# Brain Maker: The Power of Gut Microbes to Heal and Protect Your Brain–for Life, David Perlmutterwww.DrPerlmutter.com

a 2013 British report showed that since 1979, death due to brain disease increased a breathtaking 66 percent in men and 92 percent in women in America. Location 35

That amounts to approximately***$200 billion a year, twice what we spend on caring for heart disease patients*** and almost triple what we spend on treatment for cancer patients. Location 41

About one in four adults in the U.S.—more than 26 percent of the population—suffers from a diagnosable mental disorder.3 Anxiety disorders afflict more than 40 million Americans, and nearly 10 percent of the U.S. adult population has a mood disorder for which powerful drugs are prescribed.4 Depression, which affects one in ten of us (including a quarter of women in their forties and fifties), Location 43

autism, which has surged seven-to eight-fold just in the past 15 years, Location 60

brain health and, on the flip side, brain diseases, are dictated by what goes on in the gut. Location 64

up to 90 percent of all known human illness can be traced back to an unhealthy gut. Location 84

These roughly hundred trillion invisible creatures—microbes—cover your insides and outsides, thriving in your mouth, nose, ears, intestines, genitalia, and on every inch of your skin. Location 90

Scientists have so far identified some 10,000 species of microbes, and because each microbe contains its own DNA, Location 91

Most of these organisms live within your digestive tract, and while they include fungi and viruses, it appears that the bacterial species that make their home inside you dominate and take center stage in supporting every conceivable aspect of your health. Location 93

We call this complex internal ecology that thrives within us and its genetic fingerprint the microbiome Location 96

Although the human genome we all carry is almost the same, give or take the small handful of genes that encode our individual characteristics like hair color or blood type, the gut microbiome of even identical twins is vastly different. Location 98

It’s now undeniable that our intestinal organisms participate in a wide variety of physiologic actions, including immune system functioning, detoxification, inflammation, neurotransmitter and vitamin production, nutrient absorption, signaling being hungry or full, and utilizing carbohydrates and fat. All of these processes factor mightily into whether or not we experience allergies, asthma, ADHD, cancer, diabetes, or dementia. Location 111

Put simply, everything about our health—how we feel both emotionally and physically—hinges on the state of our microbiome. Location 115

As I described in my previous book Grain Brain, the two key mechanisms that lead to brain degeneration are chronic inflammation and the action of free radicals, which for now you can think of as byproducts of inflammation that cause the body to “rust.” Location 169

Your intestinal flora in fact has everything to do with inflammation and whether or not you can combat free radicals. Location 171

This highly practical regimen includes six essential keys:

1. Prebiotics
2. Probiotics
3. fermented foods
4. low-carb foods
5. gluten-free foods
6. healthful fat. Location 177

Foods such as garlic, Jerusalem artichoke, jicama, and even dandelion greens, as well as fermented foods such as sauerkraut, kombucha, and kimchi open the door for heightened levels of health in general, and brain function and protection in particular. Location 192

**GUT CHECK What Are Your Risk Factors? Location 206**

Don’t be alarmed if you find yourself answering yes to most of these questions. The more yeses you have, the higher your risk might be for having a sick or dysfunctional microbiome that could be impacting your mental health, Location 218

1. Did your mother take antibiotics while she was pregnant with you?

2. Did your mother take steroids like prednisone while she was pregnant with you?

3. Were you born by C-section?

4. Were you breast-fed for less than one month?

5. Did you suffer from frequent ear and/or throat infections as a child?

6. Did you require ear tubes as a child?

7. Did you have your tonsils removed?

8. Have you ever needed steroid medications for more than one week, including steroid nasal or breathing inhalers?

9. Do you take antibiotics at least once every two to three years?

10. Do you take acid-blocking drugs (for digestion or reflux)?

11. Are you gluten-sensitive?

12. Do you have food allergies?

13. Are you extra sensitive to chemicals often found in everyday products and goods?

14. Have you been diagnosed with an autoimmune disease?

15. Do you have type-2 diabetes?

16. Are you more than 20 pounds overweight?

17. Do you suffer from irritable bowel syndrome?

18. Do you have diarrhea or loose bowel movements at least once a month?

19. Do you require a laxative at least once a month?

20. Do you suffer from depression? Location 234

**PART I GETTING TO KNOW YOUR HUNDRED TRILLION FRIENDS**

**CHAPTER 1 Welcome Aboard Your Microbial Friends from Birth to Death**

Ikaria, is home to the highest percentage of ninety-year-olds on the planet—nearly one out of three people make it to their tenth decade in robust physical and mental health.1 They also boast about 20 percent fewer cases of cancer, half the rate of heart disease, and almost no dementia. Location 268

The latest science tells us that the intestinal flora that take up residence on the delicate folds of your intestinal walls

* Aid in digestion and the absorption of nutrients. Location 310
* Create a physical barrier against potential invaders such as bad bacteria (pathogenic flora), harmful viruses, and injurious parasites. Some Location 313
* Act as a detoxification machine. Location 316
* Profoundly influence the immune system’s response. Location 319
* Produce and release important enzymes and substances that collaborate with your biology, as well as chemicals for the brain, including vitamins and neurotransmitters. Location 322
* Help you handle stress through the flora’s effects on your endocrine—hormonal—system. Location 324
* Assist you in getting a good night’s sleep. Location 325
* Help control the body’s inflammatory pathways, which in turn affect risk for virtually all manner of chronic disease. Location 326

The vagus nerve, the longest of the twelve cranial nerves, is the primary channel of information between the hundreds of millions of nerve cells in our intestinal nervous system and our central nervous system. Location 341

Also known as cranial nerve X, it extends from the brain stem to the abdomen, directing many bodily processes that we don’t consciously control. Location 342

And it turns out that the population of bacteria in the gut directly affects the stimulation and function of the cells along the vagus nerve. Location 344

Some of the gut’s microbes can actually release chemical messengers, just as our neurons do, that speak to the brain in their own language through the vagus nerve. Location 345

The neurons in the gut are so innumerable that many scientists are now calling the totality of them “the second brain.” Location 350

You may be surprised to find out that an estimated 80 to 90 percent of the amount of serotonin in your body is manufactured by the nerve cells in your gut! Location 353

Although the body may not necessarily go into fight-or-flight mode with a pounding heart when it meets a substance or ingredient it doesn’t like, it most definitely will experience an immune response. Location 370

And chronic immune activation and resulting inflammation from such encounters can lead to chronic disease, from heart and Location 372

brain diseases like Parkinson’s, multiple sclerosis, depression, and dementia to autoimmune disorders, ulcerative colitis, and cancer. Location 372

How does the microbiome come into play? It regulates or manages the immune response. Location 375

