You've Got Your Own Private Zoo – It's Called Your Microbiota, with Laura Bridgewater (Ep. 15)

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Nivien Saleh: What do you and Planet Earth have in common?

I'm Nivien Saleh, with Houston and Nature.

If you follow this podcast, you probably support a number of important ecological ideas: That we humans need our natural environment to flourish. That a species-rich natural environment is a healthy one. And that we should do what we can to preserve the diversity of species around us.

In this episode I'd like to carry these ecological ideas in a different direction. Let's imagine each human as a tiny Planet Earth and look at the many species that populate it. Yes, each of us humans hosts over a thousand species of tiny life forms. They are our gut microbes or microbiota. For these critters our intestine is the world, and their job is to mine it for food and survival.

You know that we humans and the species that surround us depend on what Planet Earth has to offer. In the same way our gut microbes depend on us. And just as Planet Earth requires species diversity to make it what it is, so do we humans need our microbes. Because in a very important way they make us into who we are.

To explore these ideas I invited Dr. Laura Bridgewater. She lived in Houston while being a researcher at the M.D. Anderson Cancer Center. Today she is a professor of molecular biology at Brigham Young University in Utah.

How did you become interested in gut microbes?

Nivien Saleh: We're talking today about the human gut. Most people think, "oh the gut, so icky." You've been fascinated by it. Why is that, and how did you come to be interested in it?

Laura Bridgewater: The first thing that got me interested in it was hearing a presentation by someone who had been working on the way the gut microbiota affects obesity. I heard that presentation and was just fascinated. And I started studying more about it. This whole field of study is quite young - 10 to 20 years really. Most of the progress has been made the last 10 to 20 years. So many new things have been discovered, and we have found that the

gut microbiota affects our health in so many ways beyond what you would expect. You expect digestion. Anything beyond that has been quite a surprise.

Nivien Saleh: When did you listen to that lecture? Very recently?

Laura Bridgewater: It was in about 2012 or 13.

Nivien Saleh: And what did you learn in there?

Laura Bridgewater: That was a presentation of a study. And actually ended up going to do a sabbatical with the professor who had made this presentation. His name is Liping Zhao. At the time his lab was in China, in Shanghai. And I went there and worked with him for almost a year to learn more about this area.

He's now at Rutgers. So he has a lab in the U.S. now. And he presented a study detailing this case where there was a man who was quite severely obese. They looked at his gut microbiota and found that about 30% of it was composed of this one kind of bacteria that is usually in the gut microbiota in very small amounts, but it had just overgrown and it was 30% of his gut microbiota. They put him on a diet composed of lots of plant-based fibers.

He lost weight, not surprisingly. But also his gut microbiota changed as he was losing weight, but it leaves open the question of whether the gut microbiota was affecting the weight or was just affected by the diet. Cause and effect is such a difficult thing to establish in these gut microbiota studies.

What he did was take the gut microbiota from this individual and put it into germ-free mice. Mice that have no gut microbiota of their own.

What is gut microbiota?

Nivien Saleh: Let me just interject for our listeners. Gut microbiota is the population of microbes in our gut, correct?

Gut microbiota were responsible for weight gain

Laura Bridgewater: Exactly. Yep, exactly. So he was able to isolate this one overgrown kind of bacteria, put that bacteria in the gut microbiota of mice, and the mice became obese. That study was really the first demonstration of cause and effect: The bacteria had caused obesity.

It wasn't just that the bacteria changed with the diet at the same time obesity changed with the diet. The bacteria caused obesity. So that was fascinating that mice on the same diet, but without that same gut bacteria didn't gain weight the same way. That's what initially caught my attention and got me interested in this field.

Then looking into it more, I've become more and more fascinated with mental health aspects. The way the gut microbiota can affect mental functioning, which seems so outlandish, but it's real.

Nivien Saleh: I find that very fascinating too. We tend to think that we interact with nature outside of us. So there are these trees and the flowers and the animals, and we need to protect them.

But our relationship with nature is both inside and outside. So in a way we're a lot more intertwined with nature than most of us think we are. So that's why this topic interests me so much. You're a microbiologist, correct?

Stress can influence the gut microbiota

Laura Bridgewater: Molecular and microbiology. Both.

This is a fairly recent new research interest for me. Like I said, I didn't even hear that lecture until 2013 or so. One of the studies that's been most fascinating to me is we did this experiment with mice looking at the effects of diet and stress on the gut microbiota - the two individually and together. We had different groups of mice in the different experimental conditions. Some of them were on a high fat, high sugar diet. This is a diet that sometimes in research studies, people will call the Western diet, because it tries to mimic a diet that a lot of Westerners eat that is high in fat and high in sugar, simple sugars, of fast foods, packaged foods.

We had the mice on that and of course some mice in a control group on a healthier diet. And then we also exposed mice to stress, different kinds of stress - things like loud noises in their room, or fouling up their light-dark cycle.

