

BfR 2 GO



Fear
What now?

Superfoods
**The image of
superpower**

Listeria in food
**The meatball
case**

Plant protection products
**Off the
field**

Dear Readers!

Since spring 2020, our society had been in a state of emergency; the fear of the coronavirus determined our everyday life. Fear is also a major topic for the BfR. Regular surveys, such as the “BfR Consumer Monitor”, the “BfR-Corona-Monitor” and social science studies help us to include the concerns of the population in our research and communication.

In this issue, we therefore focus on the topic of fear, while at the same time embarking on a search for confidence. In the main article, we establish a theoretical approach to the topic. Here, scientists from different disciplines have their say, who already presented their perspectives and assessments on fear and confidence at the BfR Knowledge Dialogue in November 2020. Additionally, neuroscientist Professor Maren Urner explains in an interview how the media can provide solutions instead of doom and gloom.

The scientific assessment of risks can help us look to the future with confidence. The articles in this issue show why. Thanks to scientific evaluation, many risks turn out to be overestimated. One topic that worries many people, for example, is plant protection products. Some fear that the products will drift from the fields and poison them. But what has been scientifically proven in this regard? Read the report in this issue.

Even in the case of long-known health risks like listeria in food, science can show us ways forward. In the past, the cause of listeriosis outbreaks was often difficult to determine. In this issue, we show how genome sequencing of the pathogen now makes it much easier to locate the source.

Research efforts on the protection of laboratory animals also inspire confidence. In this issue, you can look over the shoulders of our scientists as they grow bone tissue on plastic chips. These “bones on a chip” can help to replace animal experiments.

Even though risk seems to be ever-present at the moment, there are also rays of hope. Our Institute’s work helps to reveal opportunities.

I hope you find this issue an encouraging and exciting read.

Professor Dr. Dr. Andreas Hensel
BfR President





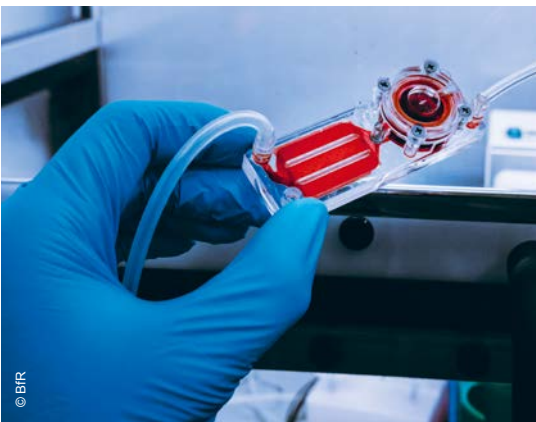
Tattooed with green and blue

Beauty has its price. Tattoos may have undesirable consequences for our health. A harmonised, EU-wide regulation on the ingredients in tattoo inks came into force in 2021. Under the European Chemicals Regulation (REACH), certain substances for tattoo inks can now be banned or restricted for use. Also pigments Blue 15:3 and Green 7 are affected by this. The industry is given a transitional period of 24 months to find safer alternatives for both pigments. A problem with both pigments is that the existing data on possible adverse health effects are incomplete. The BfR recommends improving the available data sets for both pigments. A ban alone is not sufficient since alternative substances may be even more poorly studied. This shows how important research, health risk assessment and exchanging information on the risks of tattoo inks are. In November 2021, the BfR will bring together experts from the fields of toxicology, legislation and manufacturing at the 2nd International Conference on Tattoo Safety. Furthermore, the BfR is currently working on a comprehensive strategy for the risk assessment of tattoo pigments.

More information:

www.bfr.bund.de/en > A-Z index: Tattoo

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FEAR

What now?

From coronavirus to climate change: in a world full of risks, we become prisoners of fear. The BfR embarks on a search for confidence.

Mandatory use of masks, lockdown, apocalyptic images and bleak forecasts – the fear of the novel coronavirus has had the world under its control since spring 2020. For the BfR, this crisis is the current opportunity to discuss the question of how risks and their perception challenge society. The BfR frequently addresses this topic area with regular surveys, such as the “BfR Consumer Monitor” and “BfR-Corona-Monitor” as well as social science studies.

“One could think that our society is on permanent alert,” states BfR President Professor Andreas Hensel. In addition to the coronavirus pandemic, he also refers to topics such as climate change, biodiversity, microplastics and glyphosate, and asks whether the alarm is always justified. Because thanks to scientific testing, some risks turn out to be exaggerated or even imaginary – like the dangerous giants that Don Quixote fought against and that turned out to be windmills.

First of all: fear is essential for survival because it warns humans and animals of acute, sometimes even deadly threats. It is innate and deeply rooted in evolution, an archaic heritage.

On the level of a chicken

“We have a fear system in the brain that is on the level of a chicken,” says Professor Borwin Bandelow, psychiatrist and expert on fear from the University of Göttingen. Like a fire alarm, it is calibrated to quickly sound the alarm and make the body capable of flight – or fight. The central element of this “survival system” is the thalamus, located in the diencephalon. As a “switching station”, the thalamus must react promptly to a threat and carry out a precise analysis of the situation.

In an emergency, the fear system kicks in within fractions of a second. Via the switching stations of the amygdala, hypothalamus and pituitary gland, it leads to the release of stress hormones, increasing the pulse, blood pressure and breathing rate. Blood is pumped into the arms so that we are able to fight better and into the legs to run away faster. All of this happens within a few thousandths of a second. The thalamus actually also initiates a precise analysis of the situation, but this would take too long to survive an attack. The part of the brain responsible for reasoning takes over the analysis.



Fight or flight? There are even more ways to deal with fear.

And in a crisis? That is when the primitive part of the brain responsible for fear takes control and reason takes a step back. “Fear is not a good statistician,” says Bandelow. The rather simple-minded fear system tends to initially estimate new and uncontrollable threats, such as terrorist attacks or viruses, as disproportionately high – as well as threats that address genetically programmed primal fears, such as those posed by wild animals (spiders, snakes, wolves) or high altitudes (plane crashes). On the other hand, known threats, such as cardiovascular disease or accidents in the home, are underestimated, as are invisible threats such as radioactivity and cyber-crime.

