The gut microbiome as a guarantor of health and well-being?

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The interview with Prof Gerald Lackner from the University of Bayreuth sheds light on the importance of the gut microbiome for our health. The microbiome performs key functions such as protecting us from pathogenic bacteria and producing important metabolic products. Diet plays a key role and can influence the gut bacteria. Prof Lackner explains how a varied, primarily plant-based diet strengthens the microbiome and has a long-term positive effect on health. New research approaches will also be discussed, such as individualised therapies with pro- and synbiotics and microbiome transplants. Visionary research into bioactive substances produced by microbes also promises exciting possibilities. Fundamentally, a conscious diet and a holistic approach are essential for a healthy microbiome and general well-being.

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English translation of the German interview transcript

Matthias Will: Dear audience, did you know that our gut is home to an unimaginably large number of microorganisms? The large intestine alone harbours an estimated 32 trillion bacterial cells. These microbes can have a huge impact on our health and even on our psyche. Today's edition of the Ernährungsradar focuses on the influence of nutrition on our intestinal flora and the so-called microbiome. I would like to extend a warm welcome to you. The Ernährungsradar is a joint project of the University of Bayreuth and the Akademie für Neue Medien. I am Matthias Will from the Akademie für Neue Medien. Today we are guests on the campus of the University of Bayreuth here in Kulmbach and our discussion partner is Professor Gerald Lackner, Professor of Biochemistry of Microorganisms. Professor Lackner, nice to have you with us today.

Prof Lackner: Good morning.

Matthias Will: Professor Lackner, we're all familiar with it: it tweaks, it pinches, it rumbles in our belly. Why is the belly, and of course the gut in particular, so important for our well-being or our discomfort?

Prof Lackner: There are many connections between the head and the gut. Everyone knows the saying: ‘Something has upset my stomach.’ Digestion can also be disturbed when you're excited. But this connection also goes in the other direction: if there are problems with digestion, we feel unwell, and it affects our psyche. This is known as the gut-brain axis. The microbes in our gut also play a major role here.

Matthias Will: Today we are talking about the so-called gut microbiome. In common language, we always talk about gut flora. What does the term microbiome actually mean?

Prof Lackner: In a first approximation, the microbiome is the gut flora, i.e. the entirety of microorganisms that occur in a certain habitat, e.g. in our gut. Scientifically, we speak of the microbiota, the gut microbiota, i.e. the organisms. The microbiome in its definition goes a little further: it sees the microbiota as an active and dynamic ecosystem that interacts with its environment, interacts with humans. The genes and metabolic products of the microbes are also often counted as part of the gut microbiome. This is therefore a somewhat broader term, but in principle the familiar term ‘’gut flora‘’ or "intestinal flora" is quite accurate.

Matthias Will: What is the function of this microbiome?

Prof Lackner: There are many different functions. The most important function is that our gut is colonised with protective organisms. This means that if I have this protective intestinal flora, ‘bad bacteria’ - i.e. pathogens - cannot colonise. This keeps them away. That is an important function. But the bacteria also play a role in digestion: fibre, which we cannot actually digest, reaches the large intestine, where it is then digested by the microbiota. Products such as short-chain fatty acids like acetic acid or butyric acid, which are produced by the microbiota during digestion, are important. These are absorbed by our intestinal cells, which means that on the one hand the intestine is nourished and we gain even more energy from the food. On the other hand, this protects the intestine and keeps it intact. These short-chain fatty acids, especially butyrate - butyric acid - can also counteract inflammatory

processes. This is a very important function that has a positive effect on health. There are some amazing functions: the gut can also produce hormones, for example, and here again the gut-brain axis is relevant. These hormones have various roles in the body, and the microbiome can also influence the production of such hormones and thus influence our psyche, for example.

Matthias Will: You mentioned digestion. What influence does our diet have on our intestinal flora?

Prof. Lackner: Yes, as I have already mentioned, some food components are not digested by us, e.g. soluble fibre, which reaches the large intestine and is used there as food. If these dietary fibres have an influence on the ‘good bacteria’, so to speak, then we speak of prebiotic substances. These specifically feed the good microbiota, maintain it and promote it. You can also take in living organisms with your food that may influence the microbiome. If these added microorganisms have positive effects, they are referred to as probiotics, e.g. lactic acid bacteria, which are found in fermented foods such as yoghurt or sauerkraut. These are ingested with food and can have a certain influence on the microbiome.

Matthias Will: How can we eat as gut-friendly a diet as possible?