Things that are stressful for a mouse. We did this for a period of time. And then we looked at the gut microbiota. The thing we saw in female mice, the stress affected the gut microbiota of those mice. Even if they were on a healthy diet, the stress changed their microbiota to look like they'd been eating the unhealthy diet.

Nivien Saleh: So the microbiota does not necessarily only shape mice's response to stress, but stress influences the microbiota.

Laura Bridgewater: Exactly. Exactly. And that has some pretty important repercussions when you think about it. How many times do we just plow through periods of stress in our lives? And these periods can sometimes last for several years.

We put our heads down and push through without taking care of ourselves. And this is not tested, but it made me wonder: If I do that, am I impacting my gut microbiota in a way that it might not recover? The stressful situation might end, but maybe I've done lasting harm to my gut microbiota.

It made me take much better care of myself in terms of stress management.

Nivien Saleh: I understand how you feel.

Laura Bridgewater: Yeah. And those things make an obvious difference to us psychologically. To find that they might make a difference to our gut bacteria, too, was fascinating to me.

How does food move through the human body?

Nivien Saleh: Absolutely. So we are now inside the human body. The stage of our conversation is the large intestine of the human. Let's move our way into the large intestine, little by little. Everybody knows that it plays a role in digestion. But how does food move through the human body into the large intestine?

Laura Bridgewater: Sure. You eat something, the digestion starts with chewing right in your mouth. You chew up food. It moves into the stomach. It spends maybe two to five hours in the stomach. And the stomach is mixing and churning the food. I think most people have heard of stomach acid. There are acidic conditions and enzymes that break down the food, and the stomach is churning.

Sometimes we feel when we feel upset, oh my stomach's churning. Actually, anytime we eat, our stomach is churning. We just don't usually feel it. There are a muscular effects happening that mix the food with enzymes and acids. From there, it goes into the small intestine, and it'll spend two to six hours there.

Most of the nutrients are absorbed as it moves through the small intestine. Breakdown products of the carbohydrates, the proteins, the fats, the essential nutrients that we eat get absorbed there. From there, it moves into the large intestine. When we talk about the gut microbiota, people are usually referring to the large intestine, which is the colon.

Those are two words that mean the same thing. There are bacteria at other places throughout the digestive tract, but by far, the vast majority of it is in the colon or the large intestine.

Nivien Saleh: I think the small intestine is maybe about as long as the large intestine, is that correct?

The gut microbiota produces nutrients for us

Laura Bridgewater: Yes, similar in length, but the food spends more time in the large intestine. Transit through there can take anywhere from 10 to 60 hours.

Nivien Saleh: Sixty? Six zero?

Laura Bridgewater: Yes. It can take up to three days, typically, not that long, typically more like, a couple of days for food to move through the whole digestive tract, but there's a pretty good range.

And as the food moves through there, the gut microbiota is doing additional digestion. The bacteria in the gut can digest things that we can't - fibers in particular, and can produce those nutrients for us. It can actually feed us nutrients as it's also feeding itself. At the same time, water is being absorbed and salts and vitamins.

That's what happens in the large intestine.

Nivien Saleh: I think I heard .... or read that there something called butyric acid that is produced in the large intestine. Is that correct?

Laura Bridgewater: Yes. Yes. Yep. It's a short-chain fatty acid. It's one of the things that our gut microbiota makes for us - good bacteria in our gut. It can be used as a fuel for us. So it's a way of capturing energy out of food.

The importance of food for our health

Nivien Saleh: What is the importance of food for us? What role does it play in our body?

Laura Bridgewater: It's needed for everything. It's energy. The way we think of energy, like enough energy to move and be active, but it also provides the energy that our individual cells need to be able to divide and to form tissues and to regenerate tissues. That natural turnover happens in our bodies all the time.

And the food gives us the building blocks. We need to keep our bodies intact.

Nivien Saleh: And it helps with the immune system, right?

Laura Bridgewater: You're absolutely right. The immune system. Yes, the immune system has to be maintained to function correctly. So do our heart cells, our lungs, our blood cells, the lining of our gut muscles every single part of our body has to be maintained and requires energy to do that.

Nivien Saleh: An important thing here is: When we think of energy, we think of sugar. Maybe we think of fat, but we really need also lots and lots of micronutrients. If it were just about energy, pure energy, we could say, all right, let's eat lots of sugar and lots of fat.

And that would be good for us, but really what we need is lots of micronutrients because they help us with these very complex processes. And these nutrients get extracted as the food moves through our body in the small intestine and then in the large intestine.

Our microbiota makes vitamins

Laura Bridgewater: That's right. Our gut microbiota makes vitamins. It makes vitamins that we wouldn't get other ways like B vitamins in particular, vitamin K. It's the bacteria in our gut that produce them for us.

