Gut Bacteria Help Make Broccoli a Superfood

Glucosinolates, the same small molecules that give broccoli its pungent flavor, have also been associated with decreased risk of certain cancers.

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While parents have been coaxing kids to eat more vegetables for generations, only recently have researchers delved into understanding the science behind the health benefits. Elizabeth S. Sattely, PhD (Damon Runyon Fellow ’08-’10), has been at the forefront of this trend to harness plant chemistry to improve human health. “We’re just starting to scratch the surface in quantifying the role of the many small molecules found in plants,” says Sattely, associate professor of chemical engineering at Stanford and HHMI Investigator. “Now, we are looking at how the chemicals in the food that we eat can directly impact our health.”

One of the most well-studied examples comes from the Brassica family of plants, including broccoli, cauliflower and cabbage. Glucosinolates, the same small molecules that give Brassicas a very pungent flavor, have also been associated with decreased risk of certain cancers. When gut microbiota metabolize glucosinolates, they generate chemicals called isothiocyanates that have been linked to blocking the growth of tumors in mice.

Last month, Sattely and her colleagues pinpointed a set of genes that gives the gut microbe Bacteroides thetaiotaomicron the ability to produce isothiocyanates. Mice colonized with B. thetaiotaomicron bacteria that lacked a complete set of these genes had lower levels of isothiocyanates in their digestive tract than did mice colonized with typical B. thetaiotaomicron. When the researchers introduced the genes into bacteria that do not normally help to digest glucosinolates, the microbes began producing isothiocyanates. Understanding this microbial mechanism could help efforts to engineer microbes to prevent and treat human disease, says Sattely.

This work builds on groundbreaking research by former Damon Runyon Fellow Paul Talalay, MD, at Johns Hopkins, who launched the study of “chemoprevention” with his 1992 study in Proceedings of the National Academy of Sciences that first described a protective biochemical mechanism for the action of glucosinolates in preventing certain cancers. His research fueled a growing movement built on the idea that people can improve their health by eating the right foods that continues today.

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