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You Are What You Eat

Allyson Ditmars

The gut microbiome is the wide array of good and bad bacteria found in the digestive tract of all humans. Although the composition of gut microbiota is developed before someone is even born, there are nutritional decisions made in adulthood that can impact the health of the gut. Certain nutritional foods can increase the diversity of the gut and create a beneficial environment. On the other hand, many foods found in the common American diet can negatively impact the microbiome. The gut can suffer from a poor diet when the permeability of the intestinal barrier and the diversity richness is damaged. Building this relationship can systemically be advantageous or harmful for the whole body, which is reflected by medical conditions that have been associated with an unhealthy gut. To minimize health risks, it is important to incorporate nutritious foods into one's diet, while limiting specific ingredients that are unfavorable to the gut microbiome.

Keywords: *gut microbiota, American diet, food nutrition*

Anthele Brillat-Savarin stated "Dis-moi ce que tu manges, je te dirai ce que tu es," which can be translated to "Tell me what you eat, and I will tell you what you are."[1] This fascinating connection between one's food and state of mind is rooted all the way back to 1826.[1] After further exploration of this systemic relationship, the true connection between the gut and the mind has been discovered and new information continues to evolve. The brain and the gut are directly interconnected through the vagus nerve. This connection allows the enteric nervous system (ENS), which lines the gastrointestinal tract all the way from the esophagus to the rectum, to impact the central nervous system. [2] As a result, a person's mental health has been attributed to this mind-gut connection. Certain foods are beneficial for gut health, while consumption of other foods can disrupt microbiota. Damage to this microbiome can lead to inflammation, impact cognition, and result in the development of certain diseases.

Gut microbiomes are unique to everyone. Genes, environment, medications, and nutrition all play a role in the makeup of a person's gut bacteria. The composition of the gut microbiota is developed from the fetus state to late adulthood. When in the embryo, the fetus gains their first alteration in gut microbiome through ingesting amniotic fluid and the bacteria present in utero.[3] Throughout fetal development, the composition of the gut microbiome continues to cultivate. Even at birth, vaginal or caesarean delivery determines the type of bacteria that colonizes an infant's gut. After this first exposure, the infants' primary microbiota will come from their diet. Breast milk is packed with 600 different types of bacteria, which results in optimal exposure for a diverse, rich gut microbiota. As a human begins to eat more foods, their gut diversity grows. At the age of three years old, a human has the stable gut microbiota of an adult.[3] The main factor that influences gut microbiota from this point on is the foods consumed.

Foods that promote gut diversity and richness have shown to positively impact the overall health of the gut. While probiotics contain live strains of good bacteria, prebiotics are typically high fiber foods that feed these microorganisms in the digestive system. Dietary fiber and prebiotics nourish beneficial microorganisms, lead to an auspicious outcome on the microbiota diversity and promote production of small chain fatty acids (SCFA).[4] The production of SCFA is vital to protecting the permeability of the mucus intestinal barrier. If the functionality of this barrier is damaged, it will allow for pathogens to enter and lead to inflammation. Another valuable addition to the diet is polyphenols, which include berries, vegetables, coffee, and tea. Through the increase in the good bacteria, the permeability of the gut can be further protected from outside invasion.[4] The increased intestinal integrity of the gut through the consumption of these healthy food sources can prove to be beneficial to the health of the gut and prevention in disease development.

While the intake of dietary fiber, prebiotics, and polyphenols are favorable to the gut microbiome, there are certain ingredients that can be harmful to the gut when consumed in large quantities. Both artificial sweeteners and food additives are commonly consumed in the American diet. Consumers are replacing regular sugar with certain artificial sweeteners due to their low-calorie appeal.[4] However, artificial sweeteners such as sucralose, aspartame, and saccharin have been shown to disrupt the diversity of the gut. A study by Bian and colleagues found a differing number of bacteria and higher fecal pH in rats after twelve weeks of injected sucralose, and an abundance of pro-inflammatory genes after six months.[5] Although clinical studies have only been done on rats, it is indicative of the impact that can occur in humans. Along with artificial sweeteners, food additives are harmful to the health of the ENS. Food additives, in the form of

emulsifiers, are present in a lot of the processed foods consumed today. Two specific additives, carboxymethylcellulose and polysorbate-80, can cause damage to gut diversification.[4] Processed foods cause the most damage because they lack good nutrients, which leads to inflammation and an environment for less-healthy bacteria species to colonize the gut. The lack of diversity and bacteria richness as well as inflammation that occurs with excess consumption of artificial sweeteners, food additives, and processed foods is detrimental to gut health.

The influence of diet on gut microbiota composition has been found to contribute to the development of certain health conditions. Research on gut microbiota suggests a possible relationship between a disturbance in *Firmicutes* species and depression. *Firmicutes* is a bacterium important to gut health. Its main job is to "ferment carbohydrates to a variety of short- chain fatty acids (SCFAs) and the lack of these SCFAs can lead to decreased intestinal barrier function."[6] When *Firmicutes* bacteria are absent, the permeability of the gut is decreased, the ENS gets disrupted, and inflammation occurs. Since depression has been characterized by activation of inflammatory processes, a reduction in *Firmicutes* has been reported in patients with depression. For example, in a study by Huang and colleagues, fecal samples were collected from individuals who had depression as well as those who were otherwise healthy to assess the presence of *Firmicutes*. When comparing samples, they found a greater range of microbiota diversity and bacteria richness present in the healthy participants and significantly lower levels of *Firmicutes* in the cohort with depression.[6] In addition to depression, other neurological conditions have been linked to the imbalance of gut microbiota such as Alzheimer's Disease, Parkinson's Disease, and anxiety.[7]

Understanding the connection between the brain and gut can spark potential for therapeutic correction of disease states with gut promoting techniques. Two important methods to correct the gut microbiome and in turn, ensure a healthy ENS are probiotics and use of fecal transplantation.[7] Increasing probiotics can be done through diet by consuming fermented milk or yogurt, which will enhance the good bacteria in the gut. The most common beneficial bacteria are *Lactobacillus, Bifidobacteria* and yeasts. Their main role in the gut is to promote the intestinal barrier, hinder pathogens from entering, and prevent dysbiosis among healthy bacteria. Correction of the balance of bacteria in the gut can also be modified by complete transplantation of foreign bacteria. Fecal Microbiota Transplantation (FMT) is used to restore the beneficial bacteria in individuals facing intestinal upset with the implantation of the feces of healthy individuals. This is typically performed through a colonoscopy, in which the feces of a healthy individual are inserted into the colon of the recipient. Adjustments are made to the microbiota of the individuals to lessen the effects of certain diseases, such as Parkinson's Disease and Irritable Bowel Syndrome.[7] The use of probiotic supplementation and FMT can adjust the microbiota to advantage the health of affected individuals.

Nutrition can affect the composition of gut microbiota and make one more susceptible to certain medical conditions. The intestinal barrier and dysbiosis in the gut can affect mental health through the ENS and CNS connection. Although gut microbiota can be improved with probiotics and fecal transplantation, it is important to incorporate whole grains, vegetables, and fruit into an everyday diet to promote a healthy gut. Nutrition is a very influential aspect in the promotion of systemic health because, as Anthele Brillat-Savarin implied, you are what you eat.

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