Your gut has its own immune system, the “gut-associated lymphatic tissue” (GALT). It represents 70 to 80 percent of your body’s total immune system. Location 387

The two most common groups of organisms in the gut, representing more than 90 percent of the bacterial population in the colon, are ***Firmicutes*** (pronounced fir-MIH-cue-tees) and ***Bacteroidetes*** (pronounced BAC-teer-OY-deh-tees). Location 409

What’s more, we’ve just learned *that* ***higher levels of Firmicutes actually turn on genes that increase the risk for obesity, diabetes, and even cardiovascular disease****.*11 Think of that: Changes in the ratio of these bacteria can change the actual expression of your DNA! Location 416

The two most studied strains of bacteria today are those of ***Bifidobacterium*** and ***Lactobacillus***. Location 418

you can change your set-point for inflammation through basic lifestyle interventions. Location 455

they found that infants born vaginally obtained bacterial colonies resembling their own mothers’ vaginal microbiome, dominated by beneficial Lactobacillus, whereas babies born via C-section acquired colonies similar to those found on the skin’s surface, dominated by an abundance of the potentially harmful Staphylococcus. Location 461

Here’s a small snapshot of what being born by C-section can entail, based on a large population and rigorously controlled studies:

* A five-fold increased risk of allergies23
* Triple the risk of ADHD24
* Twice the risk of autism25
* An 80 percent increased risk of celiac disease26
* A 50 percent increased risk of becoming obese as an adult (and, as we’ll see later, being obese is directly correlated with an increased risk of dementia)27
* A 70 percent increased risk of type-1 diabetes28 (and being diabetic more than doubles the risk for dementia)29 Location 488

Later in the book I’ll provide explicit information, for both expecting mothers and those who’ve already given birth, on how to compensate for a surgical delivery. Location 506

THE THREE FORCES WORKING AGAINST YOUR BELLY BUGS Location 512

* Force #1: Exposure to substances that kill or otherwise adversely change the composition of the bacterial colonies. Location 518
* Force #2: Lack of nutrients that support healthy, diverse tribes of bacteria and instead favor bad bacteria. Location 521
* Force: #3: Stress. Location 523

So the pattern of ***higher levels of Firmicutes and lower levels of Bacteroidetes is associated with a greater risk of obesity***.35 It’s seen in people from urban areas, while the opposite is more common in people from rural areas. Location 547

In those countries having the least sanitation, the prevalence of Alzheimer’s was dramatically reduced. But in countries with higher degrees of sanitation, and therefore lower levels of parasites as well as less diversity of intestinal organisms, Alzheimer’s prevalence skyrocketed. Location 554



notice how the countries in the first graphic with the highest levels of parasites, such as Kenya, are depicted in the second graphic as having the lowest rates of Alzheimer’s disease. Location 561



Just because attention to hygiene is strongly associated with increased risk of Alzheimer’s disease doesn’t necessarily mean it causes Alzheimer’s disease rates to rise. Location 565

**CHAPTER 2 Belly and Brain on Fire The New Science of Inflammation**

In 2014, I wrote an online article titled “Why We Can and Must Focus on Preventing Alzheimer’s,” Location 590

Medical researchers already have knowledge that, if implemented, could slash the number of new Alzheimer’s patients here in the U.S. by more than half. Location 609

Our best medical journals are now brimming with high-profile, rigorous studies that show a stunning correlation between high blood sugar and risk for dementia. Location 615

Blood sugar directly reflects dietary choices; eat too many refined sugars and carbs and you’ll have a hard time controlling your blood sugar. Location 622

people who added more fat, in the form of olive oil or mixed nuts, to their diets maintained their cognitive function much better over a six-year period than people who ate a low-fat diet. Location 626

INFLAMMATION: THE COMMON DENOMINATOR Location 633

Nonetheless, scientific research has, for the past several decades, clearly demonstrated over and over again that inflammation is a fundamental process that underlies the development of Alzheimer’s disease. Location 644

In Alzheimer’s patients, biochemicals that indicate that inflammation is occurring—inflammatory markers—are elevated and can even be used to predict cognitive decline and the development of dementia. Among the most famous of these biochemicals are the cytokines, small proteins released by cells that affect the behavior of other cells and are often important participants in the inflammatory process. Location 646

C-reactive protein, interleukin six (IL-6), and tumor necrosis factor alpha (TNF-α) are all cytokines. Location 649

TNF-α in particular seems to play an important role in inflammation throughout the body, and in addition to being elevated in the blood of Alzheimer’s patients, it’s been found to be elevated in a variety of other inflammatory conditions including psoriasis, rheumatoid arthritis, cardiovascular disease, Crohn’s disease, and asthma. Location 651

Elevated blood sugar stirs up inflammation in the bloodstream, as excess sugar can be toxic if it’s not swept up and used by cells. ***It also triggers a reaction called glycation—the biological process by which sugar binds to proteins and certain fats, resulting in deformed molecules that don’t function well***. These sugar proteins are technically called advanced glycation end products (AGEs). The body does not recognize AGEs as normal, so they set off inflammatory reactions. Location 662

The relationship between poor blood sugar control and Alzheimer’s disease in particular is so strong that ***researchers are now calling Alzheimer’s disease type-3 diabetes****.* Location 667

For example, the traditional Chinese herbal components berberine and ginseng, as well as the compounds found in tea, coffee, wine, and chocolate have anti-diabetic qualities through their effects on gut bacteria. These compounds either change the composition of gut bacteria for the better or are metabolized by the gut bacteria before being absorbed into the body. Location 689

Previously, I described brain-derived neurotrophic factor as a critical brain-growth protein. BDNF is involved in neurogenesis, the process by which new neurons are created. BDNF also protects existing neurons, ensuring their survival and encouraging connections, or synapses, between them. Location 699

***BDNF can be increased through aerobic exercise as well as by consuming the omega-3 fat DHA***, we are now learning that this critically important brain chemical is vitally dependent on the balance of bacteria that live within the gut. Location 703

***those individuals at the beginning of the study who had the highest levels of BDNF had less than half the risk of dementia*** compared to those with the lowest BDNF levels. Location 709

GABA, another important chemical manufactured by the gut bacteria, is an amino acid that serves as a neurotransmitter in the central nervous system. It’s the main chemical messenger in your brain that calms down nerve activity by inhibiting transmissions and normalizing brain waves. Location 713

Glutamate, yet another vital neurotransmitter that is produced by the gut bacteria, is involved in most aspects of normal brain function, including cognition, learning, and memory. Location 719

What’s even more alarming is Dr. Fasano’s recent discovery that not only is there increased gut permeability when the gut is exposed to gliadin, a protein found in gluten, ***but in fact the blood-brain barrier also becomes more permeable in response to gliadin exposure***. Location 762

