

PART II

THE FIBER FUELED APPROACH

Eat the Rainbow to Find Your Pot of Gold

Why diversity of plants should be on your mind every time you eat

Now that we've established the incredible health benefits of being *Fiber Fueled*, it's time to count our daily grams of fiber and load up on Wheaties, Fiber One bars, and Metamucil, right? Not so fast, my friends!

In 2017 I sat in the front row of a jam-packed, standing-room-only lecture in Chicago. It was Digestive Disease Week, the biggest meeting of gastroenterologists, surgeons, nutritionists, and researchers in the world, with close to twenty thousand nerds (like me) from 150 countries. I was there to hear Dr. Rob Knight speak. Dr. Knight is a god of gut health, in my opinion. He created the American Gut Project in 2012, the largest and most diverse study of microbes and microbiomes of the industrialized world. Dr. Knight was at the podium to announce the greatest predictor of a healthy microbiome using the full, unprecedented strength of his American Gut database. An announcement coming from the highest-quality source we have that would redefine how we think of gut health. His finding?

The single greatest predictor of a healthy gut microbiome is the diversity of plants in one's diet.

That's right. Not Metamucil, not simply counting grams of fiber, but the diversity of plants in your diet. More specifically, he found that the consumption

of *thirty different plants* in a given week was the greatest predictor of gut microbial diversity. Believe it or not, this was far more powerful than whether you self-identify as “vegan,” “vegetarian,” or “omnivore.” Why? Well, you can be a junk food vegan and eat very few plants and you can eat a Paleo diet that emphasizes plant-based diversity, and this can actually be a healthy diet with the proper modifications. It all comes back to diversity of plants.

Since you’ve been following along closely, I bet you’re not too surprised by this. In Chapter 2 we saw the effects of just five days on a plant-based diet for gut health, which were dramatic when compared to five days on an animal-based diet. We also know from Chapter 3 how important fiber, which is found in plants, is to gut health—specifically how important prebiotic fiber is, because it can be transformed into postbiotic SCFAs by our probiotic gut microbes. And we know that there are innumerable types of fiber in nature, and every plant provides a distinct mix that requires a unique blend of microbes to process it. A diet that maximizes a variety of dietary fibers and resistant starches supports the diverse microbial community that’s necessary to process it. As proven by the Hazda population, the more fiber and plant diversity, the more diversity in the microbiota. Why is diversity important? Because the adaptability of our gut microbiota allows us to unlock the healing power of SCFAs. We need a team of microbes to get all the benefits.

Dr. Knight’s American Gut Project study also found that people who consumed an increased diversity of plants had a greater representation of SCFA-producing bacteria. Remember in the last chapter when we discussed training your gut with fiber? Regular exercise forces your muscles to adapt and get stronger. Similarly, giving your gut regular practice with fiber increases the representation of fiber-metabolizing, SCFA-producing bugs that are hyperefficient at extracting the SCFAs for you—an adapted, stronger gut, if you will. You get better at things the more you practice, right? Well, so does your gut.

As we know from Chapter 2, the composition of our microbiome is determined in large part by the foods we eat. Dietary choices lead to the rise and fall of microbes within our gut minute by minute. Every single plant type has a community of gut microbes that thrive when that food is present and languish if that food is removed. Therefore, it makes sense that the diversity within our microbiome would be proportional to the diversity of plants in our diet. More plant-based diversity = stronger, healthier microbiota = stronger, healthier you.

Although our food technology continues to rapidly progress and we have increased availability of food, the diversity in our diet is plummeting. There are approximately four hundred thousand varieties of plants on Earth, of which

about three hundred thousand are edible. But combined globally we consume only around two hundred species in total. Folks, this means we're eating only one out of every fifteen hundred edible plants on this planet.

Not to mention that just three crops—rice, maize, and wheat—contribute nearly 60 percent of calories and proteins humans obtain from plants. Consolidation in high-yield crops is a lot easier for the food production system than supporting diversity. In the last century alone we've abandoned 75 percent of the plant diversity in our agricultural practices as farmers worldwide have been pressured to use genetically uniform, high-yielding varieties. In other words, our modern food systems are efficiently producing calories at the expense of nutrients and biodiversity.

What this means is that plant-based diversity in your diet will not happen by accident. It happens by making this your core dietary philosophy, shunning the path that our food system wants you to take. The good news is that in the pages that follow I'm going to help you maximize your plant-based diversity as a celebration of nature's bounty.

Plant-based diversity: Make it the golden rule

Plant-based diversity is in fact so powerful, so life- and health-changing, that it should be our Golden Rule of eating. By following the one Golden Rule of healthy eating you can have it all—the flavors, smells, and textures from food that you love, food that also just so happens to bring you more vitality and health rather than taking it away. Food that makes you live longer, look better, and feel better. Food that heals and improves your gut microbiome. Food that makes you feel sexy, look sexy, and want more sexy time. I've lived it firsthand, and I've witnessed it in my patients.

When you maximize plant-based diversity, you make a choice that grants you better health—you choose food that nourishes and sustains your optimal health rather than the foods that zap your energy and beat up your gut microbiota until dysbiosis, the root cause of disease, sets in. By focusing on diversity of plants, you maximize the different nutrients that your food contains to reverse your medical problems and even heal the ones that you don't yet realize exist. And by choosing plant diversity, you are fueling your microbiome with the scientifically proven number one determinant of a healthy gut and unleashing the healing power of SCFAs throughout the entire body.

We've made health too complicated with our extensive lists of foods to avoid, complex percentages of fats-to-protein-to-carb ratios, elimination diets, calorie

counting, even weighing our food—and despite all these rules, we’re not getting any better. It just doesn’t need to be this complicated. Diversity of plants. That’s it. That’s all you have to remember. Done. No more annoying food lists. If you follow this one rule, it will lead you to better health. And it will always be the truth no matter what happens: No matter what changes on this planet or in our lifestyles, this core tenet of better health will stay the same.

You might be hearing “plant-based diversity” and wondering, “But aren’t vegans—who subsist on plant-based protein including lots of beans—suffering from nutrient deficiencies?” One of the big fears with the vegan—or plant-based—diet is that we’ll be missing out on critical micronutrients. Rest assured: A 2014 study compared the overall nutritional value of multiple different diets (vegan, vegetarian, semi-vegetarian, pesco-vegetarian, and omnivorous) and found the vegan diet to be the most nutritionally complete while the omnivorous diet received the lowest score.

This approach to eating always delivers beyond expectation—you may do it to fix your diabetes, for example, but along the way you’re fixing everything else, too, including the stuff that’s not even become a problem yet. The Golden Rule of plant-based diversity is both healing and preventative. It’s incredibly powerful.

If you make it your core philosophy for how you choose to eat on a daily basis, this one simple rule will open up a world of possibility for you. No more calorie counting, eating tasteless diet foods, or restricting portion sizes. You can eat as much as you want and still be your ideal body weight and have better health. Let me repeat that: You can eat as much as you want and be your ideal body weight. Yes, I said that. I know this seems like a crazy concept in the context of what’s been dominating our health and diet culture for decades, but it’s real and it works. If you think about all the herbs, flavors, textures, and varieties of health-promoting plant food that you can eat without restriction—that’s wild. And so exciting!

Every plant has its own unique mix of gut-healing fiber

- Barley has a prebiotic fiber called beta-glucan that promotes the growth of healthy microbes, lowers total and LDL cholesterol, and helps regulate blood sugar. On a side note, barley is also rich in selenium, which is important for thyroid health and may prevent autoimmune thyroid disease.

- Whole oats are also high in beta-glucan. In addition, oats have phenolic acids that offer antioxidant and anti-inflammatory protection as a bonus.
- Flaxseeds are 20 to 40 percent soluble prebiotic fiber from mucilage gums, which give you blissful bowel movements. They also kick your gut microbes into high gear. I have more love for flaxseeds, so we'll come back to them later.
- Wheat bran has a special type of fiber made of arabinoxylan oligosaccharides shown to boost healthy gut microbes like *Bifidobacteria* and reduce digestive symptoms like flatulence and abdominal pain. It also has antioxidant and anticancer effects. One of the great scientists of our generation, Dr. Balfour Sartor at the University of North Carolina, has been touting the benefits of bran for years, even when others were criticizing wheat. Bran is the hard outer coating that protects the seed and is often removed in food processing. So if you're choosing refined grains or are unnecessarily gluten-free, you won't get to enjoy these benefits. We'll talk more about gluten later in this chapter. I know you're wondering.
- White potatoes are an excellent source of resistant starch. That's right: white potatoes. French fries and potato chips are obviously bad but my Irish microbes love a good potato mash. They're a great source of prebiotic resistant starch! In one study, they increased SCFA levels more than inulin from chicory root. Here's a tip: If you let your potatoes cool, the process of cooling creates more resistant starch. If you heat and cool repeatedly, you just keep turning it up. Leftover mashed potatoes, anyone?
- Seaweed! Seaweed rocks fiber content that is 50 to 85 percent soluble prebiotic. It may explain some of the longevity seen in Japan, where it's regularly consumed. I'll talk more about seaweed in Chapter 8. It's a great addition to a *Fiber Fueled* diet.

Phytochemicals: Game changers beyond fiber

Each plant offers you a unique mix of nutrients: fiber, plant protein, carbohydrates, healthy fats, vitamins, minerals, and so on. We have talked a lot about fiber, but the benefits of phytochemicals shouldn't be overlooked. "Phyto-" is a prefix meaning "plant." Phytochemicals are exclusive nutrients that you'll only find in plant foods, and there are at least 8,000 of them, most of which we know very little about. Only about 150 of them have actually been studied. But what we keep finding, study after study, is that phytochemicals are good for us.

Let me give you an example. People say, "An apple a day keeps the doctor away." Could this old adage possibly be true? Recent studies emphatically say, "Yes!" No surprise, apples are a great source of fiber. A medium-size apple has 4.4 grams of fiber, about two-thirds insoluble and one-third soluble fiber. That's just the beginning. Apples also contain numerous phytochemicals. Quercetin-3-galactoside, quercetin-3-glucoside, quercetin-3-rhamnoside, catechin, epicatechin, procyanidin, cyanidin-3-galactoside, coumaric acid, chlorogenic

acid, gallic acid, and phloridzin—to name just a few. Each part of the apple has a different mix of phytochemicals, depending on whether you’re looking at the peel, the pulp, or even the core.

Each of these phytochemicals has unique healing properties. For example, quercetin protects against lung and colon cancer, coronary artery disease, type 2 diabetes, asthma, and liver damage. Catechins protect against lung cancer, coronary artery disease, stroke, and chronic obstructive pulmonary disease.

And did you know apples have probiotics? Put down the capsule and pick up an apple because a single apple may contain as many as one hundred million bacteria. Plants have a microbiome, too! Just like in humans, the microbes contribute greatly to the health and development of the apple from flower to fruit. The apple has tremendous diversity, with literally thousands of species. In fact, organically produced apples have not only more microbial diversity, but they also have a shift toward higher levels of microbes known to have a benefit on human health, such as the probiotic *Lactobacilli*. Scientists now believe that this exchange between the plant microbiome and the human gut microbiome may be of special importance for human health and a crucial source of microbes for our gut. It is yet another example of how we’re all a part of the circle of life, and everything in our universe is interconnected.

Not every apple is the same. We now see that each varietal has its own unique mix of health-promoting stuff. But in all cases the fiber, phytochemicals, and microbes contribute in some way to human health. This explains why apples have been found to reduce the risk of developing cancer, heart disease, asthma, and type 2 diabetes.

So should we all gorge ourselves on a bushel of apples daily? Absolutely not. This is just a window into the magic of fruits and vegetables. Apples are one fruit, and I share this case study with you to show you some of the amazing qualities you’ll find in apples. But every single fruit, vegetable, whole grain, legume, seed, and nut has its own unique blend of fiber, phytochemicals, and microbes worthy of a celebration.

Many of the colors that you see in plants are the result of their phytochemicals. So when you hear people saying, “Eat the rainbow,” this is the reason why. It’s top secret code for “Diversity of Plants.”

<i>BENEFITS OF EATING THE RAINBOW</i>			
COLOR	PLANT	PHYTOCHEMICALS	BENEFITS
Red	Tomatoes, watermelon	Lycopene	Provides antioxidants; protects against prostate cancer

Orange	Carrots, sweet potatoes, pumpkins	Beta-carotene	Supports healthy skin, immune system, and eyes
Yellow-orange	Oranges, lemons, peaches	Limonoids, flavonoids	Protects against cancer and heart disease
Green	Spinach, kale, collards	Chlorophyll, lutein	Protects against cancer; protects healthy eyes
Green-white	Broccoli, Brussels sprouts, cabbage, cauliflower	Indoles, isothiocyanates	Very strong cancer protection
White-green	Garlic, onions, chives, asparagus	Allyl sulfides	Lowers cholesterol and blood pressure, reduces risk of stomach cancer and heart disease
Blue	Blueberries, blackberries	Anthocyanins	Provides antioxidants, improves memory, protects against cancer
Purple	Purple grapes, plums	Resveratrol	Lowers cholesterol, protects against clots
Brown	Whole grains, legumes	Fiber!	Read Chapter 3!

It gets better. Two different plants can create a synergistic effect—it's like nature's version of a match made in heaven. For example:

- **Tomatoes and avocados in guacamole:** Tomatoes are rich in lycopene, which reduces cancer risk and cardiovascular disease. Healthy fats from avocados make the lycopene more bioavailable. Yay healthy fats!
- **A mixed fruit bowl:** A study out of Cornell University discovered that combinations of fruit resulted in greater antioxidant activity that was additive and synergistic. Based upon this, the authors recommended “that to improve their nutrition and health, consumers should be getting antioxidants from a diverse diet.”
- **Kale and lemon:** Kale is a plant-based source of iron, which is non-heme and less bioavailable. Heme iron comes from animal products, is more bioavailable, but also more inflammatory and has been associated with coronary artery disease, colon cancer, and type 2 diabetes. The vitamin C from a lemon cranks up iron

absorption and allows you to get what you need from a non-heart disease/colon cancer/diabetes-inducing source, meaning a plant.

- **Turmeric and black pepper:** The active ingredient in turmeric is curcumin, a potent anti-inflammatory that actually works great for people with joint pains. By sprinkling black pepper on your curry, you increase the bioavailability of curcumin by 2,000 percent.

Picture sitting down at every meal and eating food that you absolutely love. Your plate is full of color—bright greens and reds, soothing blues and purple, sunny yellow and orange. All the flavors are there—sweet, salty, bitter, sour, and umami (savory). The smells are simply divine, conjuring up memories of the best homemade meal you ever had, making your belly feel warm and your mouth start to water. There are tons of variation in texture, with crunch balanced against soft and chewy. And when you're done eating, you feel fantastic. No food hangover that requires a bolus of caffeine to compensate for it. You feel energized and light—your very best self. How liberating would it be for you to enjoy a meal like that without worrying about compliance with complex rules or food lists, to be driven instead by color and taste and texture.

This is the life I envision for you. It's vibrantly colorful. It's fun and fresh. It's effortlessly healthy. Plant-based diversity is the antithesis of categorical food restriction. There's been a trend toward deeper and deeper food restrictions out there, but it's not working because the true solution is radical abundance, not extreme deprivation. With that in mind, I want to walk you through the science behind some of the targets of dietary restriction and show you that we're better with these foods back in our lives.

The power of whole grains

Many of us have been led to believe that whole grains are inflammatory and that they are an unhealthy product of modern agriculture; this belief makes me cringe. We really shouldn't be lumping whole grains in with refined grains, like sugar. They're totally different. Whole grains are an excellent source of prebiotic fiber and definitely belong in a diet that's rich in plant-based diversity. If you're skeptical, allow me to share some of the research.

In a systematic review and meta-analysis of forty-five studies, increasing your daily whole-grain consumption by just two pieces of whole-grain bread

rewarded the participants with a reduced risk of coronary heart disease, cardiovascular disease, and total cancer as well as a lower likelihood of death from all causes, respiratory diseases, infectious diseases, diabetes, and all non-cardiovascular, non-cancer causes. Convinced yet?

I'll give you more: In a meta-analysis of the Nurses' Health Study and the Health Professionals Follow-Up Study they found that every daily serving of whole grains reduces your risk of death by 5 percent and your risk of death by cardiovascular cause by 9 percent.

- In another meta-analysis including nearly 250,000 people, those eating the most whole grains had a 14 percent lower risk of stroke than those eating the fewest.
- A 2011 meta-analysis of prospective studies found that there was a 20 percent reduction in the risk of colorectal cancer for every three servings of whole grains consumed per day, and the risk was even lower with higher intakes.
- Another meta-analysis, this time with fifteen studies and almost 120,000 people, found that eating three servings of whole grains daily was linked to lower body mass index and less belly fat.
- A systematic review and meta-analysis of sixteen cohort studies found that eating at least three servings of whole grains per day could lower your risk of diabetes by a third! There was no such benefit from eating refined grains, by the way. In fact, whole-grain bread, whole-grain cereals, wheat bran, and brown rice were all found to be protective on sub-analysis, while white rice actually increased risk.