How do you meet a challenge like the novel coronavirus? How do we cope with fear? “With awe and healthy fatalism”, according to Bandelow. “Awe because we must not underestimate the virus, and healthy fatalism because it will work out and we probably won’t die from it.” Life is easier with a pinch of gallows humour.



Many think the worst that can happen is no longer behind us, but in front of us.

Fears imprinted from the Stone Age

“Why is it that most people think too negatively and have a too negative view of the world?” asks Maren Urner, Professor of Media Psychology at the University of Applied Sciences for Media, Communication and Economics in Cologne (see page 12). She too locates the answer in the human race’s evolutionary past, putting the “Stone Age brain”, with both its limitations and possibilities, at the centre of her observations. “It is optimised in a way that processes negative things much faster than positive things,” explains Urner.

In the Stone Age, the quick reaction to fear could be decisive when it came to life and death. But in the modern era, this imprint on the brain is only an advantage in certain circumstances. This becomes noticeable when the brain – Urner refers to it as a prediction machine – has to make decisions. Fear, uncertainty and stress, as they prevail in times of corona, dominate thinking and lead us astray.

“Decisions driven by fear are bad decisions,” says Urner. Added to this is the force of habit, which shapes the majority of our actions and prevents new and constructive solutions. Force of habit leads to fatalism. To the feeling that nothing can be changed anyway. This results in learned helplessness, a state of resignation. “We have to get away from permanent fear,” Urner demands, calling for positive learning experiences. “That is at the heart of solution-orientated thinking, which always concerns the question: what now? How do we keep going? If we don’t ask ourselves that, every thought and action will be reduced to absurdity.”

But the Stone Age problem brain also has its advantages. Urner considers our own critical thinking as an approach to achieving action from powerlessness. She assigns three essential qualities to this critical thinking: naivety, indulgence and curiosity. Naivety can help to overcome groupthink. For example, it can turn a specific fan of Borussia Dortmund into a general football fan or help to view the coronavirus as a global problem that transcends borders – so naivety means something like a fresh and genuine view of the world. Indulgence is the ability to talk to each other – “even if we all see the world differently”. And by curiosity, Urner means the ability to discover new things and to reflect, speak and act in a solution-orientated and constructive way when it comes to the future.

A formula for the moment

The sociologist and author Heinz Bude, professor at the University of Kassel, recalls the underlying feeling in the post-war era. It was characterised by cautious optimism because with war and genocide, people had already overcome “the worst that can happen”. “It’s over, and it won’t happen again.”

According to Bude, this sentiment has been reversed among the younger generation. “Many think that the worst that can happen is no longer behind us, but in front of us”, says Bude. The era of peace, freedom and prosperity could be followed by a period of crises, primed by the coronavirus pandemic, climate change, economic warfare and the demise of traditional economic sectors, such as the car industry.

In this situation, “life-enriching forgetfulness” is helpful in coping with everyday life. At the same time, it is important to stay alert. The feeling of powerlessness and helplessness that grips the individual in the pandemic must not be transferred to the whole of society. However, the most important thing for Bude is something he calls a “metaphysical quantum”. This is about regaining confidence in the world and seeing in it not only a collection of threats but also a horizon of possibilities. “Hope without optimism” is how Bude refers to his formula for the time being.

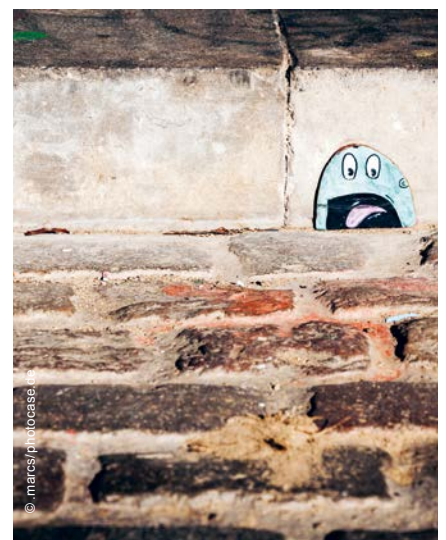
Reflection in advance

Bude encourages taking better precautions for pandemics, economic crises and other major risks. “We need a focused scientific reflection that prepares us for extreme threats, a systematic reflection in advance for general crises in society.” The aim is greater resilience in society. However, so far there is no place, an institution, in which this reflection can take place. “We should come up with something quickly,” says Bude.

“We are always afraid of the future,” states Wolfgang Freitag, Professor of Theoretical Philosophy and Philosophy of Language at the University of Mannheim. Anyone who wants to understand fear must therefore also deal with the future. Freitag contrasts fear with anticipation and establishes the categories of risk and opportunity for the future. He presents a formula with which the “probability of expectation” can be calculated. It should enable the assessment and estimation of opportunities and risks for a future event.



In a crisis, the primitive part of the brain responsible for fear takes the lead.



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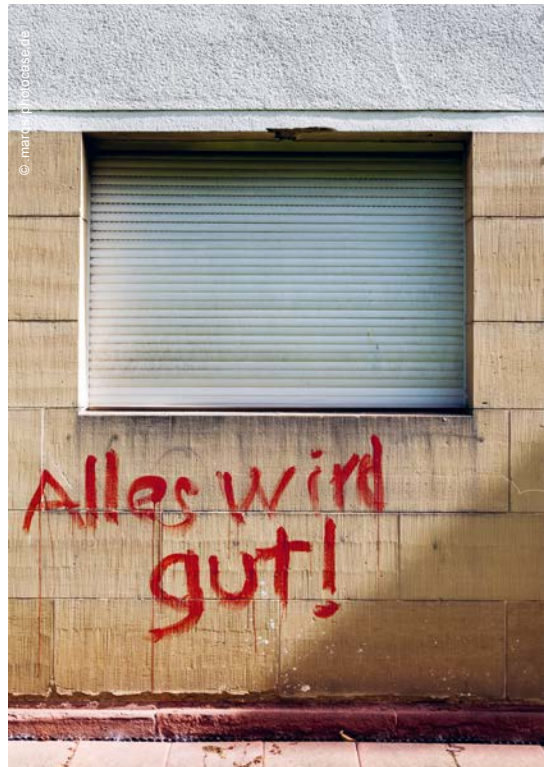


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Hope without optimism



Look ahead with positivity and yet still take precautions. Major crises can make our society resilient.