LPS: THE INCENDIARY DEVICE Location 769

***If there were ever a clear biological villain that flips on inflammatory pathways in the body, it would be lipopolysaccharide***. It is a combination of lipid (fat) and sugars and is a major component of the outer membrane of certain bacteria. Location 769

* injections of LPS into laboratory animals’ bodies (not brains) led to overwhelming learning deficits. Location 784
* LPS has also been shown to decrease production of BDNF.28 Moreover, we now have evidence that there’s three times as much LPS in the plasma of Alzheimer’s patients as in healthy controls. Location 790
* It’s a given that we all have LPS in our guts because it’s an important structural component in a lot of the bacteria there, but it shouldn’t be a given that it ends up in the bloodstream, where it can be quite destructive. Location 793

It’s well substantiated that low levels of B12 are a huge risk factor for dementia, not to mention other neurological challenges such as depression. Location 816

The health and variety of your belly’s bugs directly depend on the foods that you eat. Foods that are high in fiber, which provide fuel to the gut bacteria, and reduced in refined sugars support a robust mélange of bacterial species, which helps maintain the integrity of the gut wall, keep blood sugar in check, reduce inflammation, and manufacture all those important substances and molecules critical for brain health and function. Location 824

Omega-6 fats dominate in the Western diet today; these are the pro-inflammatory fats found in many vegetable oils that have been linked to an increased risk for brain disorders as well as heart trouble. Location 827

Omega-3 fats, on the other hand—such as the fats found in olive oil, fish, flaxseed, and wild grass-fed animals—boost brain function, help stamp out inflammation, and can actually counterbalance the detrimental effects of the omega-6 fats. Location 829

People who drank between zero and two cups daily were characterized as being “low” coffee drinkers. Those who drank between three and five cups were deemed “moderate,” Location 836

* Moderate drinkers at midlife showed an incredible 65 percent decreased risk for developing Alzheimer’s in comparison to low drinkers. Location 838
* The laboratory research is now extensive, in fact, and unambiguously shows that—through the workings of the belly’s bugs—coffee reduces the risks of type-2 diabetes, strokes, Alzheimer’s disease, Parkinson’s disease, and even cancer and cardiovascular disease. Location 845
* What’s more, we also understand that coffee is a rich source of polyphenols, molecules with known healthful properties. Location 851

In order to fully gain the health benefits of polyphenols from the foods you eat, you need a healthy microbiome. Location 857

THE TOP 3 WAYS YOUR GUTSY FRIENDS REDUCE YOUR RISK OF BRAIN DISEASE Location 858

1. They help control inflammation. Location 859

2. They bolster the intestinal wall’s integrity and prevent gut permeability. Location 862

3. They produce important chemicals for brain health, including BDNF, various vitamins such as B12, and even neurotransmitters like glutamate and GABA. Location 866

INFLAMMATION, THE GUT, AND THE MIGHTY MITOCHONDRIA Location 869

mitochondria serve us. These are the tiny organelles, found in all cells except red blood cells, that generate chemical energy in the form of ATP (adenosine triphosphate). Location 870

mitochondria should be considered part of the human microbiome. Healthy mitochondria make for a healthy human. Location 875

Basically, these organelles are able to use carbohydrate fuel and convert it to energy that powers most cell functions. Location 881

But mitochondrial respiration differs from a fire in that rather than releasing energy in an uncontrolled reaction, mitochondrial energy is stored in a unique molecular form called ATP. Location 883

Energy-rich ATP can then be delivered throughout the cell, releasing energy on demand in the presence of specific enzymes. Location 884

An important byproduct of the work done by mitochondria is the production of chemicals, related to oxygen, called reactive oxygen species (ROS). ROS are more commonly known as free radicals. Location 891

* Although they are often demonized for the negative effects they can have in the body, free radicals have a positive role in human physiology in a number of ways. They take part in regulating apoptosis, the process by which cells undergo self-destruction (suicide). Location 896
* apoptosis is a critical and necessary cellular function. Location 898
* Apoptosis is critically important, as it allows our body to rid itself of the multitude of cancer cells that appear spontaneously within us. Each day ten billion cells are terminated to make way for newer, healthier cells. And free radicals created by mitochondria during the process of energy production play a key role in this process. Location 903

when mitochondrial function becomes impaired, cellular suicide can be induced in otherwise normal, healthy cells. In fact, this is a fundamental mechanism leading to the destruction of neurons in neurodegenerative conditions such as Alzheimer’s disease, multiple sclerosis, Parkinson’s disease, and Lou Gehrig’s disease. Location 907

The radical discovery was that mitochondria control the fate of the cell: they determine whether a cell shall live or die.” Location 914

Mitochondria then, are much more than simple organelles that turn fuel into energy. They wield the sword of Damocles. And it should come as no surprise that they can be damaged very easily by inflammation—especially Location 916

we can make lifestyle changes to increase the growth of mitochondria, a process called mitochondrial biogenesis, and thereby enhance an important part of the human microbiome. Location 926

Lifestyle factors that stimulate this process include:

* eating a diet that derives more energy or calories from fat than from carbohydrate (a central theme of Grain Brain)
* reducing your caloric intake
* engaging in aerobic exercise. Location 928

Mitochondria, the source of energy to sustain our lives, are the embodiment of a purely feminine genetic code. Location 932

MS is an inflammatory disease characterized by damaged nerves in the brain and spinal cord. The insulating covering of these nerve cells, called the myelin, becomes impaired, and so the nervous system breaks down, leading to a wide range of symptoms—physical, Location 952

Over the past several years, I’ve noticed that MS patients almost always were either born by C-section, not breast-fed, or treated with antibiotics for some illness early in life. Location 958

rebuilding a healthy gut population through a revolutionary new procedure called fecal microbial transplantation, or FMT, Location 968

**CHAPTER 3 Is Your Belly Depressed? Why Angry Guts Make for Moody and Anxious Minds**

Some of my most remarkable case studies involve people changing their lives and health for the better through simple brain-making edits to their dietary choices. They cut carbs and add healthy fats, especially cholesterol—a key player in brain and psychological health. Location 1000

one in ten of those people is taking a psychiatric drug to treat a mood disorder. Location 1006

For women in their forties and fifties, one in four take an antidepressant. Location 1007

depression is now the leading cause of disability worldwide, impacting more than 350 million people Location 1012

***Last year, 30 million Americans were prescribed $12 billion worth of antidepressants***. That means that we are spending more on antidepressants than the Gross National Product of more than half of the world’s countries! Location 1014

and yet the precursor for serotonin—tryptophan—is tightly regulated by the gut bacteria. In fact, ***a particular bacterium, Bifidobacterium infantis, does a great job of making tryptophan available***. Location 1042

