BfR2GO

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THE SCIENCE MAGAZINE OF THE GERMAN FEDERAL INSTITUTE FOR RISK ASSESSMENT (BFR)

PFAS

An everlasting challenge

FOOD COLOURS
MAKING FOOD COLOURFUL

TEXTILES
CHEMICAL CHIC?

ANIMAL EXPERIMENTS
RELIABLE ALTERNATIVES

How do Europeans perceive food risks? What is currently being reported across Europe regarding food and feed safety? And how does food safety actually work in Europe?

Answers are provided by oursafefood.de from the German Federal Institute for Risk Assessment (BfR). Every week, the latest food safety news from Germany and Europe is published there. You can subscribe to the corresponding newsletter via the following email address: oursafefood@bfr.bund.de

Find out more at: oursafefood.de

Our Safe Food

How long does forever last? In the case of “forever chemicals”, one might say: probably quite a while.

Main topic
PFAS

Editorial


© BfR

Dear readers,

"There's nought outside and nought within, For she is inside out and outside in," reads Goethe's poem "Epirrhema", which is devoted to the contemplation of nature. In a figurative sense, this also applies to many substances that the German Federal Institute for Risk Assessment (BfR) deals with. Take, for example, the "forever chemicals" PFAS, which enter the human body from the environment – that is, from the outside in. It can then take a long time for them to be "outside" again. Though not an eternity, as you can read in our feature on PFAS.

Lead, microplastics and viruses in food are also covered in this issue of our science magazine "BfR2GO". From the outside in: whether heavy metals, plastics or microorganisms, none of them stop at the boundary of our bodies and they can gain unwanted entry. It is the BfR's task to help ensure that they remain "outside" as far as possible.

Raw milk, food colours, alternatives to animal testing – these and other interesting topics await you in this issue. "He who brings much will bring something to many," as Goethe once said. Whether indoors or outdoors, I hope you enjoy this varied read.

Dr Tewes Tralau
Vice-President of the BfR

Assessment.
Research.
Communication.

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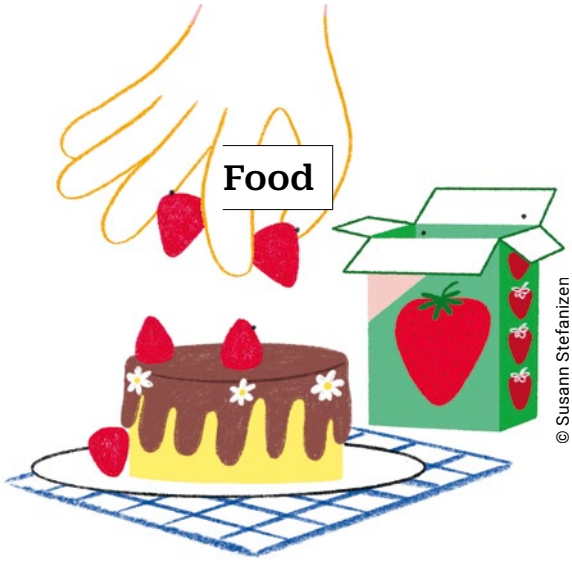

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Food

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INTERVIEW

Products & chemicals

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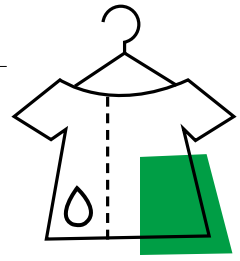


Protection of laboratory animals

© Test tube background: Paul Taylor, test tube 1: PM Images, test tube 2: turbopixel, test tube 3: OlekStock, petri dish: Anna Efetova, mouse: Richard Drury @gettyimages

Colourful and, in some cases, concerning

Slush ice drinks may contain glycerol. This liquid is permitted throughout the EU as food additive E422 in many food products. In a medical context, glycerol is used to reduce elevated intracranial pressure. The BfR has conducted a health risk assessment of the amounts of glycerol found in slush ice. The result: even with less than 200 ml of such "slushies", younger children may ingest enough glycerol to reach or exceed the therapeutically effective dose. Adverse effects may include headaches, vomiting and drowsiness.

More information

BfR FAQ
"Slush ice drinks containing glycerol"

An everlasting challenge

Illustration and infographic:
Mandy Münzner

PFAS, which are widely used as industrial chemicals, are proving to be long-lasting “forever chemicals” in the environment. The German Federal Institute for Risk Assessment is investigating the extent to which certain PFAS can affect health.

How long does forever last? One could philosophise about this at length, but in the case of “forever chemicals”, one can say: probably quite a while. The term “forever chemicals” refers to per- and polyfluoroalkyl substances, or PFAS for short. They consist of chain-like carbon molecules to which fluorine atoms are bonded.

PFAS are a group of fluorinated industrial chemicals comprising thousands of compounds. Due to their properties, they are used in numerous industrial processes, technical applications and consumer products. The substances are resistant to high temperatures and aggressive chemicals, cannot be broken down in the environment, or only to a very limited extent, and are therefore extremely durable. Despite all their potential advantages, this is a major drawback.

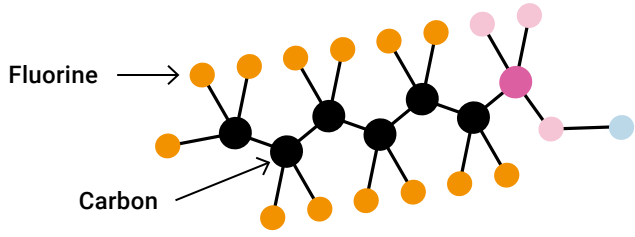
LONG-LASTING IN THE ENVIRONMENT

It is precisely this durability that poses a problem for environmental protection and from the perspective of consumer health protection. Because PFAS accumulate in the environment as well as in plants and animals, they reach humans in very small amounts on a daily basis, particularly via the food chain.

In humans, some of the ingested PFAS accumulate over time. When it comes to excretion from the organism, individual PFAS compounds behave very

The chemistry of PFAS

PFAS are not found in nature. In terms of their structure, the hydrogen atoms bonded to the carbon are completely (perfluorinated) or partially (polyfluorinated) replaced by fluorine atoms. There are at least 10,000 different PFAS compounds, 4,730 of which have a known chemical structure.



Chemical structure of perfluorohexanesulfonic acid (PFHxS)

differently. For some long-chain PFAS, it can take what seems like forever – several years – for a PFAS molecule to leave the organism. Short-chain PFAS, on the other hand, are excreted after just days or weeks.

PFAS are linked to a range of health effects. "A key factor is the long retention time of certain long-chain PFAS in the body, which leads to comparatively high concentrations," explains Dr Ulrike Pabel, a PFAS expert at the German Federal Institute for Risk Assessment (BfR). And since, according to the "basic law" of toxicology – the science of toxic substances – the dose makes the poison, this accumulation can lead to PFAS concentrations that have undesirable effects on humans.

CIRCULATING IN THE CYCLE

But how can these effects be detected? This question is not easy to answer for various reasons. In the human kidney, certain long-chain PFAS are transported back from the urine into the bloodstream, which explains their long retention time in the body and their accumulation. Rodents, on the other hand, excrete the substances much more quickly. This makes it difficult to transfer results from animal studies to humans.

Epidemiological studies therefore play a key role in the health risk assessment of PFAS. By observations within population groups, researchers attempt to identify risk factors for specific health problems, among other things. "Epidemiological studies can be used to investigate statistical associations between PFAS exposure, as measured in the blood, and health effects," says Pabel. "However, it is generally not possible to establish a clear cause-and-effect relationship."

Occurrence of PFAS in everyday life
(selection)

Cosmetics | Food packaging | Outdoor clothing | Cleaning products | Heat pumps

It is PFAS' longevity that poses a problem for environmental and consumer health protection.

EVERYWHERE IN THE ENVIRONMENT

There are further challenges: people are exposed to various PFAS, which may have different effects. And as the compounds are found everywhere in the environment, there is no "PFAS-free" control group for comparison. Age, gender, genetic predisposition, lifestyle and the level and duration of exposure to PFAS also play a role. Exposure can vary depending on regional environmental contamination.

Based on current knowledge, there is relatively strong evidence that children with higher PFAS concentrations have lower levels of antibodies in their blood serum following a standard vaccination. "PFAS affect the immune system," explains Pabel. "But the extent to which this influences the immune response has not yet been conclusively clarified."

Other effects of higher PFAS exposure in humans include an increase in blood lipid levels, particularly total cholesterol and LDL cholesterol (a risk factor for cardiovascular disease), an increase in a liver enzyme in blood serum (indicating a liver disorder) and reduced birth weight. It is not yet known how these effects arise. There is less evidence for other effects that are also discussed as health risks associated with PFAS.

A LONG-LASTING QUARTET

By far the best-studied are the four long-chain PFAS compounds perfluorooctanoic acid (PFOA), perfluorooctanesulfonic acid (PFOS), perfluorononanoic acid (PFNA) and perfluorohexanesulfonic acid (PFHxS). They belong precisely to the substances that are difficult to excrete and that accumulate in the body. The four PFAS account for around 90 percent of the PFAS detected in the blood.

How much PFAS in the body is "too much"? In 2020, the European Food Safety Authority (EFSA) published a tolerable weekly intake (TWI) of 4.4 nanograms (ng, equivalent to one billionth of a gram) per kilogram of body weight per week for the sum of the four PFAS mentioned. This describes the amount of a substance in food or drinking water that can be ingested weekly over a lifetime without posing a significant risk to health.

