

Cerealier

No. 04/2023

A magazine from
Lantmännen
Research Foundation



STUDY
**Dietary fibre
good for the elderly**

DEVELOPMENT
**Oat bread using
new technology**

RESEARCH
**New thesis on
wheat flour**

THEME

OAT RESEARCH



#04

*Benefits of
fermentation*



Helena Fredriksson
Oats – a super cereal

I'd like to start by thanking everyone who participated in our reader survey! The editorial team has taken your comments and suggestions onboard.

Oats – or why not super oats – is the theme for this issue. Here in the Nordic countries, we are good at growing and using oats, and some very interesting research on oats is underway. Lund has a platform for oat research, ScanOats, in which academia and business are collaborating on the entire chain from plant breeding to the end products. One important question for several of the researchers we have interviewed is how the various parts of the oat kernel could be used better. For example, at Norway's Nofima research institute, they have taken on the challenge of baking bread using beta-glucans, with good results.

DIETARY FIBRE IS a recurring topic in Cerealier. Read about fascinating research from Örebro University, showing how fibre can benefit muscle health in the elderly. On page 23, we write about our foundation's investments in the area of fibre, focusing on gut health. And, in the fourth part of our cereal school, it is finally the turn of dietary fibre and starch.

You can also read about one of our talented doctoral students, Louise Selga, whose thesis is about wheat flour quality.

To round off, there is a recipe for oat crispbread – always tasty, whatever the occasion.

I wish you pleasant reading and an enjoyable festive season!

Helena Fredriksson

Lantmännen Research Foundation



“...fibre can benefit muscle health in the elderly.”



PHOTO: ANDERS GOOD/TT

Oat research

In this issue we explore research on oats and their use as an ingredient.

Pages 7–15

Cerealier

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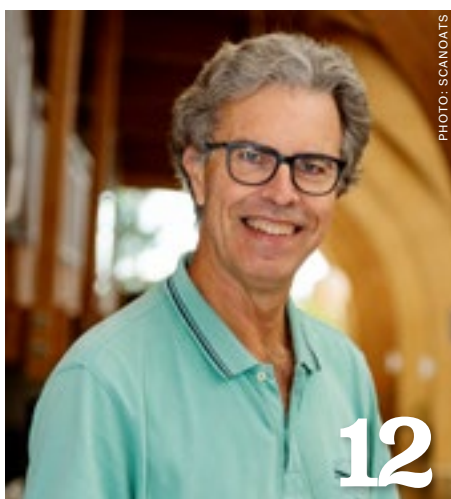
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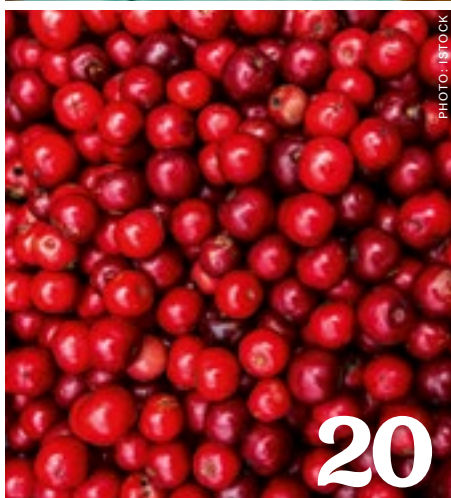
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(see also image on page 7).

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**LANTMÄNNEN
RESEARCH FOUNDATION**

New hub for food research



Lund University and Tetra Pak have founded Biotech Heights, an

innovation hub for investigating bioprocess technologies in the sustainable production of food and materials.

Biotech Heights is also a platform for stakeholder cooperation and knowledge sharing. ●

Read more: www.lu.se

50%

of grain eaten in Sweden will be wholegrains by 2035, according to the Swedish Food Agency's goals. ●



Conference in Bergen

The 13th Nordic Nutrition Congress will be held on 17–19 June 2024, in Bergen, Norway.

It will provide an overview of current nutrition research in the Nordic countries and internationally, and act as a bridge between research and societal applications. ●

Read more: www.nnc2024.org



PHOTO: ISTOCK

Literature review on food environments

The Public Health Agency of Sweden has published a literature review of Swedish research on food environments.

A food environment is a

relatively new concept. It can be defined as a place – such as a shop or school canteen – where people interact with the food system to choose what they will buy, prepare and eat. Physical, economic, social and political aspects

can also influence food-related health. ●

Read more: www.folkhalso.myndigheten.se/publikationer-och-material/publikationsarkiv/m/matmiljo-i-sverige/ (in Swedish)

RISE and Chalmers participating in Switch

Chalmers University of Technology and RISE (Research Institutes of Sweden) are two of some 20 European research organisations in Switch, an EU project. The initiative aims to promote the transition to more healthy and sustainable diets.

In Switch, research and innovation will be used to increase knowledge and accessibility and to create facilitative policies at all levels of the food system. ●

Read more: www.switchdiet.eu



ILLUSTRATION: ISTOCK



ILLUSTRATION: LENE DUE JENSEN

Dietary fibre can promote healthy ageing

It is well known that physical activity and a high-protein diet can build strong muscles, and that muscles lose mass and strength as we age. Research at Örebro University has now shown that a high-fibre diet can help reduce muscle loss.

“Muscles are responsible for much of the body’s energy metabolism, but our knowledge of how dietary fibre affects muscle health has so far been limited,” says Professor Fawzi Kadi, who leads the Eurodiet EU project, along with his colleague Andreas Nilsson, MD.

