

GUT CHECK

Recent research shows a diverse population of intestinal bacteria is essential for good health. In an effort to improve the quantity and diversity of their own personal microbiota, many health-conscious people are exploring the wild and unpredictable world of at-home fermentation.

By Hilary Achauer ■



I pulled the crock of sauerkraut from under the kitchen sink, eager to show my mother the product of my latest obsession: at-home fermentation.

I removed the dish towel covering the top and peered at the contents. Little bits of white mold floated on the surface of the brine, which covered the fermenting cabbage below.

"It's fine." I said with false confidence. "All you have to do is scrape off the mold on top."

My mom watched as I plucked the mold out of the brine.

"You missed some," she said, pointing to the side of the crock. Nobody asked for a taste, so I put the cover back on the crock and shoved the sauerkraut under the sink.

"Maybe it needs to ferment a little while longer," I said.

One hundred fifty years ago, Louis Pasteur figured out how to isolate a microorganism. His discovery led to the germ theory of disease and pasteurization, both of which saved countless lives. Winning the battle against bacteria was essential for the development of modern medicine and large-scale food production.

In the years that followed, armed with antibiotics and antibacterial soap, we've waged war on bacteria. In the process, we've reduced the number and diversity of our gut flora—the trillions of microorganisms that live in our intestines.

Unlike a hospital operating room, our bodies are not sterile environments. We are a delicate ecosystem: remove one element and everything is thrown out of balance.

A barren gut can have a negative impact on our weight and our mental health. The wrong type of gut flora may lead to obesity, could contribute to autism, and can have a negative effect on mood, behavior and feelings. In his book, *Missing Microbes: How the Overuse of Antibiotics Is Fueling Our Modern Plagues*, Dr. Martin Blaser, director of New York University's Human Microbiome Program and formerly its chairman of medicine, looked at the rise of asthma, allergies, food allergies, wheat allergy, juvenile diabetes, obesity, etc. since World War II (1). He thinks the cause is our changing microbiome.

As scientists discover the importance of a well-rounded population of gut bacteria, people have become interested in how to improve the quality of their gut microbiota. Many rely on probiotics, either in commercially made yogurt or

through supplements, but there's a growing interest in at-home fermentation to access friendly bacteria not available in the store. Just like processed food is not as healthy as a fresh, homemade meal, store-bought fermented products have many times fewer strains of good bacteria than the kind made at home.

Given the mounting evidence that the right mix of bacteria in your gut is essential for good health, what's the best approach to make sure your innards are in tip-top shape?

Healthy Gut, Healthy Life

For many years, the prevailing attitude toward weight loss has been based on a simple formula: calories in, calories out. However, recent studies have revealed many people are fighting an uphill battle when it comes to weight loss. A 2013 study showed that the gut inhabitants of the obese might differ substantially from people who are lean. In the study "Gut Microbiota From Twins Discordant for Obesity Modulate Metabolism in Mice," scientists took a sample of gut bacteria from four pairs of human twins; one of the twins was lean and the other was obese (6). Scientists transferred the gut bacteria into lean mice and found the animals with bacteria from the obese twins grew fat, while the mice with bacteria from the lean twins stayed lean.

Researchers believe when a person's gut bacteria are too efficient, that person absorbs more calories. The ideal is to have gut bacteria that extract fewer calories from the food.

It appears it's not just the bacteria's efficiency that has an impact on health. A study of close to 300 Danish volunteers (both lean and obese) found those with a low genetic diversity of bacteria had higher inflammation, greater insulin resistance and other warning signs of metabolic disease (5). Not all the obese people in the Danish study had a low genetic diversity of bacteria, so the thought is low diversity might be a risk factor for developing a metabolic disorder—such as Type 2 diabetes—that sometimes accompanies obesity.

And, as the *New York Times* article [The Fat Drug](#) pointed out, antibiotics may be a clue to the obesity epidemic. After all, farmers have been using antibiotics to fatten livestock for more than 60 years.