Prof Lackner: That is of course a broad field. I would now limit it to the microbiota. If you eat prebiotic substances, which I mentioned, as ”feed” for the good microbiome, then you promote this good microbiome. In the long term, this also has a positive effect on intestinal health or on health itself. There are various prebiotic substances that can be consumed. Resistant starch, for example, is important. Starch is known, for example, from bread, potatoes and pasta. Resistant starch is starch that we cannot digest so well. The advantage of this is that we consume less calories and at the same time ‘feed’ the microbiome, so to speak. Resistant starch is found, for example, in potatoes that have been cooked and then allowed to cool again. They then contain a particularly large amount of resistant starch. Wholemeal products such as wholemeal pasta or wholemeal bread also contain resistant starch. This is an important prebiotic. Pectin is also a prebiotic found in fruit such as apples, but also in tomatoes. Another important substance that is also marketed as a dietary supplement, let's say, is inulin. This is a so-called polysaccharide that can only be digested by the microbiota in the intestine; it cannot be digested by humans. Inulin is found, for example, in leeks and onions, but also in black salsify, which is in season in autumn, or in chicory. This substance also has a positive effect.

Matthias Will: Let's get really specific. Why don't you put together an ideal daily meal plan with breakfast, lunch and dinner?

Prof Lackner: For breakfast, I would strongly advocate oat flakes, preferably grainy oat flakes, which can be soaked a little to make them nice and tasty. You can add a little linseed and grated apple, for example. The oat flakes provide resistant starch and other favourable substances such as glucans. The apples provide pectin. This would be a great prebiotic breakfast. Add a little natural yoghurt and you also have probiotic lactic acid bacteria. I think that would be ideal. For lunch: I've already said that it's the end of October and I've seen black root in the supermarket, which is the so-called winter asparagus. It contains a large amount of inulin and you can eat it with jacket potatoes, for example, which would give you the resistant starch. Of course, you can also eat it with a little melted butter or ham. I should probably say that meat should be eaten in moderation. If you eat too much meat, for example, it can be digested in the microbiota to form toxins such as ammonia. This can therefore be critical. For dinner, you can eat wholemeal rye bread, for example, which would be very good. A little tomato and cream cheese with chives might go well with it. Pickled artichoke hearts, which contain inulin, would be a bit unusual. This would give you a microbiome-friendly diet, so to speak. But I would like to add that this is just one example. It is generally important to eat a diet rich in fibre and not to overdo it with protein and fat. I mentioned that this can lead to toxins. A very one-sided diet with little fibre, i.e. little fruit and few vegetables, tends to lead to a narrow microbiota that is no longer as broadly based. A broad-based microbiota is very important for health because it is more stable, produces

different substances and promotes different processes. This can only be achieved through a very varied and plant-based diet.

Matthias Will: So, it's the diversity that does it, let's go with that.

Prof Lackner: Yes, it's the diversity, both in the diet and in the microbiota, the microbiome.

Matthias Will: Are problems with the microbiome basically due to diet or are there other factors that are important?

Prof Lackner: Diet is one factor, but of course that is not everything. Everyone knows, for example, that antibiotic treatments, especially if they are broad-spectrum antibiotics, naturally disturb the microbiota in the gut and also kill off the good bacteria, so to speak, not just the bad guys. This can then lead to a disturbance, you notice it, you get digestive problems, diarrhoea, etc. In healthy people, the microbiota actually regulates itself again afterwards, but it can then have a different composition than before, which can then be better or worse. I would perhaps warn against demonising antibiotics completely. If you have a serious illness, a serious infection, then you have to take them. But it's not good for the microbiota. Of course, infections can also disrupt the microbiota. Everyone is familiar with diarrhoea caused by pathogens, e.g. salmonella. If you have such an infection, the microbiome is of course also disturbed.

Matthias Will: You mentioned earlier that there are good and bad microorganisms. Perhaps you could explain the difference again.

Prof Lackner: That's a very broad field, but in general the good microorganisms are those that don't cause any problems and produce these short-chain fatty acids, for example. These include *Faecalibacterium prausnitzii*, for example, which is often cited as an example of good bacteria. However, you have to have a large variety of different good bacteria in the gut for the microbiome to be stable. There are other components of the microbiome that are normal but are considered unfavourable if they get into excess. One intestinal bacterium that many listeners may be familiar with is *Escherichia coli*, also known as coli bacteria. They are found in wastewater because they occur in our intestines. If they are in the bathing lake, then there is a problem there. And there may also be a problem in our own intestines if we have too much *Escherichia coli*, especially in connection with a very meat-heavy diet, for example. These are the bacteria that digest meat, for example, and produce unfavourable substances in the process. These bacteria also produce lipopolysaccharides, for example, which promote inflammation in the body. The good bacteria, however, produce the short-chain fatty acids and thus tend to counteract inflammation. A perhaps spectacular example is *Coprococcus* and *Eubacterium*: there is a relatively new study that has shown that bacteria can actually influence our psyche. These bacteria produce cannabis-like substances that have a cannabis-like effect and can influence our motivation for sport via further signals in the brain. This means that if we lack this, we are less motivated to exercise, to do sport and this is known to have an effect on the weight and on health and so on. So that's ‘doping through the microbiome’, if you like.

