Gut bacteria help digest dietary fiber, release important antioxidant

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Dietary fiber found in grains is a large component of many diets, but little is understood about how we digest the fiber, as humans lack enzymes to break down the complex molecules. Some species of gut bacteria break down the fiber in such a way that it not only becomes digestible, but releases ferulic acid, an important antioxidant with multiple health benefits, according to a new study led by researchers at the University of Illinois Urbana-Champaign.

Grains such as rice, oats, rye and wheat are rich in a class of dietary fiber called arabinoxylans, which humans cannot digest on their own. Many gut bacteria have enzymes to break down simple components of arabinoxylans; however, they lack the ability to break down complex ones—including those containing ferulic acid.

"Ferulic acid has been shown to have antioxidant, immunomodulatory and anti-inflammatory activities, and many reports have documented its protective activities in different disease conditions including diabetes, allergic inflammation, Alzheimer's disease, cardiovascular disorders, microbial infections and cancer," said study leader Isaac Cann, a professor of animal sciences and microbiology and a member of the Carl R. Woese Institute for Genomic Biology at Illinois.

"The question, then, is what is the benefit of arabinoxylans to us, since our human genomes do not encode the enzymes that can degrade them or access the ferulic acid they contain?" Cann said.

To answer that question, Cann's group and collaborators at the University of Michigan and Mie University in Japan studied the genomes and digestive activity of bacteria in the intestine. They found that a group of Bacteroides bacteria have several enzymes that break down arabinoxylans, some of which had not been seen or catalogued before. One enzyme the group discovered is so active that it cuts off any ferulic acid it comes across, releasing large amounts of the antioxidant, Cann said. The group published its findings in the journal *Nature Communications*.

"These bacteria can sense the difference between simple and complex arabinoxylans to deploy a large set of enzymes that function like scissors to cut the linkages in complex arabinoxylans into their unit sugars, and at the same time release the ferulic acid," Cann said.

Importantly, none of the bacteria the group studied used the ferulic acid after releasing it—thus making it available for absorption in the human gut.

Understanding this mechanism of how bacteria in the colon help the body break down dietary fiber and access ferulic acid has applications for personalized nutrition. With the compound's

protective activity against certain diseases and its role in modulating inflammation and immune response, patients may benefit from probiotic ingestion of the ferulic acid-releasing bacteria or from consuming a diet rich in arabinoxylan fiber, Cann said.

"This is one example of how the microbiome impacts human health and nutrition," Cann said.

More information: Gabriel V. Pereira et al. Degradation of complex arabinoxylans by human colonic Bacteroidetes, *Nature Communications* (2021). DOI: 10.1038/s41467-020-20737-5

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