We know, for example, that the typical Western diet—high in refined carbs and factory fats—is associated with higher levels of C-reactive protein, a popular marker of inflammation. Location 1078

A diet filled with foods that are high on the glycemic index is also associated with higher levels of C-reactive protein. Location 1079

High blood sugar, in fact, is one of the biggest risk factors for depression, just as it is for Alzheimer’s. Location 1082

not only does LPS make the gut more permeable, but it can cross the blood-brain barrier and allow pro-inflammatory chemicals to bombard the brain. Location 1102

The science is showing that people who stick to a Mediterranean-type diet, rich in healthy, anti-inflammatory fats and proteins, enjoy significantly lower rates of depression. Location 1111

fructose has been shown to increase circulating LPS by 40 percent. Location 1114

Later on, we’ll see what kinds of ingredients—cocoa, coffee, and curcumin (turmeric), for example—can have the opposite effect of lowering the risk of depression by helping balance the microbiome. Location 1117

In the case of an infection, the immune system fans the flames as it tries to fight the infection. If antibiotics come into the picture, they will degrade the microbiome and further facilitate the inflammatory process. Location 1127

researchers found that 72 percent of the people who had never reported depression were breast-fed, whereas only 46 percent of the patients with depression had been breast-fed. Location 1135

“There are studies showing that what we eat can alter the composition and products of the gut flora—in particular, that people with high-vegetable, fiber-based diets have a different composition of their microbiota, Location 1170

Now we know that this has an effect not only on the metabolism but also affects brain function.” Location 1172

Elevated cortisol also has some damaging effects on the gut.

* First, it changes the mix of gut bacteria.
* Second, it increases permeability of the gut lining by triggering the release of chemicals from cells; Location 1185
* And third, cortisol enhances production of inflammatory chemicals coming from immune cells. These cytokines ramp up inflammation in the gut, leading to further permeability, and also directly and negatively stimulate the brain, Location 1187

New research is showing that many cytokines such as certain interleukins and TNF-α are important for inducing sleep, particularly deep, non-REM sleep, the most restorative kind. And it’s gut bacteria that stimulate production of these chemicals in concert with cortisol levels.35 Location 1200

It’s common to suffer from both anxiety and depression at the same time, and sometimes persistent anxiety is what leads to depressive symptoms due to its impact on one’s life. Location 1208

One of the byproducts of broken-down tryptophan is kynurenine, so high levels of kynurenine are a good indicator of low tryptophan levels. Location 1248

Elevated levels of kynurenine are routinely documented not only in patients with depression and anxiety but also Alzheimer’s disease, cardiovascular disease, and even in people with tic disorders. Location 1249

***Bifidobacterium infantis***—the same one shown to calm the stress response—is associated with lower levels of kynurenine. Location 1251

While ADHD and depression are often spoken about separately, they have a lot in common. After all, some of their symptoms are the same, and they both have the same underlying mechanism: rampant inflammation. Location 1274

Today more than 11 percent of children aged four to seventeen are diagnosed as having ADHD, and a staggering two-thirds of these kids are medicated. Location 1277

Specifically, the conversion demands both zinc and vitamin B6—two ingredients that must come from food. GABA can then be created by specific varieties of gut bacteria using these cofactors. Location 1341

Researchers reporting in the Journal of Applied Microbiology have so far discovered that specific types of Lactobacillus and Bifidobacterium produce GABA in abundance. Location 1343

**CHAPTER 4 How Your Intestinal Flora Can Make You Fat and Brainsick The Surprising Links Between Your Gut’s Bacteria and Appetite, Obesity, and the Brain**

in 1990 less than 15 percent of the U.S. population was obese in most states. By 2010, 36 states had obesity rates of 25 percent or higher, and 12 of those states had obesity rates of 30 percent or higher. Location 1376

Although there’s no perfect ratio that equates with health, we know that a higher ratio of Firmicutes to Bacteroidetes (that is, more Firmicutes than Bacteroidetes in the gut) is strongly associated with more inflammation and more obesity. Location 1408

But, as they also revealed in their study, you can change this. Just increasing dietary fiber can improve the ratio. Location 1424

***But for now we can say that you want more butyric and acetic acid and less propionic acid. Location 1428***

The African diet is high in fiber and low in sugar. Location 1430

Visceral fat is more than merely an enemy standing by. It is an enemy that is armed and dangerous. The number of health conditions now linked to visceral fat is tremendous, from the obvious ones such as obesity and metabolic syndrome to the not-so-obvious—cancer, autoimmune disorders, and brain disease. Location 1460

Put simply, the higher your waist circumference, the higher your risk for disease and death. Girth can also predict adverse structural changes in the brain. Location 1463

The bigger the belly (i.e., the larger a person’s waist-to-hip ratio), the smaller the brain’s memory center, the hippocampus. The hippocampus’s function is dependent upon its size. If your hippocampus shrinks, so does your memory. Location 1467

More striking still, the researchers found that the higher the waist-to-hip ratio, the higher the risk for small strokes, which are associated with declining brain function. Location 1469

Our cells can accept glucose only with the help of insulin, which acts like a transporter and is produced by the pancreas. Insulin shuttles glucose from the bloodstream into cells, where it can then be used as fuel. Location 1485

When a cell is normal and healthy, it has abundant receptors for insulin, so it has no problem responding to it. Location 1487

But when a cell is mercilessly exposed to high levels of insulin through a never-ending presence of glucose—caused by consuming too many carbohydrates and refined sugars—the cell does something brilliant to adapt: It reduces the number of insulin-responsive receptors on its surfaces. Location 1487

Blood sugar increases lead to a depletion of important neurotransmitters, including serotonin, epinephrine, norepinephrine, GABA, and dopamine. Location 1505

The data showing the relationship between high carbohydrate consumption and diabetes is almost indisputable. Location 1517

***In 1994, when the American Diabetes Association recommended that Americans consume 60 to 70 percent of their calories from carbohydrates, the diabetes (and obesity) epidemic took off. Location 1517***

Generally, we acknowledge that the modern Western diet, high in carbohydrates and refined sugars as well as processed fat, is responsible for the obesity epidemic. Location 1539

For example, one such missing microbe that’s associated with regulating hunger is Helicobacter pylori, which helps control appetite by affecting levels of ghrelin, the main hormone that stimulates appetite. Location 1568

One of the most insidious villains with respect to our gut’s microbiome, which I’ve briefly mentioned and will explore in further detail later, is processed fructose. ***The typical American consumes high-fructose corn syrup at the rate of 132 to 312 calories a day***. Location 1586

Although we used to think that ***sugar substitutes like saccharin, sucralose, and aspartame didn’t have a metabolic impact because they don’t raise insulin, it turns out that they can indeed wreak tremendous metabolic havoc*** and cause the same metabolic disorders as real sugar. Location 1594

