this is likely to be beneficial from the perspectives of both health and food technology," says Robert Brummer, professor of gastroenterology and clinical nutrition at Örebro University and head of PAN Sweden.

They will now look more closely at what really happens in the gut and in the body as a whole. The positive aspect is that researchers are working to supplement stool samples with breath and blood samples, for example, to accurately measure how an individual reacts to the food they eat. Ultimately, this may contribute to better understanding of how and in what way diet affects our health at different life stages.

THE CENTRE IS ALSO developing prototypes for new, plant-based foods, but the ones that have so far been produced need improvement in terms of taste. If consumers are to choose plant-based alternatives, they need to be at least as good as the animal-based products. Test groups that include vegans and omnivores have shown that they experience the taste in similar manners.

Jaqueline Auer, from the Swedish University of Agricultural Sciences, is one of the doctoral students affiliated to PAN Sweden. She recently visited the Netherlands to learn more about which food processes provide the best uptake of iron from different ingredients. Her research examines the levels of minerals, such as iron and zinc, that are present in various plant-based ingredients, and how their bioavailability is affected by processing. This is especially important for people who eat an entirely plant-based diet, as iron from plants is less bioavailable than iron from animals.

"I study soya bean, faba bean and pea products and profile their amino acids and protein availability. The more available the proteins are the better, because then they are easier to digest."

SHE WILL USE *in vitro* models of digestion to learn which ingredients and processes are most beneficial if we are to absorb the minerals and protein in a product.

Örebro University's School of Hospitality, Culinary Arts and Meal Science contributes to PAN Sweden in various ways, working with school chefs and meal managers to make school lunches even tastier and more sustainable, and to work on how restaurant guests can be attracted to eat more plant-based food.

"We are examining how different menus in fine dining restaurants influence guests' choices," says Robert Brummer, "And how to influence behaviour through menu design."

Over the next four years, he hopes to see more collaboration between the centres that received continued funding from FORMAS.

"For marine proteins, for example, which Blue Food is working on, we could investigate how well they are absorbed by the body," he says.

REGULATION AND FOOD POLICY are other areas that PAN Sweden will begin to tackle, looking at how to positively influence the entire food system at all levels.

According to Brummer, social media posts have too much impact and influence many people's dietary habits. However, their advice is rarely based on factual and theoretical information. Sustainability is one area where it has been possible to influence policy, he says, and this can certainly be done in other areas too. ●

PHOTO: PRIVAT

"I study soya bean, faba bean and pea products and profile their amino acids ..."

Jaqueline Auer
Doctoral student, PAN Sweden

Read more: www.oru.se/english/our-profile/food-and-health/pan-sweden/about-pan-sweden/

Reference: Auer *et al.* Assessing the digestibility and estimated bioavailability/ bioaccessibility of plant-based proteins and minerals from soy, pea, and faba bean ingredients. *Food Science and Technology.* 2024

PHOTO: ANNA HUOVINEN / LANTMÄNNEN

↖ PAN Sweden studies the health effects of combining dietary fibre and plant-based protein.

IMPROVING FISH FARMING WITH

Blue Food is a consortium that brings together more than 70 partners and eight universities to make seafood better, cleaner and more attractive to consumers. Over the next four-year period, one thing the centre's researchers will focus on is exploring how AI and digitalisation can improve production on fish farms. Text **Ingar Nilsson**

The centre also has a greater focus on the palatability and health benefits of seafood.

"Seafood is healthy food," says Fredrik Gröndahl, associate professor and senior lecturer at KTH Royal Institute of Technology and the coordinator for Blue Food. The project will provide evidence for this, with research groups at KTH and Chalmers University of Technology examining how the stomach, blood pressure and other bodily functions react when we eat seafood or freshwater foods.

The idea that fish from the Baltic Sea contains hazardous pollutants and should thus be avoided also requires nuance.

"Why are we so sceptical towards seafood?" he asks, rhetorically. "For a period, sushi was a breakthrough for seafood. It has also encouraged the consumption of seaweed, which is climate-friendly and does not need fertiliser."

BUT THERE ARE MORE challenges ahead. One of the centre's doctoral students, Elena Costa, is investigating how food neophobia, fear and discomfort surrounding new foods, prevents us from eating more and more types of seafood. She hopes to identify the barriers and find solutions that will increase the consumption of species other than fish and shellfish.

