The Microbiome

Before you can understand how prebiotics, probiotics, antibiotics, and postbiotics affect your health, you need to know about the microbiome. All multicellular organisms, including every animal and plant, are covered in a vast array of microorganisms. Microorganisms, also known as microbes, are extremely small (microscopic), living organisms such as bacteria, viruses, and yeast. They live on our skin, in our body fluids, and throughout our digestive tract in large quantities and varieties. The moment we are born, we come into contact with countless microorganisms; at any given moment there are just as many, if not more, single-celled organisms on you than there are cells that make up your own body! We call this collection of microorganisms, which is unique to each individual, the microbiome.

Microorganisms and Our Health

While the term ‘microorganism’ refers to all types of microbes, we are going to focus primarily on bacteria in this pamphlet. When we think about the bacteria that colonize our intestinal tract, we typically sort them into two categories: beneficial strains of bacteria (non-pathogenic), including those in the genera *Bifidobacterium* and *Lactobacillus*, and potential disease-causing strains of bacteria (pathogenic), including *Escherichia coli* and *Clostridioides difficile*. While it’s actually much more complex than this, it is an easy way to denote which bacteria will generally improve our health or harm us. Beneficial bacteria keep pathogens in check and offer many health benefits. Disease-causing bacteria release proteins and toxic byproducts that can cause infection and harmful symptoms such as diarrhea. Some, such as *Helicobacter pylori*, can be both beneficial in certain quantities and harmful in other quantities.

The balance between beneficial and harmful bacteria is important for maintaining health. Several factors can upset this balance, including diet, stress, and medications, particularly antibiotics. Adding prebiotics to the diet and taking probiotics

Prebiotics and Probiotics

There are just as many, if not more, microorganisms living in your digestive tract and on your skin as there are cells in your body!

We live in symbiosis with these microorganisms – we give them a place to live and food to eat, and they, in turn, offer us a lot of support. They produce certain vitamins and short chain fatty acids, interfere with the growth of harmful bacteria, modify the immune system, and improve our health in ways researchers are only beginning to study. However, microbes that are more harmful than helpful sometimes overrun our microbiomes. That’s where probiotics and prebiotics come to the rescue; we can use these tools to modify the balance of the microbiome and create a system that works for us instead of against us.

Beneficial Bacteria vs Probiotic

There are many bacteria that live in/on us that can be beneficial to our health, but this does not make them probiotics. Probiotics are products that contain specific strains of bacteria in adequate quantities for which there is evidence showing its efficacy at treating a specific condition.
changes the microbial population and their activity, fortifying the number of good bacteria in the gut. An increase in good bacteria can also help limit the number of harmful bacteria, since they compete for food sources and adhesion sites on the intestinal mucosa.

Modifying the Microbiome

When the microbiome is out of balance, there are a few ways to go about remedying the problem. In cases of bacterial infection, you can take an antibiotic to eradicate the offending bacteria. When the problem is ongoing, probiotics and prebiotics can help return balance to the microbiome. In this section, we will explain how we can use these tools to affect the gut.

Probiotics

Many individuals use the term “probiotic” to mean any beneficial bacteria, but this isn’t completely true. In order to qualify as a probiotic by law, the product must contain live microorganisms that research shows to be beneficial, in adequate amounts to confer a health benefit. You will most often find probiotics in the form of supplements, but some foods also contain probiotics (not to be confused with fermented foods; see below). Typically, a probiotic will contain a limited variety of beneficial bacteria, sometimes a few strains and sometimes just one. However, this will be a type of bacteria that research studies show to be effective for treating a specific ailment. The live bacteria go on to populate the gut and help improve the balance in the microbiome, as well as exert specific effects.

Bacteria from the Bifidobacterium and Lactobacillus genera can improve health in many ways, but different strains can exert different effects. For example, research shows that Lactobacillus plantarum 299V (Tuzen®) and Bifidobacterium infantis 35624 (Align®) can improve abdominal pain, bloating, and gas in those who have irritable bowel syndrome (IBS). These probiotics are effective options for individuals with these specific symptoms, but they might not be helpful for someone with a different set of symptoms or improve health in someone with no digestive troubles.

