Cerealier

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A magazine from
Lantmännen
Research Foundation

THEME THE NORDIC NUTRITION RECOMMENDATIONS

NNR 2023

PRACTICE
Dietary advice in use in school kitchens

RESEARCH
Future meat analogues

CEREAL SCHOOL
Focus on protein and fat

Helena Fredriksson
Wholegrains are right

The new Nordic Nutrition Recommendations – NNR2023 – have finally arrived. In this issue we've interviewed a few of the people who were responsible for the factual input, and those who will transform NNR2023 into dietary advice. We also take a look at how work is being conducted in Skövde Municipality's public kitchens, using current dietary advice.

You can also read about two new doctoral theses that focus on cereals. It's a great feeling when doctoral students cross the finish line – there is a huge need for new knowledge and expertise in the food industry. We will have longer interviews with more postdoctoral researchers in upcoming issues.

IN THE THIRD PART of our cereal school, the focus is on protein and fat, nutrients that may not be the ones you associate with grains. Did you know that cereal products contribute about one fifth of the total protein intake in the Nordic diet?

"If you want to follow the NNR, choose wholegrain..."

The importance of cereal quality has been highlighted by this year's very extreme growing conditions. You can read about how our foundation is working with these issues on page 23.

TO ROUND OFF, we offer a pasta recipe in which beans, seeds and lots of vegetables play the main role, with yesterday's leftover fish or meat as an optional side dish. If you want to follow the NNR, choose wholegrain pasta.

Happy reading!
Helena Fredriksson
Lantmännen Research Foundation

PHOTO: GOLDEN RETRIEVER

NNR 2023

In this issue, we take an in-depth look at the new Nordic Nutrition Recommendations and what they mean in practice.
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Cerealier

Responsible publisher
Helena Fredriksson
helena.fredriksson@lantmannen.com

Editor-in-chief
Karin Janson
journalistkarin@gmail.com

Scientific project manager
Karin Arkbåge

Editorial board
Helena Fredriksson
Karin Arkbåge
Karin Janson
Mats Larsson
Nicolina Braw
Sanna Remholt

Translation
Clare Barnes,
Åre Translation

Art direction & layout
Alenäs Grafisk Form

Cover
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Address
Lantmännen Research Foundation
Tidskriften Cerealier
Box 30 192
SE-104 25 Stockholm

Telephone
+46 (0)10-556 00 00

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

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LANTMÄNNEN
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Mapping Nordic oats

It is time for the first large-scale survey of Nordic oat varieties. Last summer, the Nordic Genetic Resource Center, NordGen, cultivated nearly 800 seed samples whose characteristics are now being analysed. Knowledge of these different varieties may be useful for stakeholders who want to develop new oat varieties that are healthier, more profitable or have other properties suitable for use in foods. ●

Read more: www.nordgen.org

90

grams of wholegrains per day is what the NNR2023 recommends for adults. ●

Upcoming European conferences

THERE WILL BE a conference on sustainable food and the food industry in Valencia, Spain, from 6–8 November.

THE FOURTEENTH European Nutrition Conference will be held in Belgrade, Serbia, from 14–17 November. ●

Read more: www.effost.org and fens2023.org

PHOTO: ISTOCK

Fibre for children

The World Health Organisation, WHO, has produced new guidelines for the healthy intake of dietary fibre and carbohydrates.

The new recommendation is that for everyone above the age or two, carbohydrates should primarily come from wholegrains, vegetables, fruit and legumes. Adults are also recommended to consume at least 400 grams of fruit and vegetables and 25 grams of naturally occurring dietary fibre every day.

THIS IS THE first time the WHO has issued fibre guidelines for children. ●

Read more: www.who.int

RECOMMENDATIONS

Fruit & veg

Age 2–5, at least 250 g per day
Age 6–9, at least 350 g per day
Age 10+, at least 400 g per day

Dietary fibre

Age 2–5, at least 15 g per day
Age 6–9, at least 21 g per day
Age 10+, at least 25 g per day

Research on perennial barley

Researchers at the Swedish University of Agricultural Sciences (SLU) in Uppsala have worked for five years on domesticating and breeding perennial barley, *Hordeum bulbosum*, as a cereal crop.

They are now working with the University of Copenhagen and the Carlsberg Research Laboratory, and have been granted DKK 23.1 million for continued research. The group will now use traditional plant breeding and advanced molecular selection to improve various cultivation characteristics. Perennial barley would mean farmers do not need to plough and sow each season, thus reducing the need for fertilisers and pesticides. ●

Read more: www.slu.se

PHOTO: PER-OLOF LUNDQUIST / SLU

ILLUSTRATION: LENE DUE JENSEN

A versatile bean

In her recent doctoral thesis, Klara Nilsson from SLU shows that Swedish-grown faba beans can be a nutritious and sustainable component of plant-based products.

These products have expanded in the Swedish market, but the proportion of domestic ingredients remains low. For more consumers to choose a plant-based diet, the consistency of the products needs to be improved.