They do this by changing the microbiome in ways that favor dysbiosis, blood sugar imbalances, and an overall unhealthy metabolism. Location 1596

Multiple studies show that when the number of Firmicutes is reduced, so is the risk for metabolic problems like diabetes. Location 1609

I should also add that exercise serves a role in promoting the right balance of microbes. Location 1612

New science reveals that exercise positively influences the gut’s balance of bacteria to favor colonies that prevent weight gain. Location 1614

These at-risk babies are typically the ones delivered by elective C-section, are mostly formula-fed, and often suffer from chronic infections for which antibiotics are prescribed. Location 1628

In the states where obesity rates are highest, so is antibiotic use. And the South wins the award for being the most overweight and overprescribed. Location 1650

**CHAPTER 5 Autism and the Gut On the Frontiers of Brain Medicine**

“Each child with autism is like a snowflake—unique from the others.”3 Location 1694

Take a look at the following chart showing the rise in cases from 1970 to 2013:5 Location 1710

the conversation was mired in the controversy about the vaccine-autism connection, a connection that has been scientifically disproven. Location 1713

You could carry genes that put you at a much higher risk for obesity, heart disease, and dementia than someone who doesn’t have underlying genetic susceptibilities, yet you may never suffer from these maladies because the genes remain dormant due to their environment. Location 1751

Fecal microbial transplant (FMT) is the most aggressive therapy available to reset and recolonize a very sick microbiome. Location 1802

Multiple studies now show that GI conditions are among the hallmarks of autism. Parents of children with autism usually report that their children suffer from abdominal pain, constipation, diarrhea, and bloating. Location 1829

Today, the CDC estimates that children with autism are more than 3.5 times more likely to experience chronic diarrhea and constipation than their peers who do not have autism—a Location 1835

One 2010 study even found a pattern of higher levels of LPS—the pro-inflammatory molecule—in patients with severe autism.13 LPS, you’ll recall, should generally not find its way to the bloodstream but can do so if the intestinal wall is compromised. Location 1838

Higher levels of clostridial species may help explain why many kids with autism crave carbohydrates—especially refined sugars, the foods that feed these bugs—creating a vicious cycle that fuels the proliferation of more Clostridia. Location 1850

In other words, different types of bacteria produce different short-chain fatty acids. Clostridial species produce propionic acid (PPA) in abundance, which, as you’re about to learn, isn’t a good thing if PPA passes into the bloodstream. Location 1886

But it’s another to see a video of these animals. MacFabe recorded his experiment so the world can see the before and after. It’s breathtaking, and you can see it for yourself on my website, where Dr. MacFabe has given me permission to post it. Location 1910

These include L-carnitine, an amino acid critical to healthy brain function; omega-3 oils; and n-acetyl cysteine (NAC), the latter of which can enhance glutathione production. Location 1913

And we have plenty of evidence to show that individuals with autism are typically deficient in glutathione, a key antioxidant in the brain that helps control oxidative damage and inflammation. Location 1914

Neurological disorders as diverse as autism, schizophrenia, bipolar disorder, Parkinson’s, and Alzheimer’s have all been linked to mitochondrial glitches. Location 1957

The researchers documented much higher levels of oxidative stress in the children with autism, as measured by higher levels of hydrogen peroxide with their mitochondria. What’s more, two of the children with autism showed deletions in their mitochondrial DNA genes, a phenomenon not seen in the control children. Location 1975

Even though genes encoded by DNA are essentially static (barring the occurrence of mutation), the expression of those genes can be highly dynamic in response to environmental influences. This field of study, called epigenetics, is now one of the hottest areas of research. Location 1998

Epigenetics, defined more technically, is the study of sections of your DNA (called “marks” or “markers”) that essentially tell your genes when and how strongly to express themselves. Location 2004

Like conductors of an orchestra, these epigenetic marks control not only your health and longevity, but also how you pass your genes on to future generations. Location 2006

**PART II TROUBLE IN BUGVILLE**

**CHAPTER 6 Punched in the Gut The Truth about Fructose and Gluten**

“Overall, dietary changes could explain 57% of the total structural variation in gut microbiota whereas changes in genetics accounted for no more than 12%. Location 2043

Diet has the dominant role in shaping gut microbiota, and changing key populations may transform healthy gut microbiota into a disease-inducing entity. Location 2046

Fructose is naturally found in fruit, but that’s not where we’re getting it from; ***most of the fructose we consume is from manufactured sources***. Location 2053

Of all naturally occurring carbohydrates, fructose is the sweetest. No wonder we love it so much. But, contrary to what you might think, it doesn’t have a high glycemic index. In fact, it has the lowest GI of all the natural sugars because the liver metabolizes most of the fructose, so it has no immediate effect on our blood-sugar and insulin levels. Location 2060

Fructose has long-term effects when it’s consumed in large quantities from unnatural sources. Location 2063

It’s a huge burden to the liver, which is forced to expend so much energy converting fructose into other molecules that it risks not having enough left for all of its other functions. Location 2065

diets high in fructose often lead to obesity and its metabolic repercussions. Location 2068

***I should add that the fiber in fruits and vegetables slows down absorption of fructose into the bloodstream***. Conversely, high-fructose corn syrup and crystalline fructose disrupt liver metabolism, which, along with excess glucose, spikes blood-sugar levels and exhausts the pancreas. Location 2069

Studies are emerging that show that gut bacteria of people who regularly consume artificial sweeteners look different from gut bacteria of people who do not. Location 2093

French researchers had followed more than 66,000 women since 1993 and found that the risk for developing diabetes was more than double for those who drank artificially sweetened drinks than it was for women who consumed sugar-sweetened beverages. Location 2096

The average American eats 80 grams of fructose each day, often in the processed form of high-fructose corn syrup. Location 2100

The fructose is rapidly fermented by the gut bacteria, resulting in byproducts like those short-chain fatty acids we discussed in chapter 5, as well as a potpourri of gases, Location 2102

Excess fructose in the gut also pulls excess water with it, which can have a laxative effect. Adding insult to injury, those short-chain fatty acids also draw more water to the bowel. Location 2105

researchers showed that high fructose can cause bacteria to exit the intestines, go into the bloodstream, and damage the liver. Location 2110

GLUTEN Location 2117

gluten in Grain Brain, calling the protein found in wheat, barley, and rye among the most inflammatory ingredients of the modern era. Location 2118

Gluten sensitivity—with or without the presence of celiac—increases the production of inflammatory cytokines, which are pivotal players in neurodegenerative conditions. Location 2121

Gluten is made up of two main groups of proteins, the glutenins and the gliadins. Location 2134

Gluten’s “sticky” attribute interferes with the breakdown and absorption of nutrients, which leads to poorly digested food that can then sound the alarm in the immune system, eventually resulting in an assault on the lining of the small intestine. Location 2139

