

Cerealier

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A magazine from
Lantmännen
Research Foundation



STUDY

**Health benefits
of wholegrains
for children**

THESIS

**Rye and
gut health**

#01

*Research: New study
about gluten sensitivity*



THEME

FERMENTATION



Helena Fredriksson
It's bubbling up!

Sourdough bread, sauerkraut and kimchi are examples of fermented food that lots of people have tried – and more are doing so. Many restaurants have joined the fermentation trend and are offering unique ingredients and dishes. Historically, the method was perhaps mainly used to preserve food and drink, but it is now utilised to enhance and improve flavours and increase nutritional value.

THE THEME OF THIS, the first issue of the year, is fermentation – a processing method with great potential, to say the least. We visit researchers around the world, all with a special interest in fermentation. Read about an exciting initiative in the HealthFerm research project, which encourages sourdough enthusiasts to send their sourdoughs to be characterised. Could your sourdough have unique properties that are beneficial in future foods? We take a closer look at sourdough below the heading “What happens in...”.

Page 23 presents the new research to receive funding from our research foundation, with many interesting and important projects ready to start. You can also read about our doctoral student Solja Pietiäinen's exciting research, where beneficial fibres in wheat bran help to improve bread quality.

Finally, a serving suggestion for outdoor eating, where both the bread and topping are fermented.

Happy reading!

Helena Fredriksson

Lantmännen Research Foundation



PHOTO: ISTOCK

“...fermentation, a processing method with great potential, to say the least...”

Fermentation

In this issue, we take an in-depth look at research on the fermentation of cereals and legumes. Pages 7–15

Cerealier

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Thesis on oat protein



In a new doctoral thesis, Mika Immonen, University of Helsinki, has

studied how the choice of extraction method can improve the properties of oat protein concentrates. Two different methods were developed, one that added α -amylase enzyme combined with wet extraction, and one with filtration and deamidation (the removal of an amino acid group). Both methods showed potential for creating oat protein concentrates with different technical and functional properties, bringing opportunities for use in different types of food. ●

Read more: <https://helda.helsinki.fi>

57%

of Swedes eat bread every day. This is an increase of ten per cent compared to 2019, according to this year's Bread Barometer. ●

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

Report on barriers to sustainable eating

A new SLU Future Food Report has been published, examining barriers to sustainable eating, such as gender, class, age, education and cultural background. The report aims to increase understanding of culturally based reasons for our eating habits, in order to influence healthier food choices. ●

Download the report here: www.slu.se (in Swedish)



PHOTO: ISTOCK

Precision nutrition can prevent disease

Bespoke dietary advice could prevent type 2 diabetes in people at high risk of the disease, according to a new study from Chalmers University of Technology. 155 participants from three countries were given meals

with a high or low glycaemic index followed by continuous measurements of their blood sugar response.

The results showed that people responded differently to the same food. One group had a significantly poorer blood sugar response, which is a risk factor for type 2

diabetes. Lead researcher Viktor Skantze says there is a need for personalised dietary advice for this risk group, which would be more effective than the general advice now available. ●

Reference: Skantze et al., *Nutrients*, 2023

Primary Stone Age food source was cereals and legumes

Making cereals and legumes the dietary mainstay may have a longer history than researchers once thought.

Previous theories were that Stone Age humans ate vegetables, fruit, lean meat, fish, nuts and eggs, but a new German study has shown that people in parts of south-east Europe

were essentially vegetarian. Chemical analysis of bones and teeth has revealed that the primary food sources for these Stone Age humans were peas, lentils and cereals such as barley. ●

Read more: <http://www.pnas.org/doi/10.1073/pnas.2312962120>



ILLUSTRATION: MACROVECTOR/FREEPIK



ILLUSTRATION: LENE DUE JENSEN

Health benefits of wholegrains for children

A new study shows several health benefits when children consume wholegrain oat and rye products.

Eating wholegrains can reduce the risk of cardiovascular disease in adults, and a Danish study has now shown the positive health effects of wholegrain consumption in children with a high BMI.

FOR EIGHT WEEKS, 55 healthy children aged eight to 13 ate wholegrain oat and rye products, corresponding to the highest recommendations for wholegrain intake. Products made from sifted cereals were used as a control.

High consumption of wholegrains from oats and rye reduced risk markers for cardiovascular disease, such as the

lipids LDL cholesterol and triacylglycerol. The proportion of some beneficial gut bacteria increased, as did the levels of beneficial short-chain fatty acids in both faeces and blood. The children also reported reduced fatigue and a tendency towards increased frequency of bowel movements.

“THE MOST NOTABLE outcome of the study is the significant reduction in LDL cholesterol, which is particularly surprising given that the participants were

ABOUT THE STUDY

The study was a randomised crossover study conducted at the University of Copenhagen, with funding from the Independent Research Fund Denmark and the Swedish Research Council.

both healthy and young. Our results also indicate that the improvement in blood cholesterol levels after consuming wholegrains seems to be linked to specific gut bacteria. This needs to be explored further,” says Marie Terese Barlebo Madsen, one of the researchers behind the study.

THE RESULTS REINFORCE recommendations that children increase their intake of wholegrain products to reduce the risk of disease in the future.