Seafood is very perishable and has a limited shelf life, which Blue Food hopes to improve.

THE DIVISION OF Food and Nutrition Science at Chalmers will investigate what happens to seafood when it is preserved. Experiments are being conducted on different techniques, such as pickling, drying and freezing.

Fish farming is one area where new digital technologies will be used. AI can

PHOTO: ISTOCK

ARTIFICIAL INTELLIGENCE

capture the sound of fish eating, and when they are satiated, which makes it possible to optimise their food supply, so avoiding adding too much feed in fish farms.

"In addition, robots can be used to check the fish farms when the weather is bad and they are not accessible by boat. Robots can also identify different types of fish, so we can get a better understanding for what lives in our waters," says Gröndahl.

FASTER PERMIT PROCESSES are necessary for establishing more primary production and fish farming on land in Sweden, and this is also something that Blue Food will work on.

"And then we must make better use of both farmed and wild-caught fish, and create more areas of use. We have already started work on this and will involve our chefs even more in producing delicious meals and products," he continues.

The tasting panels will also continue and be expanded. There will be ongoing structured trials of dishes such as herring balls, seaweed and minced sea squirts using students at schools in Värmdö Municipality and the City of Gothenburg.

SEVERAL PROJECTS WITH innovations and new meals have already been launched. Seaweed cultivation on Sweden's West Coast has expanded and resulted in a crispbread and other products that use it as a key ingredient. Trials with the invasive Pacific oyster, which is spreading along the West Coast, are also underway. It has a slightly watery texture, but could be turned into a tasty mince or burger. ●

Read more: www.bluefood.se

Reference: Vall-Ilosera *et al. Algal Research.* 2024

↖ Fish farming is one area in which new digital technologies such as AI can be used.

PHOTO: JULIA LOHMAN

"... we must make better use of both farmed and wild-caught fish, and create more areas of use."

Fredrik Gröndahl
Coordinator for Blue Food

↑ Sigrid Agenäs wants to see a systems approach to animals in our food system.

Consumer-oriented work on

the food system of the future

SustAinimal brings together key stakeholders with knowledge and experience of work on issues related to animals in our food system. The centre will now also come closer to consumers, as well as studying the effects of having grazing animals in the agricultural landscape.

Text **Ingar Nilsson**

In the next programme period, major industry stakeholders such as Arla Foods, Martin & Servera, Svensk Fågel and Svenska Ägg will become partners. They can provide additional perspectives, because these companies are active both in Sweden and internationally and in close contact with end consumers.

"If we are all to understand each other and have a good dialogue, everyone needs to be involved," says Sigrid Agenäs, professor at the Swedish University of Agricultural Sciences in Uppsala and head of the SustAinimal centre.

"OVER A LONG PERIOD, knowledge about the animals in our food system has become increasingly fragmented," she says. One of the reasons is that education in agronomy education has become more specialised, with some people studying soil science while others focus on animals or nutrition. Agenäs believes that there is a lack of systems thinking in this area.

"Consequently, research we have conducted in low-income countries that has evaluated whether or not animals are needed at a system level, has paradoxically not been applied in Sweden. Instead, we immediately start investigating how we can use GPS, AI and robotics to increase efficiency in agriculture."

During its first four years, the centre's organisation has slowly but surely been brought together so they work more closely. They have made a study trip to Scotland, a nation with many similarities to Sweden. Research at the centre is divided into different focus areas. All parties that are involved in the work can suggest which research, projects and events should be prioritised.

Currently, ten doctoral students are working on issues linked to the centre: the digitalisation of the agricultural sector; grazing and forage production; the role of animals in future food systems in different regions; and building scenarios for future sustainable food systems.

SO FAR, THIS HAS resulted in several scientific publications and two reports, one on virtual fences and one on natural grazing's obstacles and opportunities. The report on virtual fences has already attracted attention in the farming community. Many people are ready to install the technology when legislation allows.

"Every project always has a partner outside academia, who can bring a great deal of practical knowledge. Lantmännen is one example."

"Every project always has a partner outside academia, who can bring a great deal of practical knowledge."