To determine the probability of expectation, the probability of an event (such as an avalanche risk in the Alps) is multiplied by the subjective evaluation (such as anticipation of skiing in the Alps). The value determined in this way incorporates – in the form of the evaluation – both personal sensitivities and sentiments as well as – with the probability – more or less correct and reasonable estimates.

Don't leave everything to the experts

Even for experts, it is often difficult to predict how likely an event is. As an example, Freitag cites the question of the extent to which certain measures contain the spread of the coronavirus. Freitag recommends “not leaving everything to the experts, especially not the assessment of the future”. Expert advice is important for rationally estimating event probabilities. However, how the event is evaluated cannot be decided in a top-down process in a democracy.

The Cologne presenter and actress Shary Reeves makes clear how much fear is connected with expectation and the future. And even if it is only the “red light” with which the television camera signals that you are “on the air”. “There is hardly anything you have more respect for when you have a job like this.” The feeling of suddenly facing an invisible audience of millions triggers stress: “Who are the people watching me? What do they feel, what do they think? What do they want from me and what don't they like about me at this moment in time?”

Tattooed into the genes

“Fear is tattooed into our genes,” says Reeves. “More in some, less in others.” For Shary Reeves, fears and experiences of loss in her turbulent childhood and youth were formative. As the daughter of a black nurse born in Africa, she grew up in a foster family and, eventually, attended a strict boarding school. At the same time, trust in her foster parents helped her to cope with distressing experiences and discrimination and to develop a strong personality. “For me, overcoming fears always means focusing on what comes after the fear,” says Shary Reeves. “That helps me to nip doubt in the bud.”

Facing fear and at the same time thinking beyond it and gaining confidence – this underlying idea is expressed in a piece of African wisdom quoted by Reeves. “Turn your face to the sun and the shadows will fall behind you.” Reeves concludes that the light of the sun is visible even from a deep tunnel. ■

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*This text summarises presentations from the BfR Knowledge Dialogue “Between fear and confidence”.
 The event took place online on 2 November 2020 at the Magnus-Haus in Berlin.*

The daily balance of risks

Whether risks are estimated to be high or low depends on these factors:

- Choice: do we take the risk voluntarily or are we forced to? Example: smoking or passive smoking
- Controllability: can we avoid a risk through our own actions?
Example: speed when driving a car
- Risk-benefit ratio: do the benefits (or enjoyment) outweigh the risk?
Example: skydiving
- Personal involvement: do individual risks concern me in any way?
Example: children's toys
- Terribleness of the damage: how tragic is the damage?
Example: car accident versus feeling unwell
- Trust: how credible is the responsible institution?
Example: doctors versus blog articles
- Responsibility: is the risk natural or of human origin?
Example: bacteria in food versus plant protection products
- Type of damage occurrence: can the damage be precisely localised in terms of time?
Example: acute (poisoning) versus chronic (obesity) health damage
- Awareness: how new or unknown is a dangerous substance or pathogen? Example: SARS-CoV-2



© Michael Jungblut

Neuroscientist and media psychologist **Professor Dr. Maren Urner** pleads for a journalism that is orientated towards solutions instead of just pessimism – especially during the corona crisis.

“It does not help to just spread fear and terror”

Ms. Urner, you advocate for journalism to become more constructive. Has the coronavirus pandemic taught you otherwise?

On the contrary! In principle, the coronavirus pandemic is the perfect justification for the fact that we need solution-orientated journalism. We media researchers call it constructive journalism. I see a huge opportunity for it. Because everyone is asking the key question of constructive journalism at the same time, all over the world: how can it continue? The urgency to talk about how we want to continue is there every day. It does not help if the media only presents the problems, spreads fear and terror and, in doing so, generates helplessness and fatalism among the public.

Would a more constructive journalism have changed the course of the pandemic response?

I am convinced that more solution-orientated reporting would have helped – and would continue to help us cope

better with the crisis, both on a personal and societal level. This means, for example, that when it comes to the topic of vaccination, we should not have looked at the German federal states that are doing the worst. Instead, we should look at those that are doing well and from which the others can learn something. In this way, I create a different awareness, perception and perspective that provides motivation and does not end in a constant search for scapegoats.

Is the tone of reporting different in other countries, such as the UK or the US – more positive, more optimistic?

That is my impression, but of course it is personally tinted by my media consumption. A lot of what we encounter in Anglo-Saxon papers, such as The New York Times or The Economist, could be labelled “constructive journalism”. When it comes to proposing solutions to the pandemic, the tone is bolder and more encourag-

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The key question is always: how can I convey solution-orientated information?

ing. Cultural differences also play a role here. I lived in England and the Netherlands for several years, where I generally encountered a more open and reassuring attitude at universities and companies. Positive feedback and communication on an equal footing are completely normal. A German friend who had started his first job in the Netherlands once bewilderedly told me: What did I do wrong? I received praise!

You highlight the fact that fixation on danger and risk is part of our evolutionary heritage. If you want to spread courage and confidence, how do you tackle this?

We cannot get rid of this heritage; that is just how our Stone Age brain works. But this does not mean that we are powerless. We can try to deal with it better. The first step is to become aware of it all. Like an alcoholic who knows he has to change something about his behaviour. We have to realise that there is no separation between “rational” and “emotional” in the mind, just as there is not “objective” information processing. We have to deal with this constructively and ask ourselves the question: what does that entail on a private, professional and societal level?

If this is the case, what does this mean for communicating risks?

The important first step is to always ask: what is the goal? Where do I want to go? Then I can compile the material I need for my message: text, images, graphics. Every sender always has to realise that every piece of information has an impact on the recipients.

Let's take fear as an example.

Okay. Fear is notoriously a bad advisor, which brain research confirms. Fear blocks higher cognitive abilities, which are primarily located in the frontal lobe behind the forehead. It also stops us from drawing on those experiences that have helped us to make good decisions in the past. Stress and fear put us on alert, where we choose between “fight” and “flight”. But we are no longer in a position to think calmly to make solution- and future-orientated decisions.