THE PROJECT STUDIED people’s eating habits and links to diseases such as diabetes, taking into account factors such as gender and exercise habits.

“The studies showed that participants in the 65–79 age group who ate more dietary fibre had greater muscle mass

than those who ate less. This association remained after factors such as the participants’ protein intake and physical activity level were considered,” says Nilsson.

The results also showed that higher fibre intake was linked to lower levels of CRP, a biomarker for systemic inflammation, which indicates that there could be a link between fibre intake, systemic inflammation and muscle mass, according to Kadi.

THE ASSOCIATION BETWEEN fibre intake and muscle mass was weaker in men who already have elevated levels of inflammation and an increased risk of metabolic disease.

“Our conclusion is that men at a higher risk of disease and with elevated levels of some inflammatory biomarkers may need to eat more fibre to achieve a positive effect on muscle health,” says Nilsson.

The researchers also studied the effect of healthier eating habits in a group of older men and women (aged 65–70) who were randomly assigned to an experimental or control group. The experimental group increased their daily fibre intake by 26%, resulting in a decrease in several pro-inflammatory markers, while the corresponding values remained unchanged in the control group.

“Our studies indicate that daily intake of fibre-rich foods may have positive effects on muscle health and thus play a role in healthy ageing. One recommendation based on our results is at least 25 grams of dietary fibre per day for women and at least 35 grams per day for men,” says Kadi. **Åsa Eckerrot**

Eurodiet is an EU-funded research project that aims to highlight the importance of dietary habits for healthy ageing.

Read more: www.oru.se/eurodiet

New research centre, KTH Food



KTH Royal Institute of Technology is launching a new centre for food research,

KTH Food. The centre will be interdisciplinary, working in the areas of functional foods and health, logistics and consumption, sustainable food production and circular food processes. It will also issue calls for proposals for research project funding in these four areas. ●

Read more: www.kth.se



Continued work on new dietary advice

During the autumn, the Swedish Food Agency held a webinar on its ongoing work to update the Swedish dietary guidelines.

The new guidelines will consider Swedish eating habits, environmental aspects, risks associated with food, and Sweden's supply capacity and increased food production.

Next, there will be a referral round with stakeholders, and an open consultation on the Food Agency's website. The dietary guidelines are expected to be completed in 2024. ●

Read more, watch the webinar: www.livsmedelsverket.se (in Swedish)

ILLUSTRATION: LENE DUE JENSEN



Food can affect deep sleep

What you eat can affect how you sleep. This was shown in a small-scale sleep study at Uppsala University. Fifteen young men without sleep problems participated in the study; they were placed

in two groups that were allowed to eat until reasonably satiated. One group ate high-fibre food, and the other group ate foods with more simple sugars and fat. Deep sleep was significantly more superficial in the latter group.

The researchers say there are several possible

explanations, such as sugar having a negative effect on sleep or that fibre produces neurotransmitters in the gut that contribute to better sleep. ●

<https://www.uu.se/en/news/archive/2023-05-31-junk-food-may-impair-our-deep-sleep>

Increased funding proposed for SLU Grogrund

The Swedish Government's budget bill for 2024 proposes a long-term investment in the SLU Grogrund collaboration programme. SLU Grogrund was founded in 2018 as a result of Sweden's food strategy, with the aim of ensuring access to new plant varieties adapted to Swedish growing conditions. ●

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



↑ Trial cultivation, SLU Uppsala.

PHOTO: MICHAEL KVICK / SLU

THEME

OAT RESEARCH

*Oats is a crop with huge potential.
We interviewed four scientists about the latest developments in
oat research and processing into new functional foods.*

Photo Golden Retriever



OAT RESEARCH

Research on oats in food has broadened significantly in recent years. One of the most important goals for the future is utilising the whole grain.

“In a perfect world, we could use the entire oat kernel in foodstuffs,” says Emilia Nordlund, a research leader in food development at the VTT Technical Research Centre of Finland. **Text Karin Janson**

Oat research at various levels

In recent years, an increasing number of products containing oats have reached the shelves, such as oat drinks, oat-based yoghurt, cream substitutes, ice cream and chocolate.

“The industry continues to show great interest in oats. We believe in oats here in the Nordics; It’s a crop that can be grown here, we have a lot of knowledge and have developed many new products. The Nordic region is now a hub for oat research and development,” says Emilia Nordlund.

SHE SAYS THAT more research on separation and processing techniques is needed to use oats as an ingredient in more foods. Currently, various techniques are used to extract the dietary fibre beta-glucan and protein from oats, but starch, which comprises much of the oat kernel, is not fully utilised.

“As a fraction, starch is a bit overlooked. I don’t

think finding a use for the starch is a big problem, for example in bakery products, but that is not being done today. Utilising all of the oat kernel is important for increased sustainability and greater profitability.

IN TERMS OF protein extraction, Nordlund has conducted studies that include enzyme treatment. Depending on the foodstuff that will contain the oat protein, its function in wet extrusion may need to be improved.

“We have done one study on meat analogues, where because meat has a fibrous structure, we wanted to create a similar texture with the same mouthfeel as meat. We have successfully investigated enzyme treatment as a way of improving the oat protein’s structure, before we create meat-like fibre structure through wet extrusion.

VTT has also developed a new technology for fractioning oats into protein- and starch-rich ingredients.



↑ Emilia Nordlund researches food development at VTT.



PHOTO: VTT

“This is a completely new and patented innovation where oat flour or grains can be used as a raw material, thanks to dry extrusion in specific conditions. This produces two fractions – one rich in protein and one rich in starch. This technology allows us to produce a fraction with over 70% protein content and a texture that makes it a viable alternative to meat.”