Sigrid Agenäs Coordinator, SustAinimal

Pär-Johan Lööf is Lantmännen's representative in the steering committee for SustAinimal. He believes that Lantmännen's interest in the centre stems from it being the only really significant and strategic investment being made in Swedish livestock research.

"We have reasoned that if we make a solid investment, we can move the whole industry forward," he explains.

A unique new project funded by the Kamprad Family Foundation, called Blandskap, will see the centre's researchers investigating the effects of integrating grazing animals and arable land in the same agricultural landscape.

"The project will look at the benefits of grazing animals on biodiversity, soil fertility and the ability of crops to resist pests," says Agenäs. "We will also discuss how much land a group of animals can graze."

IN PARALLEL WITH the centre developing knowledge about the role of animals in the food system, the more practical 'Living Labs' will continue. To identify successful examples, specific model farms will also be studied in more detail. The focus will also shift from ruminants to monogastric animals, such as poultry and pigs. Researchers will also investigate whether there are agricultural side streams that can be used as bird feed.

"We are also going to work more with policy issues in the next programme period," says Agenäs. "County administrative boards, municipalities and regions are necessary in discussions on societal solutions, such as better access to the landscape for both animals and people." ●

Read more: www.slu.se/en/subweb/sustainimal/

PHOTO: JENNY SVENNÅS-GILLNER, SLU

Collaboration for more legumes

In the future, legumes will play a major role in the sustainable food sector. As the proposed new Swedish dietary guidelines highlight legumes, there is increasing demand for innovative products. The FINEST research centre has investigated what is necessary to scale up production. Text **Ebba Arnborg**

How can we create conditions that encourage innovation for a more sustainable food sector? Researchers at FINEST, along with the industry, have been investigating this over the past four years.

They have examined the value chain for wild berries, organising a Nordic conference on their potential in 2023. Another focus area is Swedish legumes as a complement to, and replacement for, traditional animal products. By studying the entire value chain, from farmer to consumer, researchers have identified the biggest challenges and opportunities.

THEY HAVE ALSO developed and proposed ways to speed up the introduction of new ingredients and products on the market.

"To scale up the production of legumes and obtain a reliable Swedish ingredient, we need to collaborate throughout the entire chain, from farm to fork. There are many parts that need to come together," says Karin Östergren, project manager and researcher at RISE, and head of the FINEST research centre.

"There are challenges in everything from refining ingredients to our transformative capacity," she says. These include business models, finance, production, technology and policies. And, not least, consumer attitudes. Price and ease of use are important – but taste is most important.

PHOTO: ULRIKA HÅRD

"To scale up the production of legumes and obtain a reliable Swedish ingredient, we need to collaborate throughout the entire chain..."

Karin Östergren Coordinator FINEST

"We have learned a lot about what is needed to develop attractive foods. One home study we conducted showed that many consumers had low expectations of dairy analogues made from legumes and other plant proteins and were very positively surprised," says Östergren.

THE SWEDISH FOOD AGENCY'S recent proposal for new dietary guidelines highlights the importance of eating more legumes, which may help make more consumers aware of legumes and plant-based proteins.

FINEST's researchers have studied how different pre- and post-treatments govern a protein concentrate's functional properties. Understanding these properties and being able to control them is one key to efficient work on product innovation. It is important to find the potential of new ingredients created using legumes, she says.

"So their flavour is not regarded as an aftertaste, but as a strength. One path that I personally believe in, is the development of a plant-based range based on the ingredients' unique qualities.

By finding ways to utilise and create added value from the entire ingredient, including the starch and fibre, the process will also be more economic," says Östergren.

"At the same time, there is a need for a stable supply of ingredients, which requires that farmers get competitive prices," she says.

It is important to consider sustainability throughout all development work, Östergren emphasises.

"WE MUST DO EVERYTHING we can, not only in terms of reducing climate impact, but also for societal and economic sustainability," she says.

Despite not being granted continued funding from FORMAS, Östergren is positive about the future. FINEST will continue as a platform for disseminating knowledge about the sustainable and innovative foods of the future.