The makeup of our gut has an influence that extends well

beyond weight. A study published in *Nature* revealed that fewer bacterial species in the intestine make people more likely to develop health complications such as cardiovascular diseases and diabetes (2). The study reported a species-rich bacterial flora functions entirely differently than a less-diverse microbiome.

These are fascinating findings, and they're coming when the study of gut bacteria is in its infancy. About 90 percent of the bacterial genes found in the Danish study could not even be assigned to a specific bacterial genome (6). We have a lot to learn.

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Perhaps even more astonishing than the connection between weight and our gut microbiome is growing evidence that our gut bacteria affect our brains, influencing our mood, behavior and feelings. Scientists are discovering gut microbiota influences brain function and behavior by communicating with the central nervous system, most likely through neural, endocrine and immune pathways. Studies done on animals have revealed that gut bacteria help regulate anxiety, mood, cognition and pain perception. A recent study involved mice with gastrointestinal issues whose behavior could be considered somewhat similar to that of humans with autism (4). The researchers treated the mice with probiotics, and not only did the treatment improve the gastrointestinal issues of the mice, but it also improved their behavior.

Most people think of the gut as a food processor, as a way for our body to extract nutrients from what we consume. That's just the beginning. Our guts have their own nervous system, with as many neurons as the spinal cord. That phrase "gut feeling" is more accurate than we ever



Made up of yeast and bacteria, kefir grains are live cultures that can be reused to make more kefir.

thought; the gut produces about 90 percent of the body's serotonin, a neurotransmitter thought to contribute to feelings of well-being and happiness.

Of particular interest to meat-happy CrossFit athletes is a recent study that found a diet heavy on meat and cheese and light on carbohydrates alters the gut negatively in a matter of days (3). This suggests those following a meat-heavy, low-carb diet should be assiduous about ensuring a diverse flora in their gut via probiotics.

Improving Our Gut

So does a diet full of clean, unprocessed foods guarantee a healthy gut, or do we need to take additional steps to ensure our internal ecosystems are healthy?

The world's leading proponent of at-home fermentation is Sandor Katz, a self-taught fermentation experimentalist who travels around the world leading workshops. When Michael Pollan, author of *The Omnivore's Dilemma*, *The Botany of Desire* and *In Defense of Food, Cooked*, he visited Katz.

Katz has written what many consider the bible of fermentation: *The Art of Fermentation*. As Pollan wrote in the book's foreword, "Katz's book is the main reason that my kitchen counters and basement floors have lately sprouted an assortment of mason jars, ceramic crocks, jelly jars, bottles, and carboys, the clear ones glowing with unearthly colors."

