Health

My Amazon family's gut microbes may help us fight inflammatory disease

The Yanomami people of the Amazon have the world's most diverse gut microbiome – and David Good, who is half Yanomami, thinks it might hold the clues to better health

By Clare Wilson

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Nabil NEZZAR

THE Yanomami people, based in the Amazon rainforest of southern Venezuela and northern Brazil, are one of the last Indigenous groups in the region that still live by hunter-gathering and small-scale farming. They also have the most diverse gut microbiome of any human community studied so far.

David Good is half Yanomami: his mother is a member of the Irokai-teri community and his father is from the US, where Good was brought up. After a life-changing reunion with his mother in the Amazon as an adult, Good is now doing a PhD in microbiology at the University of Guelph in Ontario, Canada. His research involves studying the Yanomami's unusual microbiomes – the bacteria, viruses and fungi that live on and in our bodies – with a view to developing new therapies for microbiome-associated conditions.

Here, he tells *New Scientist* about his work with the Yanomami, from collecting stool samples from family members and gaining first-hand experience of their diverse diet – and why he will never eat armadillo again – to what we can learn from studying their microbiomes.

Clare Wilson: Do you mind if I ask about your family? How did your parents meet?

David Good: Sure. My dad was a grad student at Pennsylvania State University and he was tasked to enter the Amazon to study the Yanomami's protein intake. At the time, in the late 1970s, there was a debate over whether protein deficiency was causing their warfare. [The Yanomami have been falsely portrayed by anthropologists as engaging in a great deal of warfare and violence over access to resources.] He fell in love with the Yanomami way of life: they wake up and they work together as a community to find food. It's not an easy world, but it's a relatively stress-free world. What was supposed to be a 15-month research programme ended up being 12 years in the jungle. And that is where he met my mother, Yarima. They developed a romance and they married according to Yanomami customs.

My dad brought my mom to the US. She adapted and she loved a lot of things about US society, but she became more and more depressed and isolated, because the only person she could talk to in this world was her husband. She made a decision to leave the family and, at 5, I lost my mom.

David Good was reunited with his mother, Yarima, in 2011
David Good

How did your mother leaving affect you?

I spent the next 20 years grappling with my identity. As a young child, I asked why did my friends have moms that make them peanut butter and jelly sandwiches, but my mom is a naked Indigenous woman eating spiders and monkeys? After I graduated from college, I decided to go on a quest to return to my Indigenous homeland to find my mother. I didn't know if she was alive.

Did you find her?

I met with Hortensia Caballero-Arias, an anthropologist at the Venezuelan Institute for Scientific Research. She and I embarked on this journey together to look for my mother. In 2011, I arrived in the Irokai-teri community, and there was mom. She had the hii-hi sticks that the Yanomami adorn themselves with in her nose and lower lips. I remember she was walking towards me, I didn't speak Yanomami, and she doesn't speak much English. I didn't know what to say.

Did you recognise her?

Of course, I recognised her from the photos and she looked as beautiful as ever. I just put my arm on her shoulder and said: "Hey Mom, it's me, David, your son. I'm home." I think she recognised that word from when I was a 5-year-old, calling her "Mom". We broke down and started crying.

I knew then and there that I didn't care why she'd left. I decided that I love my mom, I was grateful that she was alive and that I had found her. Now, all I want to do is spend as much time as I can with her. I visit as often as possible. I want to learn about my Yanomami heritage.

Can you tell me what Yanomami culture is like?

Finding food is a big part of the Yanomami way of life, but it's more than just surviving. They do it in a social way – and it's always fun. Everything that they eat is extracted from the surrounding rainforest and the Amazon is a biodiversity hotspot of flora and fauna. Plantain is a big part of their diet, and they grow it in their gardens. They're also opportunistic foragers: if it moves, you can eat it. I've eaten everything from piranhas to monkeys to capybaras, caterpillars, grub worms and so on – things you don't find in US grocery stores.

David Good

What is your favourite Yanomami food?

My favourite is boa constrictor. I remember sitting in my hammock one day and my mom came up to me and threw this 2-foot-segment [60 centimetres] of a boa constrictor on my lap and said: "Here, eat some snake." It is meaty, but it has an oily texture as well, like scallops. It's such a yummy meat.

How about your least favourite?

When I had giant armadillo, I had the worst diarrhoea I've ever had for about two or three days. I have not eaten that since.