Nivien Saleh: So without healthy gut bacteria, no healthy bones.

A microbiota connected with malnourishment

Laura Bridgewater: Healthy bones. Healthy lots of things. Yep. Yep. There was a study done. A few years ago. It was in Malawi. It was published in 2013 and really brought home for me, how powerful the gut microbiota is in nourishing our bodies. What these researchers did was look at twins, twin pairs raised in the same household same conditions, same diet. Very young children where one of the twins had this really severe malnutrition condition. It's called Kwashiorkor. That's surprising, right? How can you have twins raised with the same kind of nutrition, and one is malnourished and one is not?

They looked at the gut microbiota in these young children, they took the gut bacteria from these kids, put it into mice and fed them the traditional Malawian diet. And the mice that had the gut bacteria from the twin that was malnourished , those mice lost weight and were malnourished. They were unable to harvest the nutrition from that traditional Malawian diet. Whereas the bacteria from the healthy twin, those mice were fed the same traditional Malawian diet and they were fine.

That suggested very strongly that something about the gut microbiota was either harming or there was something missing in the sick child that made them unable to get the nutrition from their diet.

Just the gut bacteria was a huge difference for the nutritional status of those children.

We might have ten times as many bacterial cells as human cells in our body

Nivien Saleh: It's hugely fascinating. And just to establish a little bit of context. I have here a few numbers. In our large intestine, we have hundreds of species of bacteria and together they total in the trillions, and their density is about 500 billion cells per teaspoon of intestinal contents. And I want to let you know before you think I'm quoting things off the internet: It comes from a book by Justin and Erica Sonnenberg of Stanford. They wrote the book "The Good Gut".

Laura Bridgewater: Yes. The current estimates are that we have about 10 times as many bacterial cells in our body as we have human cells. There's some debate. On the low end, it's maybe one to one. But the thought that we might have as much as 10 times as many bacterial cells - they are me, right? These are part of my body - bacterial cells compared to

human cells that are me, that's amazing. We're not used to thinking of ourselves as being composed of so much bacteria, but we really are. They're integral part of our whole functioning system.

Nivien Saleh: Yeah. And that number of course, does not only refer to the gut. It also refers maybe to the skin and wherever we have microbes in our body. That's in various places, but it gives you an idea just how many bacteria we have in our body and how many reside in the gut.

Laura Bridgewater: Yes.

Nivien Saleh: Which is just mind-boggling.

Laura Bridgewater: It is. It really is.

Should we use more disinfectant?

Nivien Saleh: So maybe not the listeners of this podcast, because they're all into playing around in nature, maybe digging in the dirt. But there was a general attitude of "Ewww, but aren't microbes bad? Isn't that why we buy Lysol?" What would you say to that?

Laura Bridgewater: Some microbes are bad, absolutely. And some gut microbes are bad. If you get food poisoning from a buffet, it's a microbe. No question, some are bad. And those are the ones that we knew about first because they have such a strong impact on us when we get sick.

But more recently we've learned how many other microbes live with us and in us that either don't do anything we're aware of yet or benefit us. No, they're not all bad. If I have 10 times as many bacterial cells as human cells with me right now, and I'm not sick, they're not bad. They're actually helping me. And as we've come to understand that, we're actually learning more and more about the good things they do and what an important role they play in for example, the immune system development. They're really important.

Rethink our relationship with the microbiota

Nivien Saleh: We maybe need to rethink ourselves. In a way we are giant critter hotels. And instead of thinking of all microbes as bad, we maybe need to think of our relationship to microbes as one of balance. You want to balance out the good microbes against the bad so that the good can help us and keep the bad ones in check, right?

Laura Bridgewater: Yes, and they do. That's an important part of what our microbiota does is keep bad ones in check. Having a good, healthy gut microbiota protects against pathogens. That can help you if you do get some bad food at the buffet, like I mentioned before. Having a healthier well-established strong gut microbiota can protect you because there's competition.

Our good bacteria will compete against pathogens that enter the body. It's called competitive exclusion. That's an advantage for us if we nurture and cultivate healthy bacteria.

How do the microbes get into our gut?

Nivien Saleh: My understanding is that our gut is sterile when we are born. So how do all these microbes get into our gut?

Laura Bridgewater: Yeah, that's a good question. Most people do think that we are sterile when we're born, but not everyone agrees. There were some studies a few years ago that suggested that the womb is not a sterile environment. But then others followed it up and raised some questions. So I think it's still a little bit up in the air.

We're mostly sterile. I think we can at least say that we're not born with a fully developed microbiota. That happens in the first year of life. It happens during birth. Moving through the birth canal, there is a microbiota already there, and that begins to establish the infant's gut microbiota. Breastfeeding versus bottle feeding, and I should say a vaginal birth versus a C-section.

