Small parts – big impact?

We live in a world full of plastic. It breaks down into tiny particles through chemical and physical processes to form microplastics. There is no doubt that microplastics are found in food. However, research is still very much incomplete. The first studies at the BfR have begun.

Research can be unappetising. For instance, when it concerns microplastics in humans; more specifically, microplastics in our intestines. In a 2018 pilot study, a research team from the Austrian Federal Environment Agency and the Medical University of Vienna examined stool samples from test subjects from Europe and Japan for the first time. The test subjects wrote a nutrition diary for one week and sent a stool sample to Vienna. Every sample contained microplastics. The media response was huge – even at the BfR. Because it was proof: microplastics do not stay in the environment. They have also reached humans.

Plastics age and break down

Today, plastics are present almost everywhere in the human environment. Global production is growing, and more and more plastic is entering the environment. Microplastics are therefore being detected more and more frequently. The difficulties start with the definition itself. The term is used for small plastic particles of different origin, size, shape, and chemical composition. Size specifications are not uniformly defined and usual vary between 0.0001 millimetres (mm) and less than 5 mm. Science distinguishes between intentionally manufactured microplastics and microplastics that are the result of the decomposition process (see box).

Like many other research institutions, the BfR is also tackling this topic. Focus is on the risks to human health when food or drink contains microplastics and is then consumed. For the BfR, there are still major uncertainties and data gaps in many areas of research.
"The first investigations into microplastics began just a short time ago. We therefore lack the basis for a comprehensive health risk assessment," says Professor Alfonso Lampen. The biochemist and veterinarian is Head of the Department of Food Safety at the BfR. Data regarding intake, analysis and the effects of microplastics on people were notably lacking.

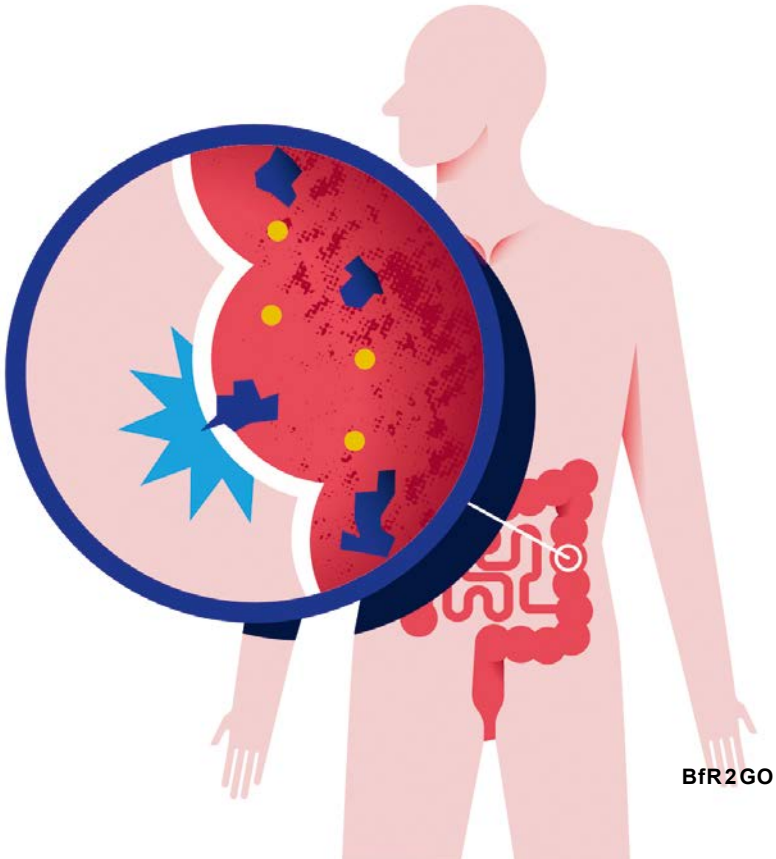
Microplastics in food – yes, but how much?

Microplastics are everywhere, This is scientifically well documented, according to Lampen. It can generally end up in food through the air, seawater, freshwater and groundwater. However, it is uncertain how much really ends up in our food. Furthermore, there is no reliable data about the types of plastic that people ingest as microplastics in food. There are always reports about detection in honey, mussels or even salt. However, information on the quantity and types of plastic is almost always lacking. Fish, for example: here the particles are mainly found in the gastrointestinal tract of the fish, which most people do not eat. Whether they also migrate to other edible parts and accumulate there, science simply does not yet know. Mineral water, for example: The Bavarian State Office for Health and Food Safety has detected microplastics in mineral water – not only in water from plastic bottles but also from glass bottles. Microplastics could therefore also get into the bottle through cleaning processes, colour pigments from the paper label, the plastic cap or even from the air.