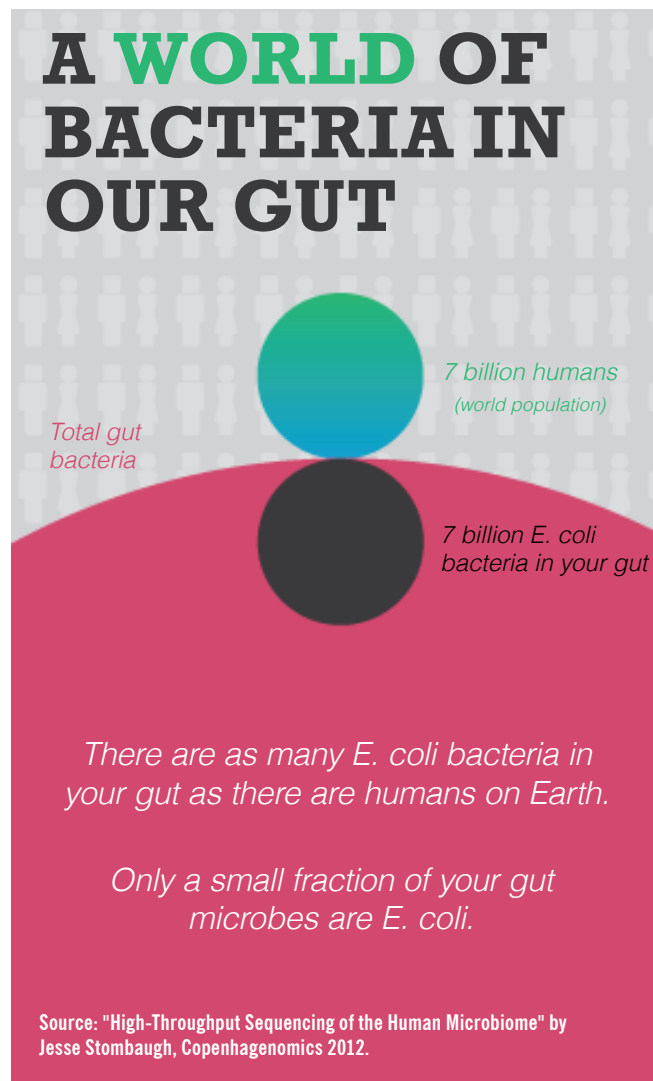
I had amassed pages of information about the importance of gut bacteria, but I hit a brick wall when I tried to find the best way to develop a diverse and happy gut. I was unable to find any studies that pointed to the superiority of fermented foods over store-bought probiotics. What's more, I wasn't even sure if supplementing with probiotics or food is even necessary for someone who eats a diet full of clean, unprocessed foods. If anyone could answer these questions, it would be Katz, who has been experimenting with fermentation since the 1990s.

When asked if he thinks it's necessary to add fermented foods to our modern diet, Katz said enhancing our gut bacteria wouldn't be necessary in a perfect world. However, we face near-constant exposure to chemicals in our modern lives. Between chlorine in the water, antibacteri-

al cleansing products and antibiotics, we are all exposed to chemicals designed to kill a broad spectrum of bacteria every day.

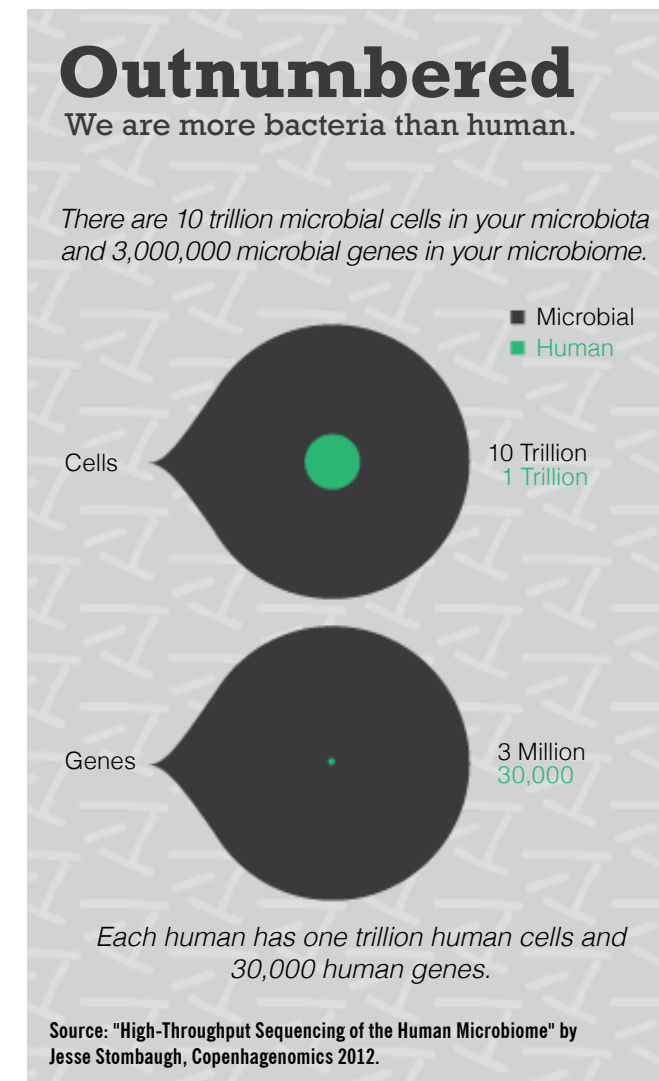
Antibacterial soaps and cleaning products do a good job of killing harmful bacterial such as *E. coli*, but they also take down the good bacteria—the bacteria that can prevent you from getting sick.