Matthias Will: Could we also say that gut bacteria have a specific effect on the development of diseases?

Prof Lackner: If we disregard infections such as salmonella, chronic health problems are also very strongly associated with the composition of the microbiome. These include, for example, inflammatory intestinal diseases, so it is plausible that there could be a connection. But obesity also often seems to be associated with a certain composition of the microbiome. More precise mechanisms are still partly the subject of research. It is very interesting that the microbiota, i.e. the intestinal contents, of obese people and slim people were taken for a large mouse study. This was even done with twins, where one twin was obese and one was slim. The human microbiota was then implanted into mice. The microbiota of the mice was previously removed using antibiotics. It was shown that the mice that were implanted with the microbiome of obese people also gained more weight than the mice that were given the microbiome of the slim twins. This shows that there is probably a causal relationship and that

the composition of the microbiome could have an influence on our weight. But how exactly this can be utilised therapeutically and so on is still rather complex.

Matthias Will: You mentioned prebiotics and probiotics earlier. What role do they play in the treatment of diseases, for example, or what role can they play?

Prof Lackner: Yes, they can indeed play a role. There are various studies that show positive results. However, the study situation is often complex. There are also always studies that show that there are no effects. This is probably also due to the fact that the whole situation is very complicated, because the microbiota is very individual. It is a large ecosystem with many different species. It is very individual for each person, like a kind of fingerprint. Of course, the bacteria have similar functions in different people, but they can also differ. It depends on the composition of the microbiota in each individual, what genetic predispositions the person has, what kind of immune system the person has, and so on. Of course, it depends on the disease itself and there are many, many different factors, including the medication. It may therefore not always be possible to achieve the same effects. In general, probiotics only work well if you really take a high dose of probiotics. Probiotics are the living microorganisms, good bacteria that you ingest. They only work if you really have a very high dose in the capsules and preferably a mixture - a good combination, a harmonised combination of many probiotics in one preparation. Probiotics work even better if prebiotics are added to support this therapy. We then speak of synbiotics. The general consensus is that it will probably come down to a very individualised therapy. You have to look at what the microbiota is like, what the person is like, what illness they have and what preparations we give them.

Matthias Will: So, there are no generalised recipes?

Prof Lackner: There is no one-size-fits-all recipe and I would also say that simply taking probiotics at random is of little use.

Matthias Will: Are there any other ways to restore balance to a diseased microbiome?

Prof Lackner: Yes, there are other possibilities. I mentioned earlier that the transplantation of a microbiome is spectacular. I mentioned it in the mouse study where a microbiome was transplanted. This has actually been used successfully in some diseases, where the microbiome of healthy people has been transplanted into sick people. This allows the microbiota to be brought back into balance, so to speak. However, this also presents difficulties. The acceptance of this therapy has to be questioned; people may not necessarily want to have the intestinal contents of other people transplanted. Then, of course, there are also tangible reasons: infectious diseases could be transmitted, and quality control of these products is of course difficult. Chronic diseases, which I have already mentioned, could perhaps also be transmitted. There is still a lot of research needed here and there. And it is also unfortunately the case that such therapies sometimes only have a short-term effect, but the microbiota later changes for the worse. A holistic approach is probably really needed; you also have to look at lifestyle, diet, other medications and so on in order to achieve success.

Matthias Will: Keyword research work - you are currently researching probiotic organisms. What are you doing specifically and what concrete benefits does your research have for the population, for people?

Prof Lackner: Our research is still a bit visionary at the moment. We are not working so much on the already established probiotic therapies, but our research group is actually looking at how microbes - the bacteria that also occur in the gut - produce certain bioactive substances. These can be antibiotic substances that can, for example, eliminate harmful microbes. But these can also be hormone-like substances, messenger substances that can influence our mood, our well-being. We are looking at how the bacteria do this. You can imagine the bacterium as a small chemical factory, where various pots, machines etc. can be found on a molecular level. We are investigating this and can also use the genes to extract mechanisms from the bacteria and implant them in other bacteria. Our approach is probiotic bacteria that we can ingest to have small positive effects on our health. Perhaps we can use these

bacteria as a transport vehicle to produce active substances in the microbiome that can either improve the microbiome itself, improve gut health or cure other diseases in the body.

Matthias Will: We wish you every success with your visionary research. Prof Lackner, thank you very much for this interview.

Prof Lackner: Thank you.