Microplastics can enter our food during cooking and eating. This is because the smallest fibres from textiles (regarded as microplastics), such as fleece or nylon, break away when we wear them and, in doing so, end up in our food.

Cosmetic products might also contribute to intake: This includes use in things such as shower gels or peeling products. However, based on the current state of

Microplastics are everywhere and reach our food through the air and water – and in this way enter the human body.



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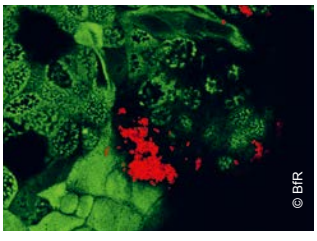


There are countless types of plastic. They are difficult to analytically detect in the micrometre range.

research, it is unlikely that the particles enter the body via the skin. "Intake via respiration seems to be more significant," says Lampen. Car tyre wear, for example, is a significant source of microplastics in the environment. It enters our lungs through the air. "We lack valid data about what we really absorb from all of these microplastics and how long they stay in our body," summarises Lampen.

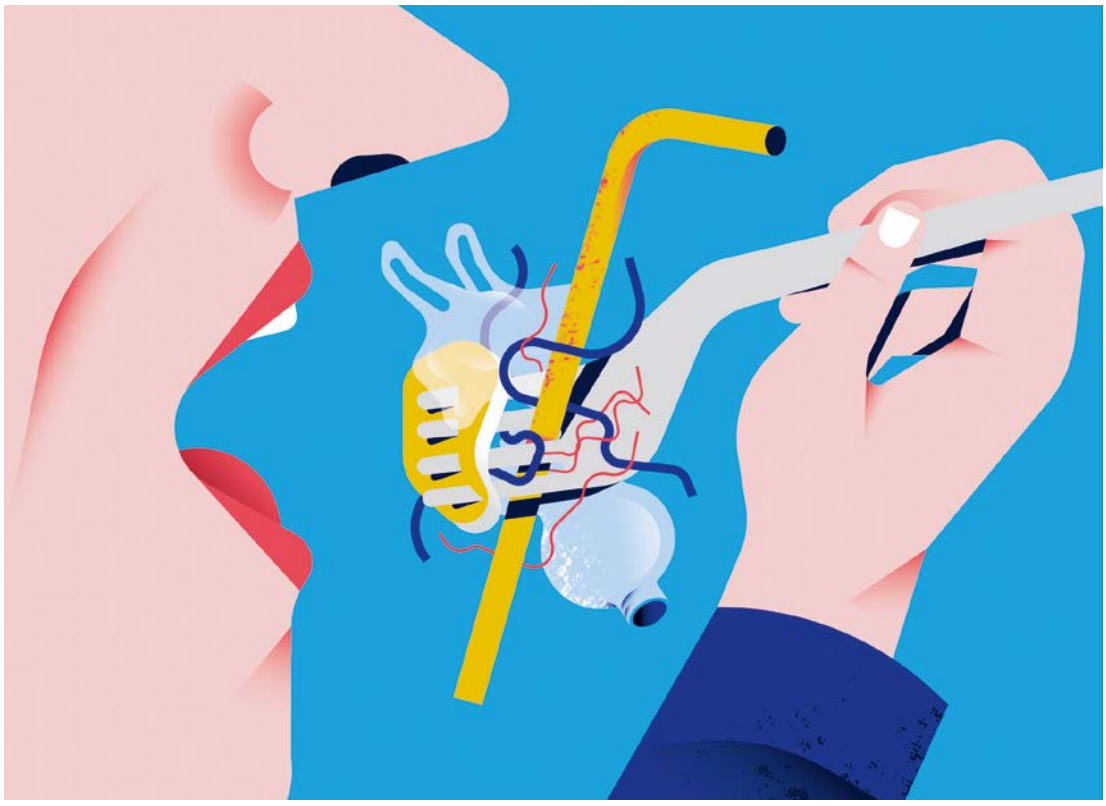
The analytical challenge

If intake is already difficult to research, this is all the more true for the analysis. There are imaging and spectroscopic methods for determining microplastics in food. However, generally recognised and validated methods for identification and quantitative analysis are lacking. One reason for this is that there are countless types of plastic. Another is that sample preparation poses a great challenge for science, according to Dr. Harald Jungnickel. The chemist is an expert in the field of product analysis at the BfR. "In the case of mineral water, it is still relatively manageable, since it is not a compound food. It gets really complicated with soil or animal samples, which are complex mixtures of many different substances." To do this, analyses must distinguish plant-based organic material from microplastics. "And it gets very difficult in the micrometre range." Various analytical approaches for determining and quantifying microplastics are currently being discussed in scientific circles. To this end, the BfR is cooperating with other institutions, such as the Max Rubner Institute, the sister authorities in Denmark (DTU) and France (ANSES), the University of Leipzig, the German Environment Agency and the Federal Institute for Materials Research and Testing. The BfR is discussing current developments with them and coordinating further joint action.