NORDLUND CONCLUDES BY saying how the research team then went on to investigate how well the protein is absorbed in the body, using an in-vitro model.

“We thought that extrusion would reduce

“We thought that extrusion would reduce uptake, but the opposite happened – it led to improved protein availability.”

Emilia Nordlund
Research Leader,
Food Solutions, VTT

uptake, but the opposite happened – it led to improved protein availability.”

In the case of beta-glucan, another important component in oats, Nordlund is studying how its structure can be broken down to improve mouthfeel.

“Beta-glucan is very slimy and gelatinous, which can make it unpleasant in the mouth. However, breaking it down reduces its health benefits. We want to find an optimal situation – the mouthfeel of beta-glucans is improved, but enough of the health benefits remain. Personally, I think it’s better to break down beta-glucan to some extent if that helps people eat it, rather than them not doing so at all.” ●



↑ Beta-glucan is a dietary fibre with great potential as a functional ingredient in bread.

Studying the health effects of beta-glucans in bread

Beta-glucan, a dietary fibre that is mainly found in oats, has great potential as a functional food ingredient. The Norwegian research institute Nofima has studied how to enrich bread with beta-glucan.

“The process has several technical challenges that we have tried to overcome,” says Simon Ballance, a senior researcher in food and health.

Text Karin Janson

Beta-glucan has been shown to both lower cholesterol and to help stabilise blood sugar after meals. In the body, the liver uses cholesterol to produce bile acid. Beta-glucan binds bile acid in the gut, increasing the liver's production of bile acid from cholesterol and leading to lower blood cholesterol levels. The stabilising effect of beta-glucan on blood sugar after meals has also been established, but there is no consensus on the mechanisms involved.

“It could be due to increased satiety, to beta-glucan reducing the absorption of glucose in the small intestine, to beta-glucan binding or inhibiting a digestive enzyme, or to beta-glucan interacting with gut mucosa in a way that makes it harder to let glucose pass through. It could be all these things. However, we do know that there is a link between beta-glucan's high viscosity

and positive health effects,” says Simon Ballance.

THE HIGHER THE VISCOSITY of the beta-glucan in a product, the slimier the texture, such as the stickiness of oatmeal porridge. In addition to its positive health effects, beta-glucan is an interesting functional ingredient in foods. For example, there is now great demand for more natural thickeners and stabilisers, where beta-glucan could be a good alternative, but it could also be used as an ingredient in meat analogues and similar products, according to Ballance.

“Beta-glucan-rich concentrates are currently on the market, but if a more concentrated product, a fibre isolate, is developed, there would be even more potential uses.”

Nofima has conducted a study on beta-glucan enriched bread.

“There are several challenges with this.

One is that enzymes that are naturally present in wheat, for example, break down beta-glucan into smaller components, reducing its health benefits – this can happen even if wheat flour is only in the air in the bakery. We baked using a wheat dough that had risen and then been mixed with a dough containing beta-glucan from oats.”

Beta-glucan produces a more compact bread because the dietary fibre absorbs a lot of water. In the end, the research team solved this by adding more water to the recipe.

“We finally succeeded in producing a moist bread with a good structure. Another challenge is that the bread must be suitable for several markets, as people in different countries eat different types of bread. But we opted for a paler bread that looks like a loaf.”

HOWEVER, IT MAY take several years for this type of beta-glucan enriched bread to reach the market, as bakeries must want to invest in the technology to produce it.

Simon Ballance and Nofima are also collaborating with Chalmers University of Technology in a study on the long-term effect of beta-glucan intake on blood sugar.

“If we can show that beta-glucan lowers blood sugar over a long period, we can conduct more studies and perhaps eventually apply for an additional health claim on oats and health within the EU. I believe that, in turn, this will increase consumer interest,” concludes Ballance. ●



PHOTO: NOFIMA

health effects.”

Simon Ballance
Researcher, Food and Health, Nofima

“However, we do know that there is a link between beta-glucan's high viscosity and positive



ScanOats develops

There is growing interest in oats. To utilise their potential at every stage, the ScanOats research programme is studying everything from genetics to growing conditions and health benefits. The aim is to develop new oat-based foods.

Text Per Westergård

There is great global demand for oats, for reasons such as its health properties, a boom in plant-based eating and oats being relatively easy to cultivate.

“The fact that oats don’t contain gluten is another reason for their popularity,”

says Leif Bülow, professor of Applied Biochemistry at Lund University and CEO of ScanOats, a research centre where academia and industry collaborate, taking an all-encompassing approach to oats.

HOWEVER, THERE IS a need for oat varieties with new and improved characteristics.

“To achieve this, we have mapped and sequenced oats’ entire genome. This has improved opportunities for developing varieties with exactly the characteristics we want.”

However, from a genetic perspective, oats are a rather difficult crop. For example, oats have 80,000 genes, whereas humans have 20,000. Also,

oats are exaploidy, so they have six sets of their seven chromosomes; humans are diploid, so we have two sets of each chromosome.

“However, thanks to our mapping and the potential of the CRISPR/Cas9 technology, we can more precisely target desired traits.”

BREEDING TARGETS INCLUDE new oat varieties with higher fibre, fat and protein content.

“It’s long been said that eating one bowl of oatmeal a day provides adequate beta-glucan, but the truth is that we need two. If our work is successful, then one will be enough,” says Bülow.