“I am convinced that ensuring significant consumption of wholegrains during childhood is very important,” concludes Barlebo Madsen.

Ebba Arnborg

Reference: Madsen, et al., *The American Journal of Clinical Nutrition*, 2023



New book about sourdough

Rågbrødsglæde – the joy of rye bread – is a new Danish book about sourdough breads. The author is Åse Solvej Hansen, professor of food science at the University of Copenhagen. The book highlights techniques for successful baking and the health benefits of sourdough. It is published by Trumf. ●

Upcoming conferences

Northern Lights on Food is hosting its fifth conference, with the theme “Boosting Structural Food Science”, in Lund on 27–29 May.

Invited experts from around the world will discuss the role of food structures for the sustainability of future food. ●

Read more: www.linx.se/events

ICCAS 2024, the International Conference on Culinary Arts and Sciences will be held 17–20 June at Kristianstad University.

The scientific programme will develop aspects related to the main theme of the conference – how can healthy and sustainable food choices be facilitated in a changing society? ●

Read more: www.hkr.se/en/collaboration/iccas-2024



ILLUSTRATION: LENE DUE JENSEN

Radio programme about oats

What's the deal with oats and oatmeal? This is the theme of an episode of the radio series *Meny*, on Swedish Radio P1.

Guests include Rikard Landberg, professor of food and health at Chalmers University of Technology, and Cecilia Tullberg, researcher at the Division of Biotechnology at Lund University.

The established health

effects of oats, new products and process methods are discussed in the programme. ●

Listen here (in Swedish): sverigesradio.se/avsnitt/grejen-med-havregrynsgröt

PHOTO: MARIA HANSSON



Crispbread gets protected origin label

Hand-baked Skedvi bröd crispbread is the twentieth Swedish food product to receive the EU's protected designation of origin label.

The EU has three protected labels, each with different requirements. Protected designation of origin means that the product comes from a specific place or country, maintains a certain quality and reputation, and is produced in that geographic area. ●

THEME

FERMENTATION

Fermentation is a traditional processing method that is generating interest in the research community. We interviewed three researchers about the health benefits of fermentation and what is happening in the field. ▶

Photo Golden Retriever





HealthFerm has a sub-project in which the public are invited to send in their sourdoughs.

European research to increase knowledge about fermentation

The HealthFerm research project is working to increase knowledge about plant-based fermented foods, including collecting sourdoughs from different parts of Europe.

“Our overall aim is to get more people to eat more plant-based foods and more fibre,” says Christophe Courtin, Professor of Food Biochemistry at KU Leuven, Belgium.

Text Karin Janson

Fermentation has a long history, but research into fermentation is an area that needs further exploration, especially when it comes to fermenting cereals and legumes, according to Christophe Courtin.

“Oat drinks, for example, are now popular but are low in protein and fibre. It could be possible to better utilise the oat material by fermenting it, thus increasing its nutritional value. Fermentation has great potential for the development of healthier foods.”

HEALTHFERM WILL USE peas, oats, wheat and fava beans as raw materials. The project has four parts: evaluation of microorganisms, consumer attitudes, process technology, and human health.

“Our goal is both to facilitate the protein shift, but also to close the fibre



“We’ve received several hundred sourdoughs, mostly from Finland.”

Christophe Courtin, Professor of Food Biochemistry at KU Leuven, Belgium.

gap. That means getting people to eat the amount of fibre stated in dietary guidelines,” says Courtin.

COLLECTION OF SOURDOUGH from different countries is currently underway as part of the evaluation of microorganisms. Anyone can register their sourdough on the website and, once approved, send it to one of HealthFerm’s project partners. The microbial content of the

HEALTHFERM

HealthFerm is a European research project on fermented foods, with a focus on cereals and legumes. It started in the autumn of 2022 and will run for four years. Twenty-three universities and research institutions in 11 countries are participating and its budget is EUR 13.1 million.

Read more: www.healthferm.eu

sourdoughs will then be analysed using DNA sequencing. The aim is to receive around a thousand sourdoughs from all over Europe.

“So far we’ve received several hundred sourdoughs, mostly from Finland. We will map and characterise various microorganisms and the data will be made available in a database,” says Courtin.

AFTER THIS, the research team will identify the health benefits of the different microorganisms. Then their aim is to create their own starter cultures that can be used in functional foods.

“Measuring the health effects of fermentation itself is difficult because sourdough bread is such a complex food. Besides the content of beneficial microorganisms in the sourdough, the effect depends on many factors, such as the environment in which the dough is fermented, the fermentation time and the age of the sourdough and, of course, the type of grain used. And then there are different baking cultures in different countries and regions.”

HEALTHFERM IS ALSO investigating consumer attitudes towards fermented plant-based foods. That study will run for 18 months.

“The results will be published in the spring. Keep an eye on our website, as we update it continuously,” says Courtin. ●

Traditional process with numerous benefits

Humans have eaten fermented foods for thousands of years, thanks to the process' great benefits for food safety, shelf life, health and flavour.

Text Karin Janson

What exactly are fermented foods? One definition is a food in which advantageous microorganisms, such as bacteria, yeasts or moulds, have been used in the production process. Fermentation means that the food changes in a desirable way in terms of its pH, composition, texture and flavour.