"Many people think they are too soft and mushy," Nilsson says. "After taste, texture is the most important factor in food, so I have investigated how the faba beans' starch, protein and fibre affect the structure and texture of different foods."

BY CONTROLLING THE AMOUNT and processing of starch, protein and fibre, the need for stabilisers can be reduced, while products with specific and desirable structures can be developed. Nilsson explains that they even 3D printed small biscuits by making an edible faba bean ink for the 3D printer. The challenge was getting the ink fluid enough to be pressed through the printer's nozzle, but firm enough for 3D-printed object to keep its shape.

"Adding fibre from faba beans improved printability and gave us airy biscuits, while the high-protein biscuits without fibre were hard."

TO STUDY THE EFFECT of different fractions on the texture of other types of food, they also made gels, a texture found in everything from yoghurt to sausages. It turned out that faba bean protein had a softening effect, says Nilsson.

Different amounts and fractions of faba beans, and different types of processing, affected the final product's microstructure, which in turn affected its texture. Simply grinding faba beans and using them in other products limits opportunities to use it as a texturising ingredient and to develop different types of products.

NILSSON'S RESEARCH ALSO shows that if protein from faba bean is reinforced with cellulose, it could potentially be used as bio-degradable packaging material.

Åsa Eckerrot

THE THESIS

Faba Bean Foods: Structure and Texture **reports on various functions for faba bean starch, protein and fibre in food systems. The thesis is available via www.slu.se**

New rules for genetic scissors

The European Commission has presented a proposed regulation on plants, aiming for increased sustainability.

One suggestion is greater authorisation for crops that have been gene edited using CRISPR-Cas9.

The purpose of allowing gene editing in agriculture is to develop more resilient crops, especially in the face of climate change, and to reduce the use of chemicals, according to the Commission. ●

Read more:
www.food.ec.europa.eu

Upcoming thesis

PHOTO: ISTOCK

On 17 November, Louise Selga, PhD student at the Swedish University of Agricultural Sciences, will defend her thesis on wheat flour quality for baking.

She investigates the link between flour quality, dough properties and bread volume. ●

Seminar on dietary advice

At the end of September, the Swedish Food Agency held a webinar on transforming the NNR2023 into Swedish dietary guidelines.

A recording of the seminar is now available on the Agency's website. ●

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

ILLUSTRATION: LENE DUE JENSEN

Swedish food crafts

The Swedish food crafts championship will be held in Borås, 17–19 October.

AROUND 500 ENTRIES are expected, with 50 different classes divided into categories such as dairy, baked goods and charcuterie.

SINCE 1996, the event has been organised by Eldrimner – financed by the government and the EU's rural development fund. The aim is to support and inspire food artisans' product development and to increase awareness of, and demand for, food crafts. ●

Read more (in Swedish):
www.eldrimner.com

Follow-up to major cardiovascular study

Sweden's largest population study, SCAPIS, will be followed up in 2024 and 2025. Internationally, SCAPIS is the most comprehensive study of cardiovascular disease ever conducted.

Since it started, 30,000 randomly selected participants have provided samples and interviews and undergone testing, to aid understanding of the links between cardiovascular disease and lifestyle factors, such as diet and exercise. In SCAPIS 2, half the participants will be re-examined. There are opportunities for locally affiliated researchers to participate through sub-studies. ●

Read more (in Swedish): www.hjart-lungfonden.se/forskning/scapis

ILLUSTRATION: ISTOCK

THEME

NNR2023

The updated Nordic Nutrition Recommendations will have a major impact on how we eat in the future. We interviewed four researchers and experts about what the advice means and how to translate it to Swedish conditions. ▶

Photo **Golden Retriever**

↖ Rune Blomhoff, professor at the University of Oslo, has led the work on NNR2023.

The new Nordic Nutrition Recommendations were published in June. The inclusion of food's impact on the climate and environment is new, as is the summary of how different food groups influence health. Text **Per Westergård**

More plant-based food in the new nutrition recommendations

A major challenge for the working group that has produced the new Nordic Nutrition Recommendations is that the scientific basis is so extensive.

"There are few areas of medical research with more activity. Every day, 300 new scientific articles on diet and health are published, so no single country could have produced this review alone," says Rune Blomhoff, professor at the University of Oslo and project manager for the work on the NNR.

HE SAYS THAT work has only been possible because of the Nordic and Baltic countries' cooperation, involving more than 400 researchers.

"The results are stronger than if countries had acted individually, which means that the recommendations we have produced are based on a more solid scientific foundation than previously. Although the recommendations are not so unlike the previous version, from 2012, the difference here is that we can make statements with greater certainty."

The most important conclusions are that we should eat more fruit, vegetables, legumes and wholegrain products, and less red meat and foods high in salt, fat and sugar. Or more simply: more plant-based, and less meat.

"...generally we've found that what is good for health is also good for the climate."

"Our recommendation to eat no more than 350 grams of red meat per week is purely a health assessment, without considering the climate impact, but generally we've found that what is good for health is also good for the climate."

THE RECOMMENDATION ON limiting the intake of meat aims to create a balance between the increased risk of bowel cancer and how much meat we should eat to obtain important nutrients that are difficult to obtain from other foods.