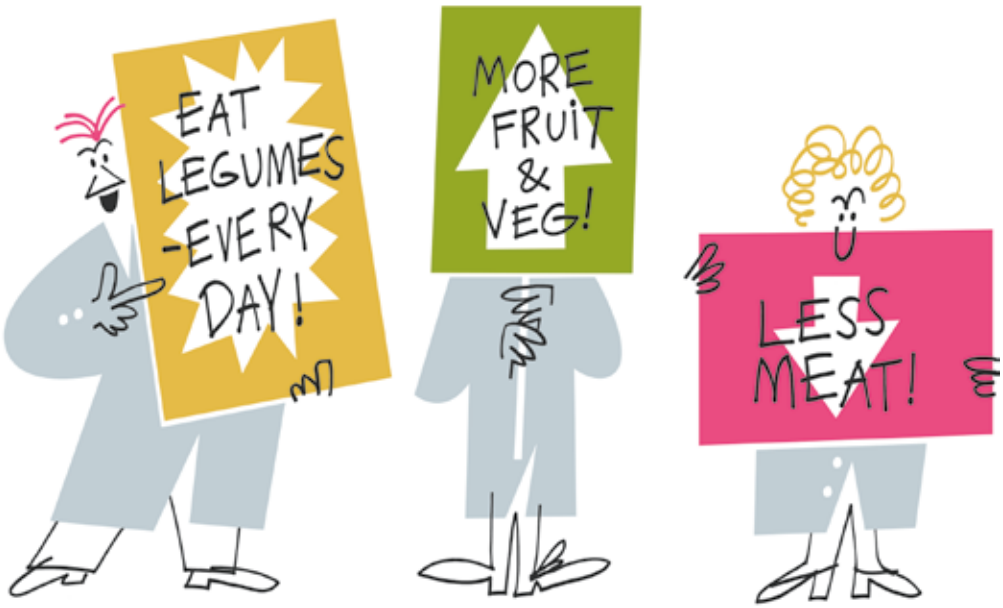
"We have a solid portfolio of ideas to take forward in other forms. We will utilise what we have learnt, and take the full range of opportunities and challenges with us as we move forward," she says. ●

Read more:
www.ri.se/en/finest

Reference:
Östlund *et al. International Journal of Gastronomy and Food Science.* 2024

PHOTO: HANS JONSSON / LANTMÄNNEN

↑ FINEST's work aims to create added value from plant-based proteins, such as legumes.



PROPOSED NEW DIETARY GUIDELINES:

Eat more legumes and wholegrains

Eat legumes often, preferably every day. This is one of the recommendations in the Swedish Food Agency's proposed new dietary guidelines. These include an increased focus on legumes, which have now been given their own category and, once again, the benefits of eating wholegrains are highlighted.

Text **Ylva Carlsson**
Illustration **Lene Due Jensen**

Swedish dietary advice is currently being updated. This time, the Swedish Food Agency has been tasked with not only considering health, but also factors such as the environment, Swedish food production and preparedness. The advice and quantity recommendations are based on what benefits public health,and correspond to the Nordic Nutrition Recommendations that were presented last year

Åsa Brugård Konde is a nutritionist at the Swedish Food Agency and project manager for work on the dietary guidelines. She emphasises how unhealthy eating habits are, after tobacco, the lifestyle factor that is considered the biggest cause of ill health and premature death in Sweden. An improved diet could prevent half of all cardiovascular disease and one in three cancers.

"Individuals have a lot to gain from eating more healthily. You don't have to make a complete change, even doing something small is good for your health," says Brugård Konde.

THE PROPOSED NEW dietary guidelines can be summarised as "more plants, less meat". Here are three of the most important new recommendations:

- Legumes, which were previously included in the fruit and vegetables category, now have their own recommendation. This is to eat them frequently, preferably every day.
- The recommended amount of fruit, vegetables and berries is 500 grams a day, preferably more.
- The recommendation for red meat is reduced from a maximum of 500 grams to 350 grams per week.

Åsa Brugård Konde:
"Because legumes such as beans, peas and lentils provide protein, fibre and minerals, legumes are an excellent substitute for meat."

Other benefits of legumes that are highlighted in the proposal are the reduced risk of cardiovascular disease and cancer – and how there is good potential for greater production of legumes in Sweden, with domestic cultivation benefitting crop rotation.

FOR WHOLEGRAINS, the proposed recommendation is a clarification; it says to "eat more wholegrains, but do not always choose brown rice." Brugård Konde says that self-assessment studies show that only one in ten Swedes eat enough wholegrains. Wholegrains are a good source of fibre, vitamins and minerals. Unfortunately, brown rice has higher levels of arsenic than other cereals and should therefore be eaten in limited quantities.

