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Modulating the Gut Microbiome to Treat Disease

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OVERVIEW

A protocol for supplementing diets with resistant starch (RS) to affect the gut microbiome

- One bacterium with specific types of pili bind resistant starch from potatoes
- This probiotic decreases gut inflammation and promotes its barrier function

BACKGROUND

Bacteria that thrive as normal inhabitants of the human intestines comprise the gut microbiome and function to produce metabolites that are essential to health. The composition and activity of the gut microbiome are influenced heavily by intake of dietary fibers including Resistant Starch (RS), a plant poly saccharide that escapes degradation in the small intestine, but which can be metabolized by specialized bacteria in the colon. In addition to influencing the regularity of bowel movements, dietary fiber contains fermentable compounds that fuel the metabolism of gut microbes and promote health.

The amount of fiber in a typical Western diet, less than half of the recommended amount, is therefore a public health concern. One strategy for addressing the shortcoming in dietary fiber is to supplement diets with purified preparations of plant fiber, such as resistant starch (RS). Unlike most processed starches, this crystalline form of starch is resistant to digestion by the a-amylases of mammals and most microbes. However, it can be cleaved by specialized bacteria of the gut microbiome that then grow by fermenting the released polysaccharides. However, the details of how bacteria in a turbulent environment like the gut capture insoluble substrates like RS are unclear, so a need exists for an improved understanding of these processes.

INNOVATION

Researchers at the University of Michigan have developed a protocol for supplementing diets with resistant starch (RS) which modulates composition and activity of the gut microbiome to foster normal homeostasis and decrease gut epithelium inflammation. The scientists discovered that some bifidobacteria produce extracellular appendages, or pili, which bind to RS from potatoes. The most responsive bacterium found in study subjects whose diets were supplemented with RS was Bifidobacterium adolescentis, which has a pilus required for attachment to RS granules. The diversity of the pilins in this strain of bacteria provides an ability to bind different substrates and ultimately occupy different niches in the human gut. Evidence suggests that B adolescentis trigger production of tryptophan-derived indole derivatives that can decrease inflammation and improve the barrier function of gut epithelium. The successful delivery of this probiotic would be as simple as providing oral intake of the bacteria attached to

its food source, resistant starch in potatoes. Additional studies using this knowledge will be important to the development and use of matched combinations of prebiotic and probiotics to investigate gut health and its relationship to illnesses such as cancer and graft versus host disease.