Those are different methods of birth that will expose the infant to different kinds of bacteria. Breastfeeding, they're bacteria from the mother's skin, from the milk versus bottle feeding you know, different kinds of bacteria. Think about how infants interact with the world.

They put everything in their mouth. From the day they're born they're putting their fist into their mouth. And then they start moving around, rolling on the floor, crawling, and they still put their hands in their mouth. Kids eat dirt. They'll pick up anything.

Mothers are always saying, "Oh, don't eat that!" That's what kids do. And that plays a role in establishing their microbiota.

Nivien Saleh: And that means that they're probably some places where you want to expose your child and you want to tell them all right, it's okay to play here, but not there. So for example, I would think that sitting in a shopping cart might be not so good for an infant, as opposed to perhaps being in a garden. What do you think?

Do we need microbes to train our immune system?

Laura Bridgewater: I'm not so sure I know. There have been studies looking specifically at asthma and allergies in children. Asthma and allergies happen when the immune system is not working quite right. It's overreacting to things that are not harmful. Think about our immune system. What is it supposed to do?

It's supposed to detect pathogens and attack them and destroy. But allergies happen when our immune system goes crazy thinking we're under attack from things like pollen or

peanuts, or different things that pose no danger. And yet our immune system reacts as if there's a danger.

Studies on children, looking at rates of allergies and asthma have shown less of those conditions in kids who grew up drinking unpasteurized milk, which means there was more bacteria in that milk. Kids in more primitive living conditions, children who have had more bacterial exposure for various reasons.

Children who have more older siblings tend to have less asthma and allergies. Children who have household pets or farm animals. There was even a study I remember seeing a few years ago where they looked at children who had grown up in really harsh conditions where there were a lot of rat feces and cockroaches. Children who had been in that condition before they were, I think it was before they were a year old, had less allergies and asthma.

If they were in it later, you know, let's say as four year olds, it may no difference. That's why I hesitate to say grocery cart versus garden. I don't know exactly what different conditions would be better or worse, but there does seem to be a general pattern that bacterial exposures in the very early years, especially in the first 12 months, help train our immune system so that it gets a better handle on recognizing what it should and shouldn't react against.

Now I have to be careful because some bacterial exposure is really harmful to a child.

I don't think we're to the point of telling people, "Do this with your children, and they'll be healthier, or do that". I think we're still learning. But what we're learning is that not all bacteria is bad.

In fact, it really plays an important role in teaching our immune systems.

There are many strains of e-coli and only some are dangerous

Nivien Saleh: Related to that we are afraid of e-coli bacteria. There are many different species of e-coli bacteria, and most of them are harmless. But one of them is harmful. So we have to be really careful with that. It's difficult to know exactly how to get it right, isn't it?

Laura Bridgewater: That's exactly right. E-coli - that's a species. So when you say there are lots of different kinds of e-coli, it's one species, and yet within that single species, there are different subspecies in different strains that have different impacts on us. Yeah.

What's the difference between microbiota and microbiome?

Nivien Saleh: Wow. Subspecies. Thank you for explaining that to me. There is microbiota, which we have been talking about and then there's microbiome. What's the difference between the two?

Laura Bridgewater: A lot of people use those words interchangeably. But if we want to be exactly right and accurate, the microbiota refers to the organisms, all the microbes, the microbial organisms that live in a particular environment.

So the gut microbiota is all those organisms. The gut microbiome is the DNA from all those organisms. So it's all the genomes of all the different organisms that are there. In practice, what we have living in us is a microbiota, but if I'm doing an experiment in the lab, I might isolate all the bacteria and take the DNA from it.

And now I'm working with the gut microbiome.

Can you affect the microbiome through lifestyle?

Nivien Saleh: Is it possible to affect the microbiome through lifestyle?

Laura Bridgewater: It is, it's not easy to do. And we don't, you don't get quick and lasting changes, but what we feed is what grows. The bacteria in our gut is dependent on us for its nutrition. So some kinds of bacteria thrive on dietary fat, for example.

And we also need fat. We require dietary fat for our own health. But if I'm eating too much, it doesn't get digested as it moves through the small intestine. It's more than my body needs, it's not taken up. Then that excess will go to the large intestine, and it can feed certain kinds of bacteria there.

There was a study within the last 10 years that showed that diets that are high in dietary fat can promote the growth of bacteria in the gut that release a metabolite called TMAO. Now this particular metabolite has been shown to promote heart disease.

So I think a lot of us are aware that saturated fats can promote heart disease. And they may in fact do that directly, but here is evidence that in addition to that, they may do it by feeding harmful bacteria in our gut, causing those bacteria to become more prevalent, release more of these metabolites, and this metabolite can then go back into the person's body and promote heart disease. That's a reason not to eat more dietary fat than we require for our own health, because we don't want those kind of bacteria to be getting a little extra leg up in the gut

Nivien Saleh: Okay. Hm.