That’s right, all humans have some degree of gluten sensitivity. Once you have a leaky gut, you’re highly susceptible to other food sensitivities in the future. Location 2147

In their conclusions, the study’s authors said that this may explain why gliadin contributes to “neurologic complications such as neuropathy, ataxia, seizures, and neurobehavioral changes.”6 Location 2154

Dr. Fasano’s research reveals that the same mechanism by which gluten increases inflammation and gut permeability also leads to a breakdown of the blood-brain barrier itself, paving the way for the production of yet more brain-crushing inflammatory chemicals. Location 2157

the same company—***Cyrex Labs—that does the blood screening tests for LPS also performs high-tech tests for gluten sensitivity*** (go to [www.DrPerlmutter.com/Resources](http://www.DrPerlmutter.com/Resources) for more about these important tests). Location 2160

Children born by C-section and those who’ve taken lots of antibiotics are at a much higher risk for developing celiac disease, and this heightened risk is a direct function of the quality of the developing microbiome and how many insults it has weathered. Location 2170

Our novel study thus suggests that dietary gluten could modulate the incidence of [type 1 diabetes] by changing the gut microbiome.” Location 2181

I like to tell patients that cleaning up their diet to nix gluten and manufactured fructose, while limiting natural fructose from real fruit, is step 1 in preserving the health and function of their microbiome and brain. Step 2, as you’re about to read, is managing exposures to chemicals and drugs that can also have health implications—the focus of this next chapter. Location 2197

**CHAPTER 7 Bust a Gut Common Exposures That Make a Good Microbiome Go Bad**

Serious diseases that once killed millions of people each year can easily be treated today thanks to antibiotics. The discovery of antibiotics (“against life”) in the early part of the 20th century has been one of our most significant medical achievements. Location 2217

Four out of five Americans take an antibiotic every year, Location 2235

The World Health Organization (WHO) has stated: “Without urgent action we are heading for a post-antibiotic era, in which common infections and minor injuries can once again kill.” Location 2239

Alexander Fleming himself warned us about these potential consequences back in 1945 during his Nobel Prize lecture, Location 2242

***Firmicutes can harvest more energy from food, thereby increasing the risk of the body absorbing more calories and gaining weight***. The guts of obese humans are routinely found to be dominated by Firmicutes, as opposed to ***Bacteroidetes, which are predominant in the guts of lean individuals***. Location 2263

In 2011, U.S. drug makers sold nearly 30 million pounds of antibiotics for livestock, the largest amount yet recorded, representing 80 percent of all antibiotics sales that year.7 Location 2281

In those individuals who’d taken the most antibiotics, the risk of breast cancer was doubled. Location 2305

The latest research indicates that there is absolutely no benefit in taking antibiotics for dental procedures if you have a total hip or knee prosthesis. Location 2344

Although virtually all medicines have some impact on the microbiome, drugs like the Pill, that are taken daily and often long-term, are the most insidious. Location 2361

* It’s also no wonder that among the most common side effects noted in using the Pill are mood and anxiety disorders. One of the vitamins depleted by the Pill is B6, which is a cofactor for the production of serotonin and GABA—two key molecules in brain health. Location 2368
* Comparing those who never used birth control pills to those who did, he found that current users had a nearly three times greater risk of Crohn’s disease. Location 2380
* In his conclusions, Dr. Khalili warned that women on birth control pills who have a strong family history of inflammatory bowel disease should especially be made aware of the research finding a link between the two. Location 2381

These days, women’s lib looks a lot more like a healthy, happy menstrual cycle free from the grips of a prescription.” Location 2387

people who have taken nonsteroidal anti-inflammatory medications such as Advil (ibuprofen) and Aleve (naproxen) for two or more years may have more than a 40 percent reduced risk for Alzheimer’s and Parkinson’s diseases. Location 2390

But newer studies are now emerging to reveal a twist in the story. It’s been shown that these medications can increase the risk of damage to the gut lining, especially in the presence of gluten. Location 2393

Traces of 232 synthetic chemicals have been found in the umbilical cord blood of infants at birth. Location 2401

In the last three decades, more than 100,000 chemicals have been approved for commercial use in the U.S., including more than 82,000 industrial chemicals, 1,000 pesticide active ingredients, 3,000 cosmetic ingredients, 9,000 food additives, and 3,000 pharmaceutical drugs. Location 2403

when the liver is overloaded with toxins to process, it can be less effective at clearing them from the body. This, in turn, changes the entire habitat of the body, as well as the microbial community. Location 2415

The two in particular that should be avoided as much as possible are pesticides and chlorine. These have been shown to have detrimental effects on the gut bacteria. Location 2433

The toxicity of pesticides is of such concern that below I’ll further note why it’s important to avoid most GMO foods due to their relationship with herbicides. Location 2441

Chemicals found in our water supply, principally residual chlorine, can also be destructive to the microbiome. Chlorine is bactericidal; it effectively kills a large variety of microbial waterborne pathogens. Location 2442

we’re exposed to larger amounts of toxic substances through a process called bioaccumulation. Location 2455

certain kinds of fish, such as swordfish, have a concentration of chemicals in their tissues exponentially greater than the concentration found in the surrounding water. On land, many livestock eat grains sprayed with pesticides and then store those toxic substances in their fat, along with potential toxins like hormones, antibiotics, and other chemicals. Location 2456

***By definition, GMOs are plants or animals that have been genetically engineered with DNA from other living things, including bacteria, viruses, plants, and animals****.* The genetic combinations that result cannot occur in nature or in traditional crossbreeding. Location 2462

***The top two GMO crops in the U.S. are corn and soy Location 2464***

So rather than having to resort to manually removing weeds, an alternative has been created. America’s farmers now spray a weed-killing chemical, glyphosate (RoundUp®), on their crops. The harvested crop is prevented from also being targeted by the herbicide because the seeds used are genetically modified to be resistant to the herbicide’s effects. In the world of agriculture, these seeds are known as “RoundUp® ready.” Location 2470

Glyphosate residues represent a threat to human health. In the wheat industry in particular, farmers saturate the fields with RoundUp® a few days before harvest to generate a bigger and better yield. Location 2475

It just may be that the rise in gluten intolerance and celiac disease is largely due to the increased use of RoundUp®. Location 2477

When you chart the incidence of celiac and the levels of glyphosate applied to wheat over the past 25 years, a stunning parallel pattern emerges.27 Location 2477



Mind you, correlation doesn’t imply causation. Location 2480

Unless it had a non-GMO or certified-organic stamp of approval, “the food almost always had considerable levels of GMOs.” Location 2507