Some other benefits of various strains of Bifidobacterium might include reducing post-antibiotic diarrhea, reducing the risk of necrotizing enterocolitis in infants, reducing symptoms in inflammatory bowel disease, preventing the growth of harmful bacteria, and improving colon regularity. Many strains of Lactobacillus offer similar potential benefits, including managing diarrheal conditions in children, improving blood lipid levels, preventing urinary tract infections in women, and treating inflammatory bowel disease.

Before taking a probiotic, speak with your healthcare team and make sure that there is evidence that the specific strain you wish to take may be beneficial for you.

Prebiotics

While the most obvious way to increase the number of beneficial bacteria in your gut is to take a probiotic, you can also feed the good bacteria already in your gut so that they reproduce and take over a higher proportion of your microbiome. There are certain carbohydrates in our food that we cannot digest, which we call fibre. There are many types of fibre in our food, and helpful bacteria love to chow down on some of them. These special fibres are prebiotics. The most well known and extensively studied prebiotic is inulin, a type of fructooligosaccharide (FOS), though there are other types as well, such as galactooligosaccharides (GOS).

Prebiotics are naturally occurring in many foods. A wide variety of plant foods, such as whole grains, legumes, tomatoes, bananas, onions, garlic, and Jerusalem artichokes, contain FOS. GOS are less common but occur in breast milk and fermented dairy products. In addition, there are many products on the market to which manufacturers have added prebiotics, usually inulin. When you eat these foods, the prebiotics stay intact through the stomach and small intestine, then bacteria in the large intestine break the fibres down (fermentation) and use them as fuel. This allows these bacteria to reproduce, leading to larger colonies of good bacteria.

Make sure to take it slowly when trying to increase your

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Key Definitions

- **Microbiome**: the aggregate of microorganisms in a specific environment (such as a human body)
- **Microbiota**: the microorganisms that inhabit a specific environment (such as a human body)
- **Microorganism**: a very small (microscopic) organism, such as a bacterium, virus, or yeast
- **Microbe**: another term for a microorganism
- **Antibiotic**: a medicine that either inhibits growth of or destroys microorganisms
- **Probiotic**: live microorganism (usually bacteria) administered with the purpose of improving health
- **Prebiotic**: a food that humans can’t digest but that feeds beneficial bacteria in the gut
- **Postbiotic**: metabolic by-product of probiotics

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prebiotic intake, since sudden changes in the amount of fibrous foods you eat can cause bloating, pain, and other digestive symptoms. You don’t want to trade one symptom for another.

**Fermented Foods**

Many people mistakenly claim that fermented foods, such as yogurt and sauerkraut, contain probiotics. As we discussed earlier, probiotics are products that must contain a certain amount and type of live bacteria, based on scientific evidence for certain conditions. Fermented foods do contain microorganisms, as these are what cause fermentation of the original food. However, the strains of bacteria that these products contain can be variable, and they may or may not still be active by the time they reach your intestinal tract. For these reasons, eating fermented foods is a less reliable way of increasing the populations of beneficial bacteria in the gut than taking supplements.

While the microbe content of fermented foods isn’t guaranteed, they are safe in most cases and might offer benefits. If it works with your dietary routine, adding in foods such as yogurt, kefir, sauerkraut, kimchi, and kombucha can be a nice addition to any probiotics you might take to treat digestive diseases and disorders. However, if you are immunocompromised (common in individuals who take corticosteroids, biologics, or immunosuppressive medicines to treat Crohn’s disease, ulcerative colitis, or some other conditions), you should speak with your doctor before eating fermented foods, as it is harder for your body to fight off any bad bacteria that might be in these products.