What does this mean for information regarding the coronavirus pandemic?

The key question is always: how can I convey solution-orientated information? How do I put people in a state of mind where they recognise the urgency of a topic without going into panic mode? This is a fine line for providing information. We have recognised the urgency of the coronavirus – it affects people, people are suffering, it is happening on our doorstep. But we cannot be allowed to dramatise it so much that fear and terror prevail, leaving only the choice between “fight” or “flight”. People must have enough cognitive capabilities to make goal-directed and long-term decisions.

Let's turn to the topic of pesticides. The BfR provided information that, according to the scientific evidence, glyphosate is not carcinogenic when used as intended. The criticism then was to play down the risk.

This brings us to an important point: Are people objective information processors? No! Everything we have previously observed in life influences us, consciously or unconsciously. Of course, the unconscious part plays a huge role in how emotionally we feel about a topic. When factual information then contradicts personal beliefs, the psychological “immune system” wakes up. It does not protect us from viruses and bacteria, but from insights and opinions that do not fit our view of the world. If it wasn't for this, we would be busy all day reinventing our identity.

What helps with this?

While useful in itself, this immune system often makes it difficult to integrate new insights and facts into our world view. This is where what I call “critical thinking” can help. This includes the skills of questioning ourselves, practising intellectual humility and being curious at the same time. This kind of thinking should be taught and encouraged not only in children and young people, but also in adults. ■

More information:

Urner, M. 2021. Raus aus der ewigen Dauerkrise. Mit dem Denken von morgen die Probleme von heute lösen. Droemer, Munich (in German)

Healthy thanks to an app?

Looking at the infection risk in the “Corona-Warn-App”, checking the toxicity of plants using a photo or meeting a GP in their virtual surgery: many people use smartphones, tablets or other mobile devices for their health. An article on the advantages and disadvantages of mobile technologies for consumer health protection.

A guest article by **Professor Dr. Constanze Rossmann** (right) and **Dr. Paula Stehr** (bottom left) from the University of Erfurt and Professor **Dr. Doreen Reifegerste** (bottom right) from Bielefeld University.



Portraits: © Universität Erfurt

Mobile information and communication technologies, such as smartphones, have become our constant companion. This opens up many possibilities to use them for healthcare, health promotion and consumer protection, also understood as mobile health or – in short – mHealth. mHealth is used in various domains: from prevention and health promotion, supporting diagnostics, communication, and training through to (remote-controlled) monitoring of health parameters and medication intake. Mobile everyday assistants can, for instance, provide very specific support for daily yoga practice, monitoring blood sugar levels, and even in searching for a suitable hospital. Currently, mHealth also plays an important role in the context of infection contact tracing.

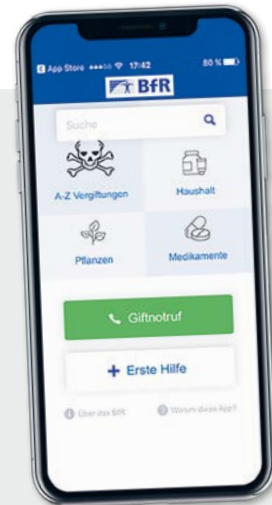
Limitations of the technologies

Mobile health has its advantages and disadvantages. One disadvantage under discussion is that certain target groups can only be reached to a limited extent because they don't use mobile media very often. Furthermore, the quality of the applications varies and not all users have the necessary health and media competence to recognise applications that are of minor quality. Another much-discussed problem is data privacy, which again became evident in the context of the coronavirus tracing app. Last but not least, the effects found so far are frequently difficult to generalise. The findings mostly come from short-term experimental studies with small samples. Therefore, transferability to the everyday use of different users is limited – particularly because too little is known about how mHealth technologies are used in everyday life in the long term.

Mobile everyday support

Nonetheless, impact studies point to the potential of mHealth in healthcare and health promotion as well as in consumer protection. Target groups can be reached independent of time and place, in a cost-effective and repeated manner, and can be addressed directly and individually. Examples include daily personal messages that are tailored to individual values. For example, a diabetes patient can receive a message advising her to check her blood glucose levels more closely and maybe even contact her GP, while another user receives suggestions for physical activity. At the same time, users can access digital health information in a straightforward way, anytime and anywhere, for example, to find information on consumer protection issues. The use of a camera, scanning function, GPS or external measuring devices also allows comprehensive monitoring. This potential has led to the costs for certain apps now being covered by statutory health insurance providers. ■

More information:
www.uni-erfurt.de > Faculty of Philosophy > Media and Communication Science > Social Communication > Research Projects