I can't write a gut health book without showing you what happens to your microbes when you consume whole grains. In a randomized controlled trial, study subjects who substituted whole grains for refined grains saw growth of SCFA-producing bacteria *Lachnospira*, increased SCFA levels, and a decrease in pro-inflammatory *Enterobacteriaceae*. They also noted improvement in the immune system and no effect on gut inflammation. In other words, whole grains were good for the gut. You may recall from Chapter 2 that the long-term adherence to a Paleolithic diet made the gut microbiota less healthy, with more TMAO and fewer SCFAs, which the authors attributed to the elimination of whole grains from the diet.

How about inflammation? Do whole grains cause inflammation? In a randomized controlled crossover study, those consuming whole grains saw their measure of inflammation, the C-reactive protein, drop by 21 percent while those who eliminated whole grains saw theirs increase by 12 percent. In a ten-year study of dietary patterns, whole-grain consumption had the *strongest* anti-inflammatory effect of the thirty-seven food groups studied. The evidence is clear: Whole grains are anti-inflammatory.

When we discuss carbohydrates, let's separate destructive, refined grains from the health-promoting whole grains. Whole grains are a great source of the fiber that we read about in Chapter 3, empowering our microbes, and releasing SCFAs that protect us against obesity, heart disease, stroke, and type 2 diabetes. Whole grains aren't inflammatory; they're quite the opposite. If you want to villainize "carbs," do it to the refined grains and leave the microbiota-supporting, health-producing whole grains alone!

But what about gluten?

There has been so much talk about gluten in recent years, so let's get into it. Gluten is a protein found in three specific whole grains: wheat, barley, and rye. And, of course, it's in any products that include wheat, barley, and rye. Since most of us have never even seen raw wheat, it's fair to acknowledge that almost all gluten-containing foods *are* processed foods—bread, pasta, pizza, and cereal. And that, my friends, is one of the main reasons that people may feel better when they go gluten-free. The elimination of ultra-processed foods, including refined carbs, is something that I support 100 percent. But does it make sense to categorically eliminate *all* gluten-containing products, or are we throwing the baby out with the bathwater?

Gluten is a problem for people with celiac disease. They need to be completely gluten-free and there's no debate. But there's the perception by some that gluten is inflammatory, causes leaky gut and autoimmune disease, and that we should all be gluten-free. It's a growing trend that started with a bunch of test-tube studies and has snowballed to this place where a third of Americans are actively restricting gluten intake. If these test-tube studies are correct and gluten really does cause leaky gut, then we should see improvements in gut health with a gluten-free diet, right?

But we don't. We actually see the opposite. After healthy subjects without celiac spent a month on a gluten-free diet, counts of healthy bacteria like *F. prausnitzii*, *Lactobacillus*, and *Bifidobacterium* declined while evildoers *E. coli* and *Enterobacteriaceae* increased.

In a randomized, controlled crossover study, a “low gluten” diet reduced healthy *Bifidobacterium* and butyrate-producing *Anaerostipes hadrus* and *Eubacterium hallii*. I know you’re still wondering whether gluten causes inflammation, affects the immune system, even causes increased intestinal permeability. When researchers tested humans, they couldn’t find any evidence of inflammation, immune activation, or increased intestinal permeability connected to the consumption of gluten in this study. But there was a difference in immune reactivity in a test tube. As I’ve mentioned before, laboratory tests don’t always translate to human studies.

In another study, whole wheat increased healthy *Bifidobacterium* and produced metabolites that *improved* intestinal integrity and *reduced* intestinal permeability. Let me say that again—whole wheat *improved* intestinal integrity and *reduced* intestinal permeability (or leaky gut).

What we’re seeing here is the difference between laboratory and human research. In the lab, you may extract the molecule of interest then study it in isolation, often in a concentrated form in a test tube. Clearly, this is quite different from when a human being actually eats a gluten-containing food in real life. For me, I take those laboratory studies with a major grain of salt and have more trust in the human studies that show us what happens in a natural setting. As you’ve seen, when healthy people eat wheat or other gluten-containing foods, we find that their gut actually appears more healthy. We’ve also seen that a gluten-free or restricted diet appears to diminish the SCFA-producing microbes and to enhance the inflammatory ones.

There’s more fallout from going gluten-free. A “low-gluten” diet causes loss of the genes for carbohydrate metabolism. Back in Chapter 3 we mentioned that we humans only have seventeen glycoside hydrolases, our digestive enzymes for complex carbohydrates. Meanwhile, our gut microbes may have sixty thousand or more of these enzymes. By depriving ourselves of gluten, we actually lose part of that carbohydrate-processing mechanism. So now the gut is weaker and less adapted to processing and unpacking complex carbs; as a result, when you try to reintroduce complex carbs in the future, you struggle. Hello, food sensitivity!

And last but not least, when we eliminate gluten from our diet, the big question is what do we replace it with? We’ve already discussed the importance of whole grains, and gluten-containing foods are the principal source of whole grains in the American diet. In a prospective cohort study of 6,500 people over 2,273,931 person-years, they found that as people consumed more gluten, their risk of ischemic heart disease *decreased*, which they attributed to the whole grains in gluten-containing foods. In other words, if you cut gluten out, you are

increasing your risk of ischemic heart disease, our number one killer. It's worth noting that this is the complete opposite of people who have celiac disease, where the consumption of gluten sets off an inflammatory cascade that may increase their risk of heart disease.

I'll admit, gluten is not a simple topic. That's why you need someone like me, who is qualified and has thoroughly reviewed the science, to give you insights on the right choice for you. In Chapter 5 I will walk you through my gluten protocol to determine whether or not you should continue to consume gluten. Here's a preview: Most of you should! But by no means am I advocating that you make gluten the centerpiece of your diet. I am advocating, however, for plant-based diversity, and to not exclude health-promoting foods from your diet because when you narrow the spectrum of plants in your diet, you also narrow the diversity of your microbiome. And this is true even with wheat.

Legumes: Small in stature, huge on gut-healing fiber!

The average American eats just 6.3 pounds of beans per year. That's down by 20 percent compared to fifty years ago. And yet some argue that legumes are the cause of every modern epidemic, which couldn't be further from the truth. Legumes are jam-packed with fiber. A cup of green peas, for example, has 7 grams of fiber. A cup of lentils? A whopping 16 grams. Pinto beans have 30 grams of fiber per cup.

It's true that the flip side of all that fiber is that consuming an excessive amount of beans can be hard to tolerate for some. But the benefits of legumes can't be argued. Excess weight melts away when you eat a diet high in legumes. Your waist gets smaller. Your blood pressure and cholesterol drop to the point of tapering your drug. Your blood sugar balances and the diabetes disappears. And your risk for having a heart attack or developing colon cancer just got chopped in half.

There are literally hundreds of studies to support beans. Let me share just one example. In a randomized, controlled trial of a legume-packed diet versus legume-free, the researchers held the number of calories constant so that it was about nutrients and not calories. What they saw in the legume group was shocking. The C-reactive protein, a marker of inflammation, dropped by 40 percent. Blood pressure and cholesterol both dropped. But what was most fascinating is that the legume group lost more weight even though they ate the same number of calories. You may recall from Chapter 1 when we discussed that your gut microbiome plays a huge role in weight control, and that it's more than

just calories in—calories out.

Should you be eating soy?

There's been some debate about soy due to the perception of its carrying estrogen, but I want you to understand that phytoestrogens aren't estrogen, nor do they act like human estrogen. Instead, phytoestrogens are isoflavones, one of the unique phytochemicals in soy beans. There are actually three soy isoflavones: genistein, daidzein, and glycitein. They have a number of health benefits, including: lowering cholesterol, strengthening bones, treating menopausal symptoms, lowering risk of coronary heart disease, and reducing risk of prostate/colon/breast/ovarian cancers.

Want even more good news about soy? There are certain gut bacteria that can convert soy isoflavones into an even more beneficial compound called equol. This is like a supercharged isoflavone, giving you even more cardiovascular, bone, and menopausal health benefits. Unfortunately, you need to have the bacteria in order to do this. Equol can be produced by 50 to 60 percent of Asian people but just 30 percent of Westerners. For what it's worth, diets high in carbohydrates (really meaning fiber) and low in saturated fat are associated with equol production, while antibiotics appear to hinder it.

I recommend consuming only non-GMO and organic soy in its whole-foods forms: edamame, tofu, miso, tempeh, tamari, and unsweetened soy milk. Model your soy consumption after the way they do it in Asia. For some delicious ways to consume soy, check out the recipes in Chapter 10.

So how about the effect of legumes on the gut microbiota? In a mouse model, both navy beans and black beans increased numbers of beneficial SCFA-producing bacteria with coinciding increased SCFA production, promoted colonic barrier integrity, and reduced bacterial endotoxin levels.

In a randomized crossover study, chickpea consumption for three weeks in addition to their regular diet led to increased growth of SCFA-producing bacteria (*Faecalibacterium prausnitzii*) and decreased growth of the pathogenic and putrefactive bacteria (*Clostridium histolyticum* and *C. lituseburens*). The authors concluded that chickpeas “have the potential to modulate the intestinal microbial composition to promote intestinal health in humans.”

Pea protein has been shown to stimulate the growth of the health-promoting bacteria *Lactobacilli* and *Bifidobacteria*. There was a corresponding shift in the bacterial metabolites with increased levels of the short-chain fatty acids (SCFAs). The authors concluded, “Such changes in microbial composition may beneficially impact the intestinal environment and exert a health-promoting effect in humans.”

Fascinating, right? So when you take all of this together it comes as no surprise that in a major study of food-intake patterns from around the world

there was one—and only one—food shown to make people live longer . . .
LEGUMES!

What about lectins?

What are lectins? Well, lectins aren't just one thing; they're actually a large family of protein compounds found in nature that are known because they bind carbohydrates. They're ubiquitous in nature—humans, animals, plants, fungi, and microorganisms all have them. You'll find varying amount of lectins in different foods. Some foods that contain higher amounts of lectins include cow's milk, eggs, beans, peanuts, lentils, tomatoes, potatoes, eggplant, fruits, wheat, and other grains.

In recent years there's been a growing perception that lectins are inflammatory; specifically, that they damage the lining of your gut and over-activate your immune system—and as a result, the thinking goes, lectins may be contributing to our twenty-first-century epidemics. According to this line of argument, the way to counter this is to reduce or eliminate all grains (including pseudo-grains), beans and legumes, nuts, fruits, and many vegetables—massive, in some cases categorical, elimination. But is it justified?

The idea that lectins may cause disease isn't very novel. It has floated around in fringe medical literature for decades based on test-tube and animal-model studies mostly from the 1970s and 1980s. If you only present those studies, lectins can sound very scary.

But there's a reason that well-respected journals and the world's leading doctors and nutritionists aren't cringing in fear from lectins or shying away from beans and grains. First, there's the other side of the story, which is that lectins from wheat, fava beans, soybeans, mushrooms, bananas, buckwheat, and jackfruit have all been implicated as protective against cancer. But more important, experts know that test-tube and animal studies often don't translate well into real life. Similar to our studies on gluten, we need to confirm the findings in human populations. Otherwise we run the risk of finding some pretty quacky things that mislead us and in some cases can harm us.

So what do we find when we study legumes and whole grains in human populations? Well, you already know. Weight loss. Lower blood pressure and lower cholesterol. Reversal of insulin resistance. Less inflammation. A shift in the microbiome to produce more SCFAs. Protection from cardiovascular disease and cancer. Longer life expectancy. Study after study has shown us that legumes and whole grains are absolutely vital to your health and your gut's health. They're a powerful source of fiber and their unique qualities make them irreplaceable if you eliminate them. Remember: What's the single greatest predictor of a healthy gut microbiome? The diversity of plants in your diet.

Let's talk about legumes and grains *together* for a minute. Did you know that when you combine beans with a whole grain, you create a complete protein package, ramp up the fiber, and get your protein from a low-calorie, high-nutrient plant source? Remember, the source of our protein matters, and when you replace animal protein with plant sources you find that people are healthier and live longer. Consider that Costa Rica outperforms the United States in life expectancy on a diet centered around beans and rice while spending a mere

fraction on health care. They're not the only ones! Legumes and whole grains are celebrated in the diets of all five Blue Zones. These are longevity foods, and they are the foundation of gut health.

It all comes back to the Golden Rule—Diversity of Plants!

Would you agree that a healthy diet is one that maximizes nutrients in terms of achieving optimal amounts for bodily function? This is the concept of “nutrient density,” meaning that we want as many nutrients as possible per calorie that we consume. But nutrient density alone just isn't enough to describe an ideal diet. What if you ate kale, and kale only, all day long, and nothing else. Would you be healthy?

Absolutely not. Kale is a superfood, but if it's the only thing you ate you'd be redundantly and excessively loading up on the nutrients that kale provides but missing out on the nutrients, fiber variety, and microbes you'd get from other plants. For example, if you consumed 2,000 calories of kale per day you'd get 30 times more copper, 80 times more vitamin A, 80 times more vitamin C, and 360 times more vitamin K than you actually need. Hopefully you just urinate it out, but there comes a point for anything in life where too much of a good thing can actually be harmful. Meanwhile you'd be sorely missing the lycopene that you find in tomatoes, the selenium you find in Brazil nuts, and the vitamin B₅ from avocados. Eventually those nutrient deficiencies set in. You'd get nearly 150 grams of fiber per day, but it would all be of the same type. No diversity of plants to provide diversity of fiber to a diversity of microbes. You would miss out on all the other species you'd find in the microbiota of other plant foods.

We have a tendency in our culture to obsess over superfoods. Like the celebrities of food, we put them on a pedestal and celebrate their elite nutrient density and special properties. I'm going to give you some of my favorites in Chapter 8, and they're foods that are dear to my heart. But if you ate *only* the foods in Chapter 8, your diet wouldn't be as healthy as the person who's just really good at maximizing plant-based diversity in their diet. In my program, I focus on maximizing plant-based diversity first, and then incorporate superfoods.

To recap:

Every time you go to the supermarket: Think *Diversity of Plants!*

Every time you're cooking a meal: *Diversity of Plants!*

When you sit down at the dinner table and start loading up your plate:
Diversity of Plants!

As a medical doctor, I know when someone is actively dying, even if they're still alive. You see how one organ affects the other. When one fails, it drags down another, setting off a chain reaction that leads to multi-organ failure and ultimate demise. What if we could do the opposite of this, and simultaneously lift all organs up at once? With a plant-centered diet, you're not just fixing one problem, you are fixing *all of them* and optimizing the health of your organs in the process. Not just treating disease, not just avoiding disease, but actually optimizing your body and making it better. Becoming your best self.

Eating a diet fully enriched with all the colors, flavors, and nutrients nature has to offer is all you need. Remember the Golden Rule that will never change:

Diversity of Plants, Diversity of Plants, Diversity of Plants.

To view the 45+ scientific references cited in this chapter, please visit me online at www.theplantfedgut.com/research/.

Finding Your Plant Passion with a Sensitive Gut

Your custom plan to ease bloating, gas, cramps, and altered bowels

I suspect that many of you are thinking right now, *How am I going to do this? I feel horrible when I eat those foods. What if my body hates fiber?* Statistically that's 15 to 20 percent of people, but since you're reading this book, there's a decent chance you have irritable bowel. Fifty to 80 percent of people with IBS have food sensitivities. But you are the person who needs this book the most. That's the great irony. The people who need fiber the most are the ones who will also struggle the most to eat it. You have to fix the gut to reap the reward of better health. And to fix the gut, we know we need fiber and diversity of plants.

So what does it say that you struggle to process fiber or certain types of plants? Well, it indicates that your gut has been damaged. Of course people with digestive disorders are going to struggle more with these foods. But it's not just them. This may also be true for people with allergic and immune system disorders. Or migraines, anxiety, or depression, or, frankly, any of the litany of conditions that we learned is associated with dysbiosis in Chapter 1. Where there's dysbiosis you'll also find food sensitivities. If that's you, then I want to help you the most because then we are correcting the root cause of your problem *and* helping you enjoy your food again.

That doesn't mean it's going to be easy. You've been searching for solutions to your problem and the solution that's been offered to you for the last fifteen years has been, "Well just get rid of it." And when you do this, you may feel

better in the short term. But are you better in the long term? Generally not. Elimination, particularly categorical elimination, is short-term gain and long-term pain.

It's clear that the Golden Rule is in direct conflict with the idea of eliminating entire plant categories. We learned in Chapter 4 that when you eliminate plant categories you deprive yourself of the health benefits and alter the balance of bacteria in your gut to favor dysbiosis.

So why do people do it? Why do people eliminate beans, grains, and nightshades?

Part of the reason is that many of these foods bring out the worst in their gut—gas, bloating, cramping pain, and weird noises. I'm sure you've seen the photos on the internet that show a protuberant, pregnancy-like belly and a flat belly from the exact same day. I can't tell you how many patients have brought these photos to my office as evidence of a problem. They're not as helpful as the poop selfies, but I understand that you want to show that something is wrong.

The thing is that these symptoms of digestive distress have been, unfortunately, misinterpreted. I see a lot of people on the Internet, even some medical doctors, claiming that bloating and gas brought on by plant foods means that they're inflammatory. But as we discussed in Chapter 4, these foods have repeatedly proven to be the opposite—*anti-inflammatory*. I've also taken care of plenty of patients who think that because they have these symptoms it means they're incapable of eating these foods, and therefore it makes sense to acknowledge the problem, eliminate the triggers, and move on.