FERMENTED PRODUCTS ARE produced from a variety of raw materials such as vegetables, cereals, legumes, milk, fish and meat. There are currently about 5,000 fermented foods and drinks in the world, which together comprise five to 40 per cent of the total diet.

THE BENEFITS OF FERMENTATION

- Extends the shelf life of food.
- Reduces the risk of unwanted microorganisms growing.
- Improves the food's flavour and texture.
- Removes substances that reduce nutrient absorption, such as phytic acid.
- May make food more digestible.

The bacterial, fungal and yeast strains used in fermentation originate from different parts of the world – see the periodic table of fermented foods on pages 14–15.

MANY FERMENTED FOODS, such as cheese, yoghurt and kombucha, contain live microorganisms. In other foods, such as bread, wine and soy sauce, the microorganisms are inactivated. During fermentation, some of the constituent carbohydrates are converted into organic acids, gas and alcohol, and new substances such as B vitamins or antioxidants can be formed. ●

FERMENTED PRODUCTS FROM AROUND THE WORLD

Lassi (India): A drink made from yoghurt, water and spices, sometimes sweetened or salted.

Kimchi (Korea): A fermented vegetable dish, usually made from napa cabbage and seasoned with chilli, ginger and garlic.

Sauerkraut (Germany): A fermented cabbage dish, where white cabbage is fermented with salt and flavoured with caraway.

Miso (Japan): A fermented paste made from soybeans, salt and sometimes rice or barley. Often used as a base for soup.

Kombucha (China/Russia): A fermented drink made from sweetened tea and kombucha mushrooms.

Kefir (Caucasus region): A probiotic milk drink fermented with kefir grains, which contain yeast and bacterial cultures.

Natto (Japan): A Japanese dish consisting of fermented soybeans, known for its characteristic flavour and sticky texture.

Surströmming (Sweden): Surströmming is a Swedish speciality, in which fish is fermented and traditionally consumed outdoors due to the strong smell it produces.

Tsampa (Tibet): A fermented dish made from roasted barley flour, sometimes mixed with fermented yoghurt.

Injera (Ethiopia and Eritrea): A fermented and fermented flatbread that is a staple of Ethiopian and Eritrean cuisine, usually made with sourdough and a mixture of flour and water.



➤ Injera bread

Uji (East Africa): A porridge made from fermented grain, such as maize, sorghum or millet, which is boiled in water. This is a common breakfast in many East African countries.

Tempeh (Indonesia): A high-protein product made from whole fermented soya beans.

Sources: www.Healthferm.eu, *Livsmedelsvetenskap* (Marklinder 2014), *Rågbrödsglädje* (Hansen 2023).

PHOTO: ISTOCK

Fermentation

What happens in a sourdough?



Baking with sourdough

Adding sourdough when baking bread helps the dough rise, as well as giving the bread a longer shelf life and a characteristic, slightly acid-ic flavour. In addition, sourdough fermentation helps increase the availability of iron and zinc.

Starting up

1 When flour is kept cool and dry, the microorganisms that are naturally present in it remain inactive. Spontaneous sourdough fermentation starts when the flour is mixed with lukewarm water. The most common types of flour used in sourdough production are rye and wheat flour, often wholegrain.

Feeding

2 For the next three days, the sourdough should be kept at room temperature, preferably slightly warmer, and fed in batches with new flour and water to maintain fermentation. Each sourdough is unique, due to factors such as the ambient temperature, microflora and the type of grain used.



PHOTO: ISTOCK

The sourdough develops

3 During fermentation, lactic acid bacteria and yeasts grow in symbiosis and sugars are converted into organic acids such as lactic and acetic acid and carbon dioxide. This allows its characteristic flavours to develop and the pH to drop, which protects against the growth of moulds and other unwanted bacteria.

The right proportions

4 In sourdough, the ratio of lactic to acetic acid should be about 80:20 to obtain a flavoursome bread. The ratio can be controlled by changing the proportions of flour and water or by placing the sourdough in different temperatures.

Ready, steady, bake!

5 After about three days, when the sourdough is ready, keep it at refrigerator temperature until it is time to bake. Sourdough needs to be fed with flour and water about once a week. Even a sourdough that has been forgotten at the back of fridge can be reawakened by feeding, provided it is not too acidic and broken down by acetic acid. ●

www.kungsornen.se/recept/niklas-ragbrod/
(in Swedish)

Fermentation can create more nutrient-dense foods

Fermented cereals with added barley malt can create more nutrient-dense and flavourful foods, according to an Ethiopian study.

“This could be a way of improving children’s nutritional status,” says Sirawdink Fikreyesus Forsido, a food science researcher at Jimma University in Ethiopia.

Text Karin Janson

Supplementary food for infants and young children in sub-Saharan Africa predominantly consists of starchy cereals, such as maize porridge.

“These are foods that do not provide children with sufficient nutrition, as they have a low energy content, few calories and low availability of vitamins and minerals. Small children also have less developed digestive systems, making it more difficult to digest the contents properly,” says Forsido.

Ethiopia has a long tradition of eating fermented foods and drinks. Many of these products are still made using tried and tested techniques and local ingredients, such as injera, a pancake-like flatbread made from teff flour, and drinks such as cheka, keribo, tella and korefe.