PHOTO: MATTIAS SÖDERMARK / LANTMÄNNEN

oats at every stage

That a crop is good in itself is not enough – it must also be possible to grow it with high enough returns. ScanOats is also hoping to develop oat varieties with better cultivation properties, with ones that can be sown in the autumn being at the top of the wish list.

THE RESEARCH GROUP is also trying to develop new product concepts. One that is almost ready is an oat-based mayonnaise, but they are also hoping to create new pharmaceuticals. New companies will be established to launch these.

“It is great that we have become a platform for business and academia, as it allows us to jointly look for answers to

PHOTO: SCANOATS



genes, through the field, and to the fork.”

Leif Bülow Professor of Applied Biochemistry, Lund University, CEO ScanOats

“...we have the opportunity to follow oats all the way from their

the questions that are most relevant to everyone,” says Bülow.

ScanOats is also able to use a pilot plant for oat drinks where, among other things, they are studying what happens if you make drinks from oats with a higher protein or fibre content.

“The overarching goal is to become a world leader in all aspects of oats. This is exciting, because we have the opportunity to follow oats all the way from their genes, through the field, and to the fork. Ultimately, this could result in us becoming a leading hub for the development of new oat-based foods.” ●

Benefits of fermentation

Fermenting oats has several benefits, for flavour, health and function in foodstuffs. The TFTAk research centre in Estonia conducts research with a range of approaches to fermenting oats.

Text Karin Janson

Oat consumption in Estonia is similar to the Nordics, with a tradition of using oats in bread, porridge and biscuits. Now, with plant-based foods in fashion, it has more areas of use.

“There is a growing interest in vegetarian and flexitarian diets, although we lag behind Finland and Sweden. Our research forms the basis of a brand, Thormi, which has more than 20 different products on the market, such as plant-based sausages, burgers and dumplings, all containing oats and peas,” says Sirli Rosenvald, head of food research and development at TFTAk.

TFTAk HAS CHOSEN to combine oat protein and pea in several studies and development projects.

“These are crops that are grown in Estonia and to which people have a positive relationship. The amino acid profiles of legumes and cereals also complement each other well – together, they can form a complete protein. Fermentation has

“Fermentation releases protein from complex structures in oats, making it more available to our digestive system...”

Sirli Rosenvald
Research Leader TFTAk

also been proven to improve taste, with the slightly nutty flavour of oats emerging while the aftertaste of peas vanishes,” says Rosenvald.

SHE SAYS THAT are other benefits to fermenting the raw material.

“Fermentation releases protein from complex structures in oats, making it more available to our digestive system so we can absorb more protein from our food. This has been investigated in several in-vitro studies. Because protein complexes are broken down during fermentation, the functionality of products is also affected. For example, a drink can contain more protein.

Recently, the research team at TFTAk conducted a study where they developed oat drinks by fermenting an oat base with four different cultures of lactic acid bacteria. The study provided an overall

picture of how the starter cultures developed during fermentation, how lactic acid bacteria are affected by pH value and how the flavour and texture of the product developed. One product had a consistency like that of fermented milk, while fermentation also resulted in a pleasant grain-like flavour.

“We can use starch from oats to feed the starter cultures, which is a circular process. Side streams are something we are focusing on right now, and starch from oats can also be used to add texture to foods,” says Rosenvald.

TFTAk IS ALSO working on two projects in the field of sensory science, one on flavour profiles in pea varieties and another on how the growing season impacts the flavour of oats.

“We’ll see whether industry or other stakeholders are interested in developing the results. Personally, I’m passionate about getting to know these crops at a molecular level,” says Rosenvald. ●

Reference: Kütt, et al, *ScienceDirect*, 2023

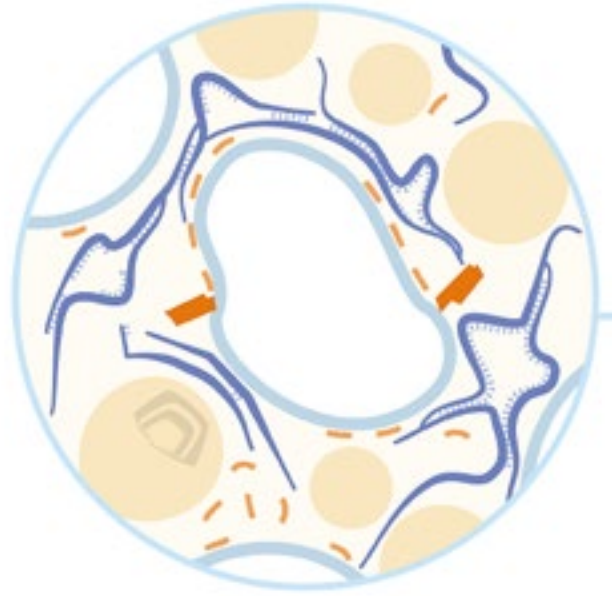
TFTAk

Estonia’s biggest research centre for protein crops. It conducts research in partnership with public authorities, organisations and industry.



↑ Sirli Rosenvald is responsible for food research and development at TFTA.

During milling and baking, it is important that flour behaves as expected – but can this be predicted? Doctoral student Louise Selga has discovered a good recipe. **Text** Linda Swartz



New quality assurance

Several quality analyses are performed on the wheat flour produced in industrial mills in Sweden but, despite meeting demands, the flour does not always meet the bakeries' requirements, where consistent flour quality is crucial for the result. Test bakes are therefore conducted with the flour before it leaves the mill.

LOUISE SELGA, WHO wrote her doctoral thesis at the Swedish University of Agricultural Sciences and Lantmännen, wanted to find out whether there were better ways of predicting flour's baking characteristics.