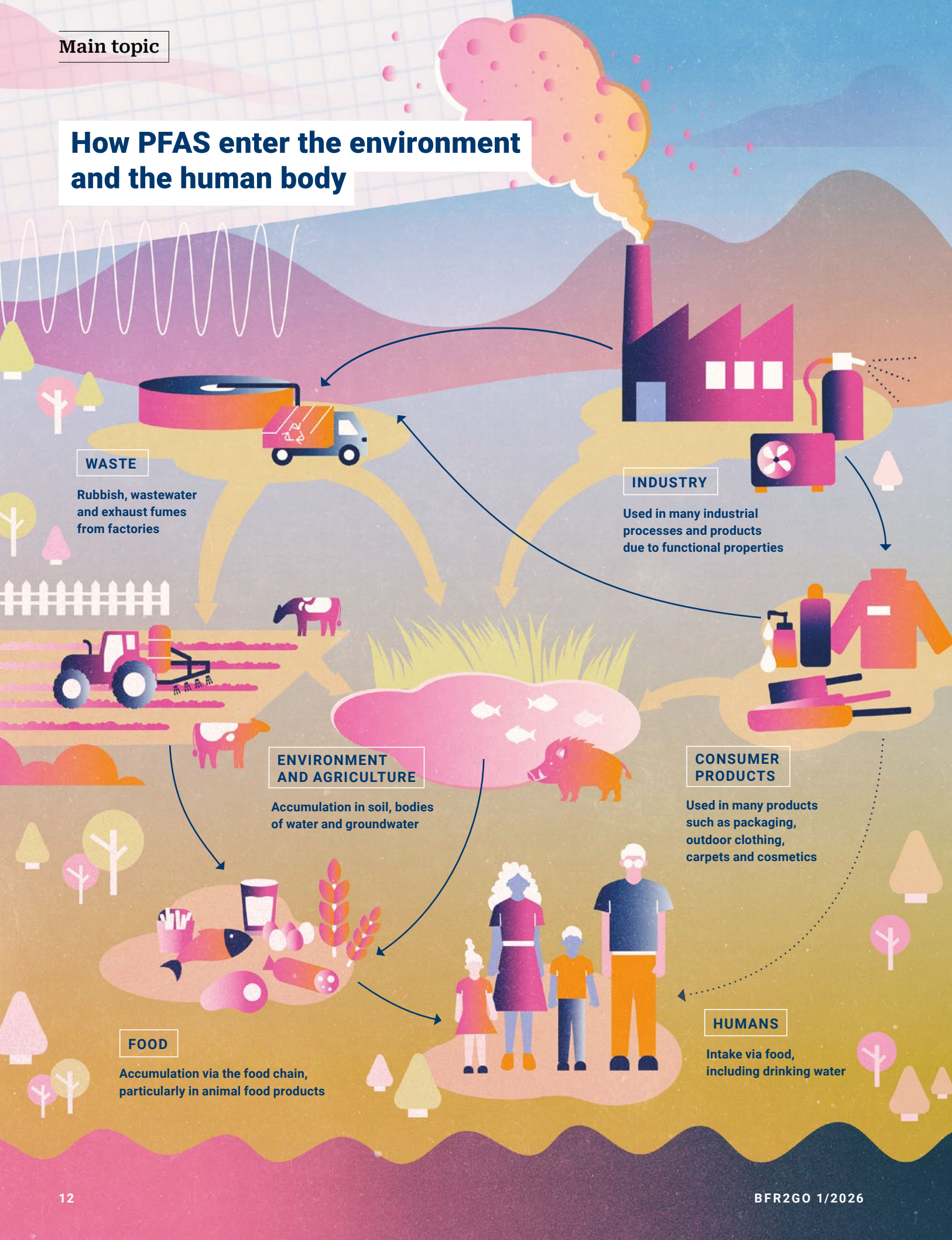
The TWI was based on data from a study of one-year-old children. This study revealed a link between higher concentrations of PFAS and lower concentrations of vaccine antibodies.

Breastfed infants can ingest PFAS via breast milk. The TWI takes into account the transfer of long-chain PFAS from mother to child during breastfeeding. As long as the mother's PFAS intake does not exceed the TWI, even infants who are breastfed for a long time are protected. This also applies to the rest of the population groups.

PFAS LEVELS IN THE POPULATION

According to a 2021 estimate by the BfR, the median PFAS intake among adolescents and adults is within the range of the TWI. For around 50 percent of them, long-term intake via food therefore exceeds the TWI as a health-based guidance value (HBGV). However, this

How PFAS enter the environment and the human body



Reducing PFAS intake – is that possible?

Foods such as fish, seafood and other animal food products (offal, meat, eggs), as well as drinking water, contribute significantly (though not exclusively) to intake. Plant-based foods and many other exposure routes, such as house dust and cosmetics, are also under discussion. "The concentration is particularly high in the liver of wild boar," says Pabel. "The Federal Ministry of the Environment therefore advises against eating this food." Apart from such exceptions, it is hardly possible to consciously influence one's personal intake.

estimate is subject to considerable uncertainty. Data on PFAS blood levels in the population – the internal exposure – suggest that the TWI is exceeded in a smaller proportion of the population.

The good news is that long-chain PFAS such as PFOS and PFOA are now strictly regulated and largely banned in the European Union (EU). Over the past few decades, there has been a significant decline in the levels of these substances in the blood. "Compared to 1990, the concentration of PFOS has decreased by 90 percent and that of PFOA, PFNA and PFHxS by 70 percent," reports Pabel. So far, no new PFAS have been identified that accumulate significantly in humans and are therefore particularly problematic.

So, is the PFAS "peak exposure" already behind us? Regulatory authorities and scientists have so far focused primarily on individual long-chain PFAS due to their long retention time in the body. Less prominent are other groups of PFAS, some of which are produced as alternatives to the compounds regulated to date. "Given the size of the PFAS group, it is not possible to fully capture all individual substances," says Pabel.

EXTENSIVE RESTRICTIONS UNDER DISCUSSION

In the EU, a far-reaching restriction on PFAS is under discussion at the suggestion of the European Chemicals Agency (ECHA). "Such a measure could lead to reduced release into the environment, and as a result, humans would also be exposed to lower levels of PFAS in the long term," explains Pabel. "However, because these substances remain in the environment for such a long time, this will still take some time."

The BfR will continue to conduct assessments of the health risks posed by PFAS. These substances serve as a striking example of the inseparable link between the environment and human health. And that will undoubtedly remain the case forever. —

More information

BfR FAQ
"Here to stay"

Do PFAS migrate from animal feed into food?

Agricultural scientist Dr Robert Pieper and his team at the BfR are investigating the path of undesirable substances from the trough to the table.

© BfR

Dr Pieper, PFAS are currently the subject of intense debate as a health risk. Does animal feed contaminated with PFAS play a role for humans?

Humans ingest PFAS largely via animal food products, such as fish, meat, milk and eggs. Naturally, feed and drinking water can play an important role. Furthermore, PFAS may be present in the soil, which animals ingest in small amounts. To trace the path of PFAS from feed, drinking water and soil into food, we conduct transfer studies at the BfR. The aim is to fill knowledge gaps. Together with the Federal Ministry of Agriculture, the Federal Office of Consumer Protection and Food Safety and the German federal states, we have also carried out a monitoring for PFAS in feed for the first time in Europe to gain an understanding of "background contamination".

What exactly are transfer studies?

These are feeding studies involving livestock, which we conduct both in collaboration with other national and international institutions and at the BfR research farm in Berlin-Marienfelde. In these studies, the animals are fed with feed containing PFAS. This may be feed from already contaminated areas or feed that has been artificially contaminated with PFAS. We then measure what accumulates in eggs, meat or milk over a period of time – in other words, the extent of the transfer. For example, using "naturally" contaminated chicken feed, we investigated how much of the PFAS compound is transferred into the eggs. It has been shown that PFAS compounds from the feed are transferred to varying degrees into the liver, muscle or eggs. Each of the different PFAS behaves differently, and the extent of transfer varies depending on the animal species and food product. This makes the issue highly complex.

In the EU, maximum levels apply to four PFAS compounds in selected animal food products. Are there similar efforts regarding feed?

Feed is key to ensuring compliance with PFAS maximum levels in animal food products. However, a solid database on background PFAS contamination in feed is required before appropriate legislation can be introduced. Our transfer studies can be helpful in this regard, and our publications on PFAS transfer from feed are attracting considerable attention across Europe. It is relatively straightforward to calculate, working backwards, which PFAS concentrations in feed should not be exceeded in order to achieve compliance with the maximum levels. One tool we have developed for this purpose is the "ConTrans" software.

What is "ConTrans" all about?

"ConTrans" is a publicly accessible web tool, i.e. an internet application, which can be used to predict the transfer of undesirable substances such as PFAS from feed into animal food products and also to determine whether maximum levels are exceeded. The programme also enables an assessment of the maximum concentration of a substance in feed that is permitted in order to ensure compliance with the maximum level in food. It has proven to be an important tool for regional authorities in the German federal states and for regulatory bodies worldwide.

What have your feed monitoring results for PFAS shown?

A key finding is that the concentration of PFAS in feed is very, very low in most regions. This is, of course, good news for consumer health protection and feed safety. —

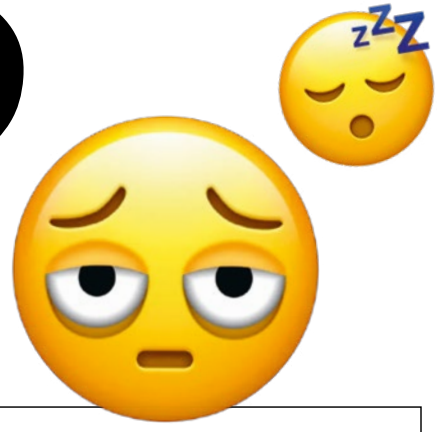
More information

BfR information
PFAS

More information

BfR information
ConTrans software

PICK-ME-UPS

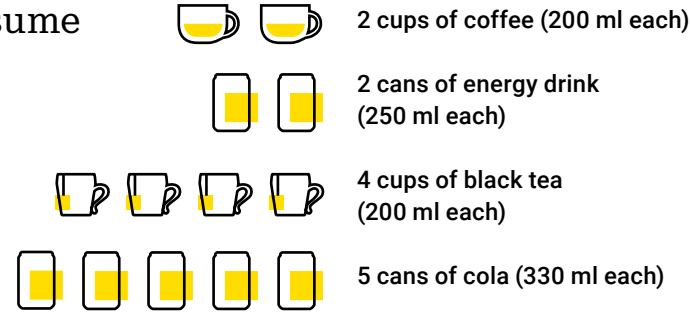


Caffeine gives you a buzz and is therefore popular. However, high amounts can cause nervousness, insomnia, sweating and a racing heart. For adults, 400 milligrams (mg) of caffeine spread over the day, or 200 mg as a single dose, is less problematic for health. Pregnant and breastfeeding women should not consume more than 200 mg per day.

More information

BfR FAQ
"Caffeine"

200 mg
of caffeine is found in ...



2 cups of coffee (200 ml each)

2 cans of energy drink (250 ml each)

4 cups of black tea (200 ml each)

5 cans of cola (330 ml each)

Scientific sniffers

Spring ragwort looks pretty when it is in bloom and yellow. However, if it gets into hay used as feed it can cause severe poisoning in cows or horses, for example. This is due to pyrrolizidine alkaloids (PA), which the plant produces naturally. The BfR is investigating whether dogs can detect such impurities. Initial tests have been positive: the dogs were able to distinguish ragwort from other plants by its scent and detect it even in small amounts in hay samples. Next, the research sniffer dogs must pass the practical test and find impurities in compressed hay bales. If successful, well-trained dogs could in future detect contaminated hay in places such as horse stables. The tests are planned for this year.