"We weighed the benefits against the risks, arriving at an amount that we believe provides us with enough nutrients without greatly increasing the risk of bowel cancer."

Including our diet's environmental and climate impact was a request from the Nordic Council of Ministers, which commissioned the new recommendations. However, the harshest criticism of their inclusion has been from the political arena.

"It feels a bit strange to be criticised for something we were asked to do, whereas the reception in academic circles has mainly been positive. Perhaps this is because we have endeavoured to be more open and transparent than before," says Blomhoff.

WORK ON PRODUCING the new nutrition recommendations would actually have been easier, says Blomhoff, if they had not had to consider environmental and climate aspects. The environmental analyses that were carried out barely affected the final results.

"It has also been important to ensure that the updated nutrition recommendations also benefit the environment and the climate," he says. ●

THE MOST IMPORTANT POINTS IN NNR2023

- More of what we eat should come from the plant kingdom. This means more fruit and vegetables, berries, wholegrain products, legumes, potatoes and nuts, and increased intake of fish from sustainably managed stocks.
- We need to be more moderate with dairy products, limit the intake of meat and foods high in salt, sugar and fat. We should also keep our alcohol intake low, preferably avoiding it entirely.
- Food's environmental and climate impact has also been analysed, but with little effect on the nutrition recommendations.

PHOTO: KYRRE VIGESTAD / UIO

Cereals

A natural element in the recommendations

For the first time, the Nordic Nutrition Recommendations now include cereals as a separate food group. An increased intake of wholegrains is beneficial both for health and for reducing environmental impact, according to the research compilation. Text **Karin Janson**

For the chapter on cereals, the authors compiled both systematic reviews and recent individual research studies. The results were unanimous.

"In principle, the pyramid of evidence is similar for all food groups, with controlled trials ranked highest, longitudinal follow-up studies ranked as average and short follow-up studies ranked the lowest. The results are evaluated and summarised," says Lars Fadnes, professor at the Department of Global Public Health and Primary Care at the University of Bergen.

FADNES IS THE lead author of the chapter on cereals, together with Guri Skeie, Professor of Medicine at the University of Tromsø. Having chapters for individual food groups is new in the NNR; previous editions only had chapters on individual nutrients. "Extensive research into food groups is now underway and a lot of new knowledge has emerged, so it's reasonable to include this knowledge when establishing nutritional recommendations," says Fadnes.

THE CHAPTER ON cereals covers both sifted cereals and wholegrain cereals. There is plenty of evidence for the health benefits of wholegrains. Results from large pooled analyses, known as meta-analyses, show that a daily intake of three to seven servings of wholegrains is associated with a lower risk of cardiovascular disease, type 2 diabetes, colon cancer and premature mortality. The lowest risks for obesity and mortality were observed for an intake of 90 to 210 grams of wholegrains per day. One portion

PHOTO: JØRGEN BARTH

↑ Lars Fadnes, professor at the Department of Global Public Health and Primary Care at the University of Bergen.

PHOTO: ISTOCK

of wholegrain pasta and two slices of crispbread are more or less equivalent to 90 grams of wholegrains.

THERE IS LESS evidence of health effects for sifted cereals, and the available research shows fewer positive health effects than for wholegrains. Current dietary advice therefore suggests replacing sifted products with wholegrains, as much as possible.

"The problem is that many of the longitudinal studies following large populations have not had enough information on sifted cereals. The available data is thus more uncertain than for wholegrains, which have been more extensively studied. We need more cohort studies with large populations that monitor intake over time, for different types of cereals and different levels of processing," says Fadnes.

WHOLEGRAIN RECOMMENDATIONS

Current Swedish dietary guidelines recommend an intake of 70 grams of wholegrains per day for women and 90 grams for men. The new NNR recommends at least 90 grams of wholegrains per day for both sexes.

REFERENCE: CEREALS CHAPTER IN NNR2023

OTHER LIMITATIONS TO working with the chapter on cereals have been that the intake of wholegrains and cereal products is measured in different ways in different countries, and that there are few studies for specific groups, such as children, the elderly, or pregnant and breastfeeding women.

The chapter identifies cereal products as a key component in reducing food's climate impact, with the exception of rice. The climate impact of wet rice cultivation is higher than for other cereals, because methane is released.

In the Nordic countries, our diet already contains a large proportion of cereals.

"Consumption data for the Nordic countries shows that we mainly consume bread made from rye and wheat, as well as a lot of porridge and breakfast cereals, especially those made from oats," concludes Fadnes. ●

↑ Swedish dietary guidelines describe what we should eat more or less of.

A stable foundation for new Swedish dietary advice

The Nordic Nutrition Recommendations are the first step, and the Swedish National Food Agency has now begun work on producing updated Swedish dietary guidelines.

Text **Per Westergård**

Developing the updated Nordic Nutrition Recommendations has involved 400 researchers, eight countries and taken five years. The next step is to develop national dietary guidelines based on NNR2023. The Swedish National Food Agency must adapt them to Swedish conditions.