The formation of microplastics

Primary microplastics are produced industrially in the form of plastic-based granules or pellets. Different plastics such as polyethylene (PE), polypropylene (PP), polystyrene (PS), polyethylene terephthalate (PET), polyvinyl chloride (PVC), polyamide (nylon) and ethylene vinyl acetate (EVA) are used.

Secondary microplastics are created by chemical and physical ageing and decomposition processes from plastic bags, bottles or tyre wear. They can also come from washing textile fibres that contain plastic, such as fleece. Based on current knowledge, microplastics found in the environment mainly originate in this way.



Many open questions about the effects

There are hardly any reliable figures on the health effects of microplastics. A lack of studies means little data for risk assessment. One of just a few studies was carried out by the BfR in 2018 (see box). Biochemist and toxicologist Albert Braeuning's unit investigated the effect of microplastics on mice and human intestinal cells. "We found that polystyrene particles are unlikely to cause intestinal damage. However, we cannot prove this for other types of plastic, such as PVC, polypropylene or polyamide. To do this, we need experimental data." Various particles, different in structure, size or shape, must be investigated accordingly. According to private lecturer Dr. Braeuning, particles that are even smaller than microplastics must also be looked at: plastic nanoparticles.

In 2017, a junior research group was founded in the Department of Food Safety at the BfR to deal with both micro- and nano-scale plastic particles (see interview on page 12). Open questions include the effects of additives that make plastics soft, strong and colourful or that protect them from UV radiation. Some of them pose a danger to health. Another area of research: substances from the environment, such as polychlorinated biphenyls or polycyclic aromatic hydrocarbons, could become attached to microplastics. These could also be a threat to our health. In addition, data on microorganisms, such as bacteria or viruses, which "cover" microplastics in the environment as a biofilm, is lacking. Some of these may pose a danger to health.

Concern increases with awareness

Research into microplastics is only just beginning. The goal over the next few years is to obtain reliable data and better assess the health risk. Nevertheless, the topic is currently very much present in the media and population. For Dr. Mark Lohmann, Head of the Sociology of Risk and Risk Benefit Appraisal Unit, the interest in the research results on microplastics is no surprise. "For several years in our surveys, we have seen that the topic is becoming more and more important to consumers. That is what the media is picking up on and looking for answers." The BfR publishes the Consumer Monitor every six months under Lohmann. As a representative population survey, it provides answers to the questions about what the public thinks about topics in the field of consumer health protection.

The results clearly show that the awareness of microplastics as a consumer issue is increasing. And concern increases with awareness. While in February 2017

44 percent of respondents were concerned about microplastics, it had increased by twelve percentage points to more than half of respondents in February 2019.

Despite all scientific uncertainties, the BfR assumes that microplastics in food are unlikely to pose any health risks to humans based on the current state of knowledge. The World Health Organization (WHO) shares a similar view with regard to drinking water. Based on previous information, it assumes that microplastics in water pose no health risk. The organization, which observes and scientifically assesses health conditions worldwide on behalf of the United Nations, also calls for even more research and more reliable data. ◘

More information:
www.bfr.bund.de > A-Z-Index: Microplastics

Experiments on microplastics in the laboratory

The BfR has investigated the effect of microplastics from polystyrene, one of the most frequently used plastics in the world. It is used, among other things, for the production of styrofoam, food packaging and everyday items such as bicycle helmets. BfR scientists used two methods: On the one hand, they used cultures of human intestinal epithelial cells (in vitro) to investigate whether polystyrene particles of different sizes might be taken up into the cells. In addition, mice were fed the particles for 28 days. “We have no clear idea of what the particles could do,” says Albert Braeuning, who is researching food safety with his unit. “An inflammatory response? Oxidative stress? There are still fundamental questions here that need investigating.” The study results showed that the polystyrene particles are generally absorbed into the intestinal cells. However, in the mice it was found that, despite the very large amounts administered, they could only be detected occasionally in the intestinal epithelial cells examined. The levels were far above those that appear to be realistic for humans.