GENERAL ACUPUNCTURE

Why You Should Care About Prebiotics (Part 2)

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In my last article [January 2018], I discussed the concept of prebiotics (also known as microfood, as a way to avoid the consumer confusion that can occur between the terms probiotic and prebiotic) and began exploring the literature supporting the health benefits of prebiotic soluble fiber. Let's continue that conversation in this article by outlining some additional benefits.

Improvement in GERD Symptoms

Our understanding of how gastro-esophageal reflux disorder (GERD) develops has evolved. Along with esophageal exposure to gastric acid, other factors involved in the pathophysiology include dysfunction of the lower esophageal sphincter (LES)[1] and variables that increase intragastric pressure, such as gastric dysmotility,[2] hiatal hernia[3] and body habitus.[4]

It is increasingly recognized that bacteria also play a role in the pathogenesis of GERD. Throughout the gastrointestinal tract, there is a mucosal barrier that defends the local epithelium against ambient aggressive factors. The nature of this barrier is, in part, a product of the local microbiome.[5] Nearly 100 commensal species of bacteria reside in the distal esophagus.[6]

A contemporary proposed pathophysiology for GERD involves alteration of the microbiome local to the distal esophagus and LES. Factors contributing to this alteration may include inappropriate diet, antibiotics, infection, toxins, etc. Once disrupted, the advantageous symbiotic relationship of the local microbiome becomes a pathogenic one. This dysbiotic state has been grossly characterized as a change in the esophageal microbiome from predominantly gram-positive to predominantly gram-negative organisms.[7]

This change alters the nature of the bacterial biofilm,[8] altering, among other things, permeability. This, in turn, can negatively affect the maintenance of a robust mucosal barrier, exposing the esophageal epithelium to pathogenic bacteria, gastric refluxate, and bacterially produced toxins.

Endotoxins, including lipopolysaccharides (LPS), are located on the outer membrane of gram-negative microorganisms. LPS are known to upregulate gene expression of proinflammatory cytokines.[9] These LPS are also capable of triggering relaxation of the LES,[10] which decreases resistance to gastric pressure and can lead to delayed gastric emptying.[11] These changes in motility promote acid-induced injury to the LES, which has been shown in animals to further decrease LES pressure.[12]

The action of a prebiotic soluble fiber may be twofold. First, the proliferation of bacterial cells should be increased, leading to a higher ratio of species producing exopolysaccharides (EPS).[13] These EPS are responsible for the creation of biofilm,[14] which can contribute to the defensive mucosal barrier.

Second, once established in a biofilm, the presence of certain gram-positive species, such as L. salivarius, L. gasseri, or Lactococcus (Lc) lactis, known to metabolize MIMO, coincides with the production of antibacterial peptides known as bacteriocins.[15-17] These bacteriocins curate the attendant species by selectively killing competing species, restoring the distal esophageal microbiome to a healthier state. This results in improvement of GERD symptoms.

This is significantly different from studies on plant-derived soluble fiber such has fructooligosaccharides (FOS), which has been shown to increase GERD symptoms.[18]

Improvement in Mineral Absorption & Bone Density

When prebiotic soluble fiber arrives in the colon, it is fermented by certain bacteria, which then produce short-chain fatty acids (SCFA),[19-20] lowering the colonic luminal pH. This, in turn, improves calcium and magnesium speciation and solubility so that passive diffusion is improved.[21-24]

Additionally, SCFA and other organic acids produced via bacterial fermentation enhance calcium absorption via both cation exchange[25] and active calcium transport.[26-27] Finally, ingestion of prebiotic soluble fiber leads to colon-wall cell growth and functional enhancement of absorptive area,[28] further increasing calcium, magnesium and other mineral absorption.

In clinical trials of prebiotic soluble fiber supplementation in infants, magnesium and iron absorption and retention were increased.[29] In adolescents, calcium absorption increased by 10 percent in boys[30] and 30 percent in girls.[31] A one-year longitudinal clinical trial in adolescent boys and girls showed significantly increased calcium absorption and improved bone density.[32]

In adults, a 28-day clinical trial of prebiotic soluble fiber supplementation demonstrated significantly improved calcium balance,[33] while postmenopausal women supplemented for five weeks experienced a significant increase in calcium absorption,[34] magnesium absorption or both.[35-36] Other studies in postmenopausal women have shown similar results.[37-40]

Improved Weight Management, Decreased Appetite

Numerous animal studies on soluble fiber supplementation have shown decreases in fat mass in animal models, with and without changes in body weight, affecting all types of adipose tissue, and often accompanied by ad libitum decrease in food / energy intake[41-47] which, if sustained in humans, would produce up to a three-fourth-pound weight loss per week.[48] Decreases in fat mass as shown in these studies, with or without weight loss, would be beneficial from a health perspective.

The mechanism for these effects is believed to be microbiome-induced changes in the activity of intestinal endocrine cells that secrete peptides involved in the regulation of energy homeostasis, such as ghrelin, glucagon-like peptide (GLP-1) and peptide YY (PYY).[49-52]

For instance, several studies in rats and mice fed prebiotic soluble fiber have shown reductions in food intake, body weight and fat mass, associated with a significant increase in portal peptides that stimulate satiety (GLP-1 and PYY), and a decrease in a hunger-inducing peptide (ghrelin).[53-58]

In healthy-human trials, supplementation with soluble fiber has been shown to promote satiety, reduce hunger and decrease food intake, leading to 10 percent lower total energy intake.[59] Based on a 2,000 kcal/day diet, that would equate to about 0.5 lb./week of fat loss.

Additionally, it has been shown that fermentation of soluble fiber by gut bacteria is associated with lower energy intake, correlated with an increase in plasma peptides GLP-1[60] and PYY, which stimulate satiety.[61] Similarly, studies in obese subjects show a decrease in food intake, body weight gain and fat mass development, correlated with a decrease in hunger peptide ghrelin following a meal.[62]

Improved Glucose & Lipid Homeostasis

In studies with diabetic rats, soluble fiber supplementation improved glucose homeostasis with improvement in insulin secretion or insulin sensitivity,[63-66] and in obese rats, improved hepatic insulin sensitivity and plasma insulin.[67] Studies in humans have shown decreased hepatic glucose production[68] and increased GLP-1 production, with a slower rise in blood glucose after a meal.[69] As for lipids, soluble fiber supplementation in rats, hamsters or mice has led to decreased serum lipids, including cholesterol and/or triglycerides.[70-75] The mechanism for these results is believed to be decreased glycaemia, a driver of lipogenesis, or the effect of SCFA produced by colonic fermentation, lowering hepatic lipid synthesis.[76-77] Modulation of intestinal metabolism of bile acids may also play a role, independent of fermentation.[78-79] Similarly, in humans, prebiotic soluble fiber supplementation may result in decreased hepatic lipid production.[80]

That completes our walk through the scientific literature on prebiotic soluble fiber. Given the voluminous literature cited above, I think it is clear how important it is to have adequate soluble fiber in the diet, either through daily consumption of both plants and fermented foods at each meal, or through a daily prebiotic soluble fiber supplement.

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