"The new Nordic Nutrition Recommendations have been eagerly awaited by those of us who work with food, health and the environment, not least because NNR2023 also has recommendations for entire food groups," says Bettina Julin, a nutritionist at the National Food Agency, who will be involved in developing the new Swedish dietary advice.

THE NATIONAL FOOD AGENCY'S task is to transform the recommendations into more practical dietary advice – what should be on our plates.

"Our job is to examine whether Sweden has specific conditions that we need to consider, such as our culinary traditions and the lifestyle diseases linked to our dietary habits – as well as how dietary advice should be designed so it can be followed. However, the results should not be regarded as prescriptive, but as a benchmark for how we should eat to maintain good health."

For the first time, environmental and climate aspects have been more comprehensively included in the NNR.

"The most important conclusion is that what is good for the body is generally also good for the climate and environment. This is not news for us in Sweden; our existing dietary guidelines from 2015 already include environmental aspects, so we don't expect huge changes when the new ones are finalised," says Julin.

ACCORDING TO JULIN, the most important result from NNR2023 is that there is an up-to-date and comprehensive compilation of everything related to the food we eat.

"Although our current advice is completely in line with the presented results, the importance of this work should not be underestimated, not least because it will be the foundation of new national guidelines for schools, health and social care."

BEFORE THE NEW Swedish dietary guidelines can be adopted, the Food Agency's proposal will be sent out for consultation. She does not expect everyone to like the new advice.

"Food is so much more than a question of nutrition and feeling full. It is just as much about norms and traditions, which makes it personal, something we must each take responsibility for. This is why our advice is not prescriptive, but advisory, and now we can provide it on a more stable scientific foundation," concludes Julin. ●

PHOTO: ISTOCK

PHOTO: LIVSMEDELSVERKET

"Our job is to examine whether Sweden has specific conditions that we need to consider ..."

Bettina Julin
Nutritionist, Swedish National Food Agency

Dietary advice in practice in school kitchens

Skövde Municipality's meal planning unit now largely works with Swedish produce, lots of vegetables and protein from the sea.

"We are already working in accordance with NNR2023," says Ida Henriksson, meal developer.

Text **Karin Janson**

Skövde Municipality has received awards and attention for its work with domestically produced food, with up to 77 per cent of what is served on the tables coming from Sweden.

Ida Henriksson, one of the municipal meal developers, says that the "Skövde model" is based on commitment, expertise and participation.

"We have 64 kitchens in preschools, schools and elderly care, and a very decentralised organisation. The chefs in each kitchen decide what will be on the menu and we have no dietary data system, although we do have guidelines to follow so we comply with Swedish dietary advice."

TO ENSURE THAT what is served is nutritious, the municipality uses a survey tool, Skolmat Sverige. The freedom given to the chefs means it is a bit like running their own restaurant, according to Henriksson.

"This helps us attract enthusiastic, competent staff. Choosing primarily Swedish food is instinctive."

She believes the new nutritional recommendations are in line with the work already done by the meal planning unit.

"We always offer a salad buffet, which includes wholegrain products, and two options for the main course, one with animal proteins and one completely vegetarian dish. Over the last few years, we have measured the carbon emissions per kilo of purchased food, and we have now surpassed the short-term target of 1.7 kg CO_2e per kilo at 1.6 – despite serving animal protein every day. I am very impressed by our chefs' work."

DUE TO A POLITICAL decision in the municipality, no schools are to have vegetarian days; some form of animal protein must always be offered.

"The challenge will thus be to reduce meat further, as the NNR recommends a maximum of 350 grams per week. We can't fill the entire quota from five school meals a week, as there will be nothing left for the pupils' meals at home," says Henriksson.

She sees the potential for offering more proteins from the sea, something the meal planning unit is already working on, but fish is expensive and school meals are under financial pressure.

"We've been trying to find new seafood products for a while, and are now partnering with a company that can supply mussels, mussel mince, seaweed and mussel powder. This autumn we'll also introduce herring mince, which is a side stream from herring fillets. The mussel mince has been very popular, and we hope the same will be true for herring mince."

Still, there can be gaps between what the kitchens serve and what pupils are used to eating at home.

"Children don't eat nutritionally calculated food, they eat what they like. This is where the teachers are important, preparing pupils for the food being offered and discussing how tasty, healthy food can have a positive impact on the body and the environment. It is important for the dining environment to be relaxed, so that pupils enjoy eating."

HENRIKSSON WANTS TO see close co-operation between Sweden's National Food Agency and its National Agency for Education when the Swedish dietary guidelines are launched.

"The National Agency for Education needs to be better at recognising the potential of school meals and work on disseminating the new dietary advice. Educational lunches could be one way of doing this, as could integrating school meals across subjects at the school." ●

"We always offer a salad buffet, which includes wholegrain products."

Ida Henriksson
Meal developer
Skövde Municipality

PHOTO: MATTIAS NILSSON / SKÖVDE KOMMUN

↑ Ida Henriksson, meal developer in Skövde Municipality.