**PART III BRAIN MAKER REHAB**

**CHAPTER 8 Feeding Your Microbiome Six Essential Keys to Boosting Your Brain by Boosting Your Gut**

Research shows that significant changes in the array of gut bacteria can take place in as little as six days after instituting a new dietary protocol, Location 2532

The following are the six essential keys to sustaining a healthy microbiome, based on the latest science. Location 2534

* KEY #1: CHOOSE FOODS RICH IN PROBIOTICS Location 2535
	+ health benefits associated with fermented foods were well recognized. Location 2538
	+ The type of fermentation that makes most foods probiotic (rich in beneficial bacteria) is called lactic acid fermentation. In this process, good bacteria convert the sugar molecules in the food into lactic acid. Location 2549
	+ In doing so, the bacteria multiply and proliferate. This lactic acid in turn protects the fermented food from being invaded by pathogenic bacteria because it creates an environment with a low pH (i.e., an acidic environment), which kills off harmful bacteria with a higher pH. Location 2550
	+ To make yogurt, for instance, all you need is a starter culture (strains of live active bacteria) and milk. Location 2553
	+ there’s no better way to consume a bevy of bifidobacteria and lactobacilli than to get them from wholly natural sources, which make them exceptionally bioavailable Location 2555
	+ These are the strains that go to work in your body in numerous ways. They help maintain the integrity of the gut lining; balance the body’s pH; serve as natural antibiotics, antivirals, and even antifungals; regulate immunity; and control inflammation. Location 2557
	+ In addition, probiotic bacteria suppress the growth and even invasion of potentially pathogenic bacteria by producing antimicrobial substances called bacteriocins. Location 2558
	+ What’s more, as these probiotic bacteria metabolize their sources of fuel from your diet, they liberate various nutrients contained in the foods you eat, making them easier to be absorbed. For example, they increase the availability of vitamins A, C, and K, as well as vitamins from the B-complex group. Location 2559
	+ Live-cultured yogurt. Location 2578
	+ Kefir. This fermented dairy product is very similar to yogurt. Location 2581
	+ Kombucha tea. Location 2584
	+ Tempeh. Many people, especially vegetarians, eat tempeh as a substitute for meat. Tempeh is fermented soybeans and is a complete protein, with all of the amino acids. Location 2586
	+ Kimchi. In addition to providing beneficial bacteria, kimchi is also a great source of calcium, iron, beta-carotene, and vitamins A, C, B1, and B2. Location 2590
	+ Sauerkraut. Not only does this fermented cabbage fuel healthy gut bacteria, but it also contains choline, a chemical needed for the proper transmission of nerve impulses from the brain through the central nervous system. Location 2592
	+ Pickles. Location 2594
	+ Pickled fruits and vegetables. Location 2596
	+ probiotic benefits are only present in unpasteurized foods pickled in brine, not vinegar. Location 2598
	+ Cultured condiments. Location 2599
	+ Fermented meat, fish, and eggs. Location 2602

* KEY #2: GO LOW-CARB, EMBRACE HIGH-QUALITY FAT Location 2606
	+ our ancestors’ diets consisted of wild animals and seasonal fruits and vegetables. Today most people’s diets are centered on grains and carbs—many of which contain gut-blasting, microbiome-damaging gluten whose downstream effects reach the brain. Location 2608
	+ one of the main reasons that consuming too many grains and carbs is so harmful is that they spike blood sugar in ways other foods, such as meat, fish, poultry, and vegetables, do not. Location 2610
	+ As we went from eating a high-fat, high-fiber, low-carb diet to a low-fat, low-fiber, high-carb one, we concomitantly began to suffer from chronic conditions linked to the brain. Location 2618
	+ diets high in sugar and low in fiber fuel unwanted bacteria and increase the chances of intestinal permeability, mitochondrial damage, immune-system compromise, and widespread inflammation that reaches the brain. And it’s a vicious cycle; all of these effects further assault that microbial balance. Location 2624
	+ fat—not carbohydrate—is the preferred fuel of human metabolism and has been for all of human evolution. Location 2626
	+ Coronary artery disease, a leading cause of heart attacks, may have more to do with inflammation than with high cholesterol. Location 2641
	+ Moreover, cholesterol acts as an antioxidant and a precursor to important brain-supporting molecules like vitamin D, as well as the steroid-related hormones Location 2643
	+ The brain demands high amounts of cholesterol as a source of fuel, but neurons cannot themselves generate significant amounts of it. So they depend on cholesterol that’s delivered by the bloodstream via a special carrier protein called LDL, or low-density lipoprotein. Location 2645
	+ They concluded that the best diet for maintaining weight loss is a low-carbohydrate, high-fat one. Location 2664
	+ A diet high in rich sources of fiber, which you’ll get from whole fruits and vegetables, feeds the good gut bacteria and produces the right balance of those short-chain fatty acids to keep the gut lining in check. Location 2669
	+ Note that the Brain Maker diet calls for the main entrée to be mostly fibrous fruits and vegetables that grow above ground, with protein as a side dish. Location 2673
	+ an ideal plate in the Brain Maker protocol is a sizeable portion of vegetables (two-thirds of your plate) and about 3 to 4 ounces of protein. Location 2675
	+ You’ll get your fats from those found naturally in protein, from ingredients used to prepare the protein dish and vegetables, such as butter and olive oil, and from nuts and seeds. Location 2677
	+ Vegetables: leafy greens and lettuces, collards, spinach, broccoli, kale, chard, cabbage, onions, mushrooms, cauliflower, Brussels sprouts, artichoke, alfalfa sprouts, green beans, celery, bok choy, radishes, watercress, turnip, asparagus, garlic, leek, fennel, shallots, scallions, ginger, jicama, parsley, water chestnuts Location 2681
	+ Low-sugar fruit: avocado, bell peppers, cucumber, tomato, zucchini, squash, pumpkin, eggplant, lemons, limes Location 2684
	+ Fermented foods: yogurt, pickled fruits and vegetables, kimchi, sauerkraut, fermented meat, fish, and eggs (see Key #1, here) Location 2686
	+ Healthy fat: extra-virgin olive oil, sesame oil, coconut oil, grass-fed tallow and organic or pasture-fed butter, ghee, almond milk, avocados, coconuts, olives, nuts and nut butters, cheese (except for blue cheeses), and seeds (flaxseed, sunflower seeds, pumpkin seeds, sesame seeds, chia seeds) Location 2688
	+ Protein: whole eggs; wild fish (salmon, black cod, mahimahi, grouper, herring, trout, sardines); shellfish and mollusks (shrimp, crab, lobster, mussels, clams, oysters); grass-fed meat, fowl, poultry, and pork (beef, lamb, liver, bison, chicken, turkey, duck, ostrich, veal); wild game Location 2690
	+ Herbs, seasonings, and condiments: mustard, horseradish, tapenade, and salsa if they are free of gluten, wheat, soy, and sugar (kiss ketchup goodbye); no restrictions on herbs and seasonings (but be mindful of packaged products that may have been made at plants that process wheat and soy) Location 2693