More information

BfR communication
"Scientific sniffers"

INFANT FORMULA WITH "PROBIOTICS"

Infant formula and follow-on formula containing "probiotics" are said to have positive effects on infant health. Manufacturers claim that the added bacterial strains help to reduce gastrointestinal infections, for example. The BfR has reassessed the effects of such products. The available data indicate neither health benefits nor adverse effects.
In studies, healthy infants fed "probiotic" formula products did not experience diarrhoea any less frequently than those given conventional infant formula. The BfR recommends further studies.

More information

BfR opinion
"Infant formula with added 'probiotics'"
(in German)

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CAN NUTRITION SAVE YOUR HAIR?

In Europe, around 80 % of men and 40 % of women lose their hair sooner or later. Hereditary baldness caused by an overreaction to male hormones – androgenetic alopecia – is very common in Europe. The BfR has conducted a scientific assessment of whether those affected can counteract hair loss with specific foods or food supplements. The conclusion: studies do not indicate any specific nutritional requirements – a balanced diet containing sufficient amounts of, for example, proteins, vitamins and minerals is sufficient.

More information

BfR opinion
"Can a special diet halt hereditary hair loss?"
(in German)

STUDY PARTICIPANTS WANTED

More and more people are following a vegan or vegetarian diet. However, there is a lack of data on the benefits and risks of plant-based diets. The COPLANT study is currently looking in particular for: pregnant women, parents with children and men who follow a vegetarian or vegetarian-with-fish diet. By taking part in the study, you will contribute to scientific knowledge and, at the same time, gain valuable insights into your health status.

More information

Website
coplant-studie.de/en/

COPLANT

How does the virus end up on your plate?

Illustration:
Susann Stefanizen

Foodborne infections can be caused not only by bacteria, but also by viruses. A common cause? Poor hygiene.

Noroviruses – they are particularly feared in nurseries, care homes and even on cruise ships. As few as 10 to 100 of these tiny diarrhoea-causing pathogens are enough to make a person ill. Particularly where many people gather in confined spaces, isolated cases of illness can quickly turn into a full-blown outbreak. This is because the pathogens are primarily transmitted from person to person. However, contaminated food can also be a source of infection – and spread noroviruses as well as some other viruses.

"Viruses can end up on food if sick people are not sufficiently rigorous about hygiene and spread the pathogens in their surroundings," explains Reimar Johne, who studies foodborne viruses at the German Federal Institute for Risk Assessment (BfR). "It can also occur if the food comes into contact with contaminated water, for example during the harvest or further processing." Experts refer to this as faecal-oral transmission; in addition to noroviruses, rotaviruses and hepatitis A viruses can also spread in this way.

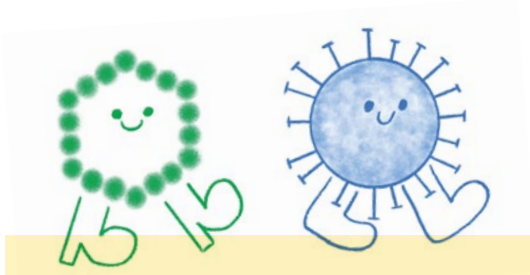
During food inspections, viruses are frequently detected on frozen fruit, and shellfish are also often mentioned in connection with viral foodborne infections. "In principle, however, all foods can transmit viruses if they are grown, produced or processed under poor hygienic conditions," says Johne.

HEPATITIS INFECTIONS ONLY BECOME NOTICEABLE LATER

The situation is somewhat different with hepatitis E viruses. "These viruses are widespread in domestic and wild pigs," says Eva Trojnar from the National Reference Laboratory (NRL) for Foodborne Viruses. "People therefore usually become infected when eating raw or undercooked pork." Unlike diarrhoea-causing pathogens, which trigger symptoms within hours or days, infection with hepatitis E or A viruses initially goes unnoticed. It is only weeks or months later that the infection may manifest as liver inflammation.

RESEARCH OBJECTIVE: MINIMISING HEALTH RISKS

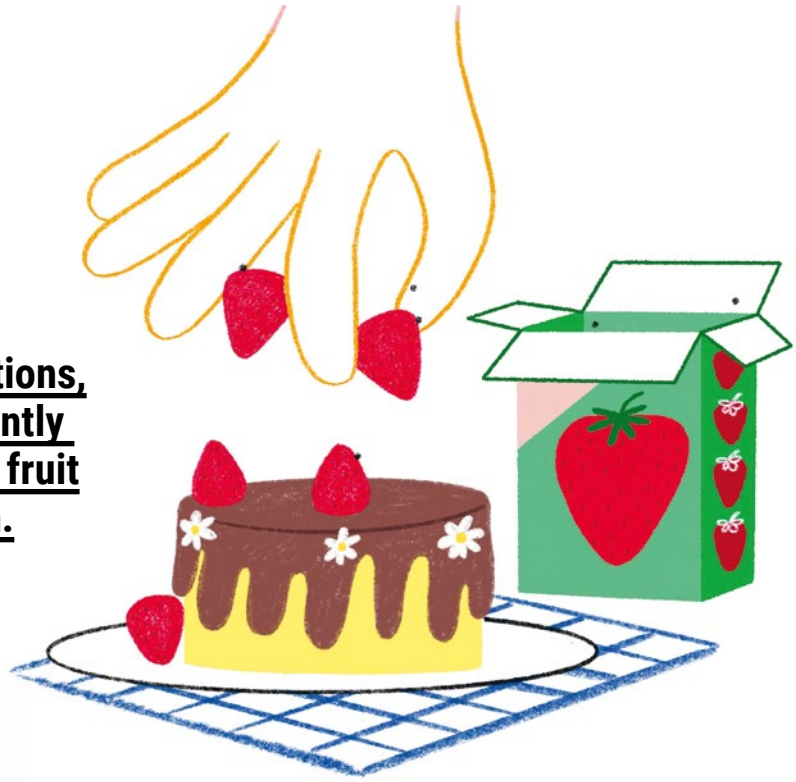
Reliable methods are needed to detect contamination. This is precisely what Trojnar and her team at the NRL are working on. "We are



HELPFUL: HEAT AND HYGIENE

You cannot tell if food is contaminated with viruses by looking at it. Nor can you smell or taste them. Norovirus, rotavirus and hepatitis A viruses are also relatively resilient: they are quite stable in the environment, and deep-freezing is just as harmless to them as briefly boiling or heating in the microwave. What helps to reduce the risk of infection when consuming food is thorough and even heating. In particular, shellfish, frozen berries, and meat and offal of wild and domestic pigs should not be eaten raw. Fruit, vegetables and leafy salads should be washed thoroughly before eating.

During food inspections, viruses are frequently detected on frozen fruit and in shellfish.



BIRD FLU VIA FOOD?

The bird flu virus is highly contagious among wild birds and poultry. It has been known for some time that, in rare cases, other animal species can also contract bird flu, such as cattle. Can humans then become infected with the virus via chicken or beef, milk or other animal food products? Probably not. In the rare cases where the virus has been detected in humans, close and direct contact with infected animals was the likely cause of infection. There is currently no evidence of transmission via food.

As the virus is sensitive to high temperatures, any pathogens present are killed during cooking and frying. Nor are any health impairments to be expected from consuming pasteurised, i.e. briefly heated, milk from potentially infected cattle, as the virus is destroyed during pasteurisation.

developing new methods or improving existing ones," says Trojnar. "This includes, for example, adapting the procedures for different types of food. After all, it makes a difference to detection whether the virus is present in a sausage sample or on a leaf of lettuce."

However, the virus researchers at the BfR are also investigating fundamental questions: How widespread are certain viruses in different animal species and foods? How stable are they and how can they be safely inactivated? How can contamination of food be prevented? The aim is to identify health risks to consumers at an early stage and to develop strategies to minimise them. —

More information

BfR information **"Viruses"**

Lead exposure

Lead enters our food via the environment and accumulates in the body, where it can be harmful to our health.

It has long been known that lead can damage the nervous system, the kidneys and the cardiovascular system. Even small amounts of lead can cause neurological impairment, particularly in unborn babies, infants and young children. The German Federal Institute for Risk Assessment (BfR) used data from the BfR MEAL study to investigate the amount of lead consumed through the diet in Germany. The study revealed that grains and grain products, as well as water and water-based drinks, contribute most to average lead intake across all age groups, accounting for around 15 to 20 percent each. For adults, drinks such as coffee are also an important source. Children aged 1 to 2 years have an estimated lead intake that is four to five times higher than for adolescents and adults. This is due to their higher consumption relative to body weight.

A SHOT OF LEAD

A special case is game meat from animals that have been hunted and killed with ammunition that contains lead. Small metal particles from the projectiles can remain in the meat. This can lead to increased lead intake – particularly among those who eat game more frequently. For most people, who only eat game meat occasionally, this contribution to lead intake is relatively small. However, for particularly vulnerable groups such as children, pregnant women and women planning to conceive, it is recommended that they avoid eating game hunted and killed using lead ammunition, in order to prevent additional lead intake via this route.

VARIETY HELPS

It is important to note that, according to current research, there is no level of lead intake that is harmless to health. The BfR therefore recommends minimising lead intake as much as possible. Ensuring varied and balanced nutrition is part of this. —

More information

BfR Opinion
"Results of the BfR-MEAL study on lead in food"

They are primarily promoted on social media as beneficial to health. Our fact sheet shows what **omega-3 fatty acids** can really do.

What are omega-3 fatty acids?

They belong to the group of polyunsaturated fatty acids. The most important types include alpha (α)-linolenic acid (ALA), eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA).

Why does the body need omega-3 fatty acids?

They play an important role in:

- **Cell structure and function**
- **The development and growth of the (unborn) child**
- **Anti-inflammatory effect**
- **Fat metabolism**
- **Blood pressure regulation**

Recommended daily intake

Of the omega-3 fatty acids, only ALA is clearly essential. This means that it cannot be produced by the body and must therefore be taken in via food.

The German Nutrition Society (DGE) estimates that an ALA intake of 0.5 percent of daily energy intake is sufficient to meet the needs of people of all age groups. For middle-aged men and women, this corresponds to approximately 1,300 milligrams (mg) of ALA per day. The body can use ALA to produce the long-chain omega-3 fatty acids EPA and DHA.

As DHA in particular is important for the development and growth of children, even before birth, the DGE recommends that pregnant and breastfeeding women should consume at least 200 mg of DHA per day.

Approx. 1,300 mg/day
alpha-linolenic acid for adults

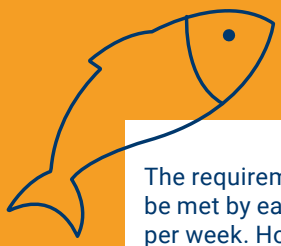
200 mg/day
docosahexaenoic acid for pregnant/breastfeeding women

Good sources

ALA is found almost exclusively in plant-based foods, whereas EPA and DHA are primarily taken in via oily sea fish. All figures are in grams (g) per 100 g.