Future meat analogues

The Like:meat research project is developing the next generation of meat analogues using fermentation and extrusion. Its aim is to increase nutritional value and use new raw materials in products.

"With better knowledge of the mechanisms behind how meat-like fibre structures form, we hope we can use more cereals and legumes," says project manager Mats Stading, a researcher at RISE.

Text **Karin Janson**

There is a huge interest in plant-based meat and milk analogues, although foods made from legumes and cereals may have low levels of bioavailable iron and zinc due to their antinutritional factors, mainly phytic acid. Legumes also contain oligosaccharides, which can cause stomach pain and gas in sensitive individuals.

PHOTO: RISE

"We've seen that fermentation can reduce phytic acid content, increasing the bioavailability of iron and zinc..."

Mats Stading
Researcher, RISE

In the Like:meat project, fermentation has been evaluated and combined with extrusion, a method where food is processed under high pressure, at different temperatures and finally pressed through a nozzle into the desired shape. Products produced by extrusion include pasta, breakfast cereals and snacks like cheese puffs.

IN SWEDEN, THIS is the first time that extrusion has been combined with fermenting the raw material as the first stage of the process. The project has

PHOTO: MARK & BJERRE / LANTMÄNNEN

↑ Plant-based burgers.

used peas as an ingredient and the first results of laboratory trials show that the method has increased the raw material's nutrient availability.

"We've seen that fermentation can reduce phytic acid content, increasing the bioavailability of iron and zinc, while the level of oligosaccharides is reduced," says Stading.

ANOTHER POSITIVE EFFECT of fermentation can be to reduce the bitter aftertaste of legume protein. Using fermentation as a first step may also help the subsequent extrusion process, as it improves the raw material's protein quality and reduces the starch content.

One important aim in the research project is learning how the meat-like fibres are formed during extrusion. Fibre structures similar to those of meat are created by first heating and then cooling protein mixtures.

"The aim is to create tasty, attractive and nutritious products, although we're not specifically focusing on flavour. We're doing that in a Formas project called 'Goa proteins', using peas," says Stading.

THIS TECHNOLOGY AND knowledge about how pea protein behaves when processed is opening up opportunities for using other legumes and cereals in meat analogues.

"Some legumes used in today's meat analogues are grown in Sweden, but this is only a small proportion. We can see that, in the long term, we can use proteins from other legumes and more Swedish-grown ones. Lantmännen's investment in a factory for pea protein in Lidköping will allow completely Swedish products in the future," he says. ●

LIKE:MEAT

This project started in November 2021 and will run until November 2023. It is financed by Vinnova, with Lantmännen and Orkla as industrial partners. Its approach is interdisciplinary, with collaboration across industry and institutes that contribute expertise in food science, food processing, nutrition, fermentation, simulation, modelling and product development.

CEREAL SCHOOL, PART 3:

Protein and fat

Cereals are perhaps most associated with carbohydrates, in the form of starch and dietary fibre. But they also contain fat and are rich in protein. Cereal products contribute about one fifth of the total protein intake in the Nordic diet.

Text **Karin Janson**
Illustration **Lene Due Jensen**

In cereals, the protein is found in all parts of the kernel, in the endosperm, germ and bran. When wheat is milled into sifted flour, the flour's protein content drops slightly due to the kernel's outer layers, which have a higher concentration of protein, being removed.

PROTEIN LEVELS IN cereals are governed by factors such as variety, soil, fertilisers and the weather during the growing season. In general, increased nitrogen availability results in a higher protein content. The protein's quality is another important factor for the area of use. The protein in common Nordic cereals is divided into four types: albumin, globulin, prolamin and glutelin, which have different nutritional and functional properties. Cereals contain different amounts: in wheat, most of the protein is gluten proteins – prolamin and glutelin. Globulin predominates in oats, while albumin is most common in rye, and prolamin in barley.