**Postbiotics**

Most of the beneficial effects of bacteria in the gut don’t come from the microorganisms themselves, but rather from their metabolic byproducts (waste). When bacteria eat, they produce waste, and while it might sound gross, these waste products can actually help us. For example, when bifidobacteria eat fibre, they produce short-chain fatty acids, which can improve immune function and strengthen the intestinal barrier.

Some researchers have been looking at these end-point products and considering the possibilities of delivering them directly to the gut instead of taking supplements that contain live bacteria and hoping that they make it to the large intestine intact. This might offer a way to bypass the complication of getting living organisms into the gut unharmed, and instead provide the benefits directly. In addition, this could be a way for individuals who are immunocompromised to obtain the benefits of probiotics.

**Antibiotics**

You are probably very familiar with antibiotics. If you’ve ever had a bacterial infection, your physician likely prescribed one of these, such as amoxicillin, to kill off the offending bacteria. Most antibiotics act sort of like ‘nukes’ to the microbiome: they kill the bacteria that are causing you to be sick, but they also kill many helpful bacteria. This can end up causing other infections, because there aren’t enough good bacteria to balance out harmful microorganisms. For instance, yeast infections and *Clostridiodes difficile* infection often occur after taking antibiotics. In some cases, taking probiotics after a course of antibiotics might be helpful for preventing further damage to the microbiome by repopulating it in a beneficial manner. However, in many cases it is unnecessary and might make it take longer for the microbiome to recover.

However, there are other types of antibiotics available now and in development that target specific bacteria rather than the entire microbiome. One such example is rifaximin (Zaxine®), which is a treatment available for IBS and hepatic encephalopathy that targets harmful bacteria in the gut and does not wipe out the beneficial ones.

**What to do With This Information**

Before taking a probiotic, talk to your doctor about which specific products would be best for you. Your ideal probiotic(s) will depend on your digestive health, which diseases you do or don’t have, your diet and lifestyle, and many other factors. For example, the bacterial strains that work well for someone with

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**Increase Your Prebiotic Intake by Adding These Foods to Your Diet:**

- jerusalem artichokes
- bananas
- artichokes
- tomatoes
- leeks
- onions
- garlic
- chicory root
- whole grains (oats, wheat, barley, etc)
- legumes (beans, lentils, soy, etc)
- nuts & seeds (almonds, flax, etc)
constipation-predominant irritable bowel syndrome are likely different than the ones that help someone with Crohn’s disease. For most people, eating fermented foods and prebiotics can help improve digestive health. Just make sure to take it slowly when adding in these foods by starting small and adding more as you can tolerate, and follow our tips for being a good microbe host.

**Benefits of Good Bacteria**
The beneficial bacteria that populate the digestive tracts of individuals who consume probiotics and prebiotics work in many possible ways, including:
- protecting against harmful bacteria
- regulating the responses of the immune system
- strengthening the tissue of the bowel wall
- helping to digest food
- producing vitamins such as thiamine, riboflavin, vitamin B12, and vitamin K
- enhance absorption of some minerals
- improve symptoms of some digestive diseases and disorders
- help regulate weight
- improve heart health

**Be a Good Microbe Host**
- eat plenty of fibre
- consume a wide variety of plant foods
- consume fermented foods
- reduce consumption of processed foods high in fat and sugar
- avoid overuse of antibiotics, if possible
- spend time in nature
- don’t overuse hand sanitizer
- don’t smoke
- get plenty of sleep and exercise

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**About the Gastrointestinal Society**
The GI (Gastrointestinal) Society is a registered Canadian charity committed to improving the lives of people with gastrointestinal and liver conditions, supporting research, advocating for appropriate patient access to healthcare, and promoting gastrointestinal and liver health.

Want to learn more on this subject? The *Inside Tract®,* the GI Society’s quarterly newsletter, provides the latest on digestive and liver research, disease and disorder treatments (e.g., medications, nutrition), and a whole lot more. If you have any kind of digestive problem, then you will want this timely, informative publication. **Subscribe today!**

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