FORSIDO HAS INVESTIGATED how cereal fermentation can be used to create more nutrient-dense foods for children. One study used teff flour, oat flour and barley flour with different protein levels. Barley malt, which is rich in the enzyme alpha-amylase and improves the digestibility of starch, was added to all three flours. Water was added and the mixture was allowed to ferment spontaneously at room temperature, around 20 degrees, for 0, 24 and 48 hours respectively. The samples were then oven-dried and ground.

“We saw an interaction between flour type,

fermentation time and malt concentration, which affected the nutritional composition in different ways,” says Forsido.

FOR ALL THREE FLOURS, fermentation for 24 hours improved sensory quality, regardless of malt concentration. The amount of dietary fibre, fat and carbohydrates decreased during fermentation with added barley malt, as did the antinutritional substances phytate and tannin. Instead, the energy value and the amount of available protein increased (see table).

“Fermentation with added barley malt increases nutrient density, because protein content increases and the level of antinutritional substances decreases, leading to increased absorption of minerals such as iron and zinc. Viscosity also reduces with fermentation, resulting in a better texture,” says Forsido.

The final part of the study was a sensory analysis, where an untrained panel of 50 mothers evaluated the appearance, smell, taste, mouth-feel, texture and acceptability of nine porridges cooked with the different flours. The oat porridge received the highest rating, followed by barley and then teff, but the ratings dropped with longer fermentation time.

“The porridge from flour fermented for a



“Fermentation with added barley malt increases nutrient density...”

Sirawdink Fikreyesus Forsido food science researcher at Jimma University, Ethiopia



↑ Teff is a common grain in Ethiopia.



PHOTO: ISTOCK

shorter time was whiter, while those fermented for 48 hours were more brown. This corresponds with previous sensory research, which shows that people prefer paler cereals,” says Forsido.

The next step is to educate mothers about the potential to combine fermentation with added malt.

“We conducted a survey of mothers in Jimma and found that 60 per cent already use fermentation. If we can provide information about the health benefits of fermentation with malt, we may be able to reduce malnutrition among children in the area.” ●

Reference: Forsido et al., *Heliyon Food Science and Nutrition*, 2020

NUTRITIONAL CONTENT

Oats	Fermentation time	Protein	Fat	Fibre
	0 hours, no malt	11,1	4,6	4,6
	24 hours, 5% malt	13,7	3,1	3,3
	48 hours, 5% malt	16,8	2,7	3,0
Barley	Fermentation time	Protein	Fat	Fibre
	0 hours, no malt	8,8	3,3	6,0
	24 hours, 5% malt	11,8	2,0	4,6
	48 hours, 5% malt	13,0	1,6	4,0
Teff	Fermentation time	Protein	Fat	Fibre
	0 hours, no malt	8,1	3,5	3,2
	24 hours, 5% malt	11,7	2,7	2,0
	48 hours, 5% malt	12,6	2,2	1,6

← The table is simplified and shows how the levels of protein, fat and fibre change with fermentation and the addition of 5% barley malt. The unit of measurement is grams per 100 grams.