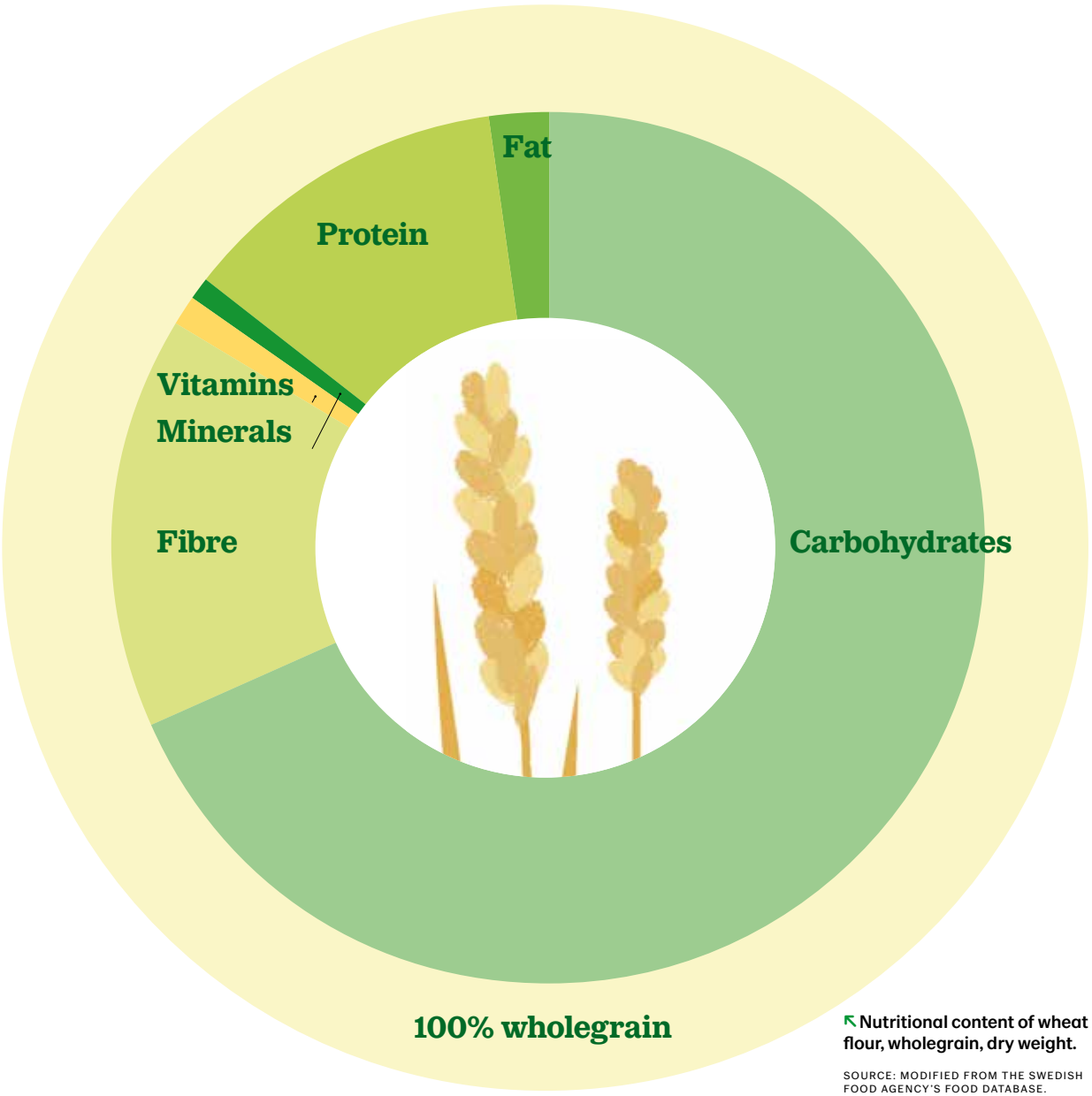
Wheat protein or gluten is the best known and most widely used cereal protein, making up 80 to 85 per cent of wheat's total protein content. When wheat flour is kneaded with water, the gluten proteins form an elastic network that allows the dough to rise, thanks to its ability to trap gases. As most of the protein in wheat is gluten proteins, a higher protein content means a greater bread volume. Barley and rye also contain gluten proteins, but these differ from those in wheat and cannot form a strong gluten network, so wheat flour is often used in rye and barley bread to increase bread volume.

IN ADDITION TO the nutritional properties of protein from oats, barley and rye, it can be used to create the required texture – such as a gel or foam – in dairy analogues. Processing methods such as enzymation, extrusion and fractionation are used to create structures and characteristics, such as meat-like fibres in meat analogues, or to improve health effects, or make products tasty and attractive.

Cereals also contain fat, with cereal products contributing eight per cent of the fat in the Nordic diet. Fat is made up of fatty acids: there are saturated, unsaturated and polyunsaturated fatty acids. These have different health properties, and affect the texture and structure of the final products in different ways. Cereals are low in fat, which is predominantly the healthy polyunsaturated fat.

Oats stand out, as they have the highest fat content at five to seven per cent. There are also high-fat varieties, with an extra high fat content. Oat enzymes are activated when the kernel is crushed or damaged which, combined with the high fat content, makes oats susceptible to rancidity. Oats are usually heat treated to avoid this happening.

OAT FAT IS LIQUID. Oat oil can be extracted and used as an ingredient in vegan chocolate or in skin care products, for example. In other cereals, the fat content is lower and the fat is concentrated in the germ. Wholegrain wheat flour has a fat content of about two per cent; this is slightly lower in sifted wheat flour. Wheat germ is an example of a high-fat cereal product, with nine per cent fat. ●



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

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

Protein

Protein is often called the body's building block. It is needed for building cells as well as forming enzymes and hormones, for example. Protein consists of about 20 amino acids in various combinations and nine of these are essential, meaning that we must get them from food because our bodies cannot produce them.