* KEY #3: ENJOY WINE, TEA, COFFEE, AND CHOCOLATE Location 2712
	+ you can embrace wine, coffee, and chocolate in moderation and tea to your heart’s desire. Location 2713
	+ Flavonoids are produced by plants to protect themselves against such perpetrators as free radicals. They are polyphenols, powerful antioxidants found in plants; they may in fact be the most abundant antioxidant in the human diet. Location 2714
	+ The main dietary sources of polyphenols are fruits and vegetables; plant-derived beverages, including coffee, red wine, and tea; and chocolate. Location 2718
	+ consuming flavonoids leads to significant improvement in blood flow to the brain. Location 2735
	+ Like chocolate, coffee packs a healthy punch and has gained fame in the past couple of years thanks to new science highlighting its impact on the microbiome. Location 2738

* KEY #4: CHOOSE FOODS RICH IN PREBIOTICS Location 2749
	+ It has been estimated that for every 100 grams of consumed carbohydrates that qualify as prebiotics, a full 30 grams of bacteria are produced. Location 2751
	+ Prebiotics, by definition, must have three characteristics. \
		- First and foremost, they must be non-digestible, meaning they pass through the stomach without being broken down by either gastric acids or enzymes. Location 2757
		- Second, they have to be able to be fermented or metabolized by the intestinal bacteria. Location 2758
		- third, this activity has to confer health benefits. Location 2759
	+ By and large, Americans don’t get enough prebiotics. I recommend aiming for 12 grams daily, either from real foods, a supplement, or a combination thereof. Below is the list of top food sources of natural prebiotics. Location 2777
		- Acacia gum (or gum arabic)
		- Raw chicory root
		- Raw Jerusalem artichoke
		- Raw dandelion greens
		- Raw garlic Location 2779
		- Raw leek
		- Raw onion
		- Cooked onion
		- Raw asparagus Location 2783

* KEY #5: DRINK FILTERED WATER Location 2788

* KEY #6: FAST EVERY SEASON Location 2821
	+ One critical mechanism of the human body is its ability to convert fat into vital fuel during times of starvation. Location 2822
	+ We can break down fat into specialized molecules called ketones, and one in particular—beta-hydroxybutyrate (beta-HBA)—is a superior fuel for the brain. Location 2822
	+ Researchers have determined that **beta-HBA, which is easily obtainable just by adding coconut oil to your diet, improves antioxidant function, increases the number of mitochondria, and stimulates the growth of new brain cells**. Location 2824
	+ **intermittent fasting—a complete restriction of food for twenty-four to seventy-two hours at regular intervals throughout the year—**is more manageable and can achieve the same results as calorie restriction. Location 2842
	+ **My fasting protocol is simple: No food but lots of water** (avoid caffeine) for a twenty-four-hour period. Location 2851
	+ I recommend fasting **at least four times a year**; fasting during the seasonal changes (for example, the last week of September, December, March, and June) is an excellent practice to keep. Location 2854

**CHAPTER 9 Go Pro The Guide to Supplements**

five core probiotic species that are widely available: Lactobacillus plantarum, Lactobacillus acidophilus, Lactobacillus brevis, Bifidobacterium lactis, and Bifidobacterium longum. Location 2950

1. Lactobacillus plantarum:1, 2 Found in kimchi, sauerkraut, and other cultured vegetables, Location 2975
2. Lactobacillus acidophilus:3 L. acidophilus is the darling of fermented dairy products, including yogurt. Location 2987
3. Lactobacillus brevis:4 Sauerkraut and pickles owe a lot of their benefits to this bug, which improves immune function by increasing cellular immunity and even enhancing killer T cell activity. Location 2993
4. Bifidobacterium lactis (also called B. animalis):6 Fermented milk products like yogurt contain this gem, which is well documented to have a powerful effect on preventing digestive ills and boosting immunity. Location 2998
5. Bifidobacterium longum:9 Just one of the 32 species that belong to the genus bifidobacterium, this is one of the first bugs to colonize our bodies at birth. Location 3008

ADDITIONAL SUPPLEMENTS TO CONSIDER Location 3056

* DHA: Docosahexaenoic acid (DHA) is a star in the supplement kingdom and one of the most well-documented darlings in protecting the brain. DHA is an omega-3 fatty acid that makes up more than 90 percent of the omega-3 fats in the brain. Location 3059
	+ Take 1,000 mg daily. Location 3063
* Turmeric: Location 3065
	+ I recommend a supplement of 500 mg twice daily. Location 3070
* Coconut oil: This superfuel for the brain also reduces inflammation, which is why it’s known in the scientific literature to prevent and treat neurodegenerative disease states. Take a teaspoon or two of it straight, or use it when you prepare meals. Location 3071
	+ Coconut oil is heat-stable, so if you are cooking at high temperatures, use this instead of canola oil. Location 3072
* Alpha-lipoic acid: Location 3073
	+ Aim for 300 mg daily. Location 3077
* Vitamin D: Location 3077
	+ For adults, I generally recommend a starting dosage of 5,000 IU of vitamin D3 daily. Location 3085
	+ It’s important to have your doctor track your vitamin D levels until you are able to identify a dosage that will keep you in the upper range of “normal” on the blood test. Location 3086

**CHAPTER 10 The Brain Maker 7-Day Meal Plan Eat Your Way to a Healthier Brain**

**At** [www.DrPerlmutter.com/Resources](http://www.DrPerlmutter.com/Resources) you’ll find my recommendations for specific brands of foods that follow my guidelines. Location 3103

To reap the benefits of acacia gum, you can buy acacia powder and mix it with water. Just 1 tablespoon will give you 6 grams of insoluble fiber—the Location 3118

**When pan-frying foods, you can use butter, organic extra-virgin olive oil, or coconut oil**. Avoid processed oils and cooking sprays, unless the spray is made from organic olive oil. Location 3119

grass-fed beef is low in saturated fat, but it also offers up to six times more omega-3 fatty acids. Location 3122

use the Monterey Bay Aquarium’s Seafood Watch website at www.seafoodwatch.org to further help you choose the highest-quality sustainable fish that contains the least amount of toxins such as mercury. Location 3124

I like to use coconut flour, nut meals (e.g., ground almonds), and flaxseed instead of regular flour or wheat. Location 3213

And cook with butter and extra-virgin olive oil, ditching the processed vegetable oils. Location 3214

make it a goal to incorporate at least one fermented food into your daily menu going forward. Location 3215

* Milk-Based Kefir Location 3282
* Yogurt Location 3309