The new dietary guidelines were out for open consultation until 22 October. They will now be reworked and adapted to the general public. The final version will be presented in early 2025. ●

Watch the hearing here:
www.livsmedelsverket.se (in Swedish)

Innovation platform will help us eat within planetary boundaries

Eight platforms will help create an innovative and sustainable food system for Sweden. One of them is "A New Recipe for Protein Shift" which explores how 9 out of 10 meals in Sweden can be within planetary boundaries by 2040.

Text **Ebba Arnborg**

Staying within the planet's limits requires system-wide changes, from how we produce food to what we eat. The platform, which started at the beginning of the year, is one of eight initiatives being funded by Vinnova.

"We are looking at how we can promote dietary change, boost innovation around sustainable protein production, reduce the food chain's impact on the planet and promote sustainable farming practices. A significant proportion of negative impacts are linked to how imported food affects land use, biodiversity and water use. To achieve our aims, one possibility could be to examine how we can grow more food here in Sweden, such as by using more residual heat from other industries," says project manager Hanna Svensson and adds, "To increase biodiversity, we also need to help smaller, alternative crops and protein sources to reach consumers, under profitable conditions. Consumers are also asking for a more varied range of alternative products."

She emphasises that continued innovation in primary production is crucial. We need to look at how current sources of protein can become more sustainable, such as by optimising the sustainable production of red proteins, of which we now consume a great deal, and helping green proteins onto the market. In addition, we need to develop more environmentally sustainable alternative proteins and dairy analogues, which taste good and meet the consumers' expectations that they are healthy options.

To accelerate the transition towards a more sustainable food system, the project is now exploring how we can accelerate the rate at which innovative solutions are implemented and simplify scaling-up processes, as well as making it easier for companies that are not scalable and spreading the risk.

The project's aim to create a common target to work towards. By opening up to a wide range of stakeholders, they hope to jointly identify barriers as well as the opportunities that can facilitate innovation, gathering insights from the entire food chain.

"People have appreciated being able to have discussions in a forum that addresses change outside their everyday perspectives, along with actors they do not normally collaborate with," says Svensson.

One focus area is simplifying matters for actors in the food system by increasing access to climate data, making it more comparable and linking it to nutrient content. This allows products to be evaluated on a level playing field.

"We also see that there is a need for financial tools to stimulate the market, as well as agile policies and regulations. We also need to keep learning more about new ingredients and how they can be combined to produce food that is both tasty and healthy. "It must be easy for consumers to choose sustainable alternatives," says Svensson. ●

"... continued innovation in primary production is crucial."

Hanna Svensson
Project Manager, RISE

Read more: https://www.ri.se/en/what-we-do/projects/a-new-recipe-for-protein-shift

↓Change is essential if we are to remain within planetary boundaries. Faba beans have the potential to be a major protein crop for human consumption.

PHOTO: ERIK PETTERSSON / LANTMÄNNEN

Peas with the perfect profile – the protein of the future?

Which peas have the right properties to become the protein crop of the future? A project called "Pea – the key for future green protein" is looking for the answer to this. Extensive collection and mapping has been carried out to find good materials, with several hundred pea varieties being studied in detail to find those with the right profile.

Text **Ingar Nilsson** Photo **Rebecca Gustafsson**

Cecilia Hammenhag, associate professor at the Swedish University of Agricultural Sciences (SLU), Alnarp, is responsible for this project, part of SLU Grogrund. She is holding a glass bottle with a clip top, which contains peas of many different colours and sizes.

"I swept these up from the floor when we had finished threshing," she says.

The peas in the bottle are just a fraction of the 300 varieties that have arrived from around the globe. They have been selected to withstand climate conditions that are increasingly frequent: long periods of drought with high rainfall in between.

"Plants have different strategies for coping with this type of climate," says Hammenhag. "They either have a big root system that helps them go deep into the ground to find water, or they are good at conserving water. Heavy rainfall means that plant tissues, like their roots, suffocate when they are under water – plants that can cope with this can quickly and effectively replace damaged root tissue. In this research project, we have found varieties that can withstand both drought and lots of water in experimental conditions."

