



# Small creatures, big impact

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Our mouth is moist, warm and full of nooks and crannies – a perfect ecosystem for fungi, viruses, protozoa and at least 700 species of bacteria that inhabit it. It is the second most colonized microbiome in the body, after the one that inhabits our digestive system. ETH professor Dr Emma Slack gave an eye-opening glimpse into the fascinating world of microorganisms at a GDI conference.

The International Food Innovation Conference is an annual event dedicated to the future of food. Held at the Gottlieb Duttweiler Institute (GDI), the conference showcases current trends. In the last years, the spotlight was on bacterial strains in our bodies and the latest scientific and clinical breakthroughs that have established links between microbiome dysbiosis (an imbalance in the human gut flora) and various health conditions. There is, for instance, a growing body of research focusing on the modulation of the microbiome through nutritional approaches. This research is relevant,

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especially as these microorganisms already initiate the digestive process in our mouths and ensure a healthy mouth. However, they can also trigger problems, of which bad breath and plaque build-up are just the beginning. Poor oral hygiene can lead to issues such as tooth decay or periodontitis (an infection of the gums), but also to much more serious conditions such as heart attacks or dementia.

### Diversity is key

Microbiome research is a very active and important field. Committed scientists want to find out, for example, whether THE healthy microbiome exists and how its bacterial composition can be stimulated in people who are not lucky enough to have it in their gut from birth. For example, we now know that cancer, autism and autoimmune diseases ranging from multiple sclerosis to rheumatoid arthritis are linked to the microbiome. One scientist at the forefront of this research is ETH Professor of Food Immunology Dr Emma Slack. At the ETH in Zurich, she is studying the underlying mechanisms

that control the interactions between the immune system, the microbiota, host metabolism and microbes and nutrition. At the International Food Innovation Conference, she graphically illustrated how the microbiome of our gut influences our health and how we can influence our gut flora. According to Slack, our gut is colonized by vital ‘farm animals’ and it is important to understand how this ecosystem works. The key question is: how do bacteria influence our health and, conversely, how can we influence the microbes? We already know a lot about what constitutes unhealthy intestinal flora. A low diversity of different microbes, for example, is unfavourable. However: “We simply don’t yet know what a healthy microbiome looks like in all its diversity,” says Slack and adds: “This is currently the biggest challenge in global research.”

### Everyone’s gut flora is individual

Today, we can easily compile a catalogue of the various microorganisms and catalogue the genes of the different bacteria, Slack explains, but we don’t know much about what the microbes actually do. This is because the catalogues say nothing about whether a bacterium is beneficial to health, neutral or pathogenic. According to Slack, there are *E. coli* strains that live in our intestines without any problems and are even beneficial to our health, while other strains are dangerous pathogens and can even be fatal. To complicate matters further, every person has a different composition of intestinal flora,

and this also varies along the intestine and depending on what we have eaten. In a nutshell: “The complex biochemical processes in the gut flora still hold many mysteries.” The *E. coli* bacterium illustrates this. In this microbe, which is probably the best-studied in the world, we only know what 70 percent of the genes do and what impact they have. Slack and her team at the ETH want to find out which genetic metabolic pathways are associated with a ‘healthy’ life. Another topic she is very interested in is the interplay between the microbiome and the immune system. This involves potentially dangerous *E. coli* and salmonella in pigs. Today, many pig farms use antibiotics to combat these germs, but the bacteria often develop resistance to them sooner or later. Together with her research team, Slack is developing a vaccine against *E. coli* and salmonella. She explains the simple idea behind it: “We feed dead bacteria, the animals love it!” Four pigs are taking part in this trial at the Strickhof Competence Center for Agriculture and Nutrition in Lindau ZH. All the animals are healthy and responding well to the oral vaccination. No results are yet available. For a second vaccination method, the research team is using individual *Salmonella* components to trigger a direct immune reaction in the mucous membranes. For now, this method is being tested on mice. The Zurich scientist is pursuing two goals with the oral vaccinations: to significantly reduce the amount of antibiotics used in pig breeding and to eliminate resistant bacteria from the microbiome. “If this works,” she says, “that would be fantastic, a huge step forward!”