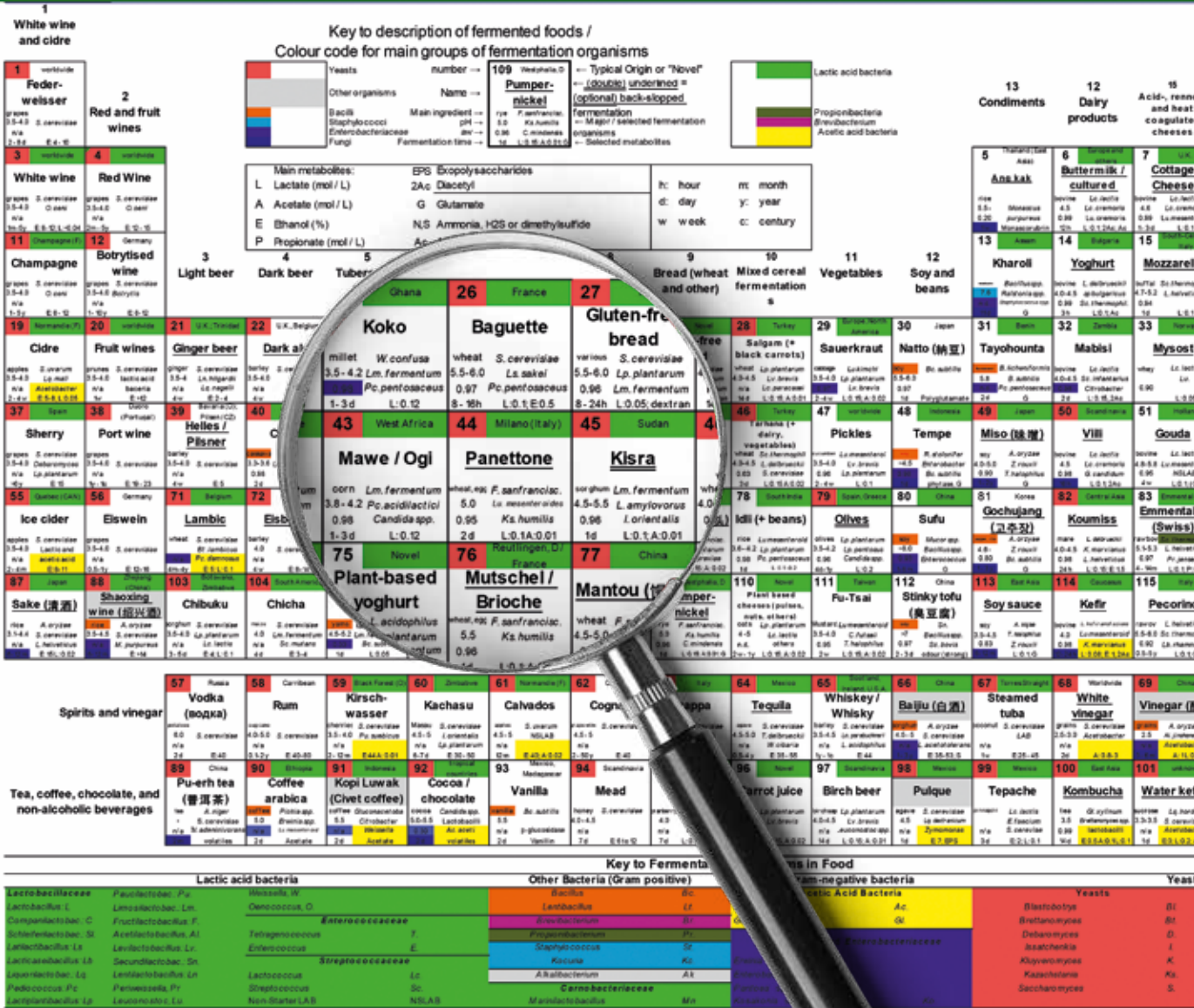
FERMENTATION



Periodic Table of Fermented Foods

Michael Gänzle

Department of Agricultural, Food and Nutritional Science, University of Alberta, Edmonton, AB, Canada



Periodic table as the inspiration for new foods

Exploring new ways to use fermentation can provide health benefits and even lead to completely new foods, says Professor Michael Gänzle, who has developed a periodic table for fermented products.

Text **Ebba Arnborg**

The image shows a grid of 118 numbered boxes, each representing a different fermented food product. The boxes are organized into categories such as Meats, Molds/ripened cheeses, Fish and fish sauce, Summer Sausage, and Aceto Balsamico. Each box contains a number, a name, and a small table of microorganisms and fermentation conditions.

For millennia, fermentation has helped us consume foods that are otherwise too challenging for our digestive systems. There is now great potential in the development of new foods that build upon our existing knowledge of fermentation, according to Professor Michael Gänzle, University of Alberta, Canada.

“If we look at the global diversity of fermented foods, there are no limits to what we can do,” he says.

MICHAEL GÄNZLE HAS launched a periodic table for fermented foods that provides an overview of some available options.

“It started as a fun Friday afternoon project but, over the years, interest in fermented foods has grown. If you want to develop fermentation methods, the periodic table can provide an overview of different possibilities and inspiration for new products in less than a minute. In my opinion, it’s much faster than starting from scratch in the lab,” he says.

The periodic table is based on science while also taking into account cultural aspects and traditional knowledge, and aims to provide a range of fermentation methods and microorganisms to use in creating innovative and healthy foods, Gänzle explains.

“You can use the table to find inspiration in the knowledge of fermentation we currently have, and so produce new foods. Microbes have no geography – the issue is not where you ferment, but why,” he says.

GÄNZLE’S OWN RESEARCH focuses on lactic acid bacteria for use as starter cultures, protective cultures or probiotics in cereal-based foods. One

aspect of this is his involvement in projects on fermented plant-based cheese and sourdough fermentation. There is a growing awareness that consuming a wide variety of bacteria brings health benefits, according to Gänzle.

“There is discussion about dietary microbes. It will take three to four years before we have clinical evidence that someone who consumes multiple lactic acid bacteria is healthier, but I think it will come. It seems reasonable to me that consuming live bacteria is good for your health,” he says.

PROBIOTICS HAVE PROVEN health benefits, Gänzle points out, noting that they can be created naturally in foods through fermentation. He also emphasises fermentation’s role in making plant-based food more appetising.

“Can fermentation make plant-based food tastier? Absolutely! Fermentation makes it flavourful. Many different microbes make fermented food more beneficial, and the more varied they are the better,” he says. ●

Read more: www.fermentationassociation.org/the-periodic-table-of-fermented-foods

PERIODIC TABLE FOR FERMENTED FOODS

The table was created by Michael Gänzle, Professor of Food Microbiology at the University of Alberta, and was last updated in 2023. It includes 118 fermented foods and their product category, country of origin, fermentation organism, fermentation substrate, metabolites and fermentation time.

Brain-gut interaction may be behind

gluten sensitivity

Negative expectations can exacerbate or even cause symptoms in people with perceived gluten sensitivity, according to a sub-study in the European research project, Well on Wheat.

“We need to do more research to understand the communication between the brain and the gut,” says Daisy Jonkers, Professor of Medicine at Maastricht University.