"Three parameters that were significant in test bakes were selected for the studies: gluten protein, arabinoxylan and damaged starch."

Arabinoxylan is the most common dietary fibre

component in wheat. Damaged starch means that its microscopic granules were broken down during milling. However, of the three components, gluten protein is the most important, as both its content and composition affects the volume of the bread.

"Our results show that the gluten composition was relatively even in the 200 flour samples we analysed. This indicates that we may not have much variation in the bread wheat that arrives at Swedish mills," says Selga.

WHAT MILLS CURRENTLY measure in routine analyses differs, depending on the measuring instruments, so Selga evaluated some of the most widely used instruments and analysis methods. As flour quality was generally consistent, it was important that these



PHOTO: PRIVAT

"Reducing test baking for winter wheat would be beneficial, both environmentally and financially."

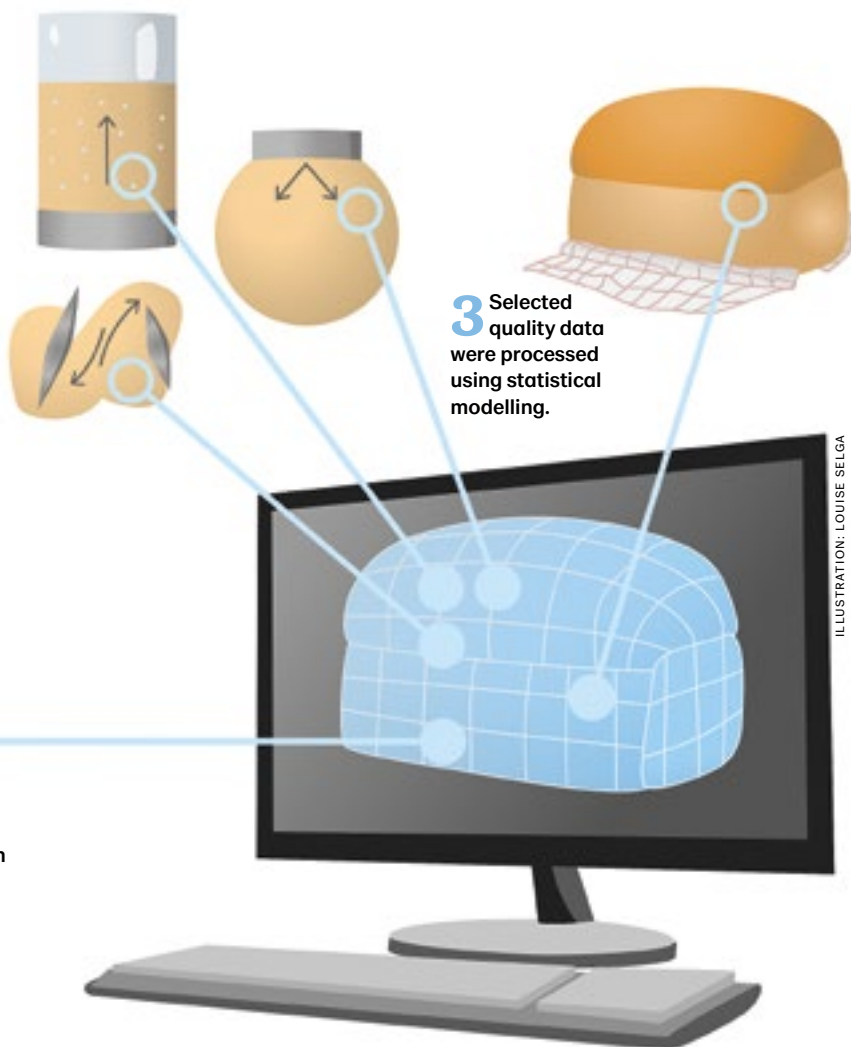
Louise Selga
Doctoral Student

2 Several different instruments were used to analyse flour quality.

1 Flour's constituents determine its quality. Gluten protein, arabinoxylan and damaged starch were analysed.

3 Selected quality data were processed using statistical modelling.

4 Predicting the results of test bakes may be an effective tool in mills' quality controls.



method for wheat flour

instruments were precise enough to detect small differences.

“One conclusion we have drawn is that, in practice, only a few parameters need to be considered.”

AFTER THE MAIN quality parameters for wheat flour had been selected, Selga wanted to investigate whether the mills really needed to conduct the next stage of their product control: test baking. Could baking results be predicted from selected quality analyses?

“The hope is that mills will be able to add an analysis that measures the dough's elasticity and gas-holding capacity. Then, using statistical modelling, they'll be able to make predictions, to calculate what the result of the test baking should be,” says Selga.

INSTRUMENTS USED TO PREDICT BREAD VOLUME

- NIR (protein and ash)
- Perten Glutomatic (wet gluten)
- Farinograph
- Alveograph

Going forward, the plan is for large-scale evaluation of the quality assurance method and flour analysis over a running-in period.

During this time, the idea is that mills will perform their quality analyses and then process the results statistically, using the model developed by Selga. A test bake should only be done if any of the values are anomalous. The model looks most promising for winter wheat, which comprises 90 per cent of all wheat grown in Sweden.

“Reducing test baking for winter wheat would be beneficial, both environmentally and financially. The main source of food waste in bakeries is flour not behaving as it should.” ●

Reference: Selga, *Wheat flour quality for baking – Linking flour components and dough performance to predict loaf volume*, SLU 2023.

Starch and dietary fibre

Carbohydrates from cereals are mostly associated with starch and dietary fibre. Cereal-based foods such as bread, porridge and cereals are important sources of carbohydrates. Altogether they contribute almost 40 per cent of the carbohydrates and one third of the dietary fibre in the Nordic diet.