	ALA	EPA	DHA
Flaxseeds	20.0	0	0
Walnuts	10.2	0	0
Rapeseed oil	8.58	0	0
Mackerel (smoked and cooked)	0.59	3.16	5.10
Herring	0.07	2.21	0.73

Source: Federal Food Code 3.02



The requirement for DHA and EPA can easily be met by eating one to two portions of oily fish per week. However, **pregnant and breastfeeding women** should avoid certain types of fish, such as tuna or redfish, due to their high concentrations of methylmercury. Pregnant and breastfeeding women who do not eat fish should take a DHA supplement after consulting their doctor.

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For fish-free nutrition

People who do not eat fish can produce EPA and DHA from ALA by specifically consuming plant-based foods with a high ALA concentration (such as rape and walnut (oil) or linseed (oil)). However, the same amounts as in a fish-based meal cannot be achieved.

Is a dietary supplement advisable?

In the BfR's view, healthy people who eat fish regularly do not need omega-3 fatty acid supplements. For people with heart disease or relevant risk factors, taking higher doses of around 2 grams (g) of DHA/EPA per day may lead to an increased risk of atrial fibrillation. In such cases, omega-3 fatty acids should not be taken as a supplement on one's own initiative, but only after consulting a doctor.

Can seaweed be an alternative?

Seaweed also contains DHA and EPA, albeit in very varying amounts. Some types of seaweed also have high iodine content (see p. 29, "Risky sources of iodine"), which can pose a health risk if consumed in large amounts.

More information

BfR FAQ **"Omega-3 fatty acids"**

HOLY (RAW) MILK

Raw milk is celebrated as a “superfood”, particularly on social media. Justified hype or a risky trend?

In the online world, raw milk is often extolled as a genuine health-booster packed with nutrients and beneficial bacteria. It can come from cows, sheep or goats and is sold to consumers untreated "direct from the farm" after milking, for example via so-called milk filling stations. Raw milk is thus not homogenised or pasteurised before sale, unlike conventional fresh or UHT milk. This is precisely where raw milk enthusiasts see the problem: they claim that heat treatment would destroy all the beneficial ingredients. But is this really the case? And can raw milk really be enjoyed without hesitation?

HIDDEN RISK OF INFECTION

"Raw milk is a sensitive food," explains Dr Anja Buschulte, a veterinary specialist in food safety at the German Federal Institute for Risk Assessment (BfR). "It can contain impurities from pathogenic bacteria such as Salmonella, Campylobacter or enterohaemorrhagic Escherichia coli (EHEC)." It is almost impossible to avoid milk containing bacteria – wether pathogenic or harmless. After all, dairy animals do not live in a sterile environment, but in the open air or in stables. Bacteria are naturally widespread there and can enter the milk during milking or processing. Furthermore, infected animals can excrete bacteria in their milk, even if they themselves do not appear visibly ill.

If a person drinks raw milk straight from the bottle, foodborne infection is possible. "This can be particularly risky for infants, young children or people with a weakened immune system, such as pregnant women or the elderly," says Buschulte. But even healthy adults face an increased risk of foodborne infection, which can lead to mild to severe illness depending on the type of pathogen.

HEAT PROTECTS

The good news is that heat kills the bacteria. Vulnerable population groups should therefore generally boil raw milk before drinking it. Under current legislation, raw milk outlets must therefore be clearly labelled with the warning: "Raw milk – boil before consumption".

The situation is different for what is known as certified raw milk – packaged raw milk from farms subject to particularly strict controls, which is also available in shops. "Strict regulations apply to its production and handling, such as enhanced microbiological testing of the milk," explains BfR scientist Buschulte. "It can therefore be assumed that the probability of infection is reduced compared to raw milk from conventional farms." However, for particularly vulnerable population groups, the BfR recommends heating even certified raw milk before consumption.

Good to know: Unpackaged raw milk may only be sold directly at the dairy farms. Sale to communal catering establishments such as canteens, hospital kitchens or catering facilities at schools and nurseries is not permitted. Nor may certified raw milk be used in communal catering without first being boiled.

UNTREATED = HEALTHIER?

Many of the supposed benefits of raw milk are either not scientifically proven or have been disproved, or, in the BfR's view, they play at best a minor role in light of the health risks. For example, pasteurisation of milk results in a slight reduction in B vitamins (approximately 10 %), but minerals and milk fats remain unchanged. These minor differences in vitamin content are insignificant for vitamin intake given the generally good nutrient supply in this country.

According to the current state of knowledge, the BfR is not aware of any adverse health effects of pasteurisation. Even though potentially pathogenic bacteria are killed, pasteurised milk remains a natural food rich in natural and beneficial ingredients. —

More information

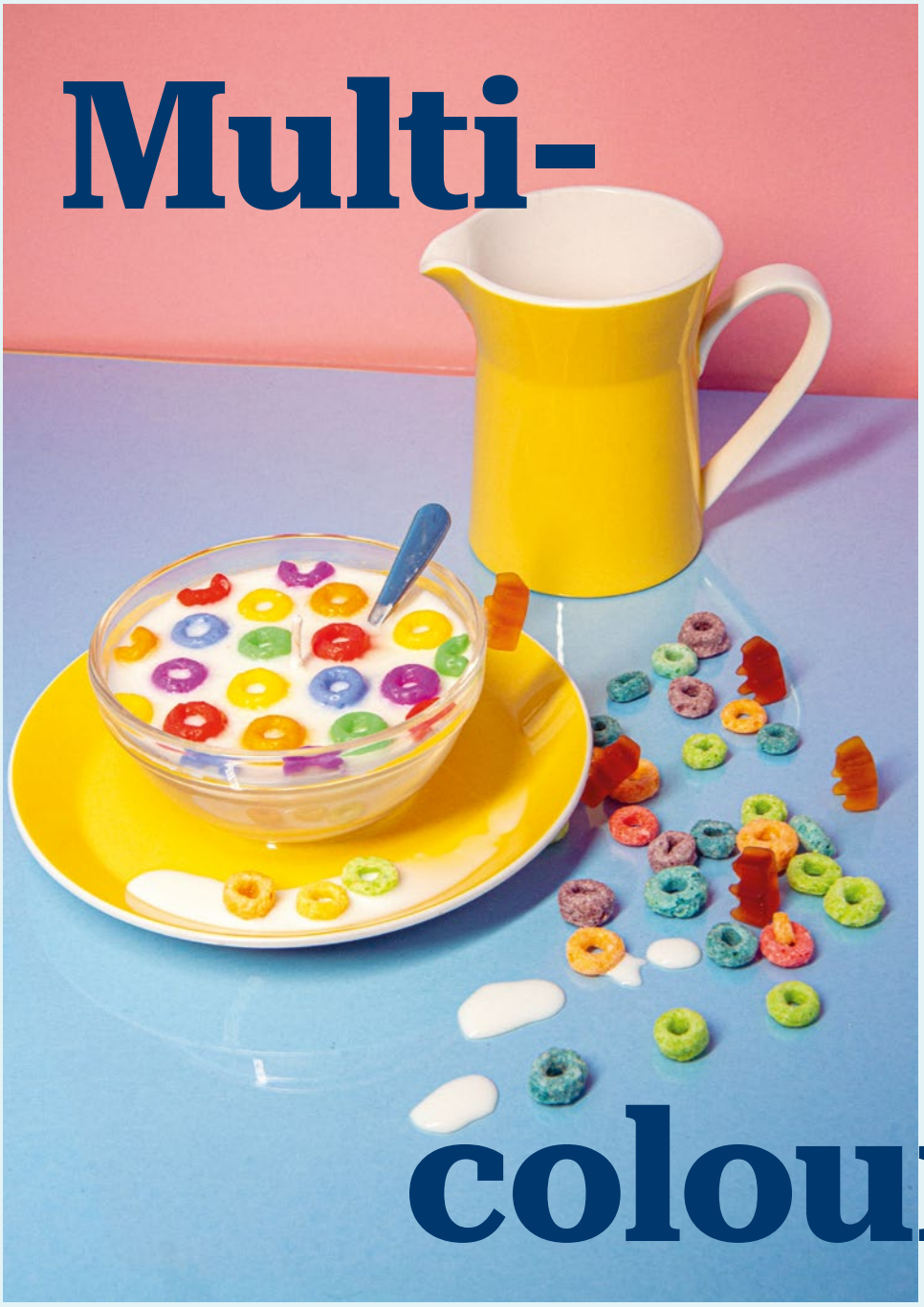
BfR FAQ
"Avoiding infections"

UNDERESTIMATED: HEALTH RISKS OF RAW MILK

Only ten percent of consumers surveyed for the BfR Consumer Monitor stated that they were concerned about the consumption of raw milk – making raw milk the issue of least concern among the risks surveyed.

More information

Brochure
BfR Consumer Monitor 05/2025



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Multi-coloured meals...

Food colours are intended to make food look appetising and attractive – for days, weeks, even months. They can be identified on packaging by their “E numbers”. They must not be harmful to health.

Food colours are added to many foods to alter or enhance their natural colour. For example, butter gets its yellow colour from the addition of beta-carotene, while sweets are coloured blue using indigotine. Sometimes food colours are also used to make a food product more appealing, for example by giving it an unusual or striking appearance. But not all foods are allowed to be coloured – milk, sugar, bread, fruit, vegetables and mushrooms, for example, are not.

MIXED FEELINGS ABOUT MIXED COLOURS

There are currently 40 food colours authorised in the European Union (EU). We come across them in many products in the supermarket – and they provoke mixed feelings, as a regular survey by the German Federal Institute for Risk Assessment (BfR) shows: just under a quarter of the respondents say they are “very concerned”. A further third say they are “not at all” concerned about the colours. However, more than a third of respondents feel they are not well informed about the substances.

TESTED AND AUTHORISED

Food colours belong to food additives and may only be used in the EU after being authorised. “The prerequisite is that the intended conditions of use do not, on the basis of the scientific evidence available, pose a safety concern to the health of the consumer,” says Dr Rainer Gürtler, a food toxicologist at the BfR, quoting the EU Food Additives Regulation. The health risk assessment is carried out by the European Food Safety Authority (EFSA), which examines extensive data on possible adverse health effects and potential intake levels. Substances that are mutagenic and/or carcinogenic are not authorised. “It does not depend on whether a substance is natural or synthetic,” explains Rainer Gürtler, “but rather on its chemical structure.”