THE 300 VARIETIES that have been collected range from wild varieties to landraces (unimproved varieties genetically adapted to the environment in which they grow) and peas that were the result of breeding programmes. Eighteen of the varieties that were then grown were subjected to stress tests. This means they were transferred to a protected environment where they grew in alternate droughts and floods. The varieties that proved to be most resistant to both waterlogging and drought were a landrace from Denmark, a modern pea variety from Holland and a breeding line from Finland.

All the pea varieties were also examined in an analyser that scans the peas and provides detailed data about their seed characteristics.

"In some cases the appearance of the seed can be linked to the quality of the pea. The size and weight of individual peas is important, as is the thousand grain weight, which indicates the potential crop yield and quality," she says.

The colour and pattern of the pea pods are also studied, because these properties may be linked to the nutritional content of the seed. A wrinkly pea has a lower starch content.

A pea that will be eaten must also be cookable. The traditional Mattson cooker is still used at SLU Alnarp to measure the cookability of different pea varieties. The pea is placed in a small hole on a plate, and then held in position by a steel pin on top. This is all lowered into boiling water. The pea is fully cooked when the pin pierces it all the way through.

"This process takes a great deal of time," says Hammenhag. "But research carried out within the project has shown that a possible alternative to this analysis method could be to see how much the peas expand when they absorb water."

SOME PEAS MAY have qualities that can be transferred to new varieties, but so far which ones could be useful is unknown.

"The food industry wants varieties with a high protein content and stable qualities that do not vary from year to year," says Hammenhag.

The next step will be investigating how to reduce the levels of bitter saponins. These are potentially toxic substances that defend the plant. Peas contain this substance, which can cause problems when protein is extracted. Naturally, it is important for the plant, as it protects it from pests and infestations.

"Of course, the best thing would be if we could produce an ingredient that tasted of nothing," says Hammenhag. "We have to balance reducing the bitter substances while maintaining the plant's defences." ●

↑ 300 pea varieties have been collected to obtain the perfect profile.

THE PROJECT

"Pea – the key for future green protein" is a collaboration between the Swedish University of Agricultural Sciences, Lantmännen Lantbruk, Lantmännen R&D, Foodhills AB, Sveriges Stärkelseproducenter u.p.a, and Kalmar-Ölands Trädgårdsprodukter. It is funded by SLU Grogrund.

SLU Grogrund is a national centre of expertise for plant breeding at SLU and focuses on developing new crop varieties that can meet future challenges in agriculture and food production.

Reference: Hammenhag *et al. Journal of the Science of Food and Agriculture.* 2023

↗Cecilia Hammenhag at SLU Alnarp is responsible for the SLU Grogrund project "Pea – the key for future green protein".

For over 30 years, finalists in the World Porridge Making Championship have flocked to the little village of Carrbridge in the Scottish Highlands. Originally, the contest was founded to attract tourists to the region in the off season, but oats have long had an important role in the Scottish diet. Text **Ingar Nilsson**

Oats in a starring role at the World Champs

Alan Rankin is the Porridge Chieftain for the World Porridge Making Championship and well-qualified for the job. Growing up, porridge was served every day and he still makes porridge for breakfast using a mixture of rolled and crushed oats.

"Oats have long been a staple food in Scotland," he says. They could be grown in poor soils and in many weather conditions. For poor tenant farmers in the Highlands, this was an important crop that they grew and cooked.

In workers' homes, known as black houses, porridge was cooked and cooled, and then sliced so the labourers could take it with them to work, so it was hardly a coincidence that two local businessmen launched the idea of a porridge competition here.

"We have lots of visitors in the summer," says Rankin. "But the number of tourists drops in the autumn. The competition for the Golden Spurtle is a way of making up lost income in the off season."

EVERY YEAR, AROUND 50 keen porridge makers enter, and then the 30 successful ones who will compete in the final in October are decided. Fourteen nationalities were represented this year, with the most distant coming from Alaska.

On the weekend of the competition, Carrbridge has over 10,000 visitors. The village has only 600 inhabitants, so it is important that many people volunteer to support the competitors and judges.

The final is divided into two categories, each with five heats. In the first one, the tastiest porridge is chosen, with oats, salt and water the only permitted ingredients. The porridge is cooked to a time limit and is judged on its taste, colour and texture.