Text Karin Janson

Carbohydrates are an umbrella term for our main source of energy: starch, dietary fibre and simple sugars.

Starch makes up almost two thirds of a cereal's kernel and is mainly concentrated in the starchy endosperm, the inside of the grain kernel.

The bran, the outer part of the cereal kernel, contains less starch and more dietary fibre. During milling, the kernel is divided into fractions, creating different fibre-rich and starch-rich flours. Bran is rich in fibre, some B vitamins and minerals such as zinc and iron. A few per cent of the kernel consists of simple sugars.

Starches are chains of glucose molecules and come in two forms: amylose (unbranched) and amylopectin (branched). In foods, starch functions as a texturant in baked goods, sauces and creams. It is also important in bread, due to ability to hold water. Another area of use is as a raw material for glucose syrup and other types of ingredients.

When starch is heated with water it swells and forms a gel, a process called gelatinisation. Amylopectin retains its swollen form better than amylose, which can form resistant starch, a form of dietary fibre. Starch must be broken down for the body to absorb it, and this process starts in the mouth.

DIETARY FIBRES ARE carbohydrates that cannot be broken down and absorbed by the body; instead, they reach the large intestine relatively unchanged. They consist of chains of three or more sugar molecules with bonds that the enzymes in the small intestine cannot break down.

Dietary fibre is essential for normal gut function. Some types of fibre are

fermented – metabolised – in the large intestine, which is good for the composition and growth of gut flora, while others bind water and thus increase stool volume.

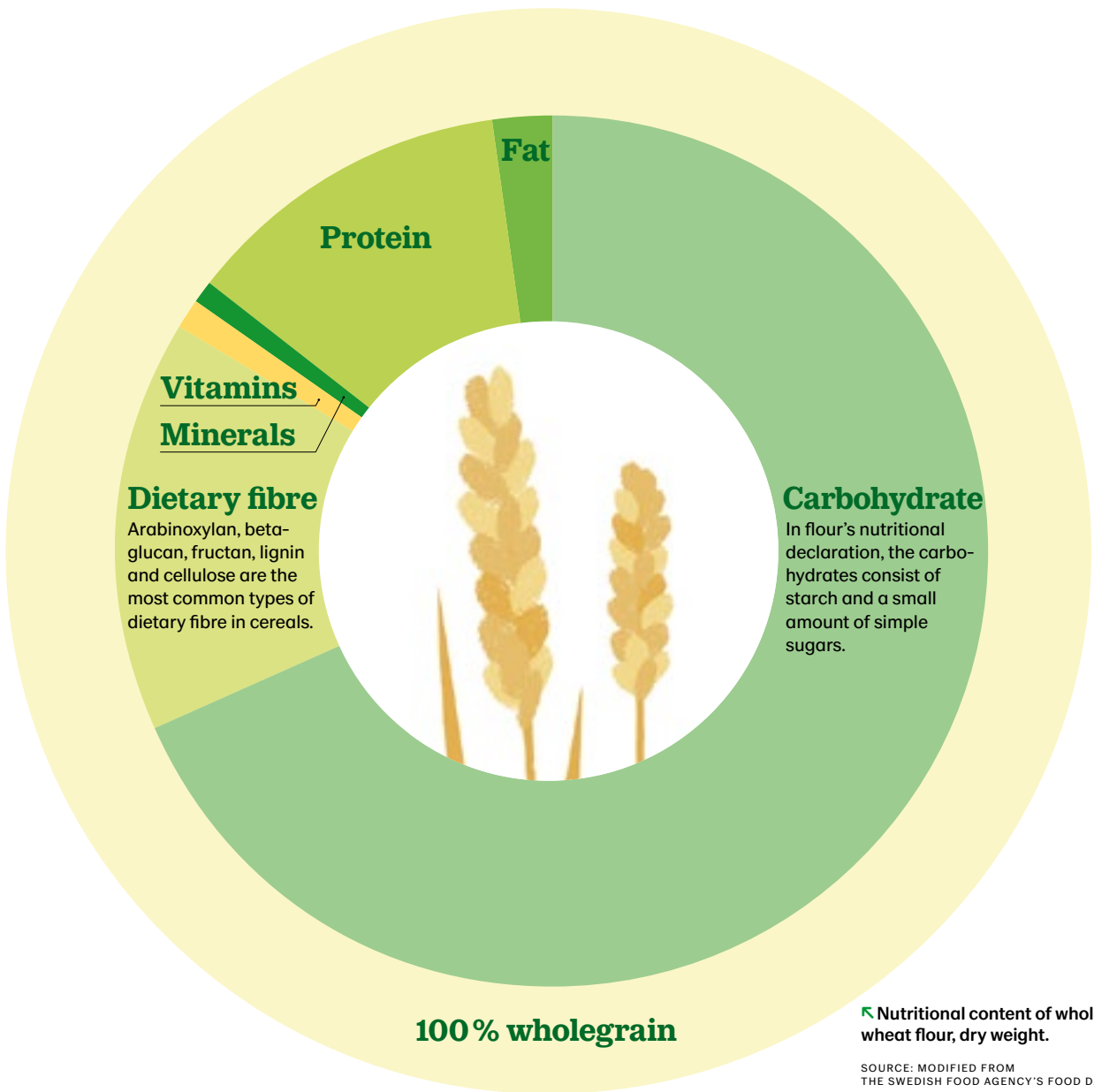
Dietary fibre occurs naturally in a range of foods, but can also be enriched. Beta-glucan concentrate, wheat bran and oat bran are examples of products and fractions where dietary fibre has been enriched or concentrated. ●

ABOUT CARBOHYDRATES

According to nutritional recommendations, 45 to 60 per cent of the energy we get from food should come from carbohydrates, which is 250 to 300 grams of carbohydrates per day. Of these, no more than 50 grams should be simple sugars and 25 to 35 grams should be dietary fibre.