NOT BLACK AND WHITE

As research constantly generates new knowledge, assessments of health safety and, consequently, the authorisation of food colours are regularly reviewed. The EU’s current review

The range of food colours

natural colours:
from plant or animal sources, e.g. the green leaf pigment chlorophyll (E140) from plants

nature-identical colours
synthetic or fermentation-produced replicas of natural molecules, e.g. riboflavin (E101), whose natural counterpart, vitamin B2, has a high prevalence in many plant and animal foods

artificial colours:
chemically synthesised substances with no natural prevalence, e.g. azo dyes

© Jena Ardell/gettyimages

Good to know

Foods with colouring properties, such as fruit and vegetable juices or spices (e.g. beetroot and saffron), are not classified as food colours. They are considered ingredients and are listed by name in the ingredients list.

programme stipulates that all food colours authorised before 20 January 2009 must undergo a re-evaluation at EU level. This was applied, for example, to titanium dioxide: the use of this white pigment as a food colour (formerly E 171) was subsequently no longer considered safe due to a possible genotoxicity, and its authorisation was withdrawn in 2022.
For some food colours, EFSA still requires further clarification for the re-evaluation. This concerns, for example, particle sizes and their distribution, as well as the possible occurrence of nanoparticles, which would necessitate a specific assessment. Consequently, some food colours have not yet been finally (re)assessed due to a lack of data or identified uncertainties. "However, there is currently no evidence to justify health concerns regarding authorised food colours," says BfR expert Gürtler in summary.

NO TO SOME (AZO) DYES

Certain substances have repeatedly been the subject of debate in the past: azo dyes. "The issue is whether they undergo chemical changes to form the substance aniline," explains Gürtler. Aniline is potentially mutagenic and carcinogenic. In this regard, EFSA conducted a re-assessment of the azo dye Red 2G (formerly E 128) in 2007. The substance is no longer authorised as a food additive. On the other hand, a (weak) suspicion of a potential genotoxic effect that existed some time ago for Allura Red AC (E 129) was not confirmed in subsequent adequate studies. "The uncertainties that existed at the time have thus been resolved," says Gürtler.

DISCOVER EVERY E

Anyone wishing to avoid certain food additives can do so when shopping: the E numbers listed on the packaging indicate whether a food product contains colours. E 100 to E 180 or the names of the colours are given in the list of ingredients for packaged foods, together with the term "colour". For example, "colour annatto" or "colour E 160b". If food colours are present in unpackaged food or in dishes, the respective retail outlets or catering establishments must provide information accordingly. —

More information

BfR information
"Health risk assessment of food additives"

Risky sources of iodine

The body needs iodine for vital processes. In Germany, however, many people do not take in enough of it through their diet. Can seaweed help?

Iodine is a tricky matter – too little can be harmful to health, but so can too much. Our thyroid gland needs this vital trace element to produce hormones that regulate key processes in metabolism. However, the soil in Germany is low in iodine; consequently, plants grown here and the food produced from them contain very little iodine. To increase intake, salt in Germany can be enriched with iodine on a voluntary basis – a measure that is also applied in other countries, in some cases on a mandatory basis.

By using iodine salt and buying products made with it, consumers can improve their iodine intake. A daily recommended intake of 150 micrograms (µg) is recommended for adults; pregnant and breastfeeding women have higher requirements and should therefore take iodine supplements after consulting a doctor. Dietary choices also help: milk, cheese and yoghurt, but above all sea fish such as pollock or herring, are good sources of iodine.

TOO MUCH OF A GOOD THING

Seaweed, which is regarded as a nutrient-rich superfood, also contains iodine. However, it often contains such high amounts that it can be too much of a good thing. EU-wide monitoring programmes show that the iodine content of seaweed can vary greatly. In particular, some edible brown seaweeds, such as kombu or sugar kelp of the genus Saccharina, sometimes have very high iodine levels. In such cases, even small portions can lead to a significant excess with respect to the tolerable upper intake level for iodine (600 µg per day for adults) and pose a health risk.

Both long-term excessive and acute excessive iodine intake can be harmful to health and may, for example, impair thyroid function. The consumption of seaweed and seaweed products is therefore not without risk if precise knowledge of the iodine content and a maximum daily intake recommendation derived from this is lacking. —

Seaweed – what to look out for?

When it comes to seaweed or foods containing it as an ingredient, consumers should ensure that the iodine content and a maximum daily intake recommendation are stated.

“Communicate with the end goal in mind”

© BfR

Professor Dr Eva Baumann is a communication scientist at the Hanover Centre for Health Communication at the Hanover University of Music, Drama and Media. She conducts research in health and risk communication and is a member of the Scientific Advisory Board of the German Federal Institute for Risk Assessment (BfR).

When many voices speak at once: communication expert Professor Dr Eva Baumann shows how risk communication provides guidance – despite the flood of information.

Professor Baumann, in your view, what is the biggest challenge when institutions such as the BfR or the media want to inform the public about health issues and risks?

The biggest challenge is that a single text or message can never reach everyone at the same time. People are just too different: in different life situations, stages of life, where they live and how they live.

What's more, on many topics, very different stakeholders are communicating at the same time. What does that mean for risk communication?

It complicates matters, because each of these stakeholders has different interests. Scientists are primarily interested in the scientific evidence. Environmental and consumer organisations want to protect consumers from unnecessary risks. Political actors want to establish and enforce a regulatory system that functions effectively within society. And finally, industry and businesses have economic interests. Everyone is trying to reach their target groups with their messages and their perspective on an issue.

So how can we reach people at all?

We need to consider: Who do I want to reach, and who do I need to reach with specific risk information? Which media do these groups use? Who do they trust? If my target group is children, I should, of course, also consider how to effectively address their parents. Perhaps I should collaborate with an influencer who includes this topic in their content. This increases the likelihood that I actually reach and can address my target group – a group that may not be interested in the topic in the first place.

Take the message to where people are already getting their information?

Exactly. Keep the end goal in mind. That means starting with the people I want to reach. The key isn't just creating and providing high-quality information, but also understanding how you reach people and stimulate their thinking.

So the "traditional" approach – writing a nice informative text, perhaps printing it as a leaflet, and waiting for people to pick it up – is outdated?

Exactly. That often costs a lot of money but yields little return.

Isn't there a risk that, with so much focus on the target audience, we end up oversimplifying things?

It's always a balancing act. But it's better to get at least one small, important message across than to reach no one at all. When simplifying, for example, for a science comic, you focus on the core of a topic and your message. And the simplification is deliberately carried out by people who know the broader context of a topic – they will make the best decisions about how to narrow the content. Formats such as comics or social media posts act as bridges to establish contact with a topic, to raise awareness and spark curiosity. This increases the motivation to then engage with the topic in greater depth. —

Risiko – The BfR Podcast

You can listen to the full interview on the BfR's German-language science podcast "Risiko", episode 15: "Risikokommunikation – vom Ende her denken"

An excess dose of caution?

When hazard becomes risk: The planned classification of ethanol threatens its use as a disinfectant and shines a spotlight on the question of how chemicals should be assessed.

As a disinfectant, alcohol is an indispensable part of our daily lives. In hospitals and doctors' surgeries, in industry or in public buildings, the substance known chemically as ethanol has long proven effective against bacteria, viruses and fungi. It is all the more surprising, then, that the future of this substance has recently been under discussion in the European Union – at least its use for disinfection, not as an ingredient in wine and beer. It is a fate that iodine and other biocides – agents against harmful organisms such as bacteria, viruses and fungi – may also share under certain circumstances. How did it come to this?

At the root of this development lies the distinction between hazard and risk. Both terms are often used synonymously, but scientifically speaking there is a significant difference between them. A "hazard" is something that has the potential to cause harm. "Risk", on the other hand, refers to the probability that a hazard will actually cause harm.

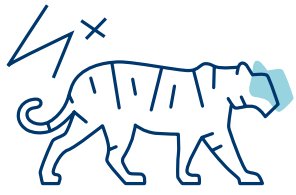
THE TIGER AND THE DOSE

To illustrate the point simply: a tiger is a hazard to other living beings, such as humans. However, if the tiger is in a cage, the risk of becoming prey is low. It only increases once the cage is opened. In relation to chemical substances, this means that the amount of a substance ingested – the dose – determines the risk to humans. A very small dose of a hazardous substance does not pose a high risk (tiger in a cage), whereas a large dose does (tiger roaming free).

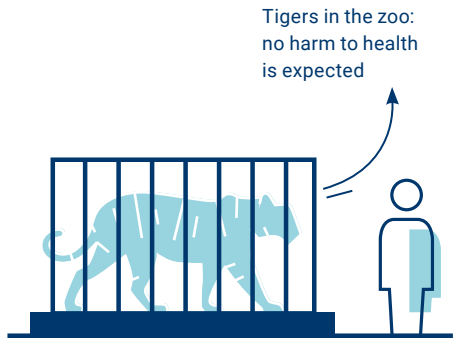
"The dose makes the poison" – this insight comes from the physician Paracelsus, who lived in the 16th century. To this day, it remains almost universally valid and forms the basis of the science of toxic substances, known as toxicology. Risk is a key consideration worldwide when it comes to assessing the potential harm posed by chemicals. In the EU, chemicals (under the REACH Regulation), plant protection products (PPP), biocides, cosmetics and other products containing chemicals are regulated primarily with

Hazard or risk?

In everyday language, we often use the two terms interchangeably. Scientific risk assessment, however, makes a strict distinction. Whether a potential hazard is associated with a risk depends on "exposure": how much, how long and how often.



HAZARD: describes the potential of something to cause harm to health (hazard potential)



RISK: describes the probability of whether and how seriously health will be harmed by something

PARTICULARLY HAZARDOUS PROPERTIES OF SUBSTANCES:

— cancer-causing (carcinogenic)
— causing genetic mutations (mutagenic)
— toxic to reproduction (reprotoxic)
— damages hormones/hormone pathways (endocrine disrupting)

These properties are summarised under the acronym CMRE (Carcinogenic, Mutagenic, Toxic to Reproduction, Endocrine Disrupting).

a view to the risks associated with them. This enables the responsible use of chemicals while ensuring a high level of protection for human health and the environment.

CLASSIFIED, LABELLED, PACKAGED

However, there are exceptions to the rule regarding risk. This applies in particular to the EU's Regulation on Classification, Labelling and Packaging (CLP Regulation) (1272/2008), which came into force in 2009, and other European legislation that refers directly to the CLP Regulation. The regulation governs the classification, labelling and packaging of chemical substances and mixtures. The core principle is to indicate hazards as a matter of course – accordingly, hazard assessment forms the basis of the CLP Regulation. It does not take into account whether the intended use of a chemical substance is actually associated with a health risk. Classification into different hazard categories is carried out by the European Chemicals Agency (ECHA).

