Bran has many important nutritional and health properties that are under-utilised by the food industry. Here, Dr Annica Andersson discusses her work to change this by improving bran’s sensorial, nutritional and technological properties.

An underestimated by-product

In what ways are the bioactive components of bran useful for humans?

Bran contains high levels of vitamins B and E, and minerals such as iron and zinc, which are essential for human health. Other components, such as dietary fibres, sterols and phenolic compounds, may also be beneficial.

These bioactive components have many different effects in humans. They may be part of the positive properties of whole grain intake observed in studies of chronic diseases, such as cardiovascular disease, Type 2 diabetes, obesity and cancer.

Why is it that wheat bran is not being used to its full potential in the food industry?

Wheat and rye bran is not used largely in food mainly because of its negative sensorial and technological properties, for example, its baking properties. Today, it is mainly used as animal feed.

What are the properties of bran that your study is most significantly focused on improving?

As wheat and rye bran are mainly comprised of insoluble dietary fibres, we want to increase the levels of the soluble component, thereby improving the nutritional and technological properties. We also want to improve its sensorial characteristics.

How does moistening and freezing impact the properties of bran?

We hypothesised that moistening and freezing would increase the solubility of dietary fibres, since wet processes may activate endogenous enzymes (those found in the bran) that loosen the cell walls, causing the cells to burst and affecting the structure of the bran. This may alter technological properties such as viscosity and binding capacity, and the increased solubility and fermentability of the dietary fibres could also impact nutritional status. Our experiments, however, have shown that these processes do not increase solubility as much as we thought, and therefore we have instead focused on the use of exogenous enzymes. Xylanases, for example, could be used to increase the solubility of arabinoxylan – the main dietary fibre in wheat and rye bran.

What does the process of extrusion involve?

Extrusion can be used to produce ready-to-eat foods (eg. snacks, confectionary and breakfast cereals) or to modify food ingredients. The solid components and water are forced to flow under mixing, heating and shear by a screw, and are pressed through a die that forms and/or puff-dries the ingredients.

The most important parameters during extrusion are: the volume of water added with the flour before it goes into the screw house, the inside temperature, where flour and water are mixed into dough and pressed forward; and the rotation speed of the screw. The combination of water content and screw speed determines the pressure and shearing effect on the material, which can change the properties of dietary fibre.

In the project, we tested two different levels of water content (low and high), three levels of temperature in the screw house (low, medium and high) and three levels of the screw speed (low, medium and high). This was done for both wheat and rye bran.

How much progress have you made toward understanding how bran can be most effectively processed to improve its properties?

We have sensorically analysed wheat and bran extruded at low water content, high or low temperature and high or low screw speed. Our results show that there are no significant differences between the samples in terms of grain aroma, oily smell and woody taste. Wheat bran samples with high screw speed and temperature had positive sensory properties such as sweet and nutty taste, higher overall flavour and crispy texture, while the samples with low screw speed and low temperature were greasy, rancid in taste and harder. Thus, both sensory and nutritional properties were improved by extrusion at low water content, high temperature and high screw speed. Our conclusion is that these are the most effective settings for improving both nutritional and sensorial properties of bran.
Scientists at the Swedish University of Agricultural Sciences are conducting research to increase the use of wheat and rye bran in food products. By improving the properties of bran, the project aims to improve population health and increase cost-efficiency in the food industry.

**BRAN IS THE** outer layer of whole cereal grains, including, for example, wheat, rye, barley, oats and rice. It is an essential part of wholegrain and is a by-product of milling in the production of refined grains. Bran is rich in dietary fibre and bioactive components – such as essential fatty acids, vitamins and minerals – which are important for human health. Despite these valuable properties, the primary use for bran is animal feed. This is because of its poor functionality, such as its tendency to become rancid, and its naturally bitter taste.

Dr Annica Andersson, Associate Professor at the Swedish University of Agricultural Sciences (SLU), aims to change this. She believes that by properly processing bran, it will be possible to increase its use as a flavoursome and healthy food item. Andersson is working to improve the properties and taste by breaking the internal fibre structure and has already identified a combination of methods with the potential to do this.

**IMPORTANT HEALTH BENEFITS**

Bran is an excellent source of dietary fibre and an important component of our diet. Dietary fibre exists in both soluble and insoluble forms, which have very different physiological effects. Insoluble varieties, including cellulose and the main part of arabinoxylan, are important for digestive health. They increase the transit rate of food through the intestines and compose the majority of dietary fibre in wheat and rye bran. Conversely, soluble forms, including beta-glucan, are mainly found in oat bran. These are important for nutrient absorption and act to decrease the levels of glucose, insulin and cholesterol in the blood, which can be harmful in excess. In fact, multiple studies have shown a connection with an increased intake of wholegrain and a reduced risk of developing metabolic syndrome and associated diseases – including heart disease and Type 2 diabetes.