On foods' nutrition labels, starches and simple sugars are called carbohydrates, and fibre is stated separately. The dietary fibre content of wholegrain products varies from 10 to 15 per cent.

SOURCE: SWEDISH FOOD AGENCY



Dietary fibre

Arabinoxylan, beta-glucan, fructan, lignin and cellulose are the most common types of dietary fibre in cereals.

Carbohydrate

In flour's nutritional declaration, the carbohydrates consist of starch and a small amount of simple sugars.

➤ **Nutritional content of wholegrain wheat flour, dry weight.**

SOURCE: MODIFIED FROM THE SWEDISH FOOD AGENCY'S FOOD DATABASE.

Arabinoxylan

has branched long-chain molecules consisting of the sugars arabinose and xylose. Arabinoxylan is mainly found in rye, wheat and barley. It has good fibre properties in its natural form, but can also be broken down into oligosaccharides, AXOS, which can boost beneficial bacteria in the large intestine. ●

Beta-glucan

has chains of glucose molecules and is a water-soluble fibre. It forms a gel when it absorbs water, which becomes obvious in oat porridge. Beta-glucan is mainly found in oats and barley. It has a cholesterol-lowering effect and contributes to a slower rise in blood sugar after meals. ●

Fructan

has chains of fructose molecules and is found in cereals, mainly rye, and in root vegetables like Jerusalem artichokes, chicory and onions. Inulin is a fructan with prebiotic properties that is derived from chicory. Some people may experience gas and indigestion when they eat fructans. Short fructan chains are called fructooligosaccharides (FOS). ●

Cellulose

has long chains of glucose molecules and is found in plants' cell walls. Along with lignin, cellulose is the frame for wood fibres. Cellulose is a fibre that functions as bulk in the gut. Hemicellulose is a mixed group of carbohydrates that are found with cellulose, but which also have units other than glucose. ●



ILLUSTRATION: LENE DUE JENSEN

FINEST promotes innovation

in food

The **FINEST** research centre aims to increase understanding for the sustainable transition and promote innovation in the food sector. This is being done in three focus areas: Swedish forest berries, protein from legumes and experimental production of food.

Text Per Westergård

Steering a research centre that focuses on the three very different value chains – Swedish forest berries, legumes and experimental production of food – may seem difficult, but Karin Östergren, senior researcher at **FINEST**, says there are many benefits.

“We see a need for transformation across the entire food sector. Our three focus areas look to the future, as well as complementing each other in their development phases. By linking our research with the innovation work taking place in companies, we can push development in the direction that we jointly believe is right.”

In **FINEST**’s work, technical solutions are just as important as consumer acceptance of new products. It often considers the social science perspective, to understand the current situation in relation to how the system has evolved.

ONE EXAMPLE OF this is the forest berry value chain, where for many decades there has been little development, while the development of new product concepts from legumes is a fast-growing area with a great need for basic research. In “experimental production of food”, the researchers are mainly studying consumer perceptions of products using ingredients such as insects and fungal proteins, as well as new technologies such as 3D printing.

“We have conducted studies on how consumers use plant-based dairy alternatives in their homes and analysed these products from sustainability and nutritional perspectives,” says Östergren.

Plant-based dairy alternatives have great potential, she says, but adds that there is still much to learn.

“In another study, we produced a status report for the nutritional strengths and challenges of Swedish meat analogues. We see that legumes have huge potential but, here too, we need to learn much more.

The carbon footprint for the Swedish pea protein value chain, water use, energy consumption and several other key environmental indicators have also been analysed as part of **FINEST**. ●

FINEST

A four-year national centre of excellence that aims to create conditions conducive to innovation for an environmentally, socially and economically sustainable food sector.

Its focus areas are Swedish forest berries, protein from legumes and the experimental production of food. Stakeholders are **RISE** Research Institutes of Sweden, Chalmers University of Technology, Uppsala University, parts of the Swedish food industry and several regions. **FORMAS** is the primary financier.

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



PHOTO: FOOD & FRIENDS

RECIPE

Crispy oat bread for the holidays

Delicious crispbread for the Christmas table and as a snack on lazy days. Try it with tasty toppings, perhaps a good Cheddar cheese or some gravlax?

Oat crispbread with seeds

Makes 1 tray
About 90 minutes preparation time

- 250 ml rolled oats
- 100 ml sesame seeds
- 100 ml pumpkin seeds
- 100 ml sunflower seeds
- 100 ml linseeds
- 50 ml chia seeds
- 200 ml hot water
- 75 ml rapeseed oil
- 1 tbsp salt flakes

INSTRUCTIONS

1. Whiz the rolled oats to a flour using a mixer (makes about 200 ml).
2. Place the oat flour and other dry ingredients in a mixing bowl. Add the hot water and rapeseed oil and combine. Leave to stand for 10 minutes.
3. Put the mixture on an oven tray covered with baking paper, then flatten it out across the entire tray. It helps to put a sheet of baking paper over the top and then spread out the mixture with your hands or a rolling pin, to make a smooth and even layer.
4. Bake in the oven at 150°C for 60 minutes. Break into pieces when cool. ●

← Recipe from AXA.