A diet that combines cereals and legumes can provide a complete intake of essential amino acids, providing protein quality like that of meat, milk and eggs. ●

Fat

Fat is made up of fatty acids, which are usually divided into three groups: saturated, monounsaturated and polyunsaturated. Monounsaturated and polyunsaturated fatty acids are collectively named unsaturated fatty acids. Unsaturated fatty acids are beneficial to our health, while saturated fatty acids generally have a negative effect. The type of fatty acids also affects the texture of foods: the more saturated fat, the firmer the texture. This is why butter (high in saturated fat) is hard when removed from the fridge, while spreadable fats that contain oil (high in unsaturated fat) are softer. ●

SOURCES: *NÄRINGSLÄRA FÖR HÖGSKOLAN* (2021), *SWEDISH FOOD AGENCY, LIVSMEDELSVETENSKAP* (2014).

ILLUSTRATION: LENE DUE JENSEN

New process for making fibre-rich oat drinks

A thesis by Siri Norlander, PhD student at Lund University, shows how enzymes can be used innovatively to extract healthy dietary fibre from oats.

Text **Åsa Eckerrot/Karin Janson**
Illustration **Lene Due Jensen**

From a health perspective, we should eat more wholegrain products and plant-based foods that are rich in dietary fibre. For example, eating 25 grams of dietary fibre a day can prevent obesity and reduce the risk of diet-related diseases.

OATS ARE A CROP that is well adapted to our Nordic climate, as well as being nutritious and full of healthy fat, protein and dietary fibre. Arabinoxylan is a dietary fibre found in the outer part of the oat kernel, in the bran fraction. Enzymes can be used to make arabinoxylan more soluble and available, according to Siri Norlander.

"Enzymatic processes allow us to create short fibres with different structures, which feed the beneficial bacteria in our intestinal flora. *In-vitro* studies have shown that specific arabinoxylan oligosaccharides can function as prebiotic fibre. Probiotic bacteria, such as *Lactobacillus* and *Bifidobacteria*, are also known to use arabinoxylan oligosaccharides as an energy source."

AIMING TO REMOVE as much arabinoxylan from oats as possible, the researchers studied various combinations of xylanases and other enzymes, finding that the enzymes' effectiveness depended on the fraction the fibre came from: oat bran or oat hulls.

"Extracting arabinoxylan is easier from bran, as it does not contain as much lignin as the hull and has a less complex structure," says Norlander.

IN THE STUDY, the researchers showed how pre-treating the bran and husk with a strong base, sodium hydroxide, can make the arabinoxylan more accessible, facilitating the subsequent enzymatic decomposition.

"We have focused on how to extract arabinoxylan from the insoluble fibre fraction of oats, but the fraction also contains starch, protein, lignin and some beta-glucan," says Norlander.

The researchers also tested adding xylanases when producing oat drink, to break down insoluble arabinoxylan fibres. The result was a liquid oat drink that was rich in arabinoxylan fibres.

"This is the first step on the road to being able to buy fibre-rich oat drinks and other healthy oat products in stores," says Norlander. ●

THE THESIS

The studies have been performed at the ScanOats research centre with support from the Swedish Foundation for Strategic Research. The public defence of the thesis, titled *Harvesting the health potentials of oat fibre: Xylanase bioprocessing of arabinoxylan*, will be held on 10 November 2023 at Kemicentrum, Lund University.

↑ Recipe from *www.sundkurs.se*

PHOTO: ULRIKA EKBLOM

RECIPE

Quick pasta with plenty of greens

An autumnal pasta with plenty of greens, in line with NNR2023. Supplement it with meat or fish from leftovers.

Pasta with beans, seeds and greens

Serves 4
35 minutes

- 250 g pasta shapes, preferably wholegrain
- 2 garlic cloves, peeled and chopped
- Olive or rapeseed oil for frying
- Pinch of chili flakes (optional)
- 200 g mangold (stalk removed) or spinach
- 1 packet butterbeans (380 g), drained and rinsed
- 100 ml finely grated parmesan
- 100 ml mixed seeds, e.g. sunflower and pumpkin seeds
- 3/4 tsp freshly ground black pepper, to taste

INSTRUCTIONS

1. Cook the pasta and then drain, saving about 200 ml of the cooking water.
2. Fry the chopped garlic in a little oil in a frying pan, without letting it brown. Add chili flakes if you want a bit of heat.
3. Add the mangold or spinach and the drained and rinsed beans. Fry them briefly.
4. Add the drained pasta, the saved pasta water, and the finely grated parmesan. Stir carefully until everything is evenly combined.
5. Season with freshly ground black pepper.
6. Using a separate pan, brown the seeds in oil.
7. Serve the pasta, topped with the toasted seeds.

Bon appétit!

Swedish agriculture's vulnerability has been roundly demonstrated this year. We must now do more to secure the food supply and introduce a comprehensive approach, writes Betty Malmberg, new chair of the National Committee for Food Research.