But think of it this way: If you have arthritis in your knee, does that mean you should buy a motorized scooter and stop walking? Sure, if you quit walking, you'll never feel that discomfort in your knee again, right? But then your exercise falls off, your legs atrophy, you gain weight, then end up on multiple medications to control your blood pressure/cholesterol/diabetes, and you feel depressed and weak. But hey, your knee doesn't hurt! Is that worth it?

If, instead, you put in the effort and decide, *I'm going to walk, do some physical therapy, exercise my leg and knee*, then you'll actually be able to lessen the pain and at the same time maintain health throughout your body. For the person with arthritis, it's painful in the beginning to start healing through exercise and therapy. But weathering that initial discomfort, the reward is a stronger knee, increased functional capacity, and better health that extends beyond the knee. The same is true with food sensitivities—if you accept that while it may not be easy in the short term, it's so much better in the long term, we can work through the short-term effects together. The point is that there will be unintended consequences when we allow unhealthy lifestyle habits to form.

But there's also the flip side, which are the unintended benefits that come when we choose health and opt for plant-based diversity.

In the coming pages I'll break down the science behind why people develop food sensitivities and lay out our plan to address them. If you take it slow and take your time adding in plant-based foods, you'll reach the long-term reward for short-term discomfort: a stronger gut, broader plant-based diversity, and better health that extends beyond the belly.

Share the Message

There are so many other people who need to hear the message of plant-based diversity for gut health. I mean, I wish I could go back to the younger version of myself and slap this book across my head. Softcover version, of course. I wouldn't have wasted all those years feeling miserable. So what I'm saying is that you, too, can be a transformative power for positive change. This book is nothing if it sits on the shelf. NOTHING. But this is something really powerful in the hands of a reader, and if you've felt that power, share it with others. Discuss it, recommend it, share your copy, gift it, send them to the library, post your favorite piece of knowledge to social media. We all can do our part to promote consciousness in our food choices and help people heal. Just think of what you've accomplished by getting one person to read this book and transform their health! We can all be instruments of change for a better world.

Why do we get food sensitivities? Why not with meat?

It's your gut microbiota! When you curse the heavens as you watch your friend scarf down unlimited quantities of that six-bean chili while you try to maintain a straight face and not show the discomfort you're experiencing, just know . . . it's not you. It's your bugs. Yes, you are 99.9 percent genetically the same as that person sitting across from you. But your gut microbiome is a totally different story, completely uniquely yours. It's just as personal as your fingerprint. There is literally no one on the planet with a gut microbiome exactly like yours. If you had an identical twin, you'd most closely resemble your twin followed by your mother, yet still be entirely distinct.

Your unique gut microbiome has strengths and weaknesses that are uniquely yours. It may be really good at processing beans but really struggle with garlic and onions. In a perfect world, if your diet perfectly complemented the strengths and weaknesses of your gut, then you wouldn't have any food sensitivity at all. None.

Since your diet and your microbiome are completely intertwined, your diet needs to be just as personal to you as your microbiome is. You need to use some trial and error to discover your custom, ideal diet. Now it may seem contradictory to say “There’s no one size fits all” immediately after defining “one Golden Rule for better health.” But it’s rather simple: You follow the Golden Rule of maximizing diversity of plants with every meal, but recognize that how that looks for you is going to be different from the person sitting next to you who is eating from the same selection of foods.

The goal is to hit that sweet spot where your dietary choices are perfectly matched to the strengths and weaknesses of your gut, and then magic ensues. No digestive distress, maximum plants, healing gut and body. We’re going to help you identify some of the strengths and weaknesses in your gut so that we can get started fine-tuning, not by eliminating foods but by going slow. We’re going to get you to that sweet spot.

The important thing to remember is that it’s not about perfection. And yes, there will be times when you’ll have gas, bloating, discomfort, or altered bowels. We all have that from time to time, myself included. But what we are going to do is optimize your gut and, in doing so, make those symptoms infrequent to the point that they no longer command your attention or affect your quality of life.

The way we accomplish this is by treating your gut like a muscle. Every time you sit down to eat it’s like your gut is going to the gym. Physical fitness is defined by health and well-being achieved through nutrition, exercise, and sufficient rest to optimize performance in some way, whether it’s sports or just activities of daily living. If our gut is a muscle, gut fitness means digestive health fueled by fiber and achieved by training your gut through plant-based diversity.

In the gym, if you always work out your biceps but never work out your triceps, you’re going to have some unbalanced, funny-looking arms. If you don’t work out a muscle group, it atrophies. If you don’t use it, you lose it, right? Same rules apply to the gut. If you eliminate a food group, your ability to consume that food dwindles.

What if you’ve been out of commission for a few months due to an injury? If you go to the gym and try to lift three hundred pounds on your first day, you’re going to hurt yourself. In the same regard, if you haven’t been eating beans and you scarf down a big bowl of the six-bean chili, you’re going to feel it because your body isn’t adapted or trained for what you’re doing.

So what’s the best approach in the gym? Work out every single muscle group, just enough to promote growth without injury, and often enough to keep them all maintained or growing. This is exactly the way we should handle our food. We need to work out our gut with every plant category, just enough without

overdoing it, and often enough to build our tolerance. Think of every single plant variety as working out a different muscle group. By emphasizing diversity of plants, you are giving your gut the dynamic workout that it's craving. So all plant groups need to be on the menu from time to time, not necessarily daily but often enough to maintain our gut fitness.

We all know the building block of muscle. It's the thing we're getting too much of yet still worry it's not enough—protein. But if we're treating the gut like a muscle, we should recognize the building block of that muscle—fiber. You can't build a healthy gut without fiber.

And here's what's cool: Just like with exercise, your gut will get stronger and become better adapted to what you're trying to do. That's a big takeaway from this book. Your gut is adaptable, and it will adjust to your choices.

Consider this example: Remember in Chapter 2 when we discussed the modern-day hunter-gatherer Hadza tribe of Tanzania? They consume more than 100 grams of fiber per day, about six hundred varieties of plants per year, and have 40 percent more gut diversity than the average American. It turns out that there's a seasonal variation to how they eat that causes a seasonal change in their microbiota. In the wet season, which lasts from November to April, they're more likely to forage for berries. During the dry season from May to October, they hunt animals. Meanwhile, year-round they consume tubers and a variety of plants to get 100 grams of fiber or more per day.

When researchers studied the microbiome of the Hazda, they saw that many species of bacteria disappear for a season and then reappear. And the functional ability of their microbiome alters as a result. Researchers found that foods eaten more regularly resulted in enrichment of the enzymes necessary to digest them. In the wet season when the Hadza consume more berries, they noticed enrichment of the enzymes needed to process a specific component of the berries called fructans. Sear that last sentence into your brain because we're going to come back to it in a moment.

Here's another example: Consider lactose, a short-chain carbohydrate (or sugar) found in dairy products. When I use the term "sugar" here, I don't mean table sugar or glucose, but rather I'm referring to a simple carbohydrate, as opposed to fiber or starch. In order for lactose to be processed we need the enzyme lactase. But 75 percent of the world's population are deficient in this enzyme, and therefore lactose intolerant. So three in four people have the potential for gas, bloating, digestive distress, and altered bowel habits if they consume dairy.

But can people make themselves *less* lactose intolerant? Is it possible to train the gut to handle lactose?

First of all, there is an amount of lactose that can be tolerated in these cases. If I take a medicine dropper and put two drops of cow's milk on someone's tongue, they're not going to have blow-out explosive diarrhea from that. No one is *that* lactose intolerant. So there's a threshold that needs to be crossed to trigger the symptoms.

Second, the gut adapts to regular exposure to lactose. For example, regular consumption of lactose over the course of ten days led to adaptation of colonic bacteria with more lactase activity, less digestive distress, and objectively far less production of gas. In another study, ten days of regular lactose consumption led to improved efficiency of lactose digestion and reduced gas production by threefold.

What does this all mean? First, there is a threshold of tolerance that exists and if we cross that threshold we get symptoms but if we stay within the bounds we should be feeling pretty good. Second, your gut adapts to what you give it. In other words, your gut can be trained to tolerate foods that you're sensitive to. Third, your gut needs to be fed in order to be trained. In other words, elimination diets will only heighten food sensitivities.

Got Milk?

For the record, you shouldn't. I am not advocating for training your gut to handle lactose. We learned about the effect of animal protein and saturated fat on the gut in Chapter 2—less SCFA-producing bacteria, more inflammatory bacteria, increased TMAO production, increased intestinal permeability, and increases in bacterial endotoxin. As we've done in the past, when we examine the whole food rather than a sum of its parts, we find that dairy products have been associated with prostate cancer and Parkinson's disease. Also the link to bone health turns out to be a myth—a prospective study of ninety-six thousand people over twenty-two years showed that milk consumption during teenage years did not protect against hip fracture later in life. In fact, men who drank more milk as a teenager actually had increased risk of hip fracture in the study. In a study of women in Sweden, high milk intake was associated with increased risk of bone fracture, heart disease, cancer, and premature death. One of the first things I do with my patients who have gas, bloating, or diarrhea is to eliminate dairy. You would not believe how many of them are cured just by doing this. Sorry, but milk doesn't do a body good. The irony is that lactose, which has been vilified through the years as evil, is probably the most redeeming thing about dairy because lactose is actually a prebiotic and can have a beneficial effect on the gut microbiota.

Let's take a step back for a moment. Remember in Chapter 3 when we discussed that we humans only have seventeen of the carbohydrate-processing enzymes called glycoside hydrolases? Meanwhile, our gut bacteria have been estimated to have as many as sixty thousand of these digestive enzymes! What

this means is we've outsourced carbohydrate processing. Why? Because it makes us adaptable to a variable diet and environment.

It also means that carbohydrate processing—including fiber—requires a healthy, properly adapted gut microbiome. When we damage the gut and reduce diversity, we also reduce the number and types of digestive enzymes in our gut. And that is the reason why there are so many people struggling to deal with carbs these days. We're not eating enough of them to train our gut, and then we're damaging our gut with the other aspects of our lifestyle—processed food, meat and dairy, antibiotics, medications, hypersterility, and sedentarism.

The irony is that we need complex carbohydrates in our diet . . . terribly. They're our prebiotic foods. That's how we *Fiber Fuel* our body and reap the healing benefits of SCFAs. So there is this vicious cycle where complex carbs cause digestive distress, which motivates us to reduce our intake or, worse yet, eliminate them, which weakens the microbiome and makes it less capable of processing carbs so that next time you try them your digestive distress is even worse. So then we label all carbs as being inflammatory and bad for us when in fact they're actually the solution. It's a common mistake that's been prescribed by numerous fad diets, and at best it's short-term gain with long-term loss.

A closer look at inflammatory foods in the gut

Studies keep showing that the complex carbohydrates you'll find in whole fruits, veggies, legumes, and whole grains are anything but inflammatory. They're actually anti-inflammatory. But we rely on our gut microbiome to process them, and if there's damage to the gut then it's also impaired in carbohydrate processing, which leads to digestive distress. That's not inflammation, that's just sloppy processing. It doesn't hurt you beyond the acute symptoms. But what does hurt you is the effect that you see from animal product consumption—less SCFA-producing good bacteria, more inflammatory bacteria, increased intestinal permeability, release of bacterial endotoxin, creation of carcinogenic secondary bile salts/polycyclic aromatic hydrocarbons/N-nitroso compounds/heterocyclic aromatic amines, and vascular disease-fueling TMAO. Yes, it is easier for our body to digest and process meat. We don't rely on our microbiome as much for that. So you may not feel any discomfort, but keep in mind what's happening inside you. Silent but deadly.

So how do we break this vicious cycle? It starts with a carb intervention. But let's address the hurdles we need to clear before we can begin the program.

Constipation?

First and foremost, if you're dealing with gas and bloating we absolutely need to

make sure there's no constipation. This is by far the number one cause of gas and bloating that I see in my clinic. It has its own vicious cycle—methane gas slows gut motility, causing constipation. Then, constipation increases the amount of gas we produce from our food. In other words, gas causes constipation, which causes more gas. I've found in my practice that if my patients maintain bowel regularity and correct the constipation, they feel so much better and the gas and bloating issues go away. But first you have to know whether or not constipation is present, and the truth is that it's more common than most people realize.

Even if you don't *feel* constipated, your ears should be perking up if you have a history of constipation, ever strain to poop, drop little nuggets or turds, or sometimes go a day without a movement. And here's the crazy thing . . . even if you have diarrhea, believe it or not you may be constipated. The most severe constipation presents with diarrhea. Basically what happens is you have a column of impacted stool stuck somewhere in your colon, and the solid stuff piles up behind the "log jam" but the liquid can still sneak through the cracks and crevices to come down to the bottom and come out loose. It's very confusing to both the doctor and the patient because severe constipation is manifesting with loose bowel movements. We call this overflow diarrhea, and the treatment is actually to purge the colon to relieve the blockage. So if there's any change in your bowel habits or a possibility of constipation, you should ask your primary care doctor to check an abdominal x-ray to rule out constipation or (under the guidance of your doctor) drink a bottle of magnesium citrate to initiate a colon purge and essentially have a fresh start.

You absolutely will not have success on a plant-based diet if you are trying to ramp up fiber consumption while being constipated. In my clinic, we don't even consider dietary changes until the constipation is corrected. I'd recommend consulting with your primary care doctor or a gastroenterologist locally to get the constipation under control before moving forward with a dietary overhaul.

Food sensitivity versus food allergy

The next thing we need to understand is whether you may be experiencing a food sensitivity or a food allergy. I hear a lot of people describing their gas and bloating as a food allergy. To me, this is more than just semantics. If you have a specific food that you're proven to be allergic to, then you actually do have a medical reason to eliminate that food. Although it is technically possible to build tolerance to a food allergy, it is a fragile, complex process that needs to be done under physician supervision. Most will just eliminate the food. Why? Because a food allergy is your immune system reacting when it's stimulated by that

particular food. The most common food allergies are to milk, fish, shellfish, eggs, nuts and peanuts, wheat, and soy. When people with an allergy eat these foods the immune system goes on the attack, launching IgE (Immunoglobulin E) antibodies like missiles to attack the allergen. This process releases chemicals that cause an allergic reaction, which can include itchiness, hives, swollen lips, a throat that closes up, trouble breathing, or even loss of consciousness. This is very different from a food sensitivity, where you may feel bloating, gas, diarrhea, abdominal discomfort, and fatigue. It's an important distinction because if you really do have a food allergy, then you absolutely should eliminate that food from your diet. But if it's a food sensitivity, then it's not your immune system reacting and you should be able to train your gut to be able to process it. If there's any question whatsoever, you need to work with your doctor to determine whether or not it's a food allergy. There's no one test that is adequately reliable to answer this question alone, and therefore you need the assistance of a qualified health professional.

Gluten

Let's deal with gluten for the last time. There are three major groups of people who should not be consuming gluten, and there are two groups who should be consuming gluten. Everyone falls into one of these five groups. For what it's worth, the latter two groups make up at least 90 percent of the American population. I'm going to describe each one and walk you through how you can determine whether or not you meet these criteria.

You should not consume gluten if you have:

CELIAC DISEASE—If you have celiac disease, you need to be 100 percent gluten-free for the rest of your life. Continued gluten consumption isn't just disruptive, it's dangerous and can lead to small bowel T-cell lymphoma, which is almost universally fatal. About 1 percent of Americans have celiac disease. Classic symptoms of celiac disease include diarrhea, bloating, gas, abdominal pain, and weight loss. Occasionally you'll find it in someone who is constipated. I also think of celiac anytime I see someone with low iron levels. The intestinal damage from celiac affects the small intestine, where iron is typically absorbed. If you have any of these symptoms or are worried that you may have celiac disease, there are two tests for you to consider that can definitively tell you whether or not you have celiac:

Genetic testing for HLA-DQ2 or DQ8: In order to have celiac you must meet three criteria—have the genes, consume gluten, and activate the gene through dysbiosis. In other words, it's impossible to have celiac disease if you don't have the gene. So you can have your blood analyzed for the celiac genes, and if they're not present, you don't have celiac. If you do have the gene, it doesn't necessarily mean you have or will ever have celiac disease. In fact, there's a 97 percent chance that you don't have celiac despite having the gene. But if you are genetically positive, it means that celiac is possible and therefore additional testing is necessary to determine whether or not it's present.

Upper endoscopy with biopsies of the small intestine: This is the gold standard test for determining whether or not celiac is present. Basically, you will need to see a gastroenterologist such as myself to be scheduled for this procedure. After you are sedated, a doctor will run a flexible tube the size of a pinkie (a cute pinkie! Not too big!) with a light and camera down into your stomach and small intestine. This allows biopsies to be taken from the small intestine—two from the first segment of the duodenum and four from the second segment. The entire procedure typically takes just five minutes. It's important for you to consume gluten in the days leading up to the procedure because that's the only way to tell if gluten is causing damage to the intestine. It is these biopsies that ultimately tell the story. A pathologist uses special criteria for evaluating for celiac disease called the Marsh classification to determine what damage, if any, is present. Marsh grade can be from I to IV, with IV being the most severe. Traditionally, grade III or IV disease is classified as celiac. But this is a spectrum, and in recent years there have been studies showing that Grades I and II are celiac, too. The reason I'm breaking this down for you is to tell you that blood tests for celiac disease are usually positive for Grade III or IV disease yet usually negative for Grade I or II. So the blood test can be negative and be wrong! Therefore, if you suspect you have celiac, you should skip the blood test and do either the genetic test or move forward with upper endoscopy with biopsies. The vast majority of celiac disease that I diagnose is Marsh I, and these

people do incredibly well when I put them on a gluten-free diet. But I would have missed them if I'd just done the traditional blood test.