THE SECOND CATEGORY is more innovative, and participants are free to choose cooking techniques and flavourings for a dish based on oats. Inventiveness seems to know no limits. Over the years, participants have created dishes such as cheesecake made from porridge, dumplings, gnocchi, and porridge with mussels and spinach, among many others.

PHOTO: JAMES M ROSS

↑ 2024's winners in the World Championship, Kim McGhee and Chris Ormiston.

↑ The competition is named after the porridge stirrer called a spurtle.

A SPURTLE, the porridge stirrer that has given the competition its name, is indispensable for making porridge, according to Rankin.

"Stirring the porridge is important, but not too much. If you use a spoon, you could crush the oats when you stir, but not with a spurtle. And remember, porridge should always be stirred clockwise, otherwise you risk a visit from the devil," concludes Rankin, and laughs.

This year there was no Swedish participant on the start list, but several Swedes have been successful in this competition over the years. Calle Myrsell won the classic category in 2018. He had qualified via the Swedish Porridge Making Championship, which was held for a few years in Steninge, in Halland.

"Now Sweden does not have an organiser, which is one of the reasons we're not represented at the World Championship," Myrsell believes.

He competed twice in Scotland with his crushed oatmeal porridge, which he soaks before cooking. His tip is to add salt late in the cooking process, as this makes it tastier. In Scotland, where traditionally porridge is served on its own, he learnt to make a less firm porridge that he likes to eat with a dash of bilberry soup, toasted and coarsely grated almond paste and chopped sweet almonds. ●

Read more: www.goldenspurtle.com

RECIPE

Oaty dessert

Named after a traditional autumn fruit jam, Dumpsie Dearie.

Recipe Simon Rookyard, finalist in eleven World Porridge Cooking Championships.

Toffee Dearie

Serves: 4
Time: 45 minutes

- 125 g oatmeal
- 750 ml pear juice
- Juice of half a lemon
- 400 g plums, pitted and cut into pieces
- 1 large apple, peeled and cut into pieces
- 2 pears, peeled and cut into small pieces
- 75 g butter, plus an extra knob
- 5 tbsp muscovado sugar
- 3 tsp ground ginger
- 1 tsp ground cinnamon
- A pinch of ground cloves

PHOTO: JAMES M ROSS

INSTRUCTIONS:

1. Put the plums and the knob of butter in a saucepan with a little water. Place on a medium heat. Once the butter has melted, add the cinnamon and cloves. Continue to cook until the plums are completely soft.

2. Pour the pear juice and lemon juice into a saucepan along with the oatmeal. Place on a high heat. When the porridge starts to thicken, turn down the heat so that the porridge is just simmering.

3. Melt the rest of the butter in a separate saucepan, add the sugar and then the chopped pear and apple. Cook on a medium heat until the fruit is soft and caramelised.

4. Add the juice from the caramelisation to the porridge. Add the ground ginger. Stir the porridge to the desired consistency.

5. Serve the porridge lukewarm over a layer of caramelised fruit. Top with the plums.

Dietary fibre has many health benefits. In the Unpuzzle+ project, researchers at Örebro University have investigated exactly what happens in our body when we eat fibre, down to the cell level. Text **Marina Nilsson**

Fragments are part of the fibre effect

PHOTO: ANH HOANG NGUYEN

↑ Victor Castro-Alves at an instrument used to analyse fibre fragments as part of the Unpuzzle project.

When we eat cereals, the dietary fibre can help balance the gut and can also act as a prebiotic, supporting the beneficial bacteria in the gut flora. The fibres also seem to have a direct influence on our immune system, by interacting with specific receptors in the cells of the intestinal wall. The idea is that this is how they regulate the immune system and its inflammatory responses in the body.

This aspect of dietary fibre has been the focus of the Unpuzzle+ research project for two years, as part of a recently completed research project that was co-funded by Lantmännen Research Foundation.

Victor Castro-Alves, a chemistry researcher at Örebro University, has studied the molecular structure of fibres following fermentation in the colon. He wanted to understand exactly what in the intestine creates a positive health effect.

AT THE PROJECT'S FINAL presentation, Castro-Alves described the very time-consuming investigations of how various enzymes break down fibre from wheat, arabinoxylan, and oats, beta-glucan, into small fibre fragments, called oligomers. Next, they investigated how oligomers react with receptors on intestinal cells, which are part of our immune system.

