How dietary fibres fight obesity and diabetes

Scientists have found an explanation to why dietary fibres keep us healthy. The discovery may lead to new treatments of metabolic diseases.

Scientists have long known that soluble dietary fibres (see Factbox 1) lower the risk of developing obesity and high cholesterol, along with a number of diseases such as diabetes and colorectal cancer.

Until now, however, it has been unclear exactly why soluble dietary fibres have this positive effect on the body.

Now a new study performed on mice shows that dietary fibres trigger the mouse intestines to send a signal to the brain about increasing the feeling of satiety. The brain then sends a message back down to the intestine telling it to produce a number of hormones which lower the blood glucose levels and speed up the resting metabolism.

The study is published in the journal *Cell* [9].

“We are very pleased with our findings and hope they will lead to the development of new treatments of metabolic diseases, as they provide an insight into how the intestines and the brain work together to regulate the body’s metabolism and hormonal system,” says Professor Fredrik Bäckhed, who is one of the researchers behind the new study. He is affiliated with the University of Copenhagen, Denmark, and the University of Gothenburg, Sweden.

Dietary fibres reduced mice’s obesity

Looking at what goes on in the intestinal system of mice when they eat soluble dietary fibres, the researchers observed that mice that received a supplement of soluble dietary fibres in conjunction with a diet of fat and sugar gained less weight than those that did not receive dietary fibres.

Previous studies had shown that the dietary fibres are converted into three types of short-chain fatty acids in the large intestine (see Factbox 2). The researchers also knew that the intestinal wall converts these short-chain fatty acids into glucose.

They therefore repeated the experiment, but this time with mice that had had a number of genes suppressed leaving their intestinal walls unable to produce glucose from the short-chain fatty acids. Here, it turned out that the dietary fibres lost all of their beneficial effects.

This suggests that it is essential that the short-chain fatty acids are converted into glucose in the intestinal wall for the soluble dietary fibres to have a beneficial effect.

This glucose causes the brain to send a message to the intestine telling it to secrete hormones so that the blood glucose levels are kept stable.
“When the blood sugar is kept low, you reduce the risk of diabetes, or type 2 diabetes, which can emerge when blood sugar levels are high. At the same time, the dietary fibres increase resting energy expenditure, which means there is a lower risk of gaining weight. In this way, dietary fibres also fight obesity,” comments Professor Oluf Borbye Pedersen, the scientific director of the Novo Nordisk Foundation Center for Basic Metabolic Research. He did not take part in the study.

Intestinal wall communicates with the brain

With the exception of the brain, the highest concentration of nerve cells is found in the intestinal mucosa. This enables the intestine to communicate effectively with the brain about what it needs and does not need.

"The study shows that when the intestinal wall cells register the glucose, they send signals to the brain telling it to produce hormones in the intestinal mucosa that lower the blood glucose and increase the resting energy expenditure,” says Pedersen.

"So the intestinal hormones contribute to keeping the blood sugar levels normal, thus preventing diabetes. This also reduces the storage of fat and, furthermore, the intestines also send signals to the brain about inhibiting the desire for more food.”

In other words, there are three ways in which soluble dietary fibres can help you to stay slim:

- Increased energy expenditure.
- Increased satiety.
- Normal blood sugar levels, so that you store less fat.

The bacteria do the work

The optimal functioning of the body relies on a crucial interaction between various bacterial species and the intestinal cells.

"Some of the bacterial species in our intestines help control hormonal production and regulate the many nerve cells. The intestine is our largest hormone-producing organ, affecting the health, metabolism and the functionality of the entire body,” says Pedersen.

The study also shows that an intake of soluble dietary fibres increases the incidence of the beneficial bacteria that break down the dietary fibres, and this is how the intestinal bacterial culture adapts to the food we eat.

Mice are not humans

Although Pedersen finds the new study interesting and solid, he is not sure if the results can be extrapolated to humans.

"I have often been disappointed when results from mouse trials are transferred onto humans because here things often turn out to be much more complicated,” he says.

"These observations therefore need to be studied in humans before we can draw any conclusions and come up with recommendations that could benefit public health.”

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Read the Danish version of this article at videnskab.dk [10]
Soluble dietary fibres help your intestines and your brain to communicate about reducing satiety and blood sugar levels, new study finds. (Photo: <a href="http://www.shutterstock.com/" target="_blank">Shutterstock</a>)

Fact box

There are two types of dietary fibre: soluble and insoluble.

**Soluble dietary fibres** can be broken down by the body’s own enzymes and continue undigested down into the large intestine, where certain bacterial species convert the fibres into short-chain fatty acids (see Factbox 2).

Sources of soluble fibre include oatmeal, apples, oranges, pears, strawberries, nuts, beans, dried peas, blueberries, cucumbers, celery, and carrots.

**Insoluble dietary fibres** pass through the gastrointestinal tract relatively intact and speed up the passage of food and waste through the gut.

Sources of insoluble fibre include whole grains, nuts, barley, brown rice, celery, broccoli, cabbage, onions, tomatoes, carrots, cucumbers, dark leafy vegetables, fruit and root vegetable skins.

Fact box

Soluble dietary fibres are converted into three types of short-chain fatty acids: acetic, buturic and propionic acids.

Short-chain fatty acids are an energy source that bacteria feed on, but they are also absorbed in the large intestinal wall, where they are converted and passed on to the liver and then to the rest of the body.

Whole grain and fibre will be the new wine  Childhood obesity gene identified  How your genes can solve obesity  Nuts good for fighting obesity and diabetes  Obesity risks for only children  Obesity starts in infancy  Possible new cause of diabetes, obesity and poor growth  Fredrik Bäckhed’s profile  Oluf Borbye Pedersen’s profile  Microbiota-Generated Metabolites Promote Metabolic Benefits via Gut-Brain Neural Circuits DOI: 10.1016/j.cell.2013.12.016

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