HAZARD: ALL OR NOTHING

If a chemical possesses CMRE properties in accordance with the CLP Regulation (see box), this may mean that it can no longer be used in certain areas of application. These hazard-based "cut-off criteria" apply in particular to plant protection products (PPPs) and biocides. Instead of a differentiated assessment that takes into account the extent to which a person is exposed to the substance, an all-or-nothing principle applies. The dose of a substance therefore no longer plays a role in its classification as a hazardous substance. "This regulation was certainly introduced with the best of intentions for consumer protection," says the BfR biocide expert Dr Vera Ritz, "but after more than ten years of experience, it has to be said that expectations have not been met and the protective effect has, in some cases, been reversed."

The problem is particularly evident with ethanol and iodine. Both are practically irreplaceable as disinfectants. Ethanol, as a chemical substance, has a probability of being classified in future under the CLP Regulation as carcinogenic and toxic to reproduction, thus meeting two CMRE criteria, even though these health effects are not a concern when used as a disinfectant – the dose taken in by the body is far too low for that, unlike, for example, with high consumption of alcoholic beverages. As a building block of thyroid hormones, iodine can adversely affect the hormonal balance in excessive concentrations, but this is not to be expected when used as a disinfectant.

Nevertheless, both substances face the threat of being phased out, or at least facing significant restrictions on their use as biocidal active substances in disinfectants, if the CMRE properties become decisive cut-off criteria in the relevant EU regulation. However, as industrial chemicals, ethanol and iodine may continue to be used in accordance with the current REACH Regulation – and, of course, wine, beer and iodine salt will not be banned.

ONE SUBSTANCE, ONE ASSESSMENT

Risk or hazard? The issue is also relevant to "One Substance, One Assessment" – the motto of an EU initiative that was enshrined in law in 2026. It provides that, despite many different regulations, a substance will in future be assessed as uniformly as possible. A common database for chemicals forms the core of this. And how should the assessment be carried out? "The only sensible approach is to adopt risk-based methods in such a harmonised assessment," says Vera

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THE DOSE MAKES THE POISON – THIS INSIGHT COMES FROM THE PHYSICIAN PARACELSUS AND FORMS THE BASIS OF TOXICOLOGY.

Ritz. “We will still need to use certain ‘hazardous’ substances in the future.”

A risk-based assessment is also beneficial for EU-wide efforts to reduce the number of animal experiments. New non-animal testing methods are being researched and developed in the EU, for example as part of the extensive PARC project. These “next-generation risk assessments” provide novel insights into the effects of chemicals on the human organism at many levels. “An understanding of these biological processes is only possible if one takes the dose of a substance into account,” says Vera Ritz.

Only time will tell whether ethanol and iodine will actually disappear as disinfectants. Associations within the German healthcare industry are warning against the reclassification of ethanol, as it would complicate or even prohibit the production and use of disinfectants, medicines and medical devices. And breastfeeding women working in the medical sector would face a ban on practising their profession if ethanol were to be classified as toxic via breast milk (lactation). At the very least, the authorisation of ethanol for use in disinfectants was recommended by the relevant ECHA committee at the end of February, though without comment on a possible classification as a CMRE substance. So is the ban still on the cards? “Everything is still open,” says Vera Ritz, “but the risk exists.” —

More information

BfR communication
“Hazard or risk as a benchmark?” *(in German)*

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Chemical chic

From the moment we are born, we constantly wear clothes directly against our skin. Chemicals are essential for their manufacture. Is this a problem?

Blouses in bright colours, antibacterial tights and waterproof jackets – modern clothing is not only meant to look good, but also to be functional and practical. Many chemicals are used in their manufacture, from the extraction of the raw fibre through its processing during spinning, weaving and colouring right through to the completion of the garment. If textiles are designed with special properties, more chemicals tend to be used. But even without "special requirements" for the clothing, textile production without chemical additives is virtually impossible nowadays.

Many of the chemicals used are no longer present in the finished product. Finishing agents, however, which provide the textiles with special properties, remain in the garment. Under certain circumstances, they may leach out of the fibre and enter the body via the skin. Is this a health concern? "Clothing manufactured

in accordance with the regulations applicable in this country generally poses no health risks to consumers," says Suna Nicolai, who assesses the safety of consumer products at the German Federal Institute for Risk Assessment (BfR). "Various laws contribute to this, regulating a range of problematic substances."

LIMIT VALUES PROVIDE PROTECTION

From a legal perspective, clothing textiles are classified as consumer goods and, according to the German Food, Consumer Goods and Feed Code (LFGB), must not pose a hazard to the health of consumers. For individual chemicals, there are specific provisions, such as limit values or bans on use, which are laid down, among other places, in the European REACH Regulation. For example, there are limit values for certain plasticisers and for other carcinogenic, mutagenic or reprotoxic (CMR) substances.

Legal provisions also apply to certain substances from the group of "forever chemicals" known as PFAS (see feature article starting on p. 8). The use of some of these problematic fluorinated chemicals – previously used in outdoor clothing due to their water- and oil-repellent properties – has now been banned, and further PFAS are set to be phased out. It is good to know that there are alternatives to these water-repellent substances in outdoor clothing.

In addition, numerous azo dyes, the largest group of dyes, are regulated. As a result of the activity of bacteria on and in the body, primary aromatic amines can be released from these dyes. These are organic compounds, some of which can be carcinogenic or mutagenic. A total of 22 of these harmful degradation by-products are listed under REACH. The use of hundreds of azo dyes is therefore effectively prohibited, as the limit values are so strict that they amount to a ban on use.

WASH FIRST, THEN WEAR

However, there are hundreds of other azo dyes whose effects on the body are not yet fully understood. "For many substances, there is currently insufficient data available for hazard classification," says Suna Nicolai. "However, data on the release of dyes from clothing textiles show that contact with these dyes is minimal in most cases. This also results in a low risk."

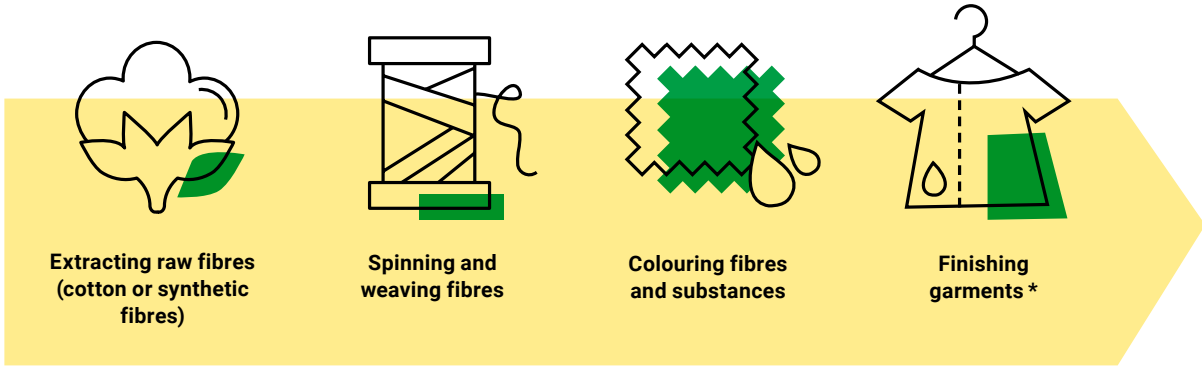
Consumers cannot tell which chemicals are present in textiles when purchasing; there is no corresponding labelling requirement. Instructions such as "wash separately" or "wash with similar colours" suggest that dyes may be released. "It is therefore a good idea to wash clothes before wearing them for the first time," says Nicolai. "This is because the amount of chemicals that could potentially be released decreases with every wash." Consumers should also consider whether they really need textiles with special properties, such as those that are non-iron or water-repellent. —

More information

BfR information
"Health assessment of textiles"

Chemicals are essential for clothing

Chemicals are used at every stage of the manufacturing process.



*** only "finishing agents" remain in the textile**

Ubiquitous and scientifically complex

Microplastics are found in the environment, in food and even in the human body. To date, there is no evidence that they are harmful to health, but research is ongoing.

Person: JulPo, confetti 1: Cineberg, confetti 2: Liudmila Chernetska @gettyimages

Microplastics are defined as plastic particles ranging in size from five millimetres (mm) to one micrometre (µm). Even smaller fragments are referred to as nanoplastics. Microplastics are manufactured, for example, as plastic granules for further processing in industry, but also for applications such as infill material for artificial turfs. Microplastics form as a result of the breakdown of improperly disposed plastic waste, as well as through tyre wear. They can also be released from textiles made of synthetic fibres. Consequently, microplastics are found in water, soil and the air – and thus also in food. "However, the mere detection of microplastics does not, in itself, indicate any health risk," says Dr Holger Sieg. The biochemist heads a working group on microplastics at the German Federal Institute for Risk Assessment (BfR).

TOUCHING, BREATHING, EATING

Humans come into contact with microplastics via the skin, breathing and diet, amongst other routes. Alongside air, dietary intake is considered the main source of exposure. However, just because microplastics enter the intestine does not mean that they are distributed throughout the body. According to current knowledge, only particles smaller than 1.5 µm (roughly the size of one-hundredth of a hair) can cross the intestinal barrier and enter the bloodstream; larger particles are excreted.

It is difficult to determine exactly what actual amount enters the body. The frequently cited figure of one credit card's weight per week is based on flawed and oversimplified assumptions and is not scientifically suitable for representing actual intake levels. "It is assumed that significantly less is taken in, and the vast majority of it is excreted again," explains Sieg. It has not yet been conclusively clarified how microplastics that remain in the body affect health.

"At the BfR, we are conducting laboratory experiments to investigate whether microplastics bind to enzymes and thus influence their functions in metabolic processes."

MICROPLASTICS IN THE BODY

Reports of microplastics in organs such as the brain are particularly worrying. Individual studies show that very small particles – particularly those on the nanoscale – can cross biological barriers. However, Dr Alexander Roloff, a scientist at the BfR specialising in the area of product analysis, points out "that the detection of such particles is methodologically very challenging and results must be interpreted with caution". It is very difficult to rule out the possibility that microplastics entered the samples during sampling or preparation – for example, via plastic materials used in the laboratory. Consequently, it is often unclear whether the organ samples were contaminated with microplastics from the environment. Process controls, i.e. the inclusion of a microplastic-free control sample during analysis, are essential. "Analytical methods for microplastics are still prone to error and imprecise," says Roloff. Reliably measuring microplastics in organs or food is akin to detective work. Samples must be processed without introducing contaminations, and analytical methods reach their limits when dealing with the smallest particles. Furthermore, some types of microplastics produce similar or even identical signals to naturally occurring substances, such as the body's own fats. Moreover, different methods make it difficult to compare studies – and consequently, the results vary considerably in some cases.