Laura Bridgewater: Beneficial bacteria in our gut in general, they tend to live on dietary fiber, the kinds of indigestible fiber. It's indigestible to us, not to them. All you just said that our gut to you said before that all got micro biota is connected to our immune system.

If we're eating a diet that has a lot of plant fiber, we can promote the growth of beneficial bacteria in our gut.

Nivien Saleh: You're making me so happy right now because I eat so many plants.

Laura Bridgewater: Good. That also makes your gut bacteria happy.

Nivien Saleh: Yeah. How does that work?

Laura Bridgewater: We don't know everything about it. The holy grail for gut microbiome work is to find out specific connections and causations. And you can imagine how great it would be to be able to say, here is a probiotic that will help decrease levels of depression and anxiety. It seems like we are going to be able to get there.

I think we are going to be able to get there. We're just not there yet, but I'm very optimistic that we'll eventually be able to identify individual bacteria that can make a difference.

Is the immune system in the gut?

Nivien Saleh: Would it be correct to say - and that is something that I've heard before - that the immune system is in the gut?

Laura Bridgewater: The immune system is throughout our body, right? So the immune cells they're our blood cells and they're made in the bone marrow, and they move throughout our body, circulating in our bloodstream. We also have our whole lymph system, you know, the lymph nodes.

We have the cells that go to the site of an infection or a cut. So the immune system is really everywhere. It's throughout our body, including in the gut.

Nivien Saleh: Thank you for clarifying that. You mentioned a little bit of auto immune issues. I believe allergy, you would say is an auto immune ... no?

Laura Bridgewater: No. Allergies are not auto-immune. An auto-immune condition is where the immune system attacks the self, the person's own body. So something like rheumatoid arthritis, where the immune system is attacking actual components of the person's joint. Allergies that's different from auto-immune.

Nivien Saleh: With an allergy, our immune system simply overreact to these external pathogens in a way that is damaging to us, but it is not a direct attack on ourselves.

Laura Bridgewater: Exactly.

Is there a connection between microbiota and auto immune diseases like rheumatoid arthritis?

Nivien Saleh: Okay, thank you. So now that we know the immune system and auto immune problems I've been wondering, so apparently the gut microbiota is connected with auto immune problems, such as rheumatoid arthritis.

I did find a report of a company called Diagnostics Solutions Lab, where they list five opportunistic bacteria. And they say that they're associated with rheumatoid arthritis. Do you know anything about that? What do you think of that?

Laura Bridgewater: I can't say anything about those specific five bacteria. "Associated" is important though. Just notice the word ...

Nivien Saleh: Correlation.

What's a "leaky gut"?

Laura Bridgewater: Yes. It's correlation. But there is really strong evidence that the kind of bacteria in the gut can affect overall levels of inflammation in the body. Some of the bacteria that lives in our gut they're endotoxins, is the word that's used.

There is something on the surface of the bacteria that they promote inflammation. Our bodies properly detect them as foreign. If we have harmful bacteria overgrowth, that can promote what's called leaky gut, a level of irritation and inflammation in the gut that can cause cells that line the gut to separate a little bit from each other in a way that the lining is not fully intact and things can leak out into the bloodstream.

There is solid evidence that in conditions like that these endotoxins can leak out of the gut and move throughout the body. And they're very low levels. Instead of having a serious illness, what a person gets is just an overall feeling of yuck. Yeah. And low energy and fogginess of the mind and just not feeling well, not feeling like you used to feel. And that could be caused by low levels of inflation in the body.

So by eating in a way that promotes the growth of harmful bacteria in the gut, we promote this condition of chronic perpetual inflammation in our bodies that makes us feel really unwell.

That's an immune system dysfunction. I don't, I shouldn't even call it a dysfunction is the immune system doing what it's supposed to do, but it feels awful. And it's not an illness that you could go to a doctor and get a treatment for. It just makes you feel not up to snuff.

Nivien Saleh: Hmmm. We have figured out that our intestine and the gut microbiota is connected to our weight, our mood, our personality. What you haven't mentioned is research with mice where you swapped. What was it?

Replacre your microbiota, and your personality may change

Laura Bridgewater: Are you getting at a study that had to do with the personality and behavior of mice? Is that the one you're thinking of? Okay. That's not one I did. That was done by someone else. But I find it to be one of the most fascinating studies. It was done back in 2011. These researchers took two different strains of lab mice.

So lab mice are commonly used in labs around the world. And there are some very distinct and very inbred strains that are used by researchers all over the world for their experiments. Two of very few strains that are commonly used have different personalities in terms of how bold they are when it comes to exploring a new environment.

The researchers used a step-down test it's called. So the mice were placed in an arena that was essentially just a box, maybe three feet on each side. So an open arena, but with walls. And then there's a platform in the middle of it. The platform is just a cylindrical platform.