"So no matter how healthy the diet you are eating, for people in the 21st century much more than for people in the past, we really need to be consciously ingesting foods and/or supplements with bacteria to replenish and diversify our gut bacteria, which we are learning are so important," Katz said.



If we accept the idea that we need to build up our gut bacteria as a defense against a lifetime of chemicals and antibiotics, why not take the easy route and buy one of the many types of probiotic supplements available in pill form? I told Katz I had been unable to find any studies or evidence that pointed to the superiority of fermented food over probiotics in pill form.

Katz said there's a simple reason for this: "Almost all the research has to do with specific, proprietary probiotic strains. Nobody is investing money in clinical trials for sauerkraut. The benefit of that does not accrue to anyone the way it does to the manufacturers of proprietary probiotic strains."



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For Katz, one of the most important things he's learned about bacteria over the years is that they are not genetically fixed, like we are. The genetic material of bacteria is free floating in the cell, and as a result they have an enormous amount of genetic flexibility.

"Two bacteria can exchange genetic material. A single bacterium can release genetics that are no longer relevant to its existence in a shifting environment," Katz said. The type of bacteria you can find in a grocery-store probiotic supplement is usually a single type of bacteria. And while the product may boast it contains billions of cells, you won't find the diversity inherent in wild fermentation.

"Eight billion cells of a single bacteria with a single set of genetic material simply does not provide the kind of stimulation that a community of bacteria with varied genetic material supplies," Katz said.

"All of the traditional fermented foods have broad communities of bacteria—in sauerkraut, in yogurt, in kefir, in kombucha, for that matter in salami, in cheese, in olives, in traditionally fermented foods," he said. Katz said these traditional foods naturally have a greater diversity of probiotics than any capsules you can find in the store. For that reason, he believes fermented food is far superior to commercially made probiotic supplements.

"But nobody has conducted clinical trials around traditional foods because nobody stands to benefit from it," he said.

"I would advocate eating different types of fermented foods at different stages of their development as being the best way you could feed more genetic material into your gut. And also, traditional fermented foods do happen to be among the most celebrated foods around the world, so that makes them more interesting than popping capsules," he said.

Over and over again, we find that when it comes to nutrition, shortcuts don't work. Pills are no substitute for the real thing. Why would it be anything different for something as complex and important as our gut microbiota?

Sandor Katz, author of *The Art of Fermentation*.

“We were all raised in what I would call the ‘war on bacteria,’” Katz said. “And we haven’t really given up the war on bacteria. There’s nothing sexier you can write on a container of soap than promising people it will kill 99.9 percent of bacteria. People are still buying it—it’s in almost all institutional bathrooms. (But) this misguided idea that it’s beneficial to eradicate all of the bacteria around us is being balanced by the idea that bacteria are really beneficial and important.”

Grow Your Own

For a week I ignored the moldy sauerkraut under the kitchen sink. It’s one thing to understand the importance of ingesting bacteria, but it’s another matter to eat fuzzy food. However, the science and the fermentation expert had spoken. That sauerkraut could be the secret to optimal health.

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At-home fermentation requires a certain leap of faith. We are so conditioned to be terrified of food that might be spoiled or past its due date that deliberately growing bacteria and then ingesting the bacteria-filled food seems wrong. One of the benefits of the modern age is that we don’t have to worry about food preservation. That’s what refrigerators are for, right?