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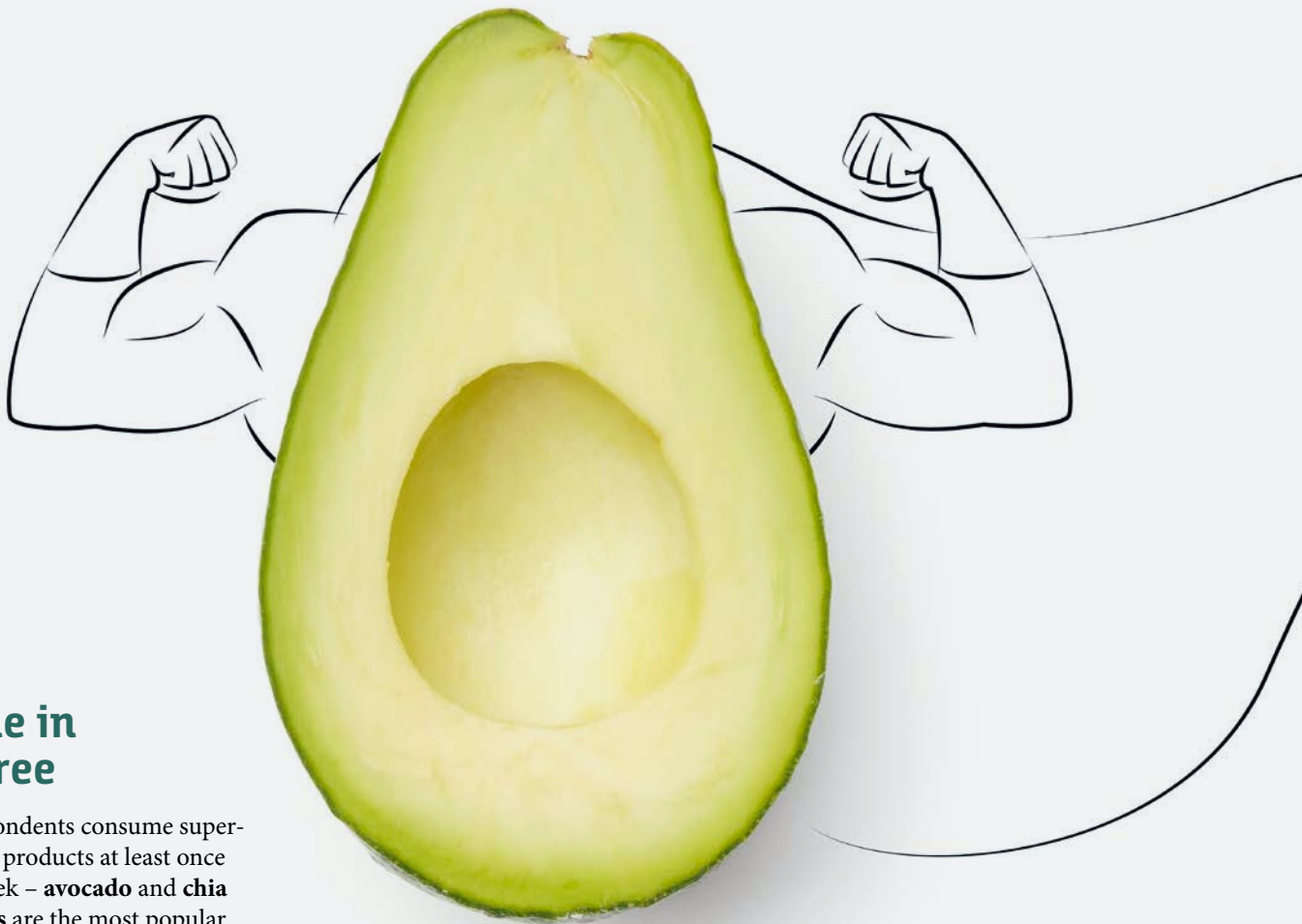
In focus: BfR app “Poisoning accidents among children”

It is beneficial, especially in critical situations, to have a smartphone at the ready – even on the go. The BfR has developed the “Poisoning accidents among children” app, which provides information about poisoning accidents and on how to properly react in an emergency. For the app to be effective, it is necessary to adapt it to the target group's prior knowledge, needs and conditions of use. The University of Erfurt, in cooperation with the BfR, is investigating how caregivers gather information about preventing accidents involving children and what role mobile media plays in this, as part of the project “Mobile Health in Consumer Health Protection (MogeV)”. The first results indicate that caregivers are not very familiar with apps concerning accidents involving children, but that they are considered suitable when it comes to gathering information about accidents in everyday life or in critical situations themselves. Apps are perceived as particularly useful when they quickly provide compact and clear information, visualised through images or videos, and personalised according to the age of the children. The use of a smartphone camera is perceived as helpful to scan potentially toxic plants, mushrooms as well as cleaning product barcodes. The unassisted realisation of the emergency measures described in many apps usually proves inadequate, which is why integrated emergency calls play a crucial role. Last but not least, it is important to caregivers that information comes from trustworthy institutions, such as health insurance providers, non-profit organisations or government agencies, such as the BfR. The first data from the MogeV project will now be validated in an online survey with 1,000 parents. The results should be available in spring 2022.

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The image of superheroes?

Chia seeds, avocado or quinoa – a representative survey by the BfR shows what the population in Germany understands by the term “superfood”.



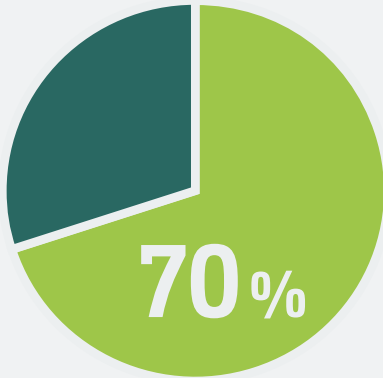
One in three

respondents consume super-food products at least once a week – **avocado** and **chia seeds** are the most popular.

Around 40 % say they do not consume superfoods at all.

Underlying study:

Representative online survey of 1,006 people (German-speaking population aged 14 and above) in July/August 2020



of people in Germany have already heard of the term “superfood”. Most people think of **healthy foods** and those with a **high vitamin content**.

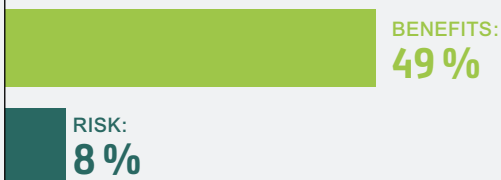
“Superfood”

The term is not legally defined. Approval procedures are mainly prescribed for what are known as “novel foods” – that is, foods that were almost never used for consumption in the EU before 1997. Some superfoods, such as chia seeds, are part of this group. Even though the positive effect of these foods usually outweighs the risks when it comes to health, certain ingredients and contaminants can be harmful to health when consumed excessively. In some cases, superfoods can trigger hypersensitivity or allergic reactions.

Imported foods in particular are seen as superfoods. For example, **chia seeds** are more often labelled “superfood” (70 %) than **linseed** (53 %), even though both have a similar nutrient profile.



The health **benefits** of superfoods are rated significantly higher than their health risks. Questionable ingredients are most likely to be seen as a **possible risk**.



Proportion response “(very) high”, values 4 + 5 on a scale from 1 to 5

2 out of 5

respondents think that superfood products **are tested** for health safety before they are enter the German market.

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More information:

www.bfr.bund.de/en > Publications > BfR Consumer Monitor > BfR 2020 Consumer Monitor, Special Superfoods

BfR Communication No. 052/2020 of 18 November 2020

“Systemic risks shape the 21st century”

What does the coronavirus have in common with microplastics? Risk researcher Professor Dr. Ortwin Renn explains how risk perspective can help address global challenges and understand public concerns.