You are now interested in Yanomami gut bacteria. Why?

The Yanomami have much higher microbial diversity in their guts compared with people living in Western industrialised societies. My research aims to look at what these "extra" bacteria are doing, given that we now know that many gut bacteria provide nutrients and resources for the cells in our bodies.

Why is the Yanomami's gut microbiome so different?

To start with, our microbiome is harmonised with the world in which we live. In the Western diet, we consume a lot of processed foods containing simple carbohydrates like sugars and refined starches in white bread and rice. This is mainly absorbed in the small intestine. Plantain and some of the other foods that the Yanomami eat contain a lot of fibre and resistant starches, so-called because they resist digestion in the small intestine and pass into the colon to feed the "good" microbes there, particularly *Prevotella* species. People in Western societies, by not providing their gut with the right food, have starved these "good" microbes. But when fed, the microbes produce beneficial metabolites, such as short-chain fatty acids, which help temper inflammation in the human body.

What impact does that have on health?

There are many illnesses that have an inflammatory component – allergies, diabetes, obesity, Crohn's disease, inflammatory bowel disease, cancer. These diseases are rare or absent in the Yanomami. Our research will provide a reference point for the microbiome and human health. I am confident that what we are learning from the Yanomami will benefit us.

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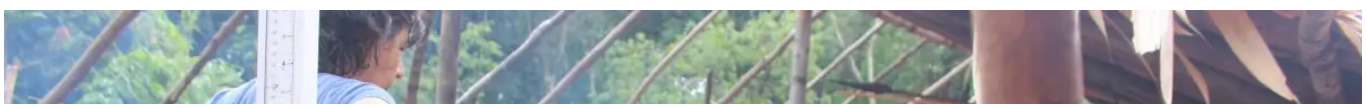
Will the Yanomami benefit from this research too?

This is my family and it's really important to get this right. My colleagues and I are working with experts from several disciplines, like anthropologists and bioethicists. We have set up a charity called The Good Project, to advance microbiome research among the Yanomami while promoting their resilience and self-determination, as well as protecting the rainforest. We go above and beyond normal ethical standards by making sure that if there's any commercial viability to this research, there is an agreement in place to ensure a meaningful benefit to the Yanomami people. Because, of course, we are aware that there is a history of biopiracy – exploiting Indigenous people, their knowledge and resources for profit without giving back to them. That's happened to vulnerable populations in the US too. We are determined to set a new standard for this type of scientific research.

There is currently a lot of interest in the idea of gut "rewilding", but would the bacteria found in Yanomami guts thrive on a Western diet?

These microbes co-evolved with the Yanomami for thousands of years. It's hard to imagine getting microbes from a hunter-gatherer society to thrive in someone who lives in New York. What feeds those microbes? Someone in New York is probably not eating monkeys or plantain. Those microbes would probably starve and die out really fast.



Good and his colleagues make regular visits to his relatives among the Yanomami
David Good

Should everyone be living more like the Yanomami?

I'm sceptical of that. I don't think the answer is "Let's all go be naked and run into the forest", because that's not who we are. But I do think there are things we could do. Maybe the answer is looking at the metabolic outputs that the microbes are producing, including the short-chain fatty acids that I mentioned earlier, but also considering the many other as-yet unexplored compounds that beneficial gut bacteria make in response to diet. Perhaps they could be harnessed to temper inflammation or to help with our body's glucose response after eating meals high in sugar or refined starch.

Studying the gut microbiome usually involves looking at faecal samples. How do your Yanomami friends and family feel about your work?

Imagine it. I am a member of their community who has been gone for a while and then come back. Obviously, I engage with them and catch up with them, but then I ask their consent to collect their faeces, and take skin and oral samples. They think: "What is this? Who is this crazy uncle

going around asking for faeces?"

How likely is it that this sort of research will lead to medically useful products?

It's fair to say this is an emerging field and we have a long way to go. We are still developing the tools to come up with a cohesive and consistent way to even describe the microbiome. The way one group extracts DNA can be different from how another group does it, and they come up with different sets of data. How can you compare conclusions, if you have different methods and protocols? I am quite new to this, but I think we are making progress and it is a very exciting field to be working in. Every day something new comes out. So far, we have just scratched the surface.

Clare Wilson is a health reporter for New Scientist. Follow her on Twitter @ClareWilsonMed

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