Not very high, but high enough that the mouse thinks twice about stepping off it. It's not just a step. It's a bit of a stretch and a climb down. So you can put a mouse on this cylindrical platform and time how long it takes til they get off it and go explore this arena. And one of the strains of mice typically took much longer than the other.

So those mice are more timid. They'll stay afraid on that platform. Whereas the other strain of mice would just step right off it and go explore. Then they took the gut microbiota from these two strains of mice and swapped them and repeated the test. And they found that this characteristic behavior switched. The timid mice became brave, and the brave mice became timid.

And the only difference was this swap of the gut microbiota. That just captured my interest because it's so unintuitive that the gut bacteria would affect behavior. That's amazing.

Should we avoid processed food?

Nivien Saleh: It is. Having established how important the microbiota is for our wellbeing, what do you think about processed food?

Laura Bridgewater: Well, I mentioned before that a lot of the bacteria that we know is beneficial for us, thrives on plant fibers. And processed foods, they're not good for us. In my opinion, their biggest harm isn't so much in what we get from them. It's in what we don't eat because we're eating the processed food.

So they take the place of better foods that we could be eating. And they don't have the nutrients, the fibers that we can get from eating fruits, vegetables, grains, roots. There's a huge variety of plants, and they all provide different kinds of beneficial nutrients to us and to our gut microbiota.

Nivien Saleh: And there's not just one kind of fiber that we're missing out on. There's at least I think three kinds of fiber that we may be missing out on when we replace these foods with processed foods. There is insoluble fiber, soluble fiber and resistant starch.

Laura Bridgewater: Yep.

There, there are certainly companies working to make healthy, processed food so we can open a wrapper and have something that's good for us instead of something that's just empty calories. And I would say that those are better than the empty calorie foods, but it's hard to say they're better than just eating the real food.

Nivien Saleh: Because the unprocessed foods come with so many micronutrients that may not be present in the processed food.

What are prebiotics?

Laura Bridgewater: And it's very hard to recreate that in a package and people try and certainly lots of companies are trying. But it's a really hard thing to do.

You know, It's the same with prebiotics. Prebiotics are fiber, essentially. People will take prebiotics as fiber purposely to feed their good gut bacteria. And feeding your good gut bacteria is obviously something we want to do.

I'm not so convinced that a canister of powder is the best way to do it. I think it's better than not feeding it at all, but even better than that is eating a variety of different foods that are going to provide different kinds of fiber.

What do antibiotics do to our microbiota?

Nivien Saleh: Antibiotics. What do you think of those?

Laura Bridgewater: So valuable and also harmful to the gut microbiota. When we take a course of antibiotics, it kills bacteria indiscriminately. You hear the term "broad spectrum antibiotics", right? Broad spectrum means this is an antibiotic that will kill a broad range of bacteria. And that means the good and the bad. Children who have been on repeated doses of antibiotics, tend to have more allergy and asthma problems.

And it's likely because of what it's done to their gut bacteria. Every time we take antibiotics, we kill the good and the bad. Not everything, but we knock the levels down. And then when we go off the antibiotics, our gut microbiota recovers, the bacteria divide, they repopulate our gut, but it's a roll of the dice, which bacteria are going to get the advantage and what will end up being more abundant.

And having antibiotics just opens the door for harmful bacteria to get the upper hand in our gut. If you talk to people who have been on a lot of antibiotics, you'll hear stories that support that. People who have lasting effects a lot of times can be traced to the gut microbiota being harmed by antibiotics.

Now, having said that, if the person hadn't taken the antibiotics, what would have happened? Maybe it was for ear infections as an infant. They could have lost their hearing

in that ear. So I'm not going to say don't take antibiotics because it's better to take them than to lose your life or to lose other important things.

But boy, sometimes antibiotics have been over prescribed for every little thing. I remember going to the doctor as a child. And they would test me for strep, but sometimes just give me a shot of penicillin in case the test was going to come back positive.

That was common at the time. And we're learning more now. But antibiotics, they're a real mixed bag. They benefit us. There's no doubt the difference they've made in lifespan, survival.

I wouldn't want our world to be without them. But there is a downside.

Nivien Saleh: Yeah. So antibiotics, you may have to use them. If you have to use them, if you can get away with a targeted antibiotic rather than a broad spectrum antibiotic, that's better.

Laura Bridgewater: But we don't have targeted antibiotics for every kind of bacterial infection. What we have available to us is generally broad spectrum antibiotics. So that's what you're going to get.

Is it okay to eat beef from the grocery store?

Nivien Saleh: Okay. Now related to that, what do you think of eating beef from the grocery store?

Laura Bridgewater: Oh, because of the antibiotics in it, is that why you're asking? I do it. And I probably haven't thought about it as much as I should. I don't know that eating beef treated with antibiotics would have an impact on my gut microbiota, like that day, the way taking an antibiotic pill would, because the levels are different. I look at antibiotics in agriculture as a bigger problem. How is it affecting our world and the body of microbes that are out there and the problems we face as a society. Because the antibiotics that are used, not just in beef, but in poultry, in all of our farming, there is really solid evidence that they are playing a role in the development of antibiotic resistance, which makes our antibiotics less useful to us when we really do have illnesses we need to treat.