"We managed to isolate and quantify bioactive fibre fragments. As a result, we now have a working method that we can use, perhaps to design dietary fibres that could improve quality of life for patients with IBD and IBS. In the long term, diet, rather than medicine, could maybe be used to reduce symptoms."

The transit time, which is the time needed for food to pass through the digestive system, is key to correctly analysing fibre's effect. This can vary greatly between individuals, and be anything from 10 to 72 hours.

IN A PLANNED PROJECT, with the working name Blue Muffin Study, Castro-Alves wants to further study the effect of fibre fragments.

In it, each subject will eat two high-fibre muffins that have been dyed blue so the test can be traced. The blue-coloured stool samples will be analysed to gain more information about digestion and how oligomers form in the body.

"If we understand how someone produces these fibre fragments when they eat dietary fibre, we can design dietary fibre that is good for that specific individual," Castro-Alves concludes. ●

Reference: Guerreiro et *al. bioRxiv.* (in press)

PHOTO: ANTON SÄLLBERG

↑ Meeting of the review panel for 'Agriculture and machinery'.

Intensive work at the research foundation as this year's applications are assessed

Lantmännen Research Foundation's review panels assess the applications that were submitted in this year's call. This year has seen a very high number of applications: 84 in total. Once the process is complete, around 20 new projects will share this year's budget of SEK 25 million.

Text **Helena Fredriksson, Lantmännen R&D**

Work began in the spring, designing the calls for our three focus areas: Food and health; Agriculture and machinery; and Bioenergy and green materials. Because our foundation conducts practical applied research, this was done in dialogue with Lantmännen's various operations and by monitoring events in world around us.

THIS YEAR'S CALL for 'Food and health' highlighted cereals and legumes as an important part of the Nordic diet. We are looking for research on health impacts and knowledge that can support the development of tasty, healthy and innovative foods and ingredients. Bread is an important food category, a key dietary staple, where research on flour and baking chemistry is the focus of development.

IN THE AREA of agriculture, the foundation wants to fund research that can support the development of profitable and sustainable crop and livestock production. In 'Bioenergy and green materials', we need to know about how the entire agricultural value chain can be used to contribute to a more bio-based society.

Three review panels – one per areas – assess the applications, first singly, then the assessments are summarised at a joint meeting. Each panel has nine participants: three academics who examine scientific excellence and quality, three farmers who look at the farming benefits and long-term approach, and three assessors from Lantmännen who consider the business benefits. When the review panels meet, the applications are ranked according to criteria such as scientific quality and the project's feasibility and relevance to the sector. The foundation's board then takes the final decision on allocating funds to different projects.

APPLICANTS FOR FUNDING in this year's open call will be informed of the outcome in December, whether their applications were granted funding or rejected. The next step is to begin planning the start of the projects that will produce new and exciting research results.

Part of the foundation's mission is disseminating the results of its research. *Cerealier* is an important channel for this, as we highlight current research on food and health with a focus on cereals and legumes. The first issue of 2025 will contain more information about these new projects.●

PHOTO: LANTMÄNNEN / MATTIAS SÖDERMARK

↑ Solja Pietiäinen investigated how wheat bran can be used to increase bread's fibre content.

The Foundation contributes to theses

Wheat fibre in bread In a thesis from the Swedish University of Agricultural Sciences (SLU), Solja Pietiäinen investigated how different ways of processing of arabinoxylan, AX, the most common fibre in wheat bran, affects its use as an ingredient in bread. Wheat bran in bread increases its nutritional content, but often challenges its quality. This research showed that AX could be used to increase fibre content and improve bread quality. ●

Importance of the right forage crop The study looked at the profitability of Swedish beef production based on current production conditions. In her thesis from SLU, Kristina Holmström showed the importance of choosing the right grass species for hayfields. In a changing climate, with more frequent extreme weather, forage crops' relative competitiveness may also change. ●

Wholegrain rye and health A thesis from Chalmers University of Technology investigated how body weight, appetite control and metabolic markers are affected by replacing sifted wheat products with wholegrain rye products. Sebastian Åberg's studies showed that wholegrain rye intake improved blood sugar control and reduced low-grade inflammation in the body. However, no differences were observed for body weight. ●

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 healthy and 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

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