WHEAT ALLERGY: This isn't necessarily a reaction to gluten, but it is a reaction to proteins found in wheat. Similar to other food allergies, the results are generally dramatic: hives, lip or throat swelling, difficulty breathing, or anaphylaxis. GI symptoms such as diarrhea and abdominal pain may also be present. Wheat allergy almost always develops in childhood, and affects 0.4 percent of American kids. It is extremely rare to develop wheat allergy as an adult unless you have occupational exposure, so bear that in mind. If you have wheat allergy, that would also be grounds to be completely wheat-free. Since it may not be gluten, it's possible that barley and rye can remain on your menu. Testing for a wheat allergy is not quite as straightforward and decisive as it is for celiac disease, so it's best to address this issue with a qualified health professional. That said, if you're having hives, lip or throat swelling, difficulty breathing, or anaphylaxis in relation to *any* food, I'd recommend you stop eating that food. Pretty straightforward.

NON-CELIAC GLUTEN SENSITIVITY WITH EXTRINTESTINAL SYMPTOMS: Okay, of the five categories that I'm going to describe, this is the one that we're working the hardest to figure out. The challenge is that we use one diagnosis to describe a whole bunch of different conditions, all of which are exceedingly rare. It's incredibly difficult to study a heterogeneous group of extremely rare conditions. They are even rarer than celiac disease. These conditions can occur outside the intestine, may be tied back to gluten, and may improve on a gluten-free diet. Specific symptoms I'm referring to are joint or muscle pain, leg or arm numbness, or neurologic symptoms like altered mental status, loss of balance or muscle control, or a rash. The classic rash is called dermatitis herpetiformis and is characterized by an itchy, vesicular rash symmetrically on the elbows, knees, butt, and trunk. Psoriasis can also be associated with celiac disease. If you or your doctor suspect celiac, it's absolutely imperative that you have celiac testing done. For example, 85 percent of adults with dermatitis herpetiformis actually have celiac. Similarly, antibodies to gluten are found in 85 percent of people with

gluten-related neurologic conditions, often in association with Marsh I histology on small intestine biopsies. If you definitively test negative for celiac disease yet wonder if gluten is causing your arthritis, leg or arm numbness, neurologic symptoms, or rash, then it would make sense to try a gluten-free diet for a few months to assess your response. If you improve, you can challenge yourself by reintroducing gluten and if symptoms come back, then you have your answer. Of course, this would be done under the guidance of a qualified health professional.

You should consume gluten if you are:

COMPLETELY SYMPTOM FREE: Let me keep this short and sweet. If you have absolutely no symptoms and absolutely no reason to suspect you have celiac disease or any of these conditions, you should *not* be on a gluten-free diet. As we discussed in Chapter 4, you are unintentionally damaging your gut and increasing your risk for other conditions like coronary artery disease. 'Nuff said!

NON-CELIAC GLUTEN SENSITIVITY WITH ONLY DIGESTIVE SYMPTOMS: If you suffer exclusively from digestive symptoms after ingestion of gluten-containing foods—bloating, gas, distension, abdominal pain, diarrhea, or constipation—then you absolutely need to have testing to rule out celiac disease. But if those tests prove decisively that you do not have it, then we need to regroup.

Recent research reveals that for many people, gluten may not be the real culprit. Consider a study in which researchers gave people with “gluten sensitivity” an oatmeal bar every day for a week. Concealed within the bar was one of three things: a placebo (sugar), gluten, or fructans. Fructans are short-chain carbohydrates that you’ll find in gluten-containing foods (wheat, barley, and rye). Every person was exposed to a different bar after taking a break for a week to let his or her system settle down. During each week they measured the average GI symptom scores for each person. Here’s what they found: Compared to placebo, the patients actually had *fewer* GI symptoms during the week that they were eating the gluten bar. Fewer symptoms! Let that register for a moment. Then when they ate the fructan bar they saw a big increase in digestive symptoms relative to both

the placebo and the gluten bar. In other words, most people who have non-celiac gluten sensitivity aren't even sensitive to gluten. They're sensitive to fructans. And their symptoms are being triggered because they have underlying dysbiosis with irritable bowel syndrome. So what are these fructans? We will cover them in the next section.

How to be gluten-free and still nurture your gut

So what's a sensible approach to gluten consumption? Well if you absolutely *need* to be gluten-free, then I would recommend paying special attention to your whole-grain intake. Since wheat is the dominant form of whole grain in the United States, you need to make sure that you're adequately supporting your gut microbiome. Thankfully, there are some delicious gluten-free whole grains available for you to routinely consume: quinoa, buckwheat, millet, sorghum, oats, and brown rice. Get them into your belly! On the flip side, if gluten is a part of your diet, which it should be for most of you, I'm not encouraging you to go eat more processed foods. Most gluten-containing foods are processed foods. What I encourage you to eat is more unprocessed or minimally processed wheat, barley, and rye. Look for whole-grain products, like whole-grain bread and pasta when they are called for. But remember not to overdo it. Moderation is just fine.

Let's talk about FODMAPs

Just a few pages ago we were chatting about how the gut microbiome has shown the ability to adapt to lactose exposure. We also talked about the Hadzas' seasonal variation in diet and how when they ate more berries they trained their microbiome to process fructans. Then we discovered that most people with GI symptoms from gluten don't actually have a problem with gluten, but likely have underlying irritable bowel syndrome being triggered by—here's that word again—fructans. So what are we referring to here? We're talking about FODMAPs. Perhaps you've heard this term dropped in conversation. FODMAPs are simple or short-chain carbohydrates found in our plant food. FODMAP is actually an acronym—fermentable oligosaccharides, disaccharides, monosaccharides, and polyols. You need to memorize that because I'm going to test you on it later. Just kidding—no, I'm not.

Anyway, these FODMAPs are foods that are, by definition, fermentable. They're also poorly absorbed, which means that they draw water into the intestine and can cause diarrhea. By escaping digestion, they reach the lower

intestine where the gut bacteria reside. These gut bacteria then feast on these carbs, in the process producing hydrogen gas along with potentially other by-products. We rely on our gut microbiota to work their magic and process these foods for us with their glycoside hydrolase enzymes. In people who have damage to their microbiota, such as those with irritable bowel syndrome, the loss of digestive capacity can lead to maldigestion, gas, bloating, discomfort, and diarrhea.

There are five categories of FODMAPs to be aware of. As you're reading this section, if you suffer from food sensitivity, consider the foods within a specific category. Do you have a sensitivity to more than one?

Lactose—A disaccharide found in dairy products like milk, ice cream, and some cheeses. For aforementioned reasons, I support the elimination of lactose from the diet. Many of you will see improvement in digestive symptoms with this simple move.

Fructose—A simple sugar found in many fruits (cherries, watermelon, apples), some veggies (asparagus, Jerusalem artichokes), high-fructose corn syrup, and honey.

Fructans—Oligosaccharides found in a variety of foods, including gluten-containing grains (wheat, barley, rye) as well as fruits and veggies (garlic, onions).

Galacto-oligosaccharides (GOS)—Complex sugars classically found in beans. *Toot toot!*

Polyols—Sugar alcohols like mannitol and sorbitol, often found in artificial sweeteners and some fruits and veggies.

Since FODMAPs can cause digestive symptoms, we should eliminate them, right? Not so fast, my friend! We need to be careful about vilifying these parts of our food when in fact they can be incredibly healthy for us. For example, fructans and galacto-oligosaccharides are prebiotics! As discussed in Chapter 3, this means that they are fuel to grow and energize the healthy bacteria in your gut and ultimately yield more postbiotic SCFAs.

Perhaps you've heard of the low FODMAP diet? The idea is that appropriate restriction of FODMAPs can reduce digestive distress in people with irritable bowel syndrome. And for some patients with irritable bowel syndrome this does work. The problem is that many people, doctors included, have misinterpreted these studies to mean that FODMAPs should be eliminated permanently. But

this cuts against the Golden Rule. Plant-based diversity is the greatest predictor of a healthy gut. And, again, FODMAPs are actually incredibly healthy and most of them are prebiotics.

So what happens if we permanently restrict FODMAPs? Their restriction, in the setting of the low FODMAP diet, may lead to harm of the beneficial bacteria and a drop in total bacterial count. So now we have fewer SCFA-producing bacteria and simultaneously are restricting prebiotics. This is a recipe for less postbiotic SCFAs. Not good.

Finally, the restrictive nature of the low FODMAP diet can lead to micronutrient deficiencies. In one study the low FODMAP diet led to significant declines in several important micronutrients: retinol, thiamin, riboflavin, and calcium. What this means is that if we want a healthy gut, then we actually need our fructans and galacto-oligosaccharides.

It's important to recognize that the low FODMAP diet, as developed at Monash University in Australia, was never meant to be a permanent elimination diet. Instead, it was meant to be a temporary FODMAP restriction for two to six weeks followed by a systematic reintroduction of the FODMAPs. The actual point of the diet is that our food sensitivities may vary among the categories of FODMAPs and that increased awareness of this can make us smart consumers. This is exactly how these FODMAP categories should be used: If you have difficulty in dealing with one particular category, then you know where the weakness in your gut lies and that you may need to go slow and easy on building up strength there. If you want a list of foods that fall into certain FODMAP categories, email me at fodmap@theplantfedgut.com and I'll send you what you need.

Bringing it back full circle now, we know that following the Golden Rule and maximizing plant-based diversity in our diet is the key to a healthier gut. It offers the prebiotic fiber and micronutrients in both balance and variety. This is fiber fuel for health. The result is a strong gut microbiota that's firing on all cylinders and optimizing health throughout our entire body.

But many of us are going to have difficulty in processing our plant carbohydrates, specifically fiber and FODMAPs. The reason for this is that we humans rely almost entirely on our gut microbiota to do this work for us, so if the gut is damaged, then the struggle is real!

It's incredibly important to understand that the plant foods we need the most to get our gut stronger are also the same foods that cause digestive distress in people with a damaged gut. Yes, it's frustrating. But it's the way it works, and we're about results so it's important to know the rules of the game. So how do we break this vicious cycle, get our guts back, and start enjoying more plant food

in our diet? We have to treat our gut like a muscle and train it. Think of Rocky, running through the streets of Philadelphia and up the steps of the Museum of Art. He didn't just wake up one morning and do that. It took time and effort to build up that level of fitness to propel him to the championship. That's what the Fiber Fueled 4 Weeks (see Chapter 10) is going to be for you. It's a structured four-week plan to start from scratch and build that gut.

Ultimately, the plan will help you understand the FODMAPs your gut is good with and which ones it needs help with. As we progressively introduce fiber and FODMAPs, it's important to start low and go slow. This may be the most important sentence in the chapter, so please sear this one into your brain. To properly train our gut, we need to start low and go slow with fiber and FODMAPs. Low and slow to grow—that's the motto. You feel me? That's the "Rocky" approach to building up your gut fitness. You can do this. And I'm here to help you.

To view the 25⁺ scientific references cited in this chapter, please visit me online at www.theplantfedgut.com/research/.

Fermentation Nation Rising

The benefits of fermented foods for gut health and where to start

Are you ready to unlock the full nutritional value of your food and take your plant-based diversity to a level that you didn't even know existed? Allow me to introduce you to one of my secret weapons—fermented foods.

I'm obsessed with fermented foods. They are really cool because they give our food a complete makeover on several levels. You start with something already delicious, sprinkle some fermentation magic (or science) on top, and the ingredient is transformed into a new healthy food.

At the crossroads of our gut microbiota and food lies fermentation. What happens inside a jar of fermenting sauerkraut is a microcosm of what's happening inside our guts. It's the same process and the same concept but it's happening before our eyes on our kitchen counters: millions of invisible microbes, working in a coordinated symphony right there in front of us. We can't see them, but we can see and taste the difference in their work. It's quite remarkable.

Every single culture in human history has fermented foods as a celebrated part of their food tradition. You have sauerkraut from Germany, kvass from Russia, kimchi from Korea, natto and miso from Japan, tempeh from Indonesia, and if you've ever had Ethiopian food you know that spongy tangy fermented bread called injera. Even sourdough bread, made by fermenting flour, has roots in the California and Klondike Gold Rush—that's what those guys in the mountains used to eat. If you study the food traditions of any culture, you will find fermentation at its heart. Sadly, we let go of our traditional foods in exchange for

hypersterile, chemical-laden convenience foods offered up by our food industry. But it's time to say, "Enough!" Today we can embrace fermented foods as the next frontier in our quest for plant-based diversity. A little fermented food every day goes a long way.

My introduction to fermented foods

As a kid, I never would have dreamed that fermented foods would be a future obsession. But the more I learned about SCFAs, gut microbiota, and the power of plants for gut health, the more curious I became about fermentation. So it was serendipity that one of my patients came in raving about how helpful sauerkraut and pickles had been for his digestive issues. That was it—I couldn't wait another day. I had to try it.

So I set out to make my first batch of sauerkraut. I found the recipe and the process to be so refreshingly basic. It's just water, salt, and cabbage. That's it. So simple. No need to add any starter culture—all the microbes you need are already part of the cabbage microbiome. But sinking my hands into the chopped cabbage and working on it to release some of the juices and soften it made me feel connected to the food. It was a living food.

I popped my mason jar of water, salt, and cabbage on the kitchen counter where it sat for weeks. Yes, weeks! My wife and I were a little bit scared of it, to be honest. It felt so weird to have food that's not in the fridge. How could this be okay to eat?

After a few weeks, we tried it. It was . . . very crunchy! I didn't expect that. It was tangy and acidic, too—and delicious. I took more bites. Many more. I was in fermented nirvana. It's been a daily part of my life ever since.

The bacterial artistry behind fermentation and healthy soil

Perhaps you haven't spent a lot of time thinking about food decomposition, but this is exactly what Louis Pasteur was thinking about when he discovered modern germ theory in the 1860s. By studying how wine is created from grapes and how milk spoils, he started to understand that microorganisms are at the heart of all of it. Understanding the process of food decomposition is an important part of assessing the nutritional value of our food.

These bacteria that are responsible for the decomposition of our perishable items—aren't they a bad thing? Certainly they frustrate and enrage us when we miss that precious small window of avocado perfection, or when we find some

lettuce we forgot in the back of our fridge that now seems like some sort of nightmare science experiment. So, yes, when our food becomes inedible it's kind of a drag, but really that's nature saying, "Hey, you had your chance to eat this food, now I'm taking it back."

It doesn't just take it back, though—when we compost our food, we're actually empowering nature to do its thing and recycle it: Similar to digestion, the microbes work in teams and use varied enzymes to break down and transform our food. Allowing the natural life cycle of dead plant matter to unfold produces humic substances—humic acids, fulvic acids, and humin. These humic substances form the basis of healthy soil, and healthy soil grows healthy plants, which feed our microbiota to help us be healthy humans. It's a beautiful part of the circle of life.

Soil health is vastly underrated and something we should take very seriously for the health of both ourselves and our planet. Bottom line: Your food is only as healthy as your soil, which means that you are only as healthy as your soil. We desperately need microbe- and humic-enriched soil. But yes, along that path of transformation to humus what starts as food does eventually become inedible. We don't need to fear this; we simply need to accept that the life cycle of our food has passed the window of human nutrition and is now moving toward soil nutrition.

But here's where the magic comes in: Microbes cause degradation, but when you tweak those microbes you can transform the process dramatically. That's fermentation in a nutshell. Instead of allowing a food to decompose and break down, you introduce a different band of bacteria that will actually prolong the life of the food and alter it. We do this with the bacteria that naturally live on the plant. They're already there as a part of the plant's microbiome; all you have to do is create the right conditions to be successful.

Let's take sauerkraut as an example. The first thing that happens when you make sauerkraut by fermenting cabbage is that anaerobic bacteria begin producing healthy acids to drop the pH of the solution. Anaerobic means they thrive where there is no oxygen, so by putting the cabbage underwater you're creating the proper conditions for anaerobes to grow. As this happens, the acid levels become too high for many bacteria, allowing *Leuconostoc mesenteroides* to take over within twenty-four hours, producing more healthy acids to drop the pH even further. If you're making sauerkraut at home, you'll know *Leuconostoc* is present when you start seeing the bubbles form. Over the following week, the environment becomes increasingly acidic, which leads to the growth of *Lactobacillus plantarum*, the primary bacteria responsible for transforming saltwater cabbage into kraut.

Back in Chapter 3 we discussed how SCFAs (short-chain fatty acids) actually reduce the pH in the colon, which inhibits pathogenic bacteria and promotes the growth of SCFA-producing commensal bacteria. You can apply that same concept here to our ferment—the drop in pH inhibits pathogenic as well as decomposing species and promotes the growth of the right species responsible for fermentation. This is the first example of how the process in a mason jar can mimic what’s happening in our gut. Isn’t it amazing that by altering the blend of bacteria, we can actually inhibit food spoilage and prolong the life of our food?