The role of probiotics in our microbiota

Nivien Saleh: Yeah. So you already told us about prebiotics. Probiotics are bacteria that we ingest, correct?

Laura Bridgewater: That's right.

Nivien Saleh: Would you explain a little more? Like where do you find probiotics?

Laura Bridgewater: you can find probiotics at any grocery store, drug store, health food store. They're everywhere. And people will, different companies will pitch theirs as this is a high quality and there are differences in the quality of probiotics. I don't know a simple way of determining the quality though.

I wish I could give you a simple formula. But probiotics are beneficial bacteria. People take them to improve the composition of their gut microbiota. There's a problem though, in that the bacteria that's already there has a real advantage.

It's well-established in its own ecosystem. Imagine the ecosystem like a jungle, the Amazon jungle. If I drop a kitten into the jungle, What are the chances that the jungle will be taken over by cats? There's some chance of that, but it's pretty remote. Most likely that kitten is just not going to survive.

And I think of it that way with our gut, too. So part of the research that's going on in my lab right now is aimed at finding ways to specifically target and reduce the levels of harmful bacteria in the gut to create some ecological space for beneficial bacteria to thrive. So the idea is the harmful bacteria knocked down. A probiotic taken with the product would then help tip the balance in the gut to a more beneficial composition.

Sorry, no probiotics in sourdough bread

Nivien Saleh: And then I would like to add, so probiotic, where can you find it? You can find it in supplements in health food stores, but they're also in fermented foods, so yogurt, sauerkraut, kefir, for example, I drink water kefir. Now some might think that sourdough contains probiotic, but that is not true.

I do make my own sourdough bread. So I wish it were full of probiotics. But the problem with sourdough bread is you have all these bacteria that ferment your dough, and then you kill them when they're in the oven. So ...

Laura Bridgewater: When you bake it. Yeah.

Nivien Saleh: No probiotic benefit there, but there are many sources of ingesting probiotics.

Laura Bridgewater: That's true.

Nivien Saleh: They are good, even if they cannot necessarily find space in your gut, because it's already taken up by all these other guys.

Laura Bridgewater: Yes. Yep. I agree.

Is out gut ecology sufficiently diverse?

Nivien Saleh: I've got another set of data, again from the book "The Good Gut", by Justin and Erica Sonnenberg. And the quotation is: "The average American adult has approximately 1,200 different species of bacteria residing in his or her gut.

That may seem like a lot until you consider that the average Amerindian living in the Amazonas of Venezuela has roughly 1,600 species, a full third more". Do you think it's bad that our gut microbiome is smaller than it could be?

Laura Bridgewater: In general studies that have looked at this question have shown that more diversity seems to be better.

Nivien Saleh: What are ways in which we can diversify our microbiome? Let's say we have been eating the standard American diet consisting of lots of processed food for years. Is there a way in which we can change things?

The impact of good nutrition lasts only as long as you eat well

Laura Bridgewater: Changing our diet is the best way to do it because like I said, what we feed is what will grow. I doubt that any bacteria ever really entirely disappears. So I think as we change our diet and eat for healthier gut bacteria, we do get changes.

That is certain. If we stop eating that way, things are going to go back. Harmful bacteria never went away. It just went to lower levels. It may have gone so low as to be undetectable, but that's still not the same as completely gone. So we have to make changes and stick with them.

Nivien Saleh: So the advice that you give is fairly simple. Eat well. Now in practice, of course, it's a lot more difficult, right?

Laura Bridgewater: Yup. Yup. It's simple to say, harder to do.

Bacteriophages, the answer to antibiotic resistance?

Nivien Saleh: Tell me, where is your own research headed?

Laura Bridgewater: We're looking for ways to create ecological space by decreasing the numbers of harmful bacteria. Our gut has bacteria, and it has bacteria phages because they live together. Bacteria phages are really fascinating little things. They attack and kill their host bacteria in the process of replicating themselves. They infect the bacteria, put their DNA into the bacteria, basically commandeer the bacterial systems to make more phage, just to copy themselves and burst the bacteria and kill it.

Bacteria phages were first studied over a hundred years ago. Then, when antibiotics came along , we sort of lost interest. And now as antibiotic resistance levels in lots of different bacteria are climbing, interest in bacteriophages has been rekindled. And a lot of people are looking at them. There are so many bacteria phages on our planet, far more than the number of bacteria. Far more.

Nivien Saleh: You know, I I've watched these documentaries about antibiotic resistance and the superbug that is going to come and get us all. It gets a little depressing. But what you just saying is that there is hope because there are bacteria phages. And you're working on that.