Mr. Renn, your institute deals with the influence of humans on our planet, the associated risks and possible solutions. One example is the distribution of microplastics on land and in the sea. Where do you start there?

Our aim is to look at problems in an interdisciplinary and transdisciplinary way. Interdisciplinary means incorporating all relevant disciplines involved. Transdisciplinary also includes integrating non-scientific knowledge to identify problems and explore solution spaces. For the problem of microplastics, we need ecology, process chemistry, behavioural science, political science and economics, among others. It is very important that all appropriate disciplines are involved, otherwise we will not recognise all the facets of a problem. To find solutions for a problem, it is also essential to work in a transdisciplinary way, meaning involving all participants and their practical knowledge.

How do you do justice to the complexity of the problems?

In my view, the risk perspective is the link. A risk concept assumes that there is a risk driver or agent and a risk-absorbing system. The risk drivers can be divided into main categories. In terms of the physical drivers, they are energy, substance and biota, i.e., bacteria, viruses and fungi. In terms of the social drivers, they are information and power. This allows entire cascades of risks to be explained. In most cases, they are interlinked. For example, an earthquake can trigger the collapse of a chemical plant. In addition to kinetic energy as a risk driver, toxic substances could be released as a consequence of the kinetic energy destroying a tank

with chemicals. False information about the event that reaches the population can be a third driver to amplify the negative health effects.

Are most risks so complex that we need several disciplines to understand and possibly minimise them?

We investigate systemic risks at our institute. These are risks that can jeopardise the functionality of an entire system. Systemic risks usually go beyond the sector in which they originate.

Like the coronavirus pandemic that is currently the cause of all our worries?

Exactly. It triggers major effects beyond its system boundaries – the health system – to other systems, such as the economy and education, and induces a complex chain of effects. Such systemic risks will shape the 21st century. We have made great progress in localised, conventional risks. For example, in food safety. All statistics show that we can minimise risks here through effective risk management and regulation. We do not yet have the right tools for dealing with systemic risks.

Are systemic and conventional risks perceived differently in terms of being seen as a threat?

Not necessarily. Systemic risks are sometimes underestimated because they have an impact on other areas and consequently fade from the view of the spectator. For example, the loss of biodiversity does not seem so dramatic to many at first because the indirect effects are hidden. Many will object that the world won't be worse off with fewer animals. However, most people as-



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”

Familiar and natural risks tend to be underestimated.

sess risks to a lesser extent according to the statistical estimates of risk but more according to psychological and social risk characteristics; among these are the voluntary nature of risk or the dread with respect to the perceived consequences.

What other risk characteristics play a role in perception?

Familiar and natural risks, for example, tend to be underestimated. There are also topics that evoke very strong emotional responses such as radioactivity. Another important point is the image of the actor who initiates an activity that poses risks to others. If we don't like this actor, for example a specific industry, the risk seems greater to us. If we believe we have agency over the risk, we tend to underestimate the risk, like with alcohol or smoking. In comparison, the risks posed by pesticides trigger great fears and concern because they can endanger our health without our consent

Scientific uncertainty plays a role in risk assessment. How does this affect the subjective perception of risk?

This is often unclear. I have the impression that when the people affected have to change themselves, they interpret ignorance in their favour. Someone who is used to wrapping everything in plastic is more likely to downplay the environmental risk than someone who is constantly annoyed that food is already wrapped in plastic in the shop.

What can scientific institutions take into consideration when communicating uncertainty?

The state of research is still not conclusive on this question. There are cases where too much emphasis has been placed on communicating uncertainty and people thought that if science doesn't even know, then the situation must be dangerous. And there are cases where uncertainty was not addressed. This resulted in allegations of concealment. For risks regarding food, the population has a high level of risk awareness. Scientific uncertainty tends to be unsettling in this respect. A suitable strategy appears to be to communicate "background noise". So, even with 100,000 studies that have not proven a risk, we know that we cannot statistically prove that there is no risk at all, but we can be sure that it is very low. ■

Hazard or risk?

In our everyday language, we pay little attention to the meaning of the two terms and even use them synonymously. However, there is a difference when it comes to scientific risk assessment. What does a potential hazard mean for the safety of substances, chemicals or products?

HAZARD

describes the potential of something to damage health (hazard potential)

RISK

describes the probability of whether and how severely health is damaged by something



BEAR



bear at the zoo: no damage to health expected

Potential hazards can also be in food:

- Pathogens, such as salmonella
- Chemical substances, e.g., residues of plant protection products
- Undesired substances, such as dioxins
- "Natural toxins", such as solanine in potatoes

PRUSSIC ACID/HYDROGEN CYANIDE



- very toxic and highly volatile liquid
- is naturally present in small amounts in flaxseed, manioc, bitter apricot kernels and persipan



Damage to health is not to be expected from:

- max. 15 g flaxseeds at once
- max. 2 bitter apricot kernels per day
- watered, ground, dried manioc
- legally regulated prussic acid levels in persipan

Whether a potential hazard is associated with a risk depends on exposure:

- How much
- How long
- How often

ACTIVE SUBSTANCE IN PLANT PROTECTION PRODUCT



- Potentially toxic substance



Damage to health is not expected if:

- active substance is tested, assessed and approved according to EU regulation
- health guidance values are not exceeded
- used as intended

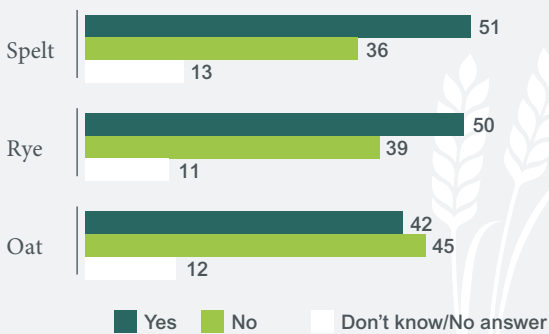
Bears, prussic acid and plant protection products are potentially dangerous. However, if you never go into a bear enclosure and follow the instructions for eating flaxseed and other foods, no damage to health is to be expected. This also applies to pesticide residues in food because they are scientifically assessed and regulated by law.