How microbes clean up our mess and don’t even get a “thank you”

As a demonstration of the cleansing, restoring power of microbes in nature, consider the Deepwater Horizon oil spill in 2010. This oil spill dumped an estimated 4.2 million barrels of oil in the Gulf of Mexico. Folks, that’s more than a billion venti Starbucks filled with oil and dumped into the ocean. To me, dumping even one venti Starbucks’ worth of oil would be a disgrace. It was an environmental catastrophe, causing widespread harm to marine life and its ecosystems from the ocean floor to the surface, extending from deep water to the coastal tidal marshes. It was the largest offshore oil spill in U.S. history, and frankly it was disgusting. But we’re not seeing oil in the Gulf water or beaches anymore. So how did the ocean heal itself?

A group of researchers from the Lawrence Berkeley National Laboratory recently showed that bacterial species survived within the oil plumes and together in cooperative fashion, these bacteria took up the challenge of degrading 4.2 million barrels. The study discovered that it was the right bacteria working at the right time in a cooperative fashion to clean the ocean. Personally, I think we need to stop destroying this planet and hoping our friendly Earthly microbes will bail us out, but to witness the incredible healing power of these microbes in real time is amazing, isn’t it? This concept of bacteria functioning in teams with the right microbe stepping up at the right time is the same process you’ll find in fermentation, healthy soil production, and even carbohydrate digestion in your gut. Invisible microbes are everywhere, doing amazing things without us even recognizing them.

A brief history of fermentation and food preservation

Fermented foods are at the heart of our human origin story. Our ancestors had a major problem that they needed to overcome: They had no way of preserving food. It held back the growth of the tribe, required constant attention to food finding, and forced the nomadic lifestyle on them. There was no settling down. For human civilization to move forward—organized society, cities, an economy, all of it—we needed to leave the famine behind and find food security by stockpiling and delayed-return subsistence. Once again, the microbes came to

our rescue.

We don't know exactly when fermentation was discovered. Fourteen-thousand-year-old bread was recently found at a Natufian hunter-gatherer camp in Jordan. There's a cave in Israel where they found a wheat/barley-based beer mixture dating back thirteen thousand years. In Sweden there are ninety-two-hundred-year-old pits in the ground used to preserve large quantities of fish. In China researchers found a nine-thousand-year-old rice, honey, and fruit libation similar to rice wine. The bottom line is that fermentation started popping up in cultures around the world at a similar time, and appears to be one of the major developments contributing to the rise of human civilization.

For thousands of years this was one of our principle forms of food preservation and a celebrated part of our ancient traditions. But in the nineteenth and twentieth centuries we developed new approaches to food preservation: canning, pasteurization, numerous preservatives, refrigeration, and freezing. Our dependence on fermentation for preservation was marginalized and, particularly in a melting-pot nation such as the United States, food traditions that included fermented foods were lost. Did we make a major mistake by turning to new forms of food preservation? I'd say so.

All food preservation techniques work by altering the microbes. For example, canning works through sterilization. Food is heated to destroy the bacteria, then sealed in a vacuum-tight container. The sealed, sterile contents aren't exposed to microbes and their enzymes of food decomposition and therefore remain preserved until the can is opened. But is this completely benign? We previously learned that an apple has one hundred million microbes in its microbiome, many of which are known to be beneficial to humans. To sterilize is to destroy the plant microbiome and any health benefits that would come from it.

How about the thousands of chemical preservatives in our processed foods? Consider the turkey or ham that sits in a deli refrigerator for months on end, with a few slices taken off every once in a while. The bread that stays soft for weeks without hardening or molding. The crackers wrapped up in a box that are as fresh as the day they were manufactured. Since processed foods are part of our daily world, we don't spend enough time questioning them or considering how unnatural they are.

I think you know where I'm going here. To pasteurize is to transiently kill the microbes and sterilize our food. But most of our food today is on a whole new level—not just sterilized, but actually crossbred with chemical preservatives that are developed with the intention of inhibiting microbes and their food-processing enzymes.

Our Food and Drug Administration labels them as “benign” or “nontoxic” to

the consumer. I can't help but consider what these chemicals designed to retard microbes do when introduced to the dense population of microbes in our colon. In one study, sulfites damaged these four probiotic superstars: *Lactobacillus casei*, *L. plantarum*, *L. rhamnosus*, and *Streptococcus thermophilus*. Those were the only four tested, so we don't know what happens with the others. There's certainly room for more research to help us understand the best way to preserve our food without compromising our gut microbiota. In the meantime, I'll happily munch my organic fruits and veggies.

Unleash the full potential in your food

Food preservation doesn't always have to be about destroying the microbes. Fermentation is one of the rare examples of food processing that actually makes our food even *more* healthy. When you think of fermentation, think of transformation. The taste and appearance get a reboot. We're breeding new microbes, transforming fiber, and generating bioactive peptides and polyphenols. All parts of our food have the possibility of changing. It's absolutely fascinating stuff that the scientific community is just beginning to understand.

You've noticed that fermented foods are often sour to some degree? As we discussed with sauerkraut, fermentation causes the release of acids that lower the pH and alter the balance of bacteria. These acids often have health-promoting properties themselves beyond just altering the balance of bacteria. For example, lactic acid has been shown to reduce inflammation and have antioxidant properties in the gut. Therefore, if a fraction of the lactic acid found in a ferment makes it to the small intestine, benefits ensue. Studies have shown that vinegar, the product of fermentation of alcohol, can improve insulin sensitivity, improve fullness after meals to promote weight loss, and may lower blood pressure and cholesterol.

The acidic environment helps to grow the right microbes. Fermented foods with live active cultures can contain upward of a billion microorganisms per gram or milliliter of food. Compared to the hyper-sterilized diet in the Western world, the consumption of fermented foods could increase the number of microbes in the diet by up to 10,000 fold. In the study comparing five days on a plant-based versus animal-based diet, Drs. Lawrence David and Peter Turnbaugh were surprised to find that foodborne microbes survived transit and were metabolically active, suggesting that the microbes naturally occurring in and on our food really may provide benefit to humans.

But before these microbes begin their incredible journey through our

intestines, they first get to work on unpacking the hidden nutrition in our food. Working in teams, they use their enzymes like the tools of a mechanic. For example, *Lactobacillus* species have specific enzymes—glycoside hydrolases, esterases, decarboxylases, and phenolic acid reductases—to enhance conversion of health-promoting flavonoids in cherries and broccoli into biologically active metabolites. These are the same *Lactobacillus* species that grow in your gut when you consume prebiotic fiber. We talked before about how glycoside hydrolases are the enzymes used to break down fiber, and here you see them showing up in our fermented food, the point being that what the microbes do during fermentation mirrors what they do during digestion.

Microbial enzymes can be natural pharmaceuticals

Nattokinase is an enzyme produced when boiled soybeans are fermented to form natto, a traditional food in Japan. Natto has been used as a folk remedy for diseases of the heart and blood vessels for hundreds of years, and now we know why. Recent research has found that nattokinase has potent clot-busting, blood pressure-lowering, cholesterol-controlling, platelet-stunning, and plaque-stabilizing properties. Basically it's like taking aspirin, heparin, blood pressure pills, and a statin all in one. The perfect cardiac cocktail. It comes as no surprise that drug companies are trying to figure out how they can turn this into a pill. But I say, why don't we just eat natto?

These enzymes allow our microbes to create nutrition where it didn't previously exist. For example, these microbial magicians are able to synthesize vitamin K and B vitamins—folate, riboflavin, and B₁₂—from non-vitamin precursors. Melatonin and GABA are both synthesized, too. Melatonin is a powerful antioxidant that I've seen help people with acid reflux. GABA has a calming effect on the brain and helps regulate blood pressure.

Any part of the food can be transformed during fermentation. For example, the microbes create supercharged forms of fiber called exopolysaccharides. They've been shown to inhibit unhealthy microbes, regulate the immune system, squash inflammation, lower cholesterol, and even protect against cancer. If that sounds an awful lot like what prebiotic fiber and SCFAs were shown to do in Chapter 3, that's because that's exactly what's happening—prebiotic exopolysaccharides produced during fermentation are then fermented by intestinal microbiota to release postbiotic SCFAs. The point being, our gut thrives on diversity of fiber and, by creating exopolysaccharides, we are adding to that diversity to support our gut microbiome. Powerful stuff, folks.

We're only beginning to study fermented foods and the bioactive molecules the microbes create. The proteins, phytochemicals, and polyphenols in food may all undergo transformation during fermentation. Here are just a few examples of what we are learning:

- Fermentation of red ginseng increases the number of bioactive saponins and helps to control blood sugar.
- Twenty-five different antioxidant peptides have been found in different types of sourdough.
- Fermentation of soy milk with *Lactobacillus paracasei* or *L. plantarum* activates isoflavones to increase bone volume and thickness in the fight against osteoporosis.

Fermentation can also practice addition by subtraction, meaning that it can enhance the nutritive qualities in the food by reducing the anti-nutritional compounds. Specifically, fermentation is known to reduce gluten, phytic acid content, and FODMAPs. For this reason, people with IBS generally tolerate sourdough bread better than traditional wheat bread. Oh, and those vicious, life-threatening lectins you've been hearing about? Fermentation removes 95 percent of them.

Just like bacteria can help us clean up an oil spill, they can also help us biodegrade and reduce pesticide residues on our plants. You can probably predict what I'm about to say, because there's a theme that keeps reemerging in nature. Teams of microbes have hydrolytic enzymes that allow them to dismantle and deactivate the pesticides.

FAQ

So if fermented foods are so great, what's stopping us? Let me take a few of the concerns head on.

Is it safe to eat fermented foods?

As long as fermentation is properly done, fermented foods are absolutely safe. This isn't creating unhealthy, contaminated food, it is actually cleaning it up. People worry about getting a bad bug or gastroenteritis, yet there are literally no reported cases of food poisoning. The large outbreaks of *Salmonella* or *E. coli* you've heard about are related to contamination of raw vegetables. Understand

two things about these outbreaks: First, the process of fermentation would eliminate these pathogenic bacteria. Remember, that's why wine was added to water in ancient times. But second and even more important, these are the consequences of industrial animal agriculture. There is no great way to dispose of the feces, and ultimately the large ponds of stool run off when it rains.

What about botulism?

Botulism is a rare but very serious neurological disease caused by a bacteria called *Clostridium botulinum*. People often inappropriately associate it with fermentation because they know that botulism can be the result of food preservation gone wrong. But to be clear, botulism is associated with canning, not fermentation. *C. botulinum* can produce a spore that's resistant to high temperature, surviving the pasteurization step in canning and then thriving in the oxygen-deprived environment of the can.

On the flip side, fermentation intentionally avoids high heat (which would kill the bacteria, including the good ones) and instead allows those friendly microbes to produce acid, which destroys *C. botulinum*.

How will I know that I'm doing it properly and growing the right bacteria?

It's actually rather simple. Just use your senses and be smart and intuitive as you observe the process. Do you see something that looks like mold—fuzzy and round, potentially colored blue, black, or pink, generally on the surface of the ferment? Technically you can skim it off, but I tend to err on the side of just starting over. I also start over if there's anything that smells off or looks funny in the ferment. Point being, I play it safe.

Can fermented foods cause cancer?

If we're discussing all fermented foods, then yes, processed meat or fish have been associated with colorectal, nasopharyngeal, esophageal, lung, stomach, and pancreatic cancer. When it comes to fermented veggies, the main concern has been stomach cancer. Epidemiologic studies from East Asia have found an association between stomach cancer and pickled vegetable consumption. Stomach cancer is a huge problem in East Asia, where it is the second most common cancer. Most cases are the result of *Helicobacter pylori*, a carcinogenic bacteria that lives in the stomach of 60 to 70 percent of Japanese and Koreans. Still, only a fraction of colonized individuals develop stomach cancer. So where do fermented veggies fit in? It turns out that salt and its by-products actually accelerate the inflammation and cancer development in the stomach lining. Should we be concerned and avoid fermented veggies with salt? No. We should moderate our salt intake, which is a smart move from the get-go. We should also

recognize that these foods are consumed at every meal in East Asia, and that we're going to be consuming them at a fraction of the quantity. We also have a much lower prevalence of *H. pylori* in the United States, and most strains are not the one widely associated with cancer.

Two main points here: First, consuming anything to ridiculous excess is bad for you. We need oxygen to live, but pure oxygen is actually toxic. Second, let's all just take a deep breath, partially to just chill for a moment; partially to reinforce the point that oxygen is completely safe at a normal dose, even if we know it can be dangerous if you have too much of it, too. There can always be too much of a good thing.

Fermented favorites

Now that we've addressed some of the big themes in fermented foods, let me introduce you to some of the superstars of fermentation:

Sauerkraut

Where would you place cabbage on a list of the world's healthiest foods? Is it top ten? Even top five? We already know that cabbage is incredibly good for us—low in calories, high in nutrients like vitamin C, high in prebiotic fiber to support a healthy gut and unleash SCFAs throughout the body. Cabbage is a part of the cruciferous family, like broccoli, cauliflower, Brussels sprouts, and kale. That's an all-star list, in part because cruciferous veggies contain glucosinolates, which are potent cancer-fighting phytochemicals. The problem is that glucosinolates need to be converted into their active form as isothiocyanates in order to fight cancer. In 2002, a group of Finnish researchers showed that fermenting cabbage produces the enzymes necessary to unleash these isothiocyanates. It's a powerful example of fermentation amping up an already healthy food and taking it to another level.

Make your own sauerkraut!

It's fun, delicious, and healthy! Before you get started, let me just say that part of making fermented foods is experimenting and trying new things. Rather than searching the Internet for specific proportions, I'd really encourage you to pull an Emeril and just go **BAM** and throw some stuff in the mason jar and see what happens. It's more fun. Here's how you do it:

1. Lightly rinse your cabbage. Nothing aggressive that would kill the

- bacteria. Peel back the top two layers of leaves.
2. Chop the cabbage to your desired kraut thickness. I like it thick! Put your hands into the cabbage and work on it to break it up and soften. Feel that connection to the food.
 3. Pack into a 1-quart mason jar. Feel free to add garlic cloves, caraway seeds, or spices if you like. No recipes here! It's fun to experiment. I use a wooden sauerkraut pounder to pack it in. Fill the jar about 75 percent.
 4. Add a fermentation weight on top. There are glass fermentation weights available commercially. Some people clean a rock from their yard and others use a few cabbage leaves for packing. The key is to use something heavy enough to keep everything submerged.
 5. Make a sea salt brine by mixing 1 cup of water with roughly 1¼ teaspoons of sea salt. I honestly don't measure, I just go by taste. It should taste salty, but not so salty that you wouldn't take a sip of it. The water needs to be chlorine free, so either use distilled water, or boil water and let it return to room temperature. The salt needs to be iodine free, which is why I use sea salt.
 6. Pour the sea salt brine over the chopped cabbage and cover with the fermentation weight. You want to completely cover the cabbage and weight but still leave a little room at the top. I remove any bits and pieces of cabbage that float to the surface.
 7. Cover the mason jar, ideally with an airlock that allows it to vacuum seal and burp on its own. If you don't use a valve to allow gas to escape, you'll need to "burp" the kraut once a day to release pressure from the gas that builds up.
 8. Place in a cool location for 1 to 4 weeks to ferment. Ideal temperature is less than 70 degrees Fahrenheit. I usually start tasting after about a week and find that it gets better with age.
 9. If you notice a white, powdery yeast at the surface, that's kahm yeast. It's common, it's not mold, and it's not harmful to your health. Simply scoop it off the surface with a paper towel. If it's fuzzy looking, blue, or green, and looks like mold, that's because it is. Some people remove it and still eat the ferment. I personally toss the batch and start over.
 10. Two things that have a big effect on fermentation are the storage temperature and salinity of the brine. The cooler the temperature, the slower the ferment progresses, which is usually a good thing. Too fast and it can cause mold. In similar fashion, increased salinity also slows down the process and protects against mold.

If at any point you decide that you want to stop progression of the fermentation, just throw it in the fridge. It's like shouting "Freeze!" to the microbes. Fermentation pauses and the kraut is good for months stored there.

Kimchi

There's not much separating kimchi from sauerkraut; they're really just two celebrated expressions of fermented cabbage from cultures on opposite sides of the world. In the case of kimchi, it is often mixed with other vegetables such as onions, garlic, hot peppers, and radishes to generate a spicy fermented salad of sorts. Once again, microbes are the stars here, and in the process of transforming, kimchi rewards us with phytochemicals, healthy acids, volatile compounds, and free amino acids.

Kimchi is a celebrated tradition in Korea, and each region has its own unique spin on the dish. It's normal to have a small side of kimchi with nearly every meal, and the average Korean eats forty-eight pounds of it per year. Forty-eight pounds! Here are some of the proven benefits of kimchi:

- Gives rise to multiple probiotic strains of bacteria shown to survive stomach acid and provide health benefits in the colon.
- Lowers cholesterol.
- Promotes weight loss!
- Includes anti-inflammatory and potentially antiaging properties.
- Improves insulin sensitivity to prevent and reverse diabetes.
- Boosts multiple mechanisms by which it may protect us from cancer.