Laura Bridgewater: Yeah, I haven't thought of it quite that way. I've focused more on the gut microbiota. Whereas those scary videos are really referring to bacterial pathogens that kill people. People get infections, and if their infection is antibiotic resistant, there's just not much we can do. We end up having to rely on their own immune system.

If it works, they're in luck, and if it is not powerful enough, then they're out of luck. And that's where we were 300 years ago. You know, it really is a dangerous situation to be creating bacteria that are resistant to our antibiotics. It sets us back a lot. So phages are a potential tool to deal with antibiotic resistant infections.

Nivien Saleh: That makes you my knightess in shining armor.

Laura Bridgewater: Great. Thank you.

Where is microbiome research headed?

Nivien Saleh: The field in general. In broad strokes, where is microbiome research headed?

Laura Bridgewater: The ideal is to figure out specific bacteria in the gut in particular. There are connections between the gut microbiota and Parkinson's disease. Autism . I've already mentioned personality and behavior. And there'll be more connections discovered. Getting to the point where we can actually treat the gut microbiota in order to affect a condition like Parkinson's disease, that's where I see the future going. And lots of people are working on this.

Now, when I mentioned autism, for example , the whole GI tract tends to be disrupted in kids with autism. One line of thought is that it has to do with their eating, because autistic children will tend to prefer certain kinds of foods. And it's very limited. So they'll have a very limited diet - maybe it's white rice and chicken nuggets or something like that.

And their parents want to see their kids eat. You cannot force a child to eat something they're not willing to eat. So they end up developing imbalances in their gut microbiome. Those things can contribute to behavioral problems. There are dysfunctional behaviors associated with autism that can be treated.

And there's evidence that treating the gut microbiota can help. So changing the gut microbiota will not undo autism. It won't change neurological pathways, but it can have an impact on dysfunctional behaviors that can make life so difficult for someone with autism. It can just ease things. It can make life better for the parents, if we could find a way to treat the gut microbiota. I see a lot of potential there.

Nivien Saleh: It sounds like this is a really fascinating field of study. And I see it a little bit in your own optimism. It's as if there are these vast open horizons. And as a scientist, you go ahead and do research and you find interesting things.

Laura Bridgewater: Yes, that's the fun of science.

How can you learn more about your own, specific, microbiome?

Nivien Saleh: Listeners might now think, wow, this is so interesting. I wonder how my gut microbiome is doing. Where would you direct them?

Laura Bridgewater: There are companies that do that. I think if you just search "analyze my gut microbiota", there'll be companies that come up that do this. You send in a little bit of a fecal sample and they isolate the DNA and sequence that DNA and tell you what bacteria are there and in what proportions to each other. Here's what I'd like to be able to do . Do that on the same person every week for six months, and see if it's reproducible and how does it change and does it affected by what they're eating to really track those kinds of changes.

I'm sure these companies look at things like that, or at least I hope they do. I'm actually not sure. I hope they do. I personally haven't, and I'm not aware of research that's done that. I think there's some uncertainty in how reliable they are in terms of consistency. And what one measure really shows you in terms of the whole picture.

Nivien Saleh: I should add for the people who haven't studied statistics. When you use the term "reliability", that's a statistical term that tells you if you collect one sample after the other to draw an inference how frequently you will get the same results.

Correct?

Laura Bridgewater: Correct. Correct. So I wonder if I do this test and send it into one of these companies once, how representative is that of my basal state. Was it one unusual day? Was it one unusual sample composition? I'm not sure. So I have those doubts about using that to assess our own health. But like I said, I've done it before.

I'm curious about it. I find it interesting. I wouldn't base any major health or medical decisions on it, but to me it's an interesting thing to do and to look at, to explore.

A word from the wise: Take good care of your microbiota

Nivien Saleh: And I just found two places where you could turn, if you were interested in investigating your own microbiome, one is the human microbiome project.

What else would you like to leave our listeners with? What advice would you like to give our listeners?

Laura Bridgewater: My parting advice would be to take care of your gut microbiota, because it has really powerful impacts on everything else about you, your mental health and your physical health. So many times I think we just choke down some unhealthy food cause we're in a rush or push ourselves forward through stressful situations because we don't have time to do anything else.

It's just not worth the harm it can do to us to not take care of our gut bacteria. Maintaining it by eating healthy has benefits in every other part of our life that I think we have to be aware of.

Nivien Saleh: Eat well, manage your stress level. Thank you so much, Laura Bridgewater.

Laura Bridgewater: Thank you. It's been a delight to be on with you.

Nivien Saleh: This is it for today's episode.

I hope I've inspired you to think not only about your external ecology, but also the one that's inside of you. And of course, the two are connected: Through the food you eat, the air you breathe, and the stress you cope with.

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And of course, as always: If you enjoyed this episode, please share it with a friend.