The dose makes the poison
(PARACELSUS)

All wheat?

Are consumers aware that, unlike rye and oat, spelt is a type of wheat? The BfR has commissioned a representative survey to question the population's level of knowledge regarding cereal. The results indicate that knowledge of cereal classifications within the population is lacking. Half of respondents correctly state that spelt belongs to the cereal genus of wheat. However, the comparison with rye and oat shows that types of cereals are also assigned to wheat that do not biologically belong to this genus. The distinction is particularly important for people who are allergic to wheat. A look at the ingredients must tell them what they can and cannot eat. Currently, cereal containing gluten, such as wheat, must be listed and highlighted in the list of ingredients. Furthermore, EU guidelines on allergen labelling provide that spelt products should refer to the cereal type wheat.

What do you think: Do the following cereals belong to the cereal genus of wheat?



Basis: 1,014 respondents; Figures given in percentages (rounding differences possible)

Ears: ©foodonwhite/shutterstock.com



What the population thinks

The effects of tattoo inks, antibiotic-resistant bacteria or nickel contact allergies – which health risks does the population perceive as particularly serious? For successful risk communication, it is important to obtain reliable information on risk perception in the population and the prioritisation of risks. A representative online survey by the BfR showed that antibiotic-resistant bacteria in particular are a central issue for the population. This issue takes the lead in the ranking of the 13 queried risks and one third of the respondents feel strongly threatened by it. A majority of respondents state that they would like to see more information about antibiotic-resistant bacteria. They predominantly see lamp oils and tattoo inks as less critical. This may be because consumers have more control over their contact with these risks.

More information:

www.bfr.bund.de > Publications: Perception and prioritising health risks – what does the population think? (in German)

Better informed

There is good news: about half of the population feels well or very well informed when it comes to consumer health protection, and this trend is on the increase. This is substantiated by the fifth evaluation on the awareness of BfR as a participant in consumer health protection in Germany. Every four years, the BfR surveys around 1,000 consumers and 500 experts from politics, science, media as well as business and consumer associations on consumer health protection topics and on the BfR's work. The evaluation also shows that the BfR is a well-known authority in consumer health protection. 82 percent of the experts are familiar with the name "BfR". When it comes to the population, this value has increased to just under 40 percent compared to 2016.



The meatball case

Ubiquitous, persistent and sometimes deadly: listeria can lead to food-borne disease. It was previously almost impossible to ascertain the source of the disease cases – until now.

In Germany's second largest listeriosis outbreak, which began in 2013, 83 people fell ill. Five of them died. The disease cases were spread over twelve German federal states. "This outbreak lasted a long time and spanned a total of six years," says Dr. Sylvia Kleta. As head of the National Reference Laboratory (NRL) for Listeria at the BfR, she routinely deals with the bacteria,

which can be found in a variety of foods. Listeriosis outbreaks occur again and again, with illnesses appearing and spreading nationwide over many months or years. The outbreaks are often only detected when the listeria found in the patients is compared using whole genome sequencing. Then the search for the origin of the outbreak begins.

Contaminated food

Listeria are widespread in the environment – in the soil, on plants, in animals as well as in faeces and sewage. The route to food is often short, especially when it comes to raw meat, minced meat, raw sausages and raw milk. Plant-based foods, such as vegetables, can also be contaminated in the field if the soil was previously fertilised with manure containing listeria.

The pathogens are a common problem in food production. They survive in cracks and crevices, among other places, in mostly humid rooms. There, the comparatively stubborn listeria get by with few nutrients. And they are able to withstand the lack of oxygen in food packaging just as well as frost in the freezer. They even cope better with salt and acid than their conspecifics.

Food manufacturers have to go to great efforts when it comes to cleaning and disinfection to keep the bacteria at bay. One infected spot on the production line is enough to contaminate a number of foodstuffs. As a result, listeria is often found in processed foods, for example, smoked fish, such as smoked salmon, and in seafood, such as sushi or oysters. Cheese, pre-cut salads or cold cuts can also be affected.

Life-threatening danger for risk groups

Of the 21 known species of listeria, only *Listeria monocytogenes* can infect humans. When a healthy person falls ill with listeriosis, this leads to a feverish reaction or gastrointestinal inflammation with a mostly mild progression. It can be life-threatening for senior citizens, people with weakened immune defences (for example transplant patients, cancer patients) and newborn babies. Infected pregnant women can also suffer miscarriage or stillbirth. The Robert Koch Institute (RKI) registered 591 disease cases in Germany in 2019; seven percent of the patients died.

Federal and state authorities work together to uncover the origin of listeriosis cases. Whole genome sequencing has provided the authorities with a powerful tool for several years now. Experts can use it to decode the genetic make-up of individual listeria isolates. Isolates are bacteria that have been taken from a food sample or a patient. The decoded sequences can be used like fingerprints. If identical fingerprints are found at different locations, clues can be derived as to the common origin.

“Whole genome sequencing has revolutionised our work,” says BfR scientist Dr. Stefanie Lüth, who also works at the NRL. In the past, it was almost impossible to identify the food to which an outbreak could be traced. The technique can be used to establish links between infections and food. “We are incredibly successful in outbreak clarification.” The method has been used to trace around 40 listeriosis outbreaks since 2016, more than ever before.



Experts take listeria isolates from various food samples. The National Reference Laboratory (NRL) for Listeria sequences isolates obtained by the German federal states during food monitoring.

99

Listeria are widespread in the environment. The route to food is often short.





Listeria in food: one contaminated spot on the production line is enough.

99

Whole genome sequencing has revolutionised our work.

5

Successful cooperation

The BfR has an important task in solving listeriosis outbreaks. Located at the BfR, the NRL sequences isolates obtained by the German federal states during food monitoring. The sequences of these isolates, which are permanently stored in a database, are regularly compared with sequences obtained from isolates of listeriosis diseases. The latter fingerprints come from the RKI, which is responsible for this area. If scientists at the RKI become aware of several identical isolates – also known as cluster – this indicates an outbreak. The BfR then receives the cluster sequence and compares it to its own entries. The federal and state food monitoring authorities are informed if any matches are found. They can then actively follow up on the suspicion and eliminate the cause of infection.