Four proposals for ensuring Swedish food security

Too much or too little water at the wrong time has affected both the levels of harvests and grain quality this summer. This, along with the increasing cost of fuel, electricity and fertiliser, will seriously impact the profitability of individual farmers, and thus Sweden's food security. One of the world's most environmentally and resource-efficient agricultural systems is in an undeniably vulnerable state. We must therefore:

1. **PROTECT ARABLE LAND:** Despite the provisions of the Environmental Code, good arable land continues to be built on, rules circumvented, and new developments allowed even on the most fertile land. This is absurd.
2. **GUARANTEE INPUT AVAILABILITY:** The invasion of Ukraine has highlighted our dependence on imports of commercial fertilisers and pesticides. This must change. This requires that industry, public policy and authorities throughout the food chain work together, promoting long-term approach and dealing with conflicting objectives. A striking example of the opposite is the company that was denied an environmental permit for the extraction of phosphorus from sewage sludge. Even the judge in this case regretted this, as he believes the decision counteracts Swedish climate and environmental goals. Silo-style rules and legislation do not work. We need a comprehensive approach.
3. **WIN THE STRUGGLE FOR YOUNG PEOPLE:** Virtually every industry is suffering from labour shortages – and the same is true of the green industries. This means it is important to convey the right image of today's agriculture, as both value-based and high-tech. Our focus on sustainability and innovation, such as satellite navigation, precision cultivation and weed control through image analysis and drones should attract young people.
4. **COMMERCIALISE MORE RESEARCH:** New solutions are necessary to meet societal challenges and increase production. These include farming methods that reduce unwanted emissions, permitting genetically engineered crops to speed up the development of hardier and higher-yielding varieties, or varieties with new health properties, or developing how cereal fractions are processed, to produce new products with commercial and export potential.

The above examples show that we can and must do more to secure Swedish agriculture and our food security. It is high time for us to roll up our sleeves and get stuck in.

Betty Malmberg

PHOTO: LANTMÄNNEN

"This means it is important to convey the right image of today's agriculture, as both value-based and high-tech."

PHOTO: LASSE HEJDENBERG

Betty Malmberg
Chair of the National Committee for Food Research

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PHOTO: HANS JONSSON / LANTMÄNNEN

↑ Fine quality oats, suitable for oatmeal.

Maintaining grain quality from farm to fork

Funding research that focuses on the grain value chain is at the heart of Lantmännen's Research Foundation. 2023's challenging farming year brings into focus the increased need for knowledge of changing weather conditions.

Text **Anders Lindgren, Lantmännen R&D**

This year's growing season was challenging, to say the least. An early summer drought was followed by torrential rainfalls at harvest time. The drought led to a lower harvest and, because of the rain, the quality is poorer than usual.

RESEARCH THAT HELPS plant breeders develop new varieties with desirable traits are some of the projects our foundation supports. The focus, in addition to high, stable harvests with consistent quality, is on specific characteristics determined by whether the grain will be used for beer, bread, meal or animal feed. For example, malting barley needs a specific protein content and high germination, while bread wheat should have a high protein content and a high falling number, a measure of baking quality. We also support cultivation-related research, because it is, after all, the management of a crop's growth that ultimately determines quality and harvest levels.

Carefully adjusted nitrogen levels, using precision fertilising, determine harvest levels and protein content, while the timing of the harvest, and not least the weather, determines the falling number. In recent years, the Foundation's focus has broadened to include factors like a crop's drought tolerance and need for irrigation.

AFTER HARVESTING, the grain is dried for stable storage, prior to further processing in a mill, malting plant or feed factory. Maintaining quality during drying and storage is important. A drying project is currently underway at the RISE research institute, with Vinnova as the main financier. It deals with both energy-efficient drying and obtaining the desired moisture content. A high drying temperature is usually more energy efficient, but too high a temperature risks destroying both germination and baking properties.

THIS PROJECT ALSO includes storage studies. Cereals must be able to be stored until the next harvest, and a lot can happen in that time. By monitoring storage, the growth of mould or insect attacks can be prevented.

This is done by measuring temperature and humidity, and even small changes signal that something is happening. The project is also testing carbon dioxide sensors as a potential early warning system that something is amiss.

In conclusion, new knowledge at every stage of the cereal value chain is crucial to future food production in a changing climate. ●

PHOTO: MATTIAS SÖDERMARK / LANTMÄNNEN

↑ New ingredient keeps bread soft for longer.

Recently completed projects

Fresh bread for longer How bread ages depends on the composition of the starch, and specifically amylopectin's ability to hold water. In this project, new technology has helped develop an ingredient that changes amylopectin's structure and increases its water-holding capacity. Baking trials resulted in bread that was less dry and hard over time, indicating that the technology produces bread that stays fresh for longer. ●

Plastic film made from wheat bran Arabinoxylan, consisting of arabinose and xylose, is the most common fibre type in wheat bran. This project studied how different extraction methods affect the arabinoxylan's ability to form films and the results show that a higher proportion of arabinose gives a more flexible film. This research demonstrates the potential to produce fossil-free plastic film from wheat bran. ●

Circular phosphorus Sweden is dependent on imports to meet the demand for phosphorus in agriculture. This feed project studied the digestibility of recycled phosphorus. Pigs and poultry were both able to utilise this phosphorus just as efficiently as from a conventional feed additive. The results can be used to influence legislation on recycled nutrients in the EU and pave the way for new products. ●

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 cereals and legumes as a natural element of sustainable future food.

The foundation has an open call every year. Applications are assessed on their newsworthiness, scientific quality and business potential. Decisions are announced in December. ●

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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