When it comes to eating kimchi, I love it for its spicy flavor but I'll readily admit it's not for everyone. My wife loves sauerkraut, but she'll never be a kimchi girl because she's not into spicy like I am. For me, I love kimchi as a condiment, or I like to throw it in a soup or rice bowl to add a unique flavor and extra spice. A little goes a long way.

Miso

I'm a *huge* miso fan! Miso is a paste made by fermenting soybeans with a fungus called *Aspergillus oryzae*. If you've never used it before, you have no clue what you're missing. It's both salty and savory at the same time, so it has a lot of umami. On a cold day it's so easy to just warm up some water and add a big scoop of miso to it for an impromptu miso soup. Even better if you have some fresh chives to cut on top and some seaweed to toss in. Miso offers:

- Protection from cancer. Miso may help prevent breast, colorectal, and liver cancer. This is actually a by-product of its soy content and the isoflavones, which are those scary “phytoestrogens” that some have vilified. It is important to set the record straight.
- And if you are worried about salt content and your blood pressure, fear not. Studies suggest miso *does not* raise blood pressure despite its salt content.
- Healthy bones! Calcium, vitamin K, and isoflavones all contribute to osteoporosis prevention.

Why drink an energy drink, another cup of coffee, or even tea when you could have a miso sipper for a healthy afternoon pick-me-up? You’ll find this as one of the things we do during the Fiber Fueled 4 Weeks (see Chapter 10), but you can start today if you like. Simply purchase fermented organic miso. You’ll find different colors—darker means stronger and saltier. White is sweeter, yellow has an earthy flavor, and red is bold with umami. I personally like red the most, but some recipes call for a gentler touch. Just add miso to warm water, stir until it dissolves into a beautiful broth, and drink! The key here is to add the miso when the water is lukewarm. If the water is scalding hot, then you’ll kill the live bacteria in the miso. But if you add it to warm but not scalding water, you’ll be good and still get the benefits.

Tempeh

Tempeh is another fermented soy product from Indonesia that has a nice, dense consistency and an earthy flavor. It’s fun to cook with tempeh because it tends to absorb the flavor of whatever spice or sauce that you throw at it. So what you have here is a versatile, delicious, and nutrient-dense food. The health benefits are the same as miso because tempeh is also made from fermented soybeans. It’s really the way that tempeh can be used that makes it unique because it’s a great source of protein that keeps its shape and can be steamed, pan-fried, blackened, or just crumbled raw over a salad or soup. It makes for great chili, stir-fries, sandwiches, stews, salads, and soups. One of my favorites is a tempeh Reuben, with nice dark rye bread, Thousand Island dressing, and some sauerkraut.

What about fermented dairy?

Why no love for kefir, yogurt, and other fermented dairy products? Let’s look more closely at

these foods. As we know, fermentation transforms our food and in many cases makes it easier to digest. This is particularly true with dairy products, where fermentation will remove most lactose. In fact, most hard cheeses, kefir, and yogurt are generally well tolerated by lactose-intolerant individuals. There are also some studies suggesting that kefir, yogurt, and other fermented dairy products may have health benefits. However, these studies were largely fraught with methodological limitations or were overtly paid for by the dairy industry.

So what are we supposed to make of corporate-sponsored research that is essentially a form of marketing and only being published because it makes the food look good and the conclusions are carefully guarded to protect the product? From my perspective, why take any risk when you can find delicious fermented nondairy yogurt and kefir? In particular, I love a coconut milk kefir that's available in Canada. No matter what you choose, make sure to pay attention to the sugar content, which is one of the big issues with all commercial products of this sort. Also, it should be noted that water kefir has absolutely nothing to do with milk and is much more similar to kombucha.

Sourdough bread

One of the things I love about sourdough bread is how simple it is to make. Just flour and water. Where's the yeast, you ask? It's true that baking bread generally requires baker's yeast, or *Saccharomyces cerevisiae*, for leavening. In the case of sourdough, you use a sourdough starter that contains a unique blend of wild yeast instead of the domesticated commercial yeast. Here's where it gets cool: You don't need to buy a starter if you don't want. Wild yeast is everywhere—in the air, in your flour, on the surface of grapes. So it's possible to use just water and flour to create your own starter, which will naturally be colonized by wild yeast to leaven your bread. But once you create a starter culture, you could use it pretty much forever. For example, the famous Boudin Bakery in San Francisco still uses the same yeast culture created by Isidore Boudin more than 170 years ago.

There are several other things I love about sourdough. First, it's delicious! I absolutely love that tangy flavor, soft bread, and flaky crust. Second, fermentation removes several of the antinutrients that some people worry about. For example, phytic acid is reduced by 62 percent. As we discussed earlier, sourdough also has less gluten and it's often better tolerated by those who are gluten intolerant. Finally, sourdough has a lower glycemic index compared to other types of bread, meaning that it causes less of a blood sugar spike and insulin response. I don't go out of my way to get more bread in my diet, but when I do eat bread I generally opt for sourdough. Rye and organic whole wheat can be great, too.

Kombucha

Kombucha is a fermented, lightly effervescent tea beverage that's all the rage. Sales are skyrocketing while people's health hopes are being hitched to this trendy beverage. I hate doing this, because I actually love kombucha, but we need to tone down our enthusiasm a little bit. Kombucha is not the lifesaving salve that people are hyping it up to be. And we shouldn't be guzzling it.

When you create kombucha, you start with old-fashioned sweet tea and introduce the right mix of bacteria and yeast. Those guys take over, consume the sugar, and transform the sweet tea into a tart, acidic beverage. In the process they construct a fibrous floating barrier at the surface called a SCOBY, standing for symbiotic culture of bacteria and yeast. It looks a little like a mushroom. I used to be scared of it. But then I started making my own kombucha, and have grown to adore and respect my SCOBY. People tend to hype up the "probiotics" in kombucha, but I actually love the other stuff—vitamins B₁, B₆, B₁₂, and C, antioxidant polyphenols, and healthy acids. Oh, and there's a little alcohol, but not enough that you'd drink kombucha for that reason although you should avoid it if you have a history of alcoholism.

While kombucha is a beverage that can be a part of a healthy diet, by itself it's not going to change your life. But nutrition is all about healthy substitutions. If you drop soda and replace it with a little kombucha, then you've done a good thing. And I absolutely love making my own kombucha at home and creating new flavors. I highly recommend it. You shouldn't drink more than 4 ounces in a day in my opinion, and I *always* dilute down my kombucha with water. It still has plenty of flavor but isn't quite so acidic. This helps alleviate one of the concerns of kombucha's acidity, which is that it can erode the enamel on your teeth.



I hope you see why fermented foods are an important part of the *Fiber Fueled* approach! Not only are they delicious but they're super-powered plant foods that have amazing healing abilities for your gut. If you don't eat many fermented foods now, have no fear. We're going to work them in nice and easy in my four-week plan. A little every day goes a long way. By the end you'll be in fermented nirvana, too.

To view the 45⁺ scientific references cited in this chapter, please visit me online at www.theplantfedgut.com/research/.

Prebiotics, Probiotics, and Postbiotics

Piecing together the “lesser biotics” to optimize your postbiotics (SCFAs)

I believe plants form the backbone of a healthy diet, and I wholeheartedly believe in the Golden Rule of maximizing plant-based diversity. Food comes first. Always.

But prebiotic and probiotic supplements can help accelerate the process of getting you *Fiber Fueled*, especially if digesting fiber is a challenge due to a damaged gut. The benefit of pre- and probiotic supplementation, particularly for anyone struggling with gut issues, is that we can augment the prebiotic fiber or healthy microbes in the gut in a targeted way without asking the gut to deal with anything else.

The healing effects can be profound and widespread. Pre- and probiotic supplements can improve our ability to process fiber and FODMAPs and also reduce the digestive distress that comes from dysbiosis and a damaged gut microbiome. Using our gut fitness analogy, it’s like working out your shoulders and feeling the effect of the shoulder workout when you bench-press. To properly train our gut, we need to start low and go slow with fiber and FODMAPs. Gut-health supplements can help. Let me show you.

The benefits of prebiotic supplements

Let’s dive straight in. If you struggle with gut issues—bloating, flatulence, and

so on—you might want to try a prebiotic supplement. Here are some of the positive outcomes we've seen in studies on prebiotic fiber supplementation:

- Growth of SCFA-producing gut microbes like *Bifidobacterium* and *Faecalibacterium prausnitzii*
- Reduced counts of unhealthy microbes such as *Bacteroides intestinalis*, *B. vulgatus*, and *Propionibacterium*
- Reduced bacterial endotoxin levels
- Reduced inflammatory markers like C-reactive protein, interleukin-6, or tumor necrosis factor
- Improvement in parameters of diabetes including lower postprandial blood sugar and insulin concentrations
- Lower total cholesterol
- Lower triglycerides
- Increased HDL cholesterol (the good cholesterol)
- Reduced fat mass
- Improved satiety with an increase in satiety hormones GLP-1 and peptide YY
- Improved absorption of calcium and magnesium

In a randomized, placebo-controlled trial of patients with IBS (both diarrhea and constipation variants included), researchers found that prebiotic galactooligosaccharides enhanced the growth of healthy gut bugs like *Bifidobacteria*, improved stool consistency to enhance bowel movement bliss, caused less flatulence and less bloating, and improved global symptoms of irritable bowel syndrome.

Now this is all well and good, but there's something interesting I found when I dug into the details of the study. They didn't just give people a single dose of a prebiotic and see what happened; they gave them one of two doses—low and high. What's interesting is that the lower dose of fiber actually produced more clinical improvement, meaning less bloating and less flatulence. How could this be? It comes back to our motto. When we're dealing with fiber and FODMAPs, low and slow is the way to grow. So when we introduce prebiotic supplements, more isn't necessarily better. Instead, let's start at a nice low dose and work our way up over time.

Choosing the right prebiotic for you

If you do decide to move forward with a prebiotic supplement, then the next question is “Which one?” We know from Chapter 3 that there are millions of types of fiber, and they’re all different. Likewise, there are different formulations of prebiotic supplements and it is difficult to know which one exactly is going to be the right choice for you. It’s about how that specific prebiotic interacts with the balance of gut microbes residing inside you.

With those thoughts in mind, here are a few favorites I use myself and with my patients:

- BETA GLUCANS: Found in oats, barley, wheat, and rye. Also found in seaweed and reishi, shiitake, and maitake mushrooms.
- PSYLLIUM: Comes from the outer coating, or “husk,” of the plantago plant’s seeds.
- PARTIALLY HYDROLYZED GUAR GUM: Derived from guar seed, a leguminous plant grown mainly in India and Pakistan.
- ACACIA POWDER: Made by grinding up acacia gum, a product of the acacia tree native to Africa. Can be taken in powder, capsule, or tablet form.
- WHEAT DEXTRIN: Most easily available. If you live in the United States you’ll find this in virtually every drugstore or supermarket as Benefiber. Technically wheat dextrin is separated from gluten, but since it is derived from wheat, I still have my patients with celiac or wheat allergy avoid this one.
- ISOMALTO-OLIGOSACCHARIDE (IMO): This is prebiotic fiber that’s been prepared by fermentation. For example, you’ll also find IMOs in miso, soy sauce, and honey. Makes it nice and gentle on the gut for the reasons we discussed in the previous chapter.

Each of these supplements is a natural prebiotic soluble fiber supplement derived from plants and offers some variety of health benefits commonly associated with prebiotics: promoting the growth of healthy gut microbes, release of postbiotic SCFAs, decrease in colon pH—inhibiting pathogenic bacteria, improvement of dysbiosis, correction of both diarrhea and constipation, lower cholesterol, blood sugar control, and protection against colorectal cancer. I’ve also found that these particular prebiotics are well tolerated relative to

others. By comparison, there's a commonly used prebiotic called inulin out there. I've tried it a few times and every time I have noticed a substantial increase in gas and flatulence. So it's not my favorite.

Is one of these clearly superior to the others? No, I wouldn't say that. I've tried all of them and have also used them in countless patients, and my experience has shown me that the fiber interacts with your unique, personal gut microbiota and so different people respond differently. The key is to experiment.

The way you add these into your diet is not complicated—it doesn't matter that much what time you take them unless you have diabetes or high cholesterol. In that case, you'll want to take them with meals. The more important thing is to take them consistently and to start slow and low and work your way up to tolerance. Start with one dosage a day to ease your body into it. I like to get my daily dose of prebiotics in my morning coffee. They are soluble fiber and so they dissolve in liquid easily. You honestly don't even know they're there.

The last thing is to remember that the one Golden Rule—plant-based diversity—applies to your prebiotics, too. I personally like to mix several different types of prebiotics into my week, so I can get the gut-building benefits of each. But in the very beginning, particularly if you have a damaged gut, you want to start low, go slow, and only do one fiber supplement at a time so you train up your gut with one type of fiber at a time.

Probiotics: Hype with a sprinkle of science

Let's look at our formula again for a moment:

$$\text{prebiotics} + \text{probiotics} = \text{postbiotics}$$

Okay, we've got prebiotics covered in our diet and supplements—check. We also get an increase in probiotic bacteria by fiber fueling our colon with plant-based diversity. Double check. But the million-dollar question is: Can we amp this healing up to an even higher level with a probiotic supplement?

So what exactly are probiotics? Well, they are live microorganisms—generally bacteria and/or yeast. But they're not just any old live microorganisms. By definition, probiotics are live microorganisms that, when administered in adequate amounts, you guessed it: “confer a health benefit on the host.” The theory with probiotics is that they mimic the effects of our intact microbiota. In other words, just like our healthy gut microbes, these probiotics should optimize our immune system, reduce inflammation, inhibit the growth of pathogenic

bacteria, correct leaky gut and restore gut barrier integrity, reestablish intestinal motility, and even improve mood. We've seen probiotics work this way in animal models, but do they translate to humans?

Right off the bat, let me say that the hype around probiotics is outpacing the science big time. Sadly, probiotics have gotten popular because of marketing and because they are what everyone wants—a new pill that's cutting edge, ideally natural, that will require zero effort and fix all your problems. But the truth is that you can't fix a bad diet with a probiotic. You can't go low carb, low fiber, and fix your gut with a probiotic. Returning to our formula: You can't get to postbiotics without prebiotics. And you can't optimize plant-based diversity by getting all of your fiber from a supplement. It just doesn't work that way. It's time to move past “biohacking” and realize that there are no shortcuts.

It's also important to know that probiotics don't stick. In other words, they generally don't colonize your gut permanently, mostly because you already have a community of bacteria in place and they're resistant to newcomers. You're not adding back new bacteria or ones you lost. If you stop taking the probiotic, then within two to five days it'll be like you never took it in the first place. So the effects of probiotics appear to occur as they transiently pass through the intestine. But along the way, they're working their magic, including helping to unleash SCFAs from our prebiotics. They do give our innate microbes a helping hand, but then they disappear.

Fermented foods vs. probiotics

What's the difference between fermented foods and probiotics? They both contain live bacteria, but beyond that they are very different. A probiotic is a highly concentrated version of a limited number of bacterial strains, usually delivered by a capsule of some sort. Fermented foods, on the other hand, are living foods that have a wider variety of microorganisms but in lower numbers. But with the fermented food you also get all the other good stuff—exopolysaccharide prebiotics, vitamins, healthy acids, bioactive peptides, and polyphenols—all of which are also providing benefit. Sometimes you need the concentrated focus of specific bacterial strains to give your gut a boost, and that's when you need a probiotic. Eating fermented foods regularly should be a part of your long-term plan to promote a healthy gut.

The science to support probiotics

It may sound like I don't believe in probiotics at all, but I recommend them in my clinic every day, often with great results. Without a doubt, some of you

reading this book would benefit from them. Let's jump into the science first; then I'll explain how to use probiotics effectively.

Probiotics often help with digestive symptoms and have been shown to improve abdominal pain, bloating, diarrhea, constipation, and other symptoms of irritable bowel syndrome. In inflammatory bowel disease, probiotics have shown benefit for patients with ulcerative colitis and pouchitis. So far there aren't any good studies of benefit in Crohn's disease.

Should you take probiotics after antibiotics? The answer may surprise you.

Probiotics are known to treat antibiotic-associated diarrhea in adults. They also protect against developing *Clostridioides difficile* infection. For years I was a believer that the best way to recover from antibiotic use was to take a probiotic for a few weeks. But a recent study has completely changed my mind. In it, researchers from Israel showed convincingly that probiotics actually impair the microbiota's ability to stabilize and return to normal after antibiotics. They actually slow recovery. So unless directly recommended by a doctor, I avoid probiotics immediately after antibiotics. Instead, focus on your diet first. Maximize plant-based diversity. Then add in prebiotics to help your gut microbes bounce back faster. Avoid chemicals, saturated fat, and pesticides in your food. No alcohol. Exercise and get into nature. Go to bed early and sleep at least eight hours. And most important, let's avoid unnecessary antibiotic use.

We previously learned that prebiotic galacto-oligosaccharides can improve lactose digestion, providing evidence that strengthening the gut can also improve our capacity to process and digest our food. Using our gut fitness analogy, that's like working out your shoulders and then discovering that your bench press got stronger. In similar fashion, we find that probiotics can also improve our ability to process lactose. This is important because it suggests that the digestive enzymes in probiotics may be able to help us break down our carbohydrates and get the benefits.