NO ACUTE TOXIC EFFECT

Microplastics are considered chemically unreactive and have no acute toxic effect. However, there is currently little awareness about how they influence cellular mechanisms. It is conceivable that they could interact with enzymes or immune cells, thereby interfering with metabolic processes or the immune system. It is also unclear whether microplastic deposits in the body can lead to long-term effects and whether any effects are even possible under realistic exposure conditions.

Another question scientists are investigating is: Does a potential health risk lie in the particles themselves or in the chemical substances that the particles contain or may carry on their surface? There is currently no reliable evidence of specific health effects. Further research is needed. —

Growing concerns about microplastics

While there is currently no evidence of health effects from microplastics, consumers are becoming increasingly concerned. This is illustrated by data from a BfR survey. More than half of the respondents are worried about microplastics. At the same time, 36 percent stated that they did not feel well informed about microplastics in food or had never heard of them.

More information

Brochure
BfR Consumer Monitor 2017, 2019, 2025

More information

BfR FAQ
"Microplastics"

Risiko – The BfR Podcast

The full interview can be listened to on the BfR science podcast "Risiko", episode 3: Microplastics *(in German)*

Full to the brim

© Ekaterina Goncharova/gettyimages

Glass, plastic or aluminium: drinking bottles are made from a variety of materials. What is known about their impact on health?

Large, small, transparent or brightly coloured, with screw-top or sip-top lids – drinking bottles come in many different colours and shapes. There is also a wide variety of materials. Depending on their intended use, drinking bottles are usually made of plastic, aluminium, stainless steel or glass.

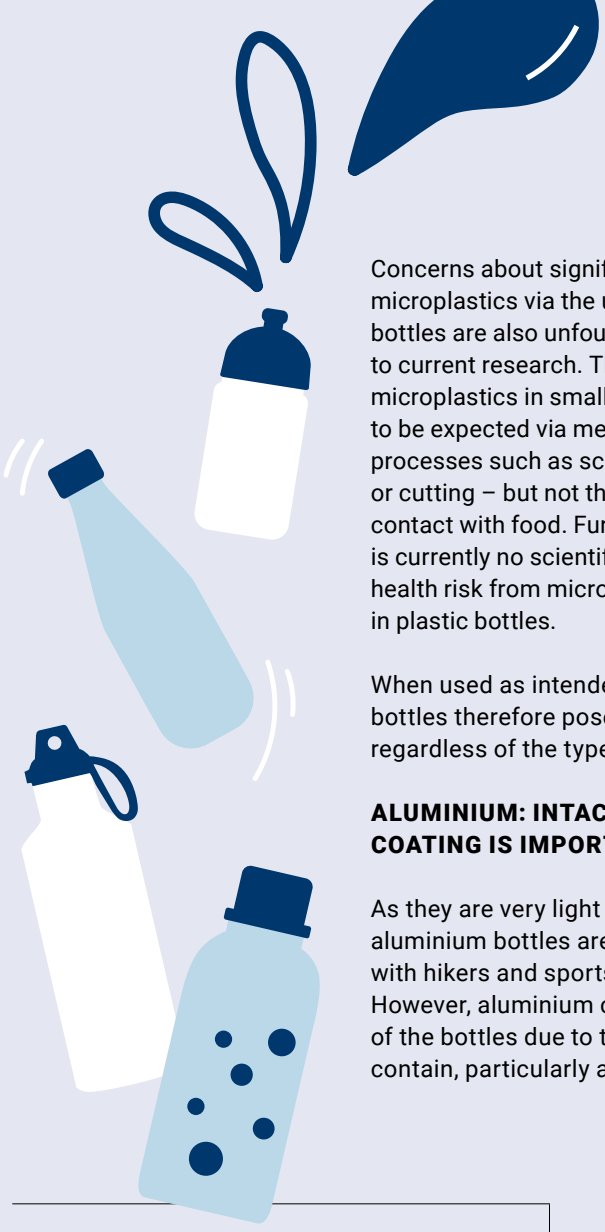
LEGAL REGULATIONS

Regardless of the material used, drinking bottles must comply with the European Union's (EU) legal requirements for materials in contact with food. Accordingly, no substances may migrate from the materials into food in amounts that would harm consumers' health. This applies both to plastics such as polyethylene terephthalate (PET), polypropylene (PP) or polyethylene (PE), and to other materials such as glass, stainless steel, aluminium, ceramics or paper and board.

PLASTIC: MICROPLASTIC CONCERNS UNFOUNDED

Plastic drinking bottles are repeatedly the focus of public attention due to alleged migration of microplastics or chemical substances, such as bisphenol A (BPA), into the liquids they contain.

These concerns are unfounded. To ensure that plastics are safe for human health, there is, at EU level, in addition to the Framework Regulation on Food Contact Materials, the so-called Plastics Regulation, which specifies which substances may be used in the manufacture of food contact materials and under what conditions. It also sets limit values for the migration of these substances into food. Furthermore, a supplementary EU regulation has banned the use of bisphenol A in food contact materials since 2024.



Concerns about significant intake of microplastics via the use of plastic bottles are also unfounded according to current research. The release of microplastics in small amounts is to be expected via mechanical processes such as scratching, tearing or cutting – but not through mere contact with food. Furthermore, there is currently no scientific evidence of a health risk from microplastic particles in plastic bottles.

When used as intended, plastic water bottles therefore pose no health risk, regardless of the type of plastic used.

ALUMINIUM: INTACT INTERNAL COATING IS IMPORTANT

As they are very light and robust, aluminium bottles are often popular with hikers and sports enthusiasts. However, aluminium can leach out of the bottles due to the liquids they contain, particularly acidic drinks such as juices or fruit teas. If ingested in large amounts over a prolonged period, aluminium can have adverse effects on the nervous system, kidneys and bones, as well as on the mental and motor development of children. Care should therefore be taken to ensure that the bottles are coated or anodised on the inside – i.e. chemically treated to make them resistant to corrosion and wear – and that the inner coating is intact.

STAINLESS STEEL: WELL SUITED FOR FOOD

Stainless steel is a very durable material and is frequently used as a food contact material due to its excellent properties. In principle, elements (metals) can migrate from metallic food contact materials into food. However, the BfR is unaware of any general issues with stainless steel products.

GLASS: CASINGS PROTECT AGAINST BREAKAGE

As a chemically stable material, glass is also highly suitable for food contact. Health risks can primarily arise from splinters or broken bottles. Special sleeves, for example made of cork or silicone, can increase the bottles' resistance to breakage, making them suitable for use on the go.

PAY ATTENTION TO HYGIENE

All drinking bottles should be cleaned regularly to prevent the growth of harmful germs. A wide opening makes cleaning easier. Whether a bottle can be washed in the dishwasher or is better washed by hand can usually be determined from the symbols on the bottle. —

More information

BfR information
"Health assessment of food contact materials"

DRINKING BOTTLE TIPS

— When buying bottles, look for the words "suitable for food contact" or the glass-and-fork symbol (labelling for food contact materials)

— Bottles should not alter the smell or taste of the drink – leave "smelly" products on the shelf

— Follow the manufacturer's instructions regarding use (suitable for microwaves?), cleaning (dishwasher-safe?) and suitable foods

— Clean regularly to prevent the growth of bacteria

— Dispose of if there is significant damage to the inside

The bottleneck

Alternative methods are intended to replace animal experiments. However, before they can be accepted internationally, they must be thoroughly tested in several laboratories.

First, an example: Vitamin A is vital for the developing organism. In adults, it contributes to a healthy immune system and good vision. The hormone-like retinoic acid, formed from vitamin A, plays a central role in this. It binds to specific binding sites (receptors) in the cells. These, in turn, activate various genes and thereby promote the formation of certain proteins. It is a sophisticated process that can be disrupted by chemicals from the environment.

How can we determine which substances might affect it? A research team, including the German Federal Institute for Risk Assessment (BfR), set out to answer this question. "We used a test to determine whether a substance activates or blocks the retinoic acid receptor in human cells," explains head of the study Dr Michael Oelgeschläger from the German Centre for the Protection of Laboratory Animals (Bf3R) at the BfR. Using this method, four different laboratories independently tested the same 30 chemicals – and arrived at the same result in around 80 percent of cases. "That is a solid result, especially as animal experiments also often fail to achieve complete agreement," says Oelgeschläger.

LABORIOUS VALIDATION

Such inter-laboratory comparison studies are intended to "validate" the test. This means examining it for reliability and relevance, and also demonstrating that the test can actually be used for a legally required (regulatory) assessment.

This requires a precise "recipe" (protocol) to ensure that different laboratories arrive at comparable results. This ensures that the method works not only in the developer's laboratory but worldwide, and that authorities and industry can reliably assess risks. It is a complex and expensive process: validation takes several years until the protocol is refined to the point where the method works everywhere.

FROM DEVELOPMENT TO APPLICATION

"Validation is the bottleneck that animal-free methods have to get through," says Michael Oelgeschläger. He coordinates the Organisation for Economic Co-operation and Development (OECD) Test Guidelines Programme for the area of human health in Germany. This programme publishes standardised test guidelines for validated methods, ensuring that the results of chemical safety assessments are comparable across all OECD member countries and are internationally recognised. There are now more than 150 standardised test methods approved by the OECD for assessing the (legally required) safety of chemicals.

"Even without validation, promising, animal-free methods can be used in research," says Oelgeschläger's colleague Dr Sophie Rigal (see also the interview on nanomaterials, page 45). "But when it comes to a legally sound health risk assessment of chemicals, new methods generally need to be successfully validated and internationally recognised. Without this validation, their results will otherwise not be accepted as the sole basis for decision-making."

ONE TEST IS USUALLY NOT ENOUGH

Animal-free methods are well established, for example, in testing for irritating or corrosive effects on the eyes or skin. More difficult are complex questions such as: does a substance increase the risk of cancer, can it cause impairment in an unborn child, or disrupt the endocrine system? "Animal experiments often cannot be replaced one-to-one," says Oelgeschläger. To perform an assessment of complex processes throughout the entire organism, toxicology is moving towards combining several alternative methods. "In future, we will have whole batteries of alternative tests with which we can address a question that previously required an animal experiment," explains Oelgeschläger.