The sauerkraut was my second fermentation attempt. I started with kefir, a fermented milk made with kefir “grains,” which are actually a combination of yeast and bacteria that live on milk products. I got hooked on the tart, fizzy taste of kefir when I tried the Trader Joe’s version, but I was annoyed by the price—US\$2.99 for 32 ounces—and the fact that they only carry a low-fat version. So I did some research and found out I’d need kefir grains to make my own. I ordered dehydrated grains online and followed the instructions for rehydrating them, and before I knew it I had my first batch of kefir.

The kefir was ready, but was I? The specter of food poisoning hung over the entire process. What if I had done something wrong? I’m a writer, not a microbiologist or professional chef.

However, I had spent a week on this project, so stubbornness won out over fear. I drank a glass of—delicious, slightly carbonated, yogurt-like—kefir and hovered around the bathroom, waiting for unpleasant consequences.

Nothing happened. I survived my first experience with home fermentation, and now I’m making about four cups of kefir a day. It’s much cheaper, and home-fermented kefir has anywhere between four and six times the amount of probiotics as store-bought products.

Now it was time to face the sauerkraut. As I spooned a small serving into a bowl, I remembered something Katz told me.

“There is no case history of illness resulting from fermenting vegetables,” he said. “In the United States, according to the USDA, there has never been a documented case of food poisoning from fermented vegetables. They’ve even been looking outside the U.S., and they can’t find any case history. Statistically speaking, vegetables become safer after you ferment them than they were when they were raw.”



Sean Timberlake of Punkdomestics.com.

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—Sandor Katz

I took a bite. The sauerkraut was delicious, a complex mix of salty and earthy flavors, with a hint of the caraway seeds and juniper berries I had used as seasoning. Twenty-four hours after ingesting the formerly mold-covered concoction, I was fine. I’ve been eating it almost every day since, with no hint of illness or stomach distress.

The world of at-home fermentation is new to me, but the fermentation revival has been building for years.

Four years ago, Sean Timberlake started [Punk Domestics](#), a website that’s a clearinghouse for food preservation (including canning, preserving, pickling and fermenting).

“It’s a labor of love,” Timberlake said.

“I came into this whole DIY thing as a journey of curiosity,” he said. “I learned about canning. I had no idea prior to that that you could do such a thing. All of a sudden, I was like, ‘You could do this?’”

Timberlake said he wanted to create a website that functioned as a discovery engine for anyone else who had that same spark of curiosity and wanted to take learning to a new level. He said people started submitting recipes for fermented foods almost immediately.

As the submissions increased, Timberlake found his understanding of fermented foods expanded.

“(I began) to understand that (fermentation) was really a global phenomenon and not something that is new or trendy but actually the oldest food-production method that we know. It’s been sort of obfuscated by contemporary techniques and technology,” he said.

As the interest in the Paleo Diet grew, Timberlake saw increased interest in fermentation on his site.



Originally from Indonesia, tempeh is made by fermenting soybeans, which can be done in a banana leaf.

“Paleo adherents are very big into fermentation because it’s a great way to add flavor to food without adding carbohydrates. It also tends to make food more digestible and more approachable for the gut,” he said. “A lot of people are concerned about making sure their gut is as healthy as can be, which does absolutely have a huge impact on your overall health, not just physical but mental.”

Try This at Home

My journey into the world of fermentation developed much the same way as my foray into CrossFit. I first wandered into a CrossFit gym in 2010 because I wanted to get fit. What I didn’t realize is that I was also deathly bored of my Monday, Wednesday and Friday bootcamp class at the local Globo Gym. One of the trainers had us literally running around in circles—we spent part of the class running laps around the basement aerobics room.

The complexity and range of skills required in CrossFit is intimidating but exhilarating. There is always something to learn, some new technique to improve.

Similarly, Timberlake said he’s found people are drawn to fermenting because of the effort required.

“It’s geeky, and there’s a technique involved, and they want

to play with it,” he said.