Current Nordic nutrition recommendations suggest that dietary fibre intake for adults should be 25-35 grams per day. Although bran obtained during the milling of wheat and rye contains as much as 50 per cent dietary fibre, current intake means that most adults are only getting two-thirds of their recommended daily amount. By improving the taste and functional properties of bran, it could be used in a wide range of products, increasing dietary fibre intake and improving health – while reducing waste and enhancing cost-effectiveness.

**KLIFUNK**

Andersson is part of the ‘New Technologies to Improve Bran Properties’ (KLIFUNK) project, an interdisciplinary research programme arising from a partnership between the Department of Food Science at SLU and Lantmännen, an agricultural cooperative. The project aims to increase the usability and consumption of bran by enhancing its nutritional properties (soluble fibre content) and sensory characteristics (palatability).

The team at SLU is investigating how bran processing affects multiple aspects of dietary fibre, including solubility, molecular weight and structure – all properties that are strongly associated with the technological, nutritional and sensorial characteristics of bran. The study builds on a rich history of dietary fibre research in Sweden and will use this knowledge to develop pioneering techniques.

**EXTRUSION TRIALS**

Andersson and her team at SLU and Lantmännen are processing wheat and rye bran using three different methods – moistening, freezing and extrusion – in order to study their effect on dietary fibre and sensory properties.

Moistening and freezing cause cells to burst, a process which is associated with changes to the bran structure that is thought to increase the solubility of dietary fibres. However, enzymatic
INTELLIGENCE

NEW TECHNOLOGIES TO IMPROVE PROPERTIES OF BRAN

OBJECTIVES
To increase the use of wheat bran and rye bran in food products by improving the nutritional, technological and sensorial properties using different processes such as extrusion.

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ANNICA ANDERSSON was born in 1969 in Sweden. She studied Agronomy and completed a PhD in Food Science – specifically Plant Products – at the Swedish University of Agricultural Sciences (SLU) in Uppsala in 1999. In 2010, she was appointed Associate Professor in Food Science at SLU.

processes that might take place during moistening can negatively affect the molecular weight distribution of dietary fibres, and further experiments have shown that moistening and freezing do not increase solubility as much as expected. Conversely, previous work conducted by the researchers showed that the alternative process of extrusion significantly increases the solubility of dietary fibres without affecting the molecular weight. Similar studies have also shown that it improves the nutritional quality of bran.

This evidence led the team to consider the possibility of using extrusion – a process that involves subjecting bran to high pressures and temperatures – to improve the food appeal. The group began by conducting a trial into the process parameters that influence the properties of bran. They were able to increase solubility by about 38 per cent in wheat bran; and 33 per cent in rye bran – clearly demonstrating the potential of extrusion to increase the solubility of dietary fibre. Moreover, sensory screening revealed that these samples were most palatable, with a mild, sweet taste and porous texture.

In a second extrusion trial, Andersson attempted to mix wheat bran with either rye or barley flour before beginning extrusion. “Results from these experiments are promising and show increased solubility of arabinoxylan – one of the main dietary fibres in wheat bran – and even better sensorial properties,” she explains. Moreover, the addition of other dietary fibres means the end product has a more widespread health-promoting effect.

Currently, Andersson is conducting trials which involve the addition of xylanase enzymes to bran, in order to break down arabinoxylan, in combination with low heat treatment and small quantities of water. These experiments have increased the solubility of dietary fibres – a very encouraging result. It seems that by combining enzyme addition and extrusion

Andersson has made great strides to realise bran’s full potential, but this is only the beginning: “We hope that more food products made from bran, with high dietary fibre content and good sensorial properties, will soon be found on the market,” she explains. This is especially important in light of the obesity crisis, as currently most food products containing bran – most notably breakfast cereals – have large quantities of sugar to mask the negative characteristics. If Andersson is able to improve the taste of bran without the need for sugar, the nutritional value of a whole host of foods will be much improved.

The benefits of this project are broad, as Andersson explains: “If bran can be used as food instead of feed, we will have a better use for a valuable by-product and the food industry will be more cost-effective”. The processed bran will be highly sought after for many food applications, as will findings regarding nutritional and sensorial properties.