FROM MY PERSPECTIVE

International demand for plant-based food and drink is high. It is time for Sweden to join in and invest more in research, writes Marie Gidlund, director of Sweden Food Arena.

Sweden needs broader cooperation on food

Danish industry has calculated that every per cent of market share they gain in the international market creates 9,000 new jobs in the sector – this figure should also be relevant in Sweden.

Internationally, numerous countries are investing huge amounts of resources in research, innovation, implementation and international market development to support the development, competitiveness and profitability of plant-based industry. It's time for Sweden to do the same, because the race is on. To boost Swedish development, we have identified the following needs in innovation and research:

CONSUMERS AND MARKET: Important parameters for food consumers are health, flavour and price, so there is a need to develop attractive, tasty plant-based foods and recipes. To increase the proportion of plants in food intake, we need to better understand the consumers, driving forces and trends in our selected markets.

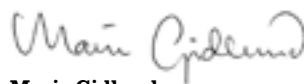
PREPARATION AND PROCESSING: Scaling up to industrial levels is based on advanced knowledge of process technologies and their impact on flavour, nutrition and product characteristics. Recipe and product development depends on progress in

sensory science. In the future, we want a smart and flexible value chain that is circular, reduces waste, is scalable, and is both automated and digitalised.

PRIMARY PRODUCTION: In the future, profitable cultivation will require increased knowledge of water management, precision cultivation, management of residual flows and nutrients. More demonstration farms and field trials are necessary. Sustainability mapping, sustainability databases and active advisory services for producers will contribute to increased efficiency and improved competitiveness.

PLANT BREEDING: There is a need for more crops adapted to Swedish growing conditions.

If the production of Swedish plant-based food and drink is to expand, we must work together. Successful companies launch innovations they have developed by working with customers, suppliers, and experts – like researchers. Together, we can also develop new business models that reduce risk and increase opportunities.



Marie Gidlund

“It’s time for Sweden to do the same, because the race is on.”



PHOTO: DAVID THUNANDER

Marie Gidlund
Sweden Food Arena

Want to feature in “From my perspective”? Email us at tidskriftenc@lantmannen.com
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PHOTO: JAKOB FRIDHOLM / LANTMÄNNEN

↑ There is a clear link between the consumption of dietary fibre and better health.

Studying the gut's link to health

Gut research is on a journey, and is somewhere between the identification of bacteria and their effects on wellbeing. The destination may be a personalised diet. Funding from Lantmännen Research Foundation is helping find answers in this field.

Lovisa Martin Marais Lantmännen R&D

Consumption of grain fibre has a strong link to health, with low consumption of wholegrains being the biggest factor globally in cardiovascular disease and diabetes. But exactly how wholegrains and fibre affect our health is something that we and others are exploring.

WE HAVE SOME ANSWERS. We know that when dietary fibre reaches the large intestine, it can become available as a substrate for beneficial gut bacteria, so the fibre can act as a prebiotic. We know that bacteria in the large intestine produce metabolites, as

short-chain fatty acids, a kind of postbiotics. This is something that a research group at Örebro University has studied in several projects funded by our foundation. One of the projects has shown that wheat bran can increase the amount of butyric acid produced in the large intestine, which is associated with health effects, and a recently completed project studied the effect of butyric acid on glucose response and intestinal permeability in type 2 diabetics. Another project studied how butyric acid can affect intestinal permeability and stress resistance in healthy people, using a unique in-vivo model.

THE UNIVERSITY OF Eastern Finland is running a project that aims to study metabolites, substances produced by gut bacteria when they ferment fibre, in pig organs after the consumption of wholegrain rye and wheat. We are now waiting to see the results of these studies in scientific journals.

The concepts of pre-, pro- and postbiotics are hot topics. Prebiotics are fibres

that encourage the growth of beneficial gut bacteria. Probiotics are bacteria with health-promoting effects that are ingested through food or as supplements. Postbiotics, a more recent term, are fermentation products or metabolites formed by bacteria in the large intestine, substances that have a positive health effect in themselves. The use of these terms helps us better understand the bacterial machinery of our gut.

IN THE FUTURE, research may advise you what to eat based on your gut flora's composition and how you do or do not benefit from different foods. Understanding the role of diet on, and its synergy with, gut bacteria and the effect of their metabolites on our body can pave the way towards personal solutions, ones that are good for your health and your tastebuds.

While we wait for more detailed advice, we can follow the new Nordic Nutrition Recommendations – eat at least 90 grams of wholegrains per day. The science is on this clear. ●

NEWS FROM LANTMÄNNEN RESEARCH FOUNDATION



PHOTO: JOHAN OLSSON / LANTMÄNNEN

↑ Lantmännen Research Foundation supports a project on fava beans at SLU Grogrund.

Lantmännen Research Foundation supports



SLU Grogrund

The Swedish centre for breeding food crops,

where academia, society and industry collaborate. Its aim is to secure the supply of robust plant varieties and contribute to sustainable and competitive agricultural and horticultural production. ●

Read more: www.slu.se



LADS – a platform for digitalisation

The Swedish University of Agricultural

Sciences in Skara has a collaboration platform, LADS, for research that provides agriculture with digital services for increased harvests, better quality and reduced environmental impact. Work is conducted in partnership with public authorities, industry and farmers. ●

Read more: www.slu.se



Healthgrain forum

A European network of

universities, institutes and industry that develops research and communication activities with the overall aim of increasing knowledge about, and the intake of, wholegrains. ●

Read more: www.healthgrain.org

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

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