Food in sight? The liver is ready in minutes: Study shows how adapting sugar metabolism starts in the brain

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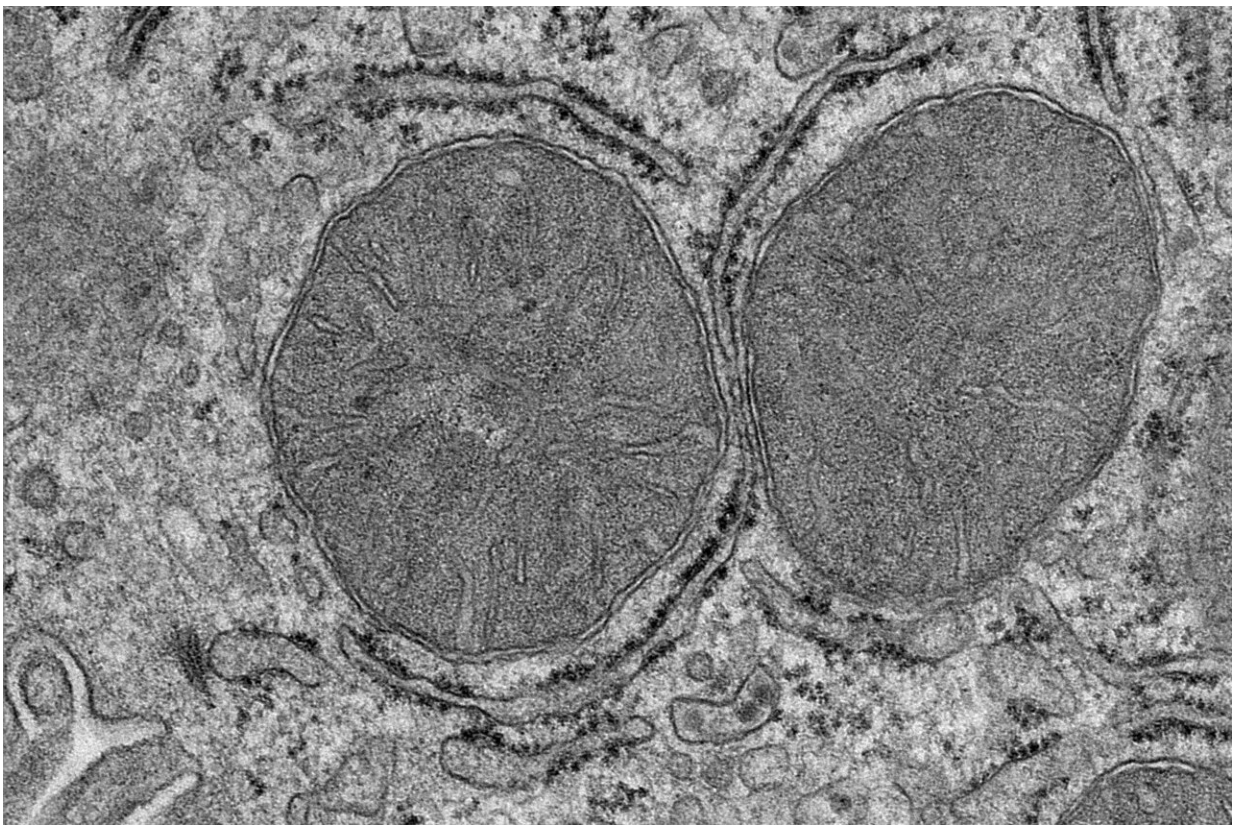

The mitochondria in the liver change their shape as soon as food is perceived. The image shows an electron micrograph of the mitochondria in liver cells. Credit: S. Henscke/Max Planck Institute for Metabolism Research

What happens in the body when we are hungry and see and smell food? A team of researchers at the Max Planck Institute for Metabolism Research has now been able to show in mice that adaptations in the liver mitochondria take place after only a few minutes.

Stimulated by the activation of a group of nerve cells in the brain, the mitochondria of the liver cells change and prepare the liver for the adaptation of the sugar metabolism. The findings, published in the journal *Science*, could open up new avenues for the treatment of type 2 diabetes.

The researchers fed hungry mice that could only see and smell the food without eating it. After just a few minutes, the researchers analyzed the mitochondria in the liver and found that processes normally stimulated by food intake were activated.

The studies show that it is sufficient for the mice to see and smell food for a few minutes to influence the mitochondria in the liver cells. This is mediated by a previously uncharacterized phosphorylation in a mitochondrial protein. Phosphorylation is an important modification for the regulation of protein activity. The researchers also show that this phosphorylation affects the sensitivity of the liver to insulin, and have thus discovered a new signaling pathway that regulates insulin sensitivity in the body.

Nerve cells in the hypothalamus

The effect on the liver is mediated by a group of nerve cells called POMC neurons. These neurons are activated within seconds by the sight and smell of food, signaling the liver to prepare for the incoming nutrients. The researchers also showed that the activation of POMC neurons alone is sufficient to adapt the mitochondria in the liver, even in the absence of food.

"When our senses detect food, our body prepares for food intake by producing saliva and digestive acid. We knew from previous studies that the liver also prepares for food intake. Now we have taken a closer look at the mitochondria in liver cells, because they are essential cell organelles for metabolism and energy production, and realized how surprisingly fast this adaptation takes place," explains Sinika Henschke, first author of the study.

Jens Brüning, head of the study and director at the Max Planck Institute for Metabolism Research, said, "Our study shows how closely the sensory perception of food, adaptive processes in the mitochondria and insulin sensitivity are linked. Understanding these mechanisms is also important because insulin sensitivity is impaired in type 2 diabetes mellitus."

Jens Brüning is also a research group leader at the CECAD Cluster of Excellence in Aging Research at the University of Cologne and Director of the Department of Endocrinology, Diabetology and Preventive Medicine at Cologne University Hospital.

More information: Sinika Henschke et al, Food perception promotes phosphorylation of MFFS131 and mitochondrial fragmentation in liver, *Science* (2024). DOI: 10.1126/science.adk1005. www.science.org/doi/10.1126/science.adk1005

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