ENCOURAGING MICROBES TO WORK FOR US

FAO experts are helping expand microbiome science across the spectrum, from nutrition to ecosystems

A microbiome is the genome of all the microorganisms living in and on all vertebrates. Though a new science, it is already helping us better understand the relationship between food and non-communicable diseases. ©Kateryna Kon/shutterstock.com

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In 1826, the genial French gastronome Brillat-Savarin penned the phrase "Tell me what you eat, and I will tell you what you are."

Two hundred years later, pathbreaking research suggests that what we eat doesn't just give us fuel and pleasure but also feeds the trillions of microbes in our gut microbiome, and thus constitutes one of the most consequential interactive exposures we have to our environments.

The science behind microbiome – a term used to describe the genome of all the microorganisms living in and on all vertebrates - is still in its infancy but is already helping unpack mysteries related to diet-related non-communicable diseases such as cancer and diabetes, and even to our moods. It suggests that metabolism may best be understood not as a factory process turning food into dietary energy, but a complex regulatory interface mediated by microorganisms whose function is tantamount to that of a human organ like the heart or liver.

"It's not only about us," says Fanette Fontaine, a microbiologist who is producing some benchmark reports for FAO on the subject. "We are walking ecosystems."

The gut microbiome weighs as much as our brains and hosts about 1 000 different species of bacteria, with high variability as only one-sixth of these are typically found in the majority of individuals.

Thanks to the development of rapid and affordable genomic sequencing technologies, we can now identify the presence and function of a huge array of bacteria, viruses, protozoa and fungi as well as their theater of action. It turns out that many of these creatures, once feared as potentially dangerous invasive germs, perform roles that train our immune systems and influence various brain and bodily functions central to healthy lives.

It's now clear that some gut microbiomes foster obesity - even when calorie intake wouldn't predict it - while others correlate strongly to Type 2 diabetes, cardiovascular diseases, asthma, allergies and childhood stunting.

Expanding "edibility"

Evidence obtained so far points quite strongly at one practical implication: we should eat more fermentable dietary fibres.

Humans cannot technically digest most dietary fibres, but gut microbes can, feeding themselves and producing beneficial small molecules (Short-Chain Fatty Acids), which serve as an important human energy source.

Highly processed foods, for example, may lack elements which ultimately impact the survival of bacterial species in our guts. "The gut is never a desert, so if you don't feed the good guys you will have more of something else," says Fontaine.

We each receive our first microbiome endowment from our mothers at birth. Breastfeeding also conveys specialized sugar molecules that have no nutritive function for the infant but promote the *Bifidobacterium* species (associated at later ages with improved metabolic signals, weight loss and less inflammation) in baby's intestines.

When a gut microbial community is out of balance, less benign species are more likely to forage for their own survival by, for example, consuming proteins and fats instead of complex carbohydrates for energy, a process that can interfere with insulin resistance, promote unwanted fat cells and even produce carcinogenic effects. Some microbe species will even degrade the mucus barrier on our intestines, our major bastion of defense against low-grade inflammation that is common to several chronic diseases.

"Microbiome science is redefining nutrition and shows it involves more than just the nutrient composition of food," says Karel Callens, an FAO food security expert who set up the Organization's informal interdisciplinary microbiome team. Some key vitamins, amino acids and even neurotransmitters are important byproducts of microbial actions in our guts, he notes.

"Our lifestyle has changed faster than ever in recent decades, and our microbiome has responded much more quickly than our genome," adds Fontaine. "The difference in pace may have disturbed the symbiotic relationship we have with our microbiome, which exacts a toll on our health."

As our genome co-evolved with diets over millennia, increasing the diversity of plant-based food intake may bridge the gap she says.

We know less than one percent of the different microbial species in the world or about how they perform, but they are crucial to the health of people, animals, plants and the environment, making this science an important element of FAO's One Health approach. ©Alpha Tauri 3D Graphics/shutterstock.com

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