There are now numerous studies to suggest that probiotics may be beneficial for intestinal bloating. Some specific strains that have been shown to be beneficial in studies include *Lactobacillus plantarum*, *Bifidobacterium infantis*, *L. acidophilus*, and *Bifidobacterium lactis*. Even a group of healthy people reported that their bowel movements were more blissful when they were using a daily probiotic.

A more targeted role for probiotics

So yes, probiotics actually do something. Are they a silver bullet as they're marketed at times to be, capable of fixing all of our problems? Nope. That is hype rather than science. Separating fact from fiction requires us to get smart and understand how probiotics work, and also learn how to be smart shoppers so we can pick the best one for us.

Let's start here . . . diet always comes first. The average human eats eighty thousand pounds of food during their lifetime, and a supplement will never overcome a bad diet. But in pre- and probiotics are an additional tool to help you optimize SCFA levels and restore gut health. Here's what to prioritize:

1. **The Golden Rule—Diversity of Plants**
2. **Prebiotics**
3. **Probiotics**

I can't wait for the day when we can analyze a person's individual microbiome, identify the strengths and weaknesses, and then give them the exact strains in the exact proportions that they need for optimal health or to fix a problem. Studies are starting to emerge showing us that probiotic colonization can be personalized. But unfortunately, that day has not arrived yet. So the current reality is that we're shooting in the dark. We're choosing a probiotic blindly without knowing how it fits with our completely personal, unique microbiota. We can only hope that it'll match, but it doesn't always work that way. So we *have* to accept a trial-and-error element. If it works and you notice a difference, stick with it. If it doesn't, move on. It may be the best probiotic in the world, but it doesn't mean it's the best probiotic for you.

Should everyone be taking a pre- and probiotic?

Are there benefits to prebiotics and probiotics in a healthy population, meaning: Do they boost your health if you are not taking them to address any specific symptom or health issue? I would argue that prebiotics provide more benefit in this circumstance. In normal, healthy adults, prebiotics have still been shown to improve metabolic parameters. For example, they help regulate blood sugar after meals, lower insulin concentrations (improved insulin sensitivity), and increase satiety to make you feel full faster. I use a prebiotic most days. I'm committed to the Golden Rule, so I often rotate through several types. There are definitely days that I forget it, and I notice a difference. When I'm taking it, my bowel movements are glorious. I'll just leave it at that.

As for probiotics, a comprehensive review found that they reduced the incidence, duration, and symptoms of the common cold (but not influenza), suggesting an immune benefit. There

was minimal effect on metabolic parameters such as cholesterol level, weight, blood sugar, or insulin with probiotics.

When considering whether or not prebiotics and probiotics make sense in the absence of disease, there are two additional considerations. One is safety. Both have been used widespread for decades now by the general population and the safety record has been excellent in both health and disease. There are case reports of infectious complications with probiotics, one study with increased risk if probiotics are given to someone with severe acute pancreatitis and one series where probiotics caused reversible brain fog in a population with severe motility disorders. This may sound scary, but consider the millions of people taking a probiotic on a daily basis for decades now and that these possibilities are at the most extremely rare. It goes without saying that you should discuss these issues with your doctor and obviously stop any medicine or supplement that you believe is causing an adverse effect. But that said, the safety record of both pre- and probiotics is very good.

The second consideration is cost. Prebiotics are not very expensive, but a good probiotic is around \$40. Sure, you can find \$5 probiotics at the store, but they're so impotent you'd be better off buying a tub of sauerkraut. So it's up to you and what works best with your budget. Until proven otherwise, I'm a bigger believer in prebiotic supplementation over probiotics if you're healthy and trying to stay that way.

If you are trying to figure out where to start with a probiotic, start with this question: What are you trying to accomplish? Do you have a specific symptom that you're trying to alleviate? You should have a reason that you're opting to take a probiotic, and if you don't or it's simply, "I want a healthier gut," then food is best. Remember, every plant has its own microbiome. So when we eat them, there's a sharing of microbes that occurs, and that's one advantage of consuming living food. When we opt for a little fermented food every day, we're taking that to the next level.

But if you have an answer to the question, "What are you trying to accomplish?" you'll want to find some studies that have been done to see if there's something out there that's known to work best for your specific issue. You can head to my website, www.theplantfedgut.com, where I've got lots of resources and support for how to research and choose a probiotic that's best for you. Here's the key: You want to find the probiotic that fits your treatment goal. You can do this by finding a study that shows a benefit, and then choosing that probiotic and using it the way they did in the study. For example, if you're trying to correct constipation, then you'd look for a probiotic with *Bifidobacterium lactis* in at least 17.2 billion colony-forming units (the unit of measurement for number of bacteria) because that's what worked for constipation in a placebo-controlled trial.

Beyond looking at studies for guidance on which probiotic and at what dose, I'm a big believer in quality. Here's a list of the things I look for in assessing whether a probiotic is of sufficient quality:

Quantity of bacteria: More is generally better. Typically I look for 25 billion to 50 billion minimum if trying to correct a medical issue.

Number of individual strains: Again, more is better. We know that bacteria work in “guilds” or teams, so it’s better to have a diverse team than to pretend these bacteria work in isolation. Now, which bacteria you need for a specific disease are to be determined, but until then we know that multistrain probiotics tend to outperform single-strain probiotics.

Guaranteed quantity at expiration: The packaging should define not just how many bacteria there are at the time of manufacture, but how many are guaranteed by a defined expiration date. This is a marker of probiotic quality and, if absent, raises concerns.

Allergen free: I prefer my probiotic to be free of dairy, eggs, nuts, seafood, soy, wheat, and gluten. While we’re on the topic, I personally want my probiotic to be vegan. This ensures that it’s not dairy based, which many of the probiotics on the market are.

Delayed-release capsule: We need to get the probiotics to the area in your body where the bacteria actually live, which is in the colon. Without a special delayed-release capsule, many of them will be destroyed by your stomach acid.

Packaging and need for refrigeration: Let me say this: I generally refrigerate anyway. But it’s a sign of improved survivability of the probiotic if it does not *require* refrigeration. I love my probiotics in blister packs, which means that each individual capsule is protected from bacteria-damaging humidity.

When will the future of probiotics arrive?

Knowing which bacterial strains to combine in our probiotics is the challenge. Again, we know that microbes function as teams, or “guilds.” We need to figure out how to build the proper team to accomplish our specific goal. It’s an incredibly challenging process to engineer because we’re talking about measuring hundreds of species, which dynamically change by the millisecond, differ by anatomical geography, and interact with each other and their environment. But the probiotic engineered by nature over three million years already contains those guilds and that balance. Yes, I’m talking about POOP! We disrespect and overlook it, but it may be the savior of modern medicine. There are dozens of active clinical trials evaluating the role of fecal transplant in human health. My prediction is that fecal transplant will be more effective for acute illnesses (like infection) than for chronic illnesses (like colitis or Crohn’s

disease) and that concurrent lifestyle changes are needed to support the newly received microbiota. I'm excited to see what the studies find!

To view the 35+ scientific references cited in this chapter, please visit me online at www.theplantfedgut.com/research/.

The Fiber Fueled Foods

Inspiring your gut microbes to do the Riverdance at every meal

You may have noticed that our food culture is obsessed with “superfoods.” We’re all looking for that one game changer that’s going to fix all of our health problems and make us feel like a million bucks. We’re encouraged to reach for pills we can pop to make everything better. Minimal effort with maximum results. Don’t get me wrong, superfoods (and medications, when you need them) are great. But we got it a little twisted because no *one* food is capable of meeting that expectation. There aren’t three hundred thousand plants on Earth so that we could pick just one and gorge ourselves on it.

There’s no perfect food—they all have strengths and weaknesses. I’m the first to admit that there are weaknesses to the healthy foods I’m promoting in this book. It goes back to our conversation from Chapter 4. Too much of a good thing can hurt you. If all you ate was kale, you would be *incredibly* unhealthy.

When we focus on superfoods alone, we miss out on diversity of plants. Superfoods are cool, but I will take plant-based diversity over superfoods every day of the week.

Remember that food is not just a bunch of individual components, it’s an entire package. Do the benefits outweigh the negatives? Bring food into your life that’s more positive than negative. When we do that, we get the best from our diet. That’s where plant-based diversity comes in—each plant might not be individually perfect, but the positives far outweigh the negatives, and when you consider them collectively you have a diet perfectly tailored to support a healthy gut microbiota and overall health.

That said, we can focus on diversity of plants and at the same time incorporate foods that are true nutritional powerhouses to get the best of both those worlds. These turbocharged foods can be our “best friends,” but they shouldn’t be our only friends.

Here are my favorite Fiber Fueled foods, conveniently organized into an acronym to make them easy to remember. These are the foods I try to sneak in as often as possible, but they are most powerful in combination and when you eat them with more plant varieties.

F GOALS

F: Fruit & Fermented

G: Greens & Grains

O: Omega-3 Super Seeds

A: Aromatics (onions, garlic)

L: Legumes

S: Sulforaphane (broccoli sprouts and other cruciferous veggies)

F: Fruit & Fermented

In Chapter 6, we celebrated fermented foods for their increased nutritional value, prebiotics, probiotics, and enrichment with postbiotics. They also add further plant-based diversity to our diet. Remember that our goal is to add a small serving of fermented foods to our daily routine.

But there’s a second “F” in our F GOALS and that’s fruit. There’s an inordinate amount of fear of fruit out there, particularly in the fitness community where I’ve seen or heard many personal trainers say, “Fruit has sugar, and excess sugar can lead to weight gain.” Folks, we shouldn’t look at any food only through the lens of its individual components because it will cause us to make conclusions that are flat-out wrong. We need to look at whole foods. The sugar in fruit is by no means the same as processed sugar. It’s packed in with everything else in the fruit, including vitamins and minerals, phytochemicals, and *fiber*.

And no, eating whole fruit does not cause “weight gain.” It’s actually quite the opposite. It doesn’t cause diabetes, either, for that matter. Instead, it actually can protect against it. For example, as sweet as berries may be, they actually lower

blood sugar and insulin release after a meal. Whether you are diabetic or looking to avoid sugar for another reason, don't make the mistake of lumping natural sugar in whole fruit in with added or processed sugars. You absolutely should be eating fruit! It can help you lose weight and control your diabetes.

What about juicing?

Is juiced fruit the same as sinking your teeth into the whole food? No, unfortunately, it's not. When you process your food, the rules no longer apply. When you juice your fruit, you are removing most of the fiber and artificially concentrating the sugar. For example, one small orange has 45 calories, 2.3 grams of fiber, and 9 grams of sugars. One cup of OJ packs in 134 calories, just 0.5 gram of fiber, and 23.3 grams of sugars. Fruit juice is a sugar beverage, created by the manipulation of a whole food.

I could write an entire book about the health benefits you'll find in fruit. In Chapter 4 we learned that apples are an excellent source of prebiotic fiber, healthy microbes, and numerous beneficial polyphenol phytochemicals contributing to reduced risk of heart disease, stroke, lung cancer, diabetes, asthma, and weight loss. Oranges have vitamin C and antioxidant flavonoids and anthocyanins that protect against hypertension, high cholesterol, kidney stones, and iron deficiency. Nice, right?

So apples and oranges are great, but let me tell you about my deep and abiding love for *berries*: blueberries, blackberries, raspberries, strawberries, and the lesser known acai and goji berries. Give me all of them!

Berries come in incredible colors: blue, purple, red, and pink. The color actually comes from a phytochemical (remember, "phyto" means "plant-based") called anthocyanins. Without anthocyanins, blueberries would be green! That's why immature blueberries aren't blue, because the anthocyanins haven't come in yet. Anthocyanins are pretty magical. They help protect against cancer, and they also boost cognition. For example, in one study women who ate just two servings of strawberries or one serving of blueberries per week postponed cognitive decline and made their brain behave like it was thirty months younger. In another study, two servings of berries a week yielded a 23 percent less chance of developing Parkinson's. And when wild blueberries were given to kids, they saw almost immediate improvements in cognitive performance that increased based upon the dose of blueberries. I recently took a grueling eight-hour exam to renew my board certification in internal medicine. Guess what I was eating all day? Blueberries.

Pro Tip: Blueberries

Opt for the smaller blueberries, ideally wild. Smaller blueberries are less sweet but have higher levels of antioxidants.

But let's not ignore the fiber content. In a one-cup serving of strawberries, blueberries, blackberries, and raspberries, you'll find 3, 4, 8, and 8 grams of fiber in each, respectively. Considering that the average American is only getting 15 or 16 grams of fiber in a day, a simple handful of berries can make a big difference. I love popping a couple of handfuls of berries as an afternoon snack or when I have a sweet tooth.

G: Greens & Grains

In Chapter 4 we discussed the merits of whole grains, such as reduced risk of coronary heart disease, cardiovascular disease, and total cancer as well as lower likelihood of death from all causes, respiratory diseases, infectious diseases, diabetes, and all non-cardiovascular, non-cancer causes. That was just one study.

It's pretty straightforward from my perspective. Drop the refined grains, no doubt. I'm with you 100 percent. But if you want a healthy microbiota, whole grains are at the foundation of building a healthy gut. And the numerous studies cited in Chapter 4 support it.

There's a second important "G" in the house, and that's greens. There is so much plant-based diversity when it comes to greens: collards, kale, arugula, spinach, romaine, bok choy, watercress, Swiss chard, broccoli raab, mustard greens, sorrel, escarole, kohlrabi, and more. And there are varieties within these foods, too. For example, kale varieties include curly, lacinato (aka dinosaur or Tuscan kale), Redbor, or Siberian. Even the leaves of some favorite root veggies like beet, turnip, dandelion, radish, and carrots are edible and offer more variety in the green category.

When we assess the health benefits of food, nutrient density is a key concept. The idea is to get the maximum amount of nutrients—vitamins, minerals, phytochemicals, fiber—per calorie consumed. This becomes a simple formula: nutrient density equals nutrients divided by calories. So if you think about oil, for example, it's high in calories and low in nutrients. Poor nutrient density. Or potato chips. High in calories, low in nutrients. This is a pretty straightforward, logical approach, right?

We call it the ANDI score, which stands for Aggregate Nutrient Density Index and was developed by the legendary Dr. Joel Fuhrman, one of my personal health heroes. The score is from 1 to 1,000, with 1 being the worst. For example,

cola, corn chips, and vanilla ice cream got the lowest score. Sounds about right. As for the high performers, there were five with a perfect 1,000 score—kale, collards, mustard greens, watercress, and Swiss chard. Bok choy, spinach, arugula, and romaine were the next four highest scores. In other words, greens were the top nine foods on the list. This wasn't a list restricted to just greens. All foods were eligible, yet greens hold a monopoly at the top.

The absurd amount of nutrient density in greens is a present from Mother Nature. You get tons of nutrients packaged with almost no calories, so you can literally eat as much as you want. It's getting your nutrients served without the calories! For example, an entire pound of leafy greens has only 100 calories. That's about one egg or two bites of steak. I've stopped worrying about portion size ever since I transitioned to a plant-based diet, but if you do continue to consume high-calorie foods after reading this book, know that you can throw unlimited amounts of greens in there to get more nutrients in your diet without compromising calories.

Let's highlight a few examples of this nutrient density hard at work:

- **Kale:** Kale contains antioxidant phytochemicals lutein and zeaxanthin, which are required by the eyes to prevent macular degeneration. It also contains beta-carotene, which reduces the risk of getting cataracts.
- **Collard greens:** You can't live in Charleston, South Carolina, and not love collard greens. But what's beautiful is that they can sneak nutrients in on even the most unsuspecting Southern palate. Turns out that collards bind bile acids in the intestines and eliminate them in our stool. This helps to lower cholesterol and reduces carcinogenic secondary bile acids.

Pro Tip: Greens

Steam your greens to improve bile salt-binding activity! This helps protect against cancer, specifically colon and liver cancer.

- **Spinach:** You may recall that Popeye got his superhuman strength by popping a can of spinach. Popeye was created in 1929, so this was incredibly forward-thinking. And it's true! Just one cup of cooked spinach offers 36 percent of your daily value

for iron and 11 percent for protein, not to mention a bonus of vitamins A and K, calcium, magnesium, potassium, and manganese. Oh, and 4 grams of fiber.

- **Arugula:** Arugula is a cancer destroyer. It has a unique mix of phytochemicals like thiocyanates, sulforaphane, and indoles that may help fight some of our most deadly cancers—prostate, breast, colon, ovarian, and cervical. We'll come back to sulforaphane in a minute.
- **Bok choy:** Bok choy is great for your bones, offering critical minerals like iron, zinc, and magnesium in combination with vitamin K.
- **Romaine:** If you're looking for healthy skin and to reverse aging, grab some romaine. The vitamins A and C in romaine help to lay down fresh collagen to prevent wrinkles and neutralize oxidizing free radicals. The result is glowing, radiant skin with improved elasticity.

O: Omega-3 Super Seeds

I absolutely adore this category because I feel like these foods have it all—they are nutritious, delicious, versatile, and unique. But before I jump in, a few words on omega-3 and omega-6 fatty acids. You've heard of different fat types: trans, saturated, monounsaturated, polyunsaturated. These omega-3 and -6 fats are polyunsaturated fats, and they're considered "essential" because our body is not capable of intrinsically making them so we are required to get them from our diet. If you don't consume them, you develop a deficiency, which can lead to sickness.