Text Karin Janson

Illustration Lene Due Jensen

Many people now exclude gluten from their diet, despite not having coeliac disease or a wheat allergy, because they experience symptoms such as bloating, diarrhoea, constipation, headaches and fatigue. However, there is a lack of knowledge about the underlying mechanisms.

“Not enough is known about the negative health effects in people who experience gluten or wheat sensitivity. Wheat, especially wholegrain wheat, is an important dietary component because wholegrains are so beneficial for health,” says Daisy Jonkers.

IN THE NOCEBO STUDY, the research team studied people’s negative expectations of gluten and how this affects perceived symptoms. The nocebo effect is the opposite of the placebo effect, which means that negative expectations exacerbate or

even create symptoms. The study was a randomised double-blind study in which 83 people, aged 18 to 70, with self-perceived negative problems with gluten intake, participated. They were first tested to rule out coeliac disease, wheat allergy or other gastrointestinal disease and then randomly assigned to one of four study groups:

- A. Expecting to consume bread with gluten and actual intake of bread with gluten
- B. Expecting to consume gluten-free bread but actual intake of bread with gluten
- C. Expecting to consume bread with gluten but actual intake of gluten-free bread
- D. Expecting to consume gluten-free bread and actual intake of gluten-free bread

Groups B and C did not know that they received bread with gluten or gluten-free bread, respectively.

“The two groups who did not expect to eat gluten had the lowest level of perceived symptoms...”

Daisy Jonkers Professor of Medicine, Maastricht University

The groups followed their prescribed diet for one week. Gastrointestinal symptoms were measured using self-assessment with the visual analogue scale before breakfast and then every hour for eight hours.

THE RESULTS SHOWED that group A, who expected to eat gluten and who also ate bread with gluten, reported significantly more symptoms than the other groups. Their symptoms were primarily bloating, stomach pain and diarrhoea.

“The two groups who did not expect to eat gluten had the lowest level of perceived symptoms, whether they were given gluten or not,” says Jonkers.

She emphasises that the research team takes the symptoms very seriously and the results indicate that the gut-brain axis is involved.

“I’m sure many people can recognise the feeling of stomach ache before a difficult exam. The question is why this happens. The connection between the brain and the gut is a hot research topic right now. We know that signalling occurs in both directions, that the gut microbiota can be influenced by the brain and that they can send information to the brain – it would be interesting to study whether some people have heightened sensitivity to this signalling,” says Jonkers.

The researchers have conducted several studies as part of the Well on Wheat project. In one, subjects with perceived sensitivity to wheat were ▶



Four study groups:

A

Expecting to consume bread with gluten and actual intake of bread with gluten

B

Expecting to consume gluten-free bread but actual intake of bread with gluten

C

Expecting to consume bread with gluten but actual intake of gluten-free bread

D

Expecting to consume gluten-free bread and actual intake of gluten-free bread



PHOTO: MARCEL VAN HOORN

↑ Daisy Jonkers
Professor of Medicine,
Maastricht University.

“In our cultivation study, we noted that the main difference in wheat sensitivity did not depend on where in Europe the wheat was grown, but which year.”

given bread made from different wheat varieties: a modern bread wheat, or spelt and emmer, which are older varieties. Two participant groups of 20 people ate sourdough bread and yeast-baked bread from the different wheat varieties, in a randomised order.

“We wanted to see whether they could tolerate certain types of wheat better than others, and whether they tolerated sourdough bread better. One hypothesis was that emmer, which is a very old variety, could be tolerated by more people.”

HOWEVER, THE RESULTS showed no clear pattern for which breads made from the

various wheat varieties the participants felt they could tolerate or not.

“Nor did we see any difference between sourdough and yeast bread. Overall, between 50 and 70 per cent of participants experienced symptoms. The only conclusion we can really draw from the study is that, for people with wheat sensitivity, it may be worth trying different types of wheat, as tolerance can be individual.”

Another complicating factor with wheat sensitivity is that wheat varieties can vary from year to year.

“In our cultivation study, we noted that the main difference in wheat sensitivity did not depend on where in Europe the wheat was grown, but which year.”

THE QUESTION REMAINS – why do some people with no known medical explanation such as coeliac disease, wheat allergy or gastrointestinal disease, experience sensitivity to gluten and wheat? Well on Wheat has now ended, but Jonkers and her colleagues at Maastricht University are continuing to explore the issue. In addition to conducting follow-up studies on the gut-brain connection, they will continue research into amylase-trypsin inhibitors, a protein found in wheat.

“This is a protein that defends the wheat plant against attack and disease, and cell and animal studies have indicated that this could trigger an immune response in the gut, so now we’re trying to study the protein in more detail. We want to know whether it could be a contributing factor for symptoms in humans but it’s complicated – amylase-trypsin inhibitors are part of the gluten protein and therefore difficult to isolate,” says Jonkers. ●

Reference: Jonkers et al., *The Lancet*, 2023
Read more: <https://www.wellonwheat.org/>

WELL ON WHEAT

Well on Wheat was a European research project that investigated health aspects of wheat and gluten, mapping different wheat varieties, cultivation and processing methods and consumer attitudes. It was funded by the Dutch government and industrial partners in the food supply chain.



