Not all dietary fibers are equal

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The health benefits of dietary fiber vary across individuals and may depend on the specific type of fiber and the dose consumed, researchers report April 28th in the journal *Cell Host & Microbe*.

"Our results demonstrate that the physiological, microbial, and molecular

effects of individual fibers differ substantially," says senior study author Michael Snyder, a geneticist at Stanford School of Medicine. "Further, our results demonstrate the tantalizing prospect of using targeted fibers, mediated by the microbiome, to drive health and systems biology in a predictable, personalized direction."

High-fiber diets reduce the risk of heart attack, stroke, and cardiovascular disease. They act by lowering cholesterol and promoting a healthier lipid profile for people eating a Westernized diet. Dietary fibers are carbohydrates that are selectively metabolized by gut microbes but are otherwise indigestible by humans. Understanding how they affect the microbiome and in turn human biochemistry and physiology is critical for effectively using dietary fiber supplementation to improve human health.

Chemically, fibers are diverse in length, branching, solubility, charge, and other properties. "They are usually studied as complex mixtures from their plant source," Snyder says. "There is a need for determining the unadulterated effects of individual fibers on the microbiome and for establishing associated health biomarkers, ideally by testing different fibers on the same individuals."

To address this need, Snyder and his colleagues set out to understand how purified individual fiber components affect the same group of participants. Specifically, they investigated the physiological effects of dietary supplementation with two common and structurally distinct soluble fibers: arabinoxylan (AX), which is common in whole grains, and long-chain inulin (LCI), which is found in onions, chicory root, and Jerusalem artichokes.

The researchers used stool metagenomics, plasma proteomics, metabolomics, lipidomics, and analyzed serum cytokines and clinical values in 18 participants. "Fiber is associated with improved metabolic

and cardiovascular health, but understanding the effects of individual fibers on microbial and metabolomic response has not been studied using a multiomics dataset," Snyder says.

The participants consumed 10 grams of fiber per day during the first week, 20 grams per day during the second week, and 30 grams per day during the third week. The results revealed fiber- and often dose-dependent microbial and systemic responses. On average, AX consumption was associated with a significant reduction in low-density lipoprotein (LDL), known as the bad cholesterol, and an increase in bile acids, which may be contributing to the cholesterol reduction. Yet individual responses varied, and some participants saw little to no change in cholesterol levels.

"Several high-fiber foods have cholesterol-reducing effects, and our study suggests that these reductions may be driven by individual constituents of the mix of fibers in unrefined plant foods," Snyder says.

Meanwhile, LCI was associated with a modest decrease in inflammation markers and an increase in the abundance of *Bifidobacterium*—a generally beneficial type of gut microbe known to produce healthy short-chain fatty acids. But at the highest dose, there was an increase in inflammation and levels of a liver enzyme called alanine aminotransferase, suggesting that too much of this fiber may be harmful. Again, these potentially negative responses were variable across the participants.

Two limitations of the study were its short duration and the small number of participants. But according to the authors, the study provides insights into mechanisms behind fiber-induced cholesterol reduction, reveals the deleterious effects of high inulin consumption, and highlights the association of individual, purified fibers with the microbiome.

"Overall, our findings show that the benefits of fiber are dependent on fiber type, dose, and participant—a landscape of factors resulting from interactions between fiber, the gut microbiome, and host," Snyder says. "These results have important implications in personalized response and interventions."

More information: Samuel M. Lancaster et al, Global, distinctive, and personal changes in molecular and microbial profiles by specific fibers in humans, *Cell Host & Microbe* (2022). DOI: 10.1016/j.chom.2022.03.036

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