Generally speaking, polyunsaturated fats are considered healthy and are important for many functions in the body. But you've probably heard about omega-3s more than omega-6s. Part of the reason why you've heard so much about omega-3s is that the modern Western diet provides an excessive amount of omega-6s and an inadequate amount of omega-3s. The ratio of omega-6s to omega-3s is a marker of health. Traditional cultures are thought to have evolved with a nearly even mix between omega-6s and omega-3s, while most Westerners are functioning with a ratio between 15 and 16.7 to 1 of excess omega-6s. It's a ratio that when skewed can promote disease: cardiovascular disease, cancer, osteoporosis, and autoimmune diseases. Our goal is to balance this ratio, which means that we need an influx of omega-3s in our diet.

And I know just where we can find them—omega-3 super seeds. To be

specific, I'm referring to three types of seeds that contain plant-based omega-3s: flaxseeds, chia seeds, and hemp seeds. While each offers the omega-3s, there are differences between each so let's break it down a little bit.

- **Flaxseed:** Flaxseeds are an excellent source of omega-3 alpha-linolenic acid (ALA), with 2,300 milligrams of ALA per tablespoon of flax. But it is also an excellent source of soluble fiber, which is part of the reason why it's a traditional remedy for constipation. You get all the goodness that comes with prebiotic fiber as discussed in Chapter 3. Flax is also particularly rich in lignans, which are plant chemicals that strongly protect against hormonal cancers like breast and prostate cancer.

Pro Tip: Flaxseed

Flaxseeds have a hard shell and must be ground or thoroughly chewed in order for their nutrients to be absorbed. If you buy pre-ground flax, simply keep it in your freezer to maintain freshness.

- **Chia seeds:** You'll find lignans in chia seeds as well, though the levels are higher in flax. Chia has ever so slightly more omega-3s (2,400 vs. 2,300 milligrams per tablespoon) and significantly more fiber (5 grams in chia vs. 3 grams in flax). Chia seeds are 40 percent fiber by weight, making them one of the top sources of fiber in the world. This is mostly soluble fiber, which is the prebiotic kind. You can see the soluble fiber on display if you stir a tablespoon of chia into a quarter cup of liquid and within ten minutes you'll find a viscous gel. Chia seeds can absorb ten to twelve times their weight in water. Let them sit in water for a few hours and you'll make chia pudding, which is nutritious and has a texture resembling tapioca pudding.
- **Hemp seeds:** Last but not least are hemp seeds. They're, ahem, different from flax and chia. Okay, let me just get this out of the way. Yes, hemp seeds come from the same plant as marijuana. But they're legal! They don't contain THC, the psychoactive part of cannabis. So they won't get you high, but they *will* get you healthy. Hems seeds have about 40 percent of the omega-3 ALA

that you find in chia and flax, but less fiber. When you think of hemp seeds, think of protein. Hemp seeds are unique in that they are complete protein, meaning they contain all of the essential amino acids. So hemp seeds are a one-stop shop for both essential fats and amino acids.



I love throwing omega-3 super seeds in my smoothie. Honestly, I'll often put all three in at the same time. They go well with oatmeal or in some cases on a fresh salad. And you'll find a mouthwatering recipe for chia pudding ([Zesty Lemon Chia Pudding](#)) in Chapter 10, "The Fiber Fueled 4 Weeks."

There are a few other sources of plant-based omega-3s to be aware of—walnuts, firm tofu, and edamame have a decent amount of ALA, although much less than flax or chia. Beans and Brussels sprouts have a small amount, as well.

A: Aromatics (Onions, Garlic)

These are the flavor foods! Think of a heavenly, slow-simmered Italian sauce heavily laden with garlic, onions, and basil.

Always add fresh herbs

Herbs are incredibly nutrient-dense. Basil alone has numerous phytochemicals, giving it anti-inflammatory, chemo-preventive, radio-protective, antimicrobial, analgesic, antipyretic, antidiabetic, hepatoprotective, hypolipidemic, and immunomodulatory properties. Here's my point: Any time you have the opportunity to add fresh herbs and spices to a dish, do it! You're adding flavor, plant-based diversity, and multiple phytochemicals.

The great flavor that you get with onions and garlic is because they're both allium vegetables. Others in this category with similar benefits are leeks, shallots, chives, and scallions. At baseline, allium vegetables are jam-packed with nutrients: vitamins B₁, B₂, B₃, B₆, C, E, K, folate, iron, magnesium, phosphorus, sodium, and zinc. Jam. Packed.

But then we get into the really good stuff. Allium contains aromatic organosulfur compounds that are responsible for their smell, their taste, and their health benefits. For example, when fresh garlic or onions are chopped or crushed, an enzyme called alliinase is activated and converts alliin into allicin. It takes ten minutes for the enzyme to activate the allicin, a compound that has

antibacterial, antifungal, antiparasitic, and even antiviral properties. The stronger the smell, the better it is for your health. To allow allicin to activate, *CHOP, then STOP* and wait for ten minutes before cooking with alliums. The allicin appears to target the bad guys like multidrug-resistant enterotoxigenic *E. coli* and *Candida albicans*. And it promotes the growth of *Bifidobacteria* and other healthy microbes in the gut. It's worth noting that alliums are also an excellent source of prebiotic fiber.

Garlic: my secret weapon in the fight against the common cold

In our family we have a tradition of using garlic to fight the common cold. At the first sign of a sore throat, we start ingesting garlic. Basically, we will cut two to four garlic cloves into pill-size pieces. CHOP then STOP. Wait ten minutes for the alliinase to activate the allicin, then swallow whole. I'll do this daily until the cold is gone, and I've actually reversed colds by consuming the garlic pieces when I just start to feel symptoms. There's a placebo controlled trial that supports my experience. But you do smell a little like garlic while you're talking.
Small price to pay.

Allium veggies also have potent anticancer activity, particularly against gastric and prostate cancer. There are two layers to the anticancer activity. First, the organosulfur compounds like allicin detoxify carcinogens, block tumor growth, and prevent blood flow to the tumor. Second, allium veggies contain at least twenty-four different flavonoid phytochemicals, such as quercetin. Red onions have the added benefit of anthocyanidins. The flavonoids have anti-inflammatory effects that may help protect us from cancer.

These antioxidant compounds also appear to be beneficial for Alzheimer's dementia and heart disease.

Pro Tip: Onions

When you chop an onion, you set off a reaction creating the organosulfides that makes your eyes tear. These are the cancer-fighting and anti-inflammatory compounds, so we embrace them. If you tear up when cutting your onion, try throwing the onion in the freezer for five minutes to make it cold before cutting. To get the most out of your allium veggies, it's ideal to eat them raw but if not, cut them and let them sit to form the compounds before cooking.
(CHOP, then STOP.)

L: Legumes

Legumes are among the healthiest foods on the planet. And they are dirt cheap!

They are at the foundation of a healthy gut microbiota, offering prebiotic fiber and resistant starches in spades. Please don't pass up the opportunity to build your gut on these irreplaceable foods. See Chapter 4 for more information on legumes.

S: Sulforaphane (Broccoli Sprouts and Other Cruciferous Veggies)

Plants are like my children. I love all of them, and I can see the beauty in their individuality. But if there's one I love the most, this is the one. I have been waiting eight chapters to talk to you about cruciferous vegetables and their super chemical *sulforaphane*.

We all know broccoli, kale, arugula, cabbage, cauliflower, and Brussels sprouts as healthy foods. But what's so special about them? They're part of a family of vegetables that we refer to as cruciferous. There are at least forty family members, but they share a common lineage. Through billions of years of plant evolution, they evolved a common defense system using an enzyme called myrosinase to convert glucosinolates into "toxic" compounds. The myrosinase and glucosinolates are stored in separate compartments within the plant, so under normal circumstances they don't mix. But when an insect or invading herbivore—like yours truly—starts mashing on the plant, they'll break the separating chambers, mix the chemicals, and set off a chemical reaction leading to the production of isothiocyanates (ITCs) like sulforaphane. It's conceptually similar to a bomb. So what happens when the bomb goes off and these ITCs are released? Cancer is cured, inflammation is squashed, hearts get healthy, blood sugar comes down, fat gets burned, and hormones get balanced. ITCs are powerfully health promoting. This is yet another example where a plant's defense mechanism can also do double duty as *our* defense against cancer cells.

Pro Tip: Cruciferous Vegetables

Cruciferous veggies are similar to onions and garlic in that they have an enzyme that needs to be activated to get the most healing benefits and therefore are best consumed raw. Similar to the aromatics, you can employ the CHOP then STOP technique to activate the enzyme prior to cooking or eating. If the broccoli or cauliflower has already been cooked, as happens with frozen vegetables that have been heat blanched prior to freezing, you can replace some of the enzyme that has been lost and restore the healing isothiocyanate phytochemicals by sprinkling mustard seed powder on the vegetables after cooking. A cool trick!

Let's talk about my favorite isothiocyanate—sulforaphane. You get sulforaphane from cruciferous vegetables like broccoli, Brussels sprouts, kale,

and cabbage. In 1992, Dr. Paul Talalay, a true pioneer in the field of cancer prevention, opened Pandora's box when he first published on the cancer protective effects of sulforaphane. Since that time there have been hundreds of laboratory, animal, and some human studies (many by Dr. Talalay himself, who recently passed away at age ninety-five) suggesting that sulforaphane may be the driving force behind these incredibly healthy foods. Here's what we have learned about sulforaphane, this medicinal phytochemical:

- Protects us from cancer by seven mechanisms: inhibits the production of carcinogens, activates enzymes to detoxify the carcinogens that are produced, shuts down blood flow to the tumor (which is needed to fuel growth), inhibits cancer cell migration and invasion, promotes self-destruction of cancer cells (apoptosis), and even regulates cancer development through epigenetics.
- Undermines lung, colon, breast, prostate, skin, pancreatic, liver, throat, and bladder cancer, osteosarcoma, glioblastoma, leukemia, melanoma—and potentially more.
- Shuts down the pro-inflammatory pathways that get activated by bacterial endotoxin.
- Works as a powerful antioxidant to detoxify free radicals and reduce cellular damage.
- May benefit Parkinson's, and recovery from stroke, concussion, or other brain trauma.
- Reduces amyloid beta plaques and improves cognitive impairment in Alzheimer's patients.
- Improves mood, as well as anxiety and depression.
- Boosts brain function, improving memory and focus.
- Regulates the immune system, ameliorating autoimmune diseases like experimental multiple sclerosis and rheumatoid arthritis.
- Flips the body into fat-burning mode to promote weight loss, amazingly by reducing pathogenic bad bacteria in the gut and limiting bacterial endotoxin release in addition to other mechanisms.
- Combats bacterial and fungal infections. In one study, twenty-three out of twenty-eight pathogenic bacterial and fungal species were inhibited.
- Protects the heart by improving lipids, lowering blood pressure,

inhibiting platelet aggregation, and even directly suppressing inflammation in the arteries.

- Improves insulin sensitivity to correct type 2 diabetes.
- Repairs the damage of diabetes, correcting diabetic heart and kidney damage.
- Protects the liver and kidneys from the damage done by some chemotherapeutic drugs.

Believe it or not, I could keep going. So how does sulforaphane interact with our gut microbiota? We saw above that sulforaphane is capable of reducing levels of pathogenic bacteria and bacterial endotoxin release. But there's so much more. In another study, sulforaphane corrected gut dysbiosis by increasing healthy gut microbes, *increasing butyrate release*, and repairing the intestinal lining to reverse leaky gut by upregulating tight junction formation. Mind. Blown. What I'm saying here is that part of the way sulforaphane works its absolute magic is by tag teaming with SCFAs to create the most powerful gut-healing superhero duo of all time.

It's all about the cruciferous veggies, specifically broccoli, Brussels sprouts, cabbage, cauliflower, and kale. But there is one food that *dominates* all others in terms of offering more sulforaphane: *broccoli sprouts*. These are essentially immature broccoli, where the seed has just recently hatched and we have the earliest thing beyond a seed. The concept is the same as bean sprouts or alfalfa sprouts. Broccoli sprouts can produce ten to one hundred times more sulforaphane than mature broccoli. What this means is that you can either eat massive quantities of fully mature broccoli or a small amount of broccoli sprouts and achieve the same effect.

Grow your own broccoli sprouts! It's easy.

- Add 2 tablespoons of broccoli sprouting seeds to a wide-mouthed 1-quart mason jar.
- Cover with 2 inches of filtered water and cap with a sprouting lid. Store in a warm, dark place, like the kitchen cabinet, overnight. In the morning you're going to drain the water. This is the only time you're going to leave the seeds submerged in water. From here on out it'll be rinse and drain.
- Rinse the seeds with fresh water two or three times per day. Swirl, then drain the water. It's important to get most of the water out, so one strategy is to place the mason jar upside down in a large bowl so that it's at a 45-degree angle (or so) so the drops can continue to fall out. Again, this is the process you're repeating two or three times daily

—rinse, swirl, drain, rest in the cabinet, repeat.

Over the course of days you will see changes: first they break open and grow (so cute!), then they extend to be an inch or so long with yellow leaves. At this point, it's time for them to get some sunlight. Sunlight will help them mature, the leaves will turn green, and you are done! Cover them with an airtight seal and store in the fridge.

Broccoli sprouts have a bitter, peppery flavor, but it's that bitterness that is blasting cancer cells on your behalf. And note: Taking a supplement instead just can't match the effect of the broccoli sprouts. In a study comparing broccoli sprouts to a supplement, the real thing dominated. Whole foods win, yet again! If the taste bothers you, try using broccoli sprouts in a smoothie, soup, or larger salad.

Bonus: Shrooms & Seaweed

I'm pretty sure you now understand why sulforaphane deserved its own category. Honestly, there may be no single food that represents the idea of "Food Is Medicine" better than broccoli sprouts. But mushrooms and seaweed deserve a quick shout-out as a bonus category.

Shrooms deserve mention because they are entirely unique—they're not even plants! They're fungi, but let's make them honorary plants because they sure behave as such. They contain prebiotic beta-glucan, which strengthens the immune system to prevent infections and even cancer. Several types even offer unique protection against breast cancer. Eating one button mushroom per day is associated with a 64 percent reduction in breast cancer risk. One beautiful thing about mushrooms is the variety: white, cremini, oyster, portobello, maitake, reishi, cordyceps. Each offers its own unique blend of health benefits. So in addition to plant-based diversity, I advocate for toadstool diversity!

Pro Tip: Mushrooms

Make sure to cook your mushrooms. Several types contain a substance called agaritine, which is potentially carcinogenic but significantly reduced by cooking.

Seaweed deserves a little more respect. It's not a weed, it's a vegetable. It just so happens to come from the ocean. And what's cool is if we're talking about plant-based diversity, seaweed is a fantastic way to add it because, not only is it high in fiber, but it actually has several unique types of fiber that you won't find

in terrestrial plants—ulvans, xylans, agars. Naturally, these are prebiotic fibers. Brown algae, such as kelp or wakame, contain a unique compound called fucoxanthin that helps reduce the accumulation of fats, promotes weight loss, improves insulin sensitivity, and improves blood lipid profiles. Sea veggies are also an excellent source of iodine for thyroid health and vitamin B₁₂.

Since sea veggies and algae aren't a traditional part of the American diet, you may be at a loss for where to start with them. No worries. Let's do a quick little run-through of some options and how to incorporate them.

- **Nori:** These are the crisp sheets that can be softened to make sushi rolls. They're a lightweight, nutritious snack as is, but can also be broken into "flakes" and sprinkled on your salad for some added crunch.
- **Kelp/Kombu:** Generally sold in dried strips and "meaty" versions, kelp adds a nice umami flavor to savory soups, like the [Biome Broth](#) you'll find in Chapter 10, "The Fiber Fueled 4 Weeks." The Japanese even drink kombu tea.
- **Wakame:** A delicate, lightly sweet seaweed that makes a nice addition to miso soup, or combine it with crunchy veggies like cucumber to make a delicious seaweed salad.
- **Spirulina:** A nutrient-dense blue-green algae found in powder or tablet form that's very high in iron, calcium, protein, B vitamins, and chlorophyll. Sprinkle it into your smoothies and enjoy its deep color.

Public service announcement: Make sure your F GOALS foods are organic!

F GOALS plants are thin-skinned foods. There's no rind or skin to peel away, with the exception of onions and garlic. So any chemical that's sprayed on it is a part of it, and you can't guarantee that you can wash it off. In a prospective cohort study of more than sixty-eight thousand French volunteers, people who ate organic food had a lower overall risk of cancer, non-Hodgkin's lymphoma, and postmenopausal breast cancer. More studies are sure to come, but when considering the addition of industrial chemicals to our food, I think our base position should be one of protection—we should assume that pesticides are poison until proven otherwise.

Adding F GOALS to your daily routine

Okay, so we have our list of foundational foods and now it's time to shift our eating. Be conscious of the fiber and FODMAP content on the F GOALS list. It's no coincidence that these are high-fiber, high FODMAP foods. As we've discussed, FODMAPs aren't the enemy, they're our friend. But whenever we're adding in fiber and FODMAPs, we want to go low and slow to grow—that's the motto.

To view the 60+ scientific references cited in this chapter, please visit me online at www.theplantfedgut.com/research/.