PHOTO: ISTOCK

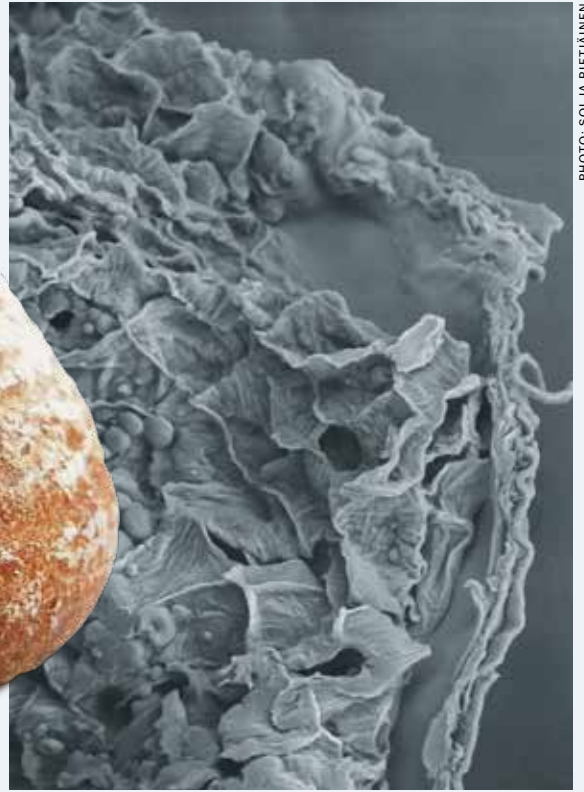


PHOTO: SOLJA PIETIÄINEN

↑ Wheat bran, magnified x 400.

Optimised fibre structure for better bread

A specific fibre from wheat bran can be used to bake bread that is tasty, healthy and sustainable. Doctoral student Solja Pietiäinen sees huge potential to create of added value with wheat bran.

Text Ylva Carlsson

That many people do not get enough dietary fibre is a well-known fact; many people eat white bread for breakfast instead of the more fibre-rich wholegrain bread.

SOLJA PIETIÄINEN, doctoral student at Lantmännen and the Swedish University of Agricultural Sciences, is writing her thesis on how wheat bran fibre can be used as a

health-promoting food ingredient. The main dietary fibre in wheat bran is arabinoxylan, which is a functional component of bread due to its ability to retain water.

Solja Pietiäinen has spent many hours in the lab finding the optimal arabinoxylan structure for baking. She has baked several hundred loaves and examined how the fibre additive affects bread quality.

“Bread is a complex substance. Small changes can make a huge difference. Adding fibre from wheat bran to the dough in a simple manner has been a major challenge.”

ONE THING THAT has surprised her is the amount of impact the fibre structure has on bread quality.

“I was surprised that the bread



PHOTO: PRIVAT

“Adding fibre from wheat bran to the dough in a simple manner has been a major challenge.”

Solja Pietiäinen, doctoral student, Lantmännen and the Swedish University of Agricultural Sciences

could look so different and that the texture could vary so much,” says Pietiäinen.

Test baking has shown that it is perfectly possible to bake good quality bread with a significant amount of added arabinoxylan. The bread becomes soft and moist, which also gives it a longer shelf life.

“Wheat bran absorbs and binds a lot of water, which usually reduces bread quality, but an optimised arabinoxylan structure can improve softness and volume,” she says.

PIETIÄINEN WILL PRESENT her thesis in December, after which she hopes to turn her research into a business.

“This project has great potential – and may eventually contribute to better public health, reduced food waste and increased sustainability in the grain chain.” ●



Can wholegrains

Does wholegrain intake affect our gut bacteria, and could this improve our cognitive function and stress levels? A new doctoral thesis has taken a closer look.

Text **Ebba Arnborg**

Wholegrain intake has been shown to reduce the risk of many diseases, but what effect does it have on the gut's microbiota, the bacteria in the gut? And could this affect communication between the gut and the brain? Laura Pirkola, a recently graduated doctoral student at the Swedish University of Agricultural Sciences and Fazer, has investigated this.

"This is an exciting new area to study,



"The microbiota affects our health in many ways"

Laura Pirkola, doctoral student, Swedish University of Agricultural Sciences and Fazer

as the microbiota affects our health in many ways," she says.

HER DOCTORAL WORK included a dietary study in which subjects were fed a significant amount of wholegrain rye bread or low-fibre white bread every day for

three weeks. After this, blood markers, gut microbiota, stress response and cognitive performance were analysed.

"We saw an increased amount of two microbes that produce a short-chain fatty acid called butyric acid, as well as increased butyric acid levels in the blood of participants who ate wholegrain rye," says Pirkola.

THIS MEANS THAT rye can potentially increase butyric acid production, probably because rye positively affects the composition of the gut microbiota, she adds.

"Our study was quite small and relatively short, so it is positive that we were still able to see a link. Rye has been associated with health benefits in many studies. A partial explanation could be an increased production of butyric acid," she says.



help us destress?

Butyric acid is believed to be a key metabolite for the gut-brain axis – the two-way communication between the gut and the central nervous system. The gut microbiota sends signals to the brain, which can then influence the gut and the microbiota, Pirkola explains.