The scientific evidence regarding the importance of gut bacteria is overwhelming. What’s not clear is exactly what to do with that information. Are we OK if we avoid unnecessary antibiotics and antibacterial soap and eat a healthy, varied diet? Is home-fermented food truly that much more superior to probiotics in a pill?

Over time we might get a definitive answer, but right now buying a probiotic supplement at the health-food store is a lot like running in circles around the aerobics room. It’s certainly better than doing nothing, but it’s really not much fun.

References

1. Blaser, M. *Missing Microbes: How the Overuse of Antibiotics Is Fueling Our Modern Plagues*. New York, N.Y.: Henry Holt & Co., 2014.
2. Cotillard A, Kennedy SP, Chun Kong L, Prifti E, Pons N, Le Chatelier E, Almeida M, Quinquis B, Levenez F, Galleron N, Gougis S, Rizkalla S, Batto J-M, Pierre Renault, ANR MicroO-



A renowned expert, Katz teaches fermenting practices at workshops around the world.

bes consortium, Doré J, Zucker J-D, Clément K, Ehrlich SD, Blottière H, Leclerc M, Juste C, De Wouters T, Lepage P, Foucheray C. Dietary intervention impact on gut microbial gene richness. *Nature* 500: 585-588, August 2013.

3. Doucleff, M. Chowing down on meat, dairy alters gut bacteria a lot, and quickly. NPR.org. Dec. 11, 2013. Available at <http://www.npr.org/blogs/thesalt/2013/12/10/250007042/chowing-down-on-meat-and-dairy-alters-gut-bacteria-a-lot-and-quickly>. Accessed May 2, 2014.

4. Hsiao EY, McBride SW, Hsien S, Sharon G, Hyde ER, McCue T, Codelli JA, Chow J, Reisman SE, Petrosino JF, Patterson PH, Mazmanian SK. Microbiota modulate behavioral and physiological abnormalities associated with neurodevelopmental disorders. *Cell* 155(7): 1451-1363, December 2013.

5. Le Chatelier E, Nielsen T, Qin J, Prifti E, Hildebrand F, Falony G, Almeida M, Arumugam M, Batto JM, Kennedy S, Leonard P, Li J, Burgdorf K, Grarup N, Jørgensen T, Brandslund I, Nielsen HB, Juncker AS, Bertalan M, Levenez F, Pons N, Rasmussen S, Sunagawa S, Tap J, Tims S, Zoetendal EG, Brunak S, Clément K, Doré J, Kleerebezem M, Kristiansen K, Renault P, Sicheritz-Ponten T, De Vos WM, Zucker JD, Raes J, Hansen T, MetaHIT consortium, Bork P, Wang J, Ehrlich SD, Pedersen O. Richness of human gut microbiome correlates with metabolic markers. *Nature* 500(7464): 541-6, August 2013.

6. Ridaura VK, Faith JJ, Rey FE, Cheng J, Duncan AE, Kau AL, Griffin NW, Lombard V, Henrissat B, Bain JR, Muehlbauer MJ, Ilkayeva O, Semenkovich CF, Funai K, Hayashi DK, Lyle BJ, Martini MC, Ursell LK, Clemente JC, Van Treuren W, Walters WA, Knight R, Newgard CB, Heath AC, Gordon JI. Gut microbiota from twins discordant for obesity modulate metabolism in mice. *Science* 241(6150): 2013.

Additional Reading

The Art of Fermentation by Sandor Katz. (Chelsea Green Publishing, 2012).

Wild Fermentation by Sandor Katz. (Microcosm Publishing, 2001).

About the Author

Hilary Achauer is an award-winning freelance writer and editor specializing in health and wellness content. In addition to writing articles, online content, blogs and newsletters, Hilary is an editor and writer for the **CrossFit Journal** and contributes to the *CrossFit Games* site. An amateur boxer-turned-CrossFit-athlete, Hilary lives in San Diego with her husband and two small children and trains at CrossFit Pacific Beach. To contact her, visit hilaryachauer.com.