"Validation is the bottleneck that animal-free methods have to get through"

DR MICHAEL OELGESCHLÄGER, HEAD OF THE GERMAN CENTRE FOR THE PROTECTION OF LABORATORY ANIMALS AT THE BFR

FASTER PROGRESS

At the BfR, research is being conducted into alternative methods for animal experiments, and the validation of test procedures is being driven forward. A role model for Oelgeschläger and Rigal is the French validation organisation "PEPPER". It coordinates validation projects for tests that detect hormone-like effects of chemicals. Collaboration with PEPPER allows the BfR to simultaneously benefit from their experience and support the PEPPER team. A win-win situation. "Bf3R-VALIDITIE" is based on "PEPPER". The project, led by Rigal, is funded by the Federal Ministry of Agriculture, Food and Regional Identity (BMLEH) and aims to establish a laboratory infrastructure and organisational platform by the end of 2027. For years now, the BfR has been supporting experts in method development by helping them to submit applications for and perform transferability and validation studies. VALIDITIE aims to further expand these advisory and expertise capacities so that scientific methods can be transformed into tools that can be used worldwide. They can help to conduct assessments of the safety of chemicals – and reduce animal experiments.

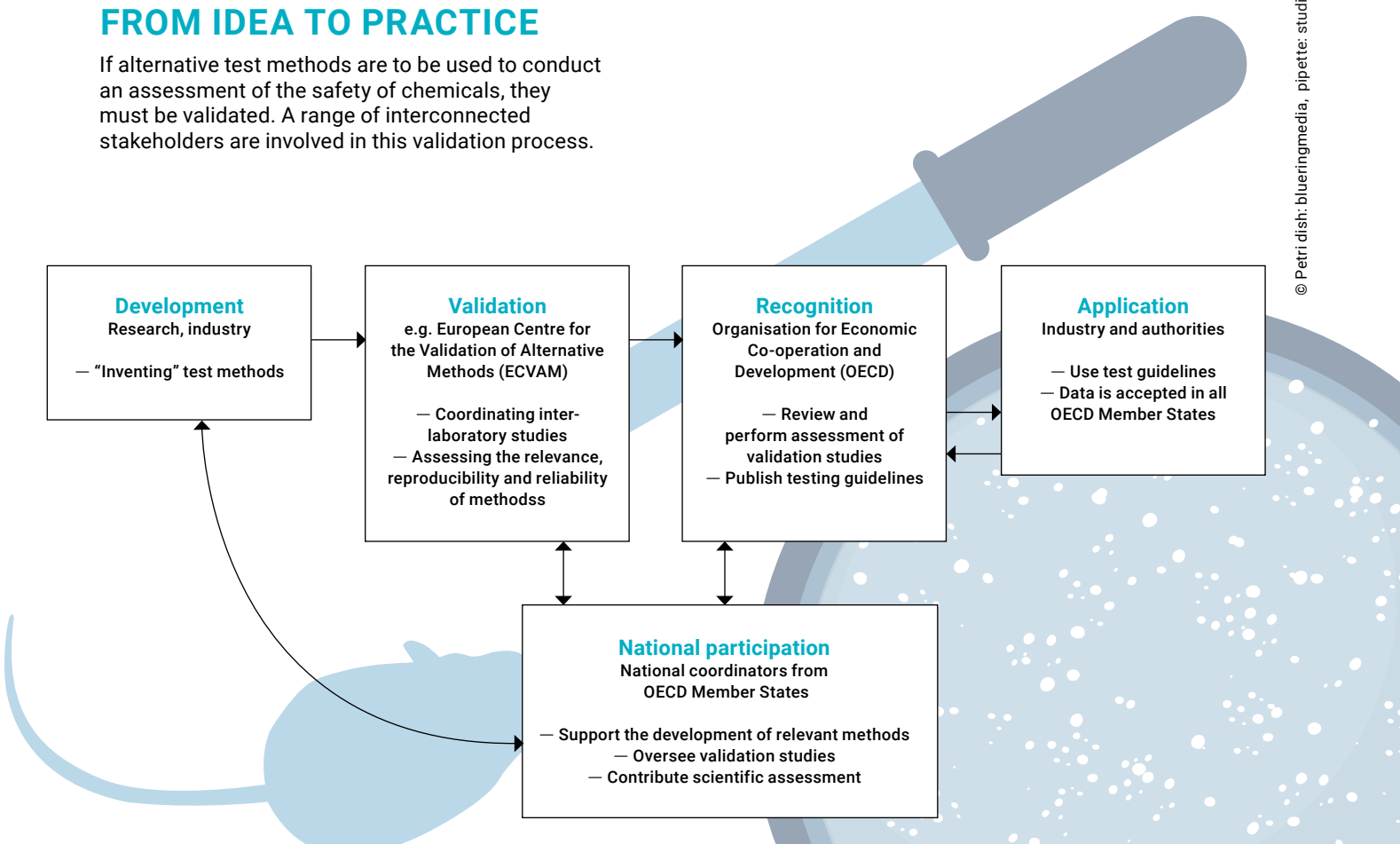
If everything goes according to plan, the retinoic acid receptor test will also be included. —

More information

BfR information
Validation platform "Bf3R-VALIDITIE"

FROM IDEA TO PRACTICE

If alternative test methods are to be used to conduct an assessment of the safety of chemicals, they must be validated. A range of interconnected stakeholders are involved in this validation process.



NEW methods for tiny particles

NAMs4NANO aims to make animal-free tests for the health risk assessment of nano-materials available even before validation. At the BfR, Dr Andrea Haase leads a key part of the project, which is funded by the European Food Safety Authority (EFSA).

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Dr Haase, what is special about tests for nanomaterials?

Although nanomaterials often consist of known substances, they occur in extremely small particle sizes. Due to their small size, they can behave differently in the body – for example, by overcoming barriers more easily – but they can also impair the measurements themselves. Many traditional testing methods are not designed to account for these specific characteristics.

You propose the use of alternative methods even without validation – that is, demonstrating that a method is relevant and reliable. Can that work?

Qualification should under no circumstances replace validation. Our proposal is that experts should assess for which specific applications a method already works reliably. In such cases, data from qualified methods could then – together with other data – be used for assessments even without validation.

What has been the response to your proposal – and what happens next?

Our approach has received a great deal of attention and support worldwide. We are currently testing the qualification procedure in case studies and are drawing up a proposal for EFSA on how a qualification system can be implemented in practice. —

More information

BfR information **"Nanomaterials"**

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INTERNATIONAL NEWS

Chemical assessment with a global perspective
Under the chairmanship of the BfR, ILMERAC's activities continue to grow. Within this international network, methods for the risk assessment of chemicals in food and feed are being further developed. In 2025, experts shared their knowledge on topics including artificial intelligence (AI), new approach methodologies (NAMs) and international cooperation at forums organised by the World Health Organisation in Dubai, Vietnam and China. In 2026, the focus will be on novel technologies in chemical risk assessment. The annual meeting will take place on the fringes of an AI conference in Paris.

ILMERAC
International Liaison Group on Methods for Risk Assessment of Chemicals in Food and Feed

More information

BfR information
ILMERAC

INTERNA

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Cooperation without borders
Strengthening consumer protection across national borders: to this end, the BfR expanded its cooperation with new partners from Moldova, Saudi Arabia and Latvia in 2025. The focus is on the exchange of scientific risk assessment, knowledge transfer, capacity building and the networking of experts. In addition to food safety, common topics include new assessment methods, digital tools and clear risk communication.

More information

BfR information
"Co-operation"

Partnership-based exchange
The strategic development of the BfR and its French and Danish partner institutions, ANSES and DTU Food, was the focus of the annual meeting in March 2026 in Berlin. Other topics included joint cooperation with international organisations and the exchange of specialist knowledge, for example on the use of artificial intelligence and capacity building in risk assessment. Exchanges of experts to explore these shared topics in greater depth are now planned.

More information

BfR press release
The BfR, DTU and ANSES sign a cooperation agreement" *(in German)*

EVENTS

Working together on AI
Artificial intelligence (AI) is also gaining importance in the field of consumer health protection. Experts will discuss how AI technologies could be used for monitoring along the food chain in October 2026 in Paris at the AI Conference on Food Safety, Animal and Plant Health, organised by the French Agency for Food Safety (ANSES) in collaboration with the BfR, Denmark's National Food Institute (DTU Food) and the South Korean partner institute NIFDS.

When? 29-30 October 2026
Where? Maisons-Alfort/Paris

More information

ANSES conference information

Legal notice

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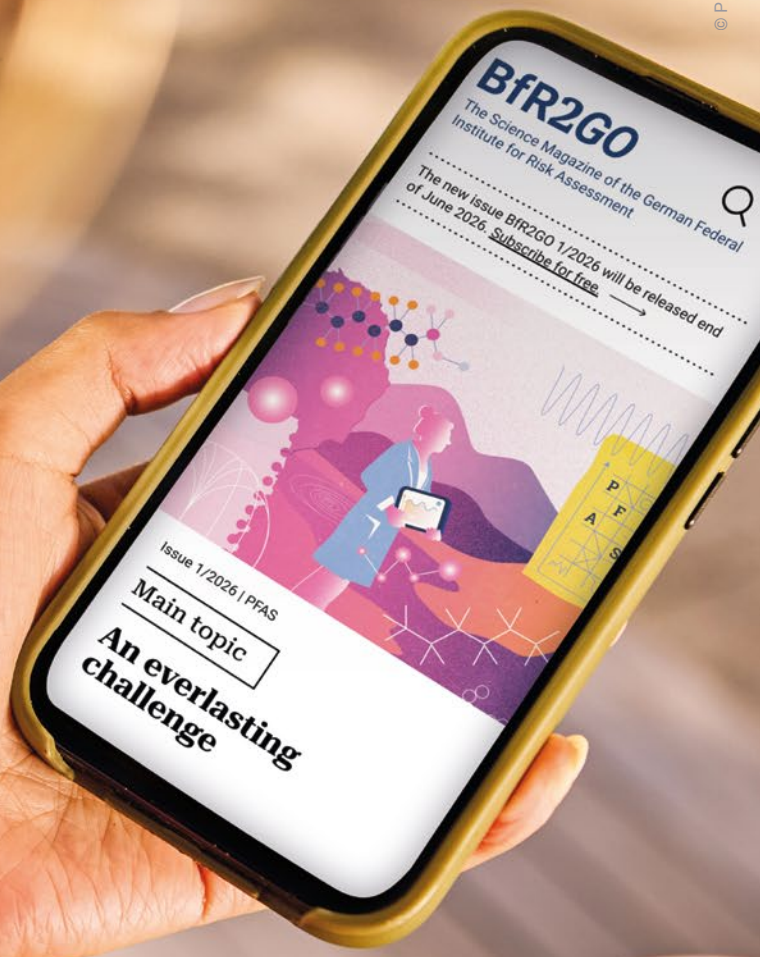
The science magazine of the German Federal Institute for Risk Assessment, BfR2GO, is now also available as a website. At bfr2go.de/en, articles on the safety of food and feed, products and chemicals can be found even more quickly and easily and are also accessible on mobile devices – making them perfect for when you're on the move. This way, knowledge really does travel with you.



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