“In this way, what we eat could affect cognitive function, such as reducing stress. However, the study found no effect on the gut-brain connection. The results could have been different if the study had a longer duration, more participants and other products,” she says.

AN IN VITRO STUDY was also part of the project, investigating the microbiota composition in faecal samples from two individuals. There were differences between the samples in terms of butyric acid and other short-chain fatty acids,

as well as how dietary fibre was metabolised, which suggests that microbiota composition can affect how nutrients from bread, for example, can be utilised by the gut bacteria, Pirkola says.

“There is a lot of individual variation in the composition of the gut microbiota. This can affect which substances are produced, so eating wholemeal rye may not have the same effect for everyone,” she says.

ABOUT THE THESIS

In a laboratory study and in an intervention study, rye was found to potentially increase the production of butyric acid, which is considered a key metabolite for the two-way communication between the gut and the brain. Rye could thus be thought to improve our cognitive abilities.

Pirkola still believes the hypothesis that whole grains can increase cognitive ability and reduce stress, and would like to see more and larger studies in this area.

“We need longer intervention studies with more subjects and possibly other products,” she says.

PIRKOLA STATES THAT including wholegrain products in your diet is important for health:

“In general, people do not consume enough wholegrains to follow the recommendations, so almost everyone would find increasing their consumption and eating a variety of wholegrain products beneficial,” she concludes. ●

Reference: Pirkola, *Whole grain and the gut-brain axis*, SLU 2023.



RECIPE

Simple and tasty outdoor food

Sausage and sauerkraut makes easy and delicious food around a firepit. Choose sourdough bread and make your own sauerkraut for an extra fermentation experience!

Sausage and sauerkraut

Serves 4

- 4 large or 8 small sausages of any type
- Sourdough baguettes
- 300–400 ml sauerkraut
- 3–4 tbsp mustard, any kind
- 2 tbsp mayonnaise
- Ketchup
- Caraway seeds

INSTRUCTIONS

1. Heat the sauerkraut over a low heat in a pan with a lid. Grill or fry the sausages.
2. Combine the mustard and mayonnaise in a bowl.
3. Toast and slice the bread. Add the mustard mayonnaise, ketchup, sausages and sauerkraut, and top with a few caraway seeds. ●



↑ Recipe from Korvbrödsbagarn.



PHOTO: APELÖGA / LANTMÄNNEN

↑ Improving bread quality is the focus of one new research projects in the area of food.

Research for future agriculture, materials and food

Lantmännen Research Foundation's most recent call for proposals resulted in SEK 28 million being allocated to innovative projects in three main areas: agriculture and machinery, food and health, and bioenergy and green materials.

Helena Fredriksson, Head of Research
Lantmännen Research Foundation

Since 1986, our foundation has invested in research relating to the entire agricultural value chain. Over time, a network of researchers has been established, working together to secure a robust food supply, contributing to a more biobased society and promoting the development of future foods and ingredients that utilise cereals and legumes.

ALL APPLICATIONS ARE assessed by review panels consisting of representatives

from academia, Lantmännen's staff and its members – working Swedish farmers – to ensure they have broad support and offer potential benefits.

ONE OF THE NEW projects in the area of food is about meeting the demand for improved bread quality. It will study how various components of flour, such as starch, gluten and fibre, interact. Another project will investigate the role of cereal products in a healthy diet; specifically, whether individual metabolic responses differ after consuming wholegrains. Improved flavour and function for protein from oats and legumes are important issues in several of the projects starting this year.

How residual streams can be used in the green batteries of the future is one example of a research topic in the area of bioenergy.

One of the agricultural projects will study a seed's vigour, its ability to grow.

The aim is to develop a better measure of seed quality with improved germination and the potential for higher yields. Another project will develop methodology for faster and more accurate analysis of seed-borne diseases. Funding has also been granted for a project to analyse grain quality using AI technology, while a fourth important project focuses on reducing the harvest gap, which is the difference between the field's maximum potential and its current harvest outcome.

LANTMÄNNEN RESEARCH FOUNDATION has so far participated in over five hundred research projects and studies. Long-term research initiatives are crucial for driving the transition, solving sustainability challenges and closing the innovation gap by 2050. It is with pride and pleasure that our foundation contributes to this transition. ●



↑ Bumblebees are important for seed harvests.

Recently completed projects



Bumblebees decide the harvest

Perennial red clover is an im-

portant source of cattle feed in northern Sweden, but the seed harvests for sowing are often low. Researchers at SLU have studied whether the explanation may be a lack of the right kind of pollinators. They concluded that long-tongued bumblebees are important for the seed harvest, so should be protected in landscapes where their presence is low. ●



Starch in flour

Starch is the largest component in wheat flour and

consists of A and B starch granules. Researchers at RISE have studied the different granules' properties and how the ratio between them affects water distribution in dough and bread, and thus bread quality. More research is necessary to put the results into practice. ●



Frozen doughs and breads

Researchers at the University

of Helsinki have studied whether the quality of frozen dough and bread can be improved by using a protein derived from wheat bran. The addition of the protein had positive effects on the volume and texture of the bread in initial trials, but further studies are needed to evaluate the potential of this functional protein. ●

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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