The BfR's matching initially remained unsuccessful for a long time in the case of Germany's second-largest listeriosis outbreak. A match was only found in 2017, four and a half years after the first reported illness case. An isolate from a ready-to-eat meatball, which was sequenced as part of a research project, matched the outbreak cluster. This information led authorities to inspect the manufacturer. They found the outbreak strain at the manufacturer's facilities. 18 other listeria strains were detected in addition to this one. One of them was responsible for a second listeria cluster. The food processing facility was closed and the Germany-wide listeriosis outbreak stopped. ■

More information:
www.bfr.bund.de/en > A-Z-Index: *Listeria monocytogenes*

Resistant bacteria in the cowshed

The BfR has been able to detect methicillin-resistant *Staphylococcus aureus* (MRSA) in the milk of cows and in swab samples of calves, young cattle, the environment of the animals, as well as in milking equipment and personnel. MRSA have been occurring in hospitals for many years (HA-MRSA) and can cause severe illness. The bacteria are resistant to many antibiotics. Certain MRSA (LA-MRSA) are also frequently found in livestock and farm workers. They have also been found in cow's milk. To better understand the spread, the BfR analysed milk and swab samples from 20 German dairy farms at which MRSA were previously discovered. The results show that raw milk can contain MRSA and that milking and personnel hygiene are particularly important on affected farms. To protect against food-borne infections, the BfR recommends using pasteurised milk or milk heated at high temperatures, and boiling raw milk before consumption. The investigation is part of the “#1Health-PREVENT” project, which is funded by the Federal Ministry of Education and Research.

More information:

Schnitt, A. et al. 2020. The occurrence and distribution of livestock-associated methicillin resistant *Staphylococcus aureus* ST398 on German dairy farms. *J. Dairy Sci.* 103:11806–11819. DOI: 10.3168/jds.2020-18958



Vegan diet bone test

Is a complete exclusion of animal-based food associated with poorer bone health? The BfR examined the bone health of 36 vegans and 36 people on a mixed-food diet using an ultrasound measurement of the heel bone. The result: on average, people following a vegan diet had lower ultrasound values compared to the other group. This indicates poorer bone health and may mean that the bones have lower density, which is associated with a higher risk of fractures. In the study, the BfR also investigated biomarkers of nutritional status and bone metabolism in blood and urine to explore the differences in ultrasound measurements more extensively and derive a possible biomarker pattern. Scientists were able to identify a pattern of twelve parameters that were most closely linked to bone health. This could be a possible explanation for the poorer bone health of the vegan group. Further studies are necessary.

More information:

Menzel, J. et al. 2021: Vegan Diet and Bone Health – Results from the Cross-Sectional RBVD Study. *Nutrients.* 13(2), 685. DOI: 10.3390/nu13020685



Rooted and half-eaten

Pigs need suitable materials to perform natural behaviour, such as rooting. A BfR team observed how fattening pigs deal with different materials, such as rooting soil and disinfectant powder, and whether they might consume a portion thereof. It quickly became clear: the pigs' interest depends on the type of material. But no matter how fascinating, the pigs consumed all materials. Modern analytical methods confirmed this observation. The substances naturally occurring in rooting soil, for example, were detected in the pigs' faeces. Enrichment materials are not covered by the definition of feed material. However, they may contain substances that are considered as undesirable in feed (heavy metals, for example). Hence, undesirable substances may enter the food chain. To better estimate the risk, it is now aimed to determine the amount of these materials actually ingested by pigs.

Nature's weapon



Plants have to withstand to many pests. Some – like the potato – produce substances for this purpose that can also be toxic to humans.

Consider it from a potato's point of view: humans are just another thing at the end of a long line of creatures that want to eat it. Even before this, the tuber fights against all kinds of pests and pathogens.

Not just a good spud

Potatoes are part of the solanaceous herb family. In addition to many valuable ingredients, they can contain "glycoalkaloids". These substances, that this plant family uses to protect itself from pests, include α -solanine and α -chaconine. They can leave a bitter taste and a burning sensation in the mouth when the concentration in the potato exceeds a certain amount. In mild cases, glycoalkaloids cause nausea, abdominal pain, vomiting and diarrhoea, sometimes accompanied by fever. Severe cases of poisoning can lead to consciousness and impairment of respiration, circulation and brain functions. However, there have hardly been any cases observed in the last 100 years.

There is no need for any serious worry these days: when properly grown, harvested and stored, potato varieties on the market usually contain α -solanine and α -chaconine only in quantities where health risks are unlikely. They are mostly found in the peel, and greenish coloured areas. Shoots and shoot buds ("eyes") also have a higher alkaloid concentration. For this reason, it is advisable to be careful when preparing potatoes: some of the alkaloids pass into the water during cooking – it should not be reused. Potatoes should be stored in a cool, dark and dry place. Old, dried, green, sprouting or damaged ones should not be eaten; green areas and shoot buds should be properly removed. The BfR also advises against small children eating the skins. ■

More information:

BfR Opinion No. 010/2018 of 23 April 2018

A herb with adverse effects

Other candidates from nature's poison kitchen are pyrrolizidine alkaloids (PA for short). Some of these substances can damage the liver and animal experiments have shown that they can alter genetic material and cause cancer. PA are primarily produced by plants from the composite family, the borage family and the legume family. PA can find their way into herbal and rooibos teas and even into spice and herb mixtures via these wild herbs on areas where crop plants are grown. Even food supplements containing borage, coltsfoot or boneset, for example, may also contain considerable PA concentrations. Those who consume a wide variety of food and drink and demonstrate expertise in collecting herbs do not ingest too much PA. Incidentally, the butterfly species *Utetheisa ornatix* uses the effect of PA for itself and, even as a caterpillar, deliberately eats plants that defend themselves against external attacks with PA. This makes the butterfly inedible for predators, such as birds or spiders.



Everything okay with iodine?

Eating less salt is good, refraining from iodized salt is not. Without iodized salt, the risk of iodine deficiency increases.

Fleur de sel, sea salt and Himalayan salt – we are spoiled for choice at the supermarket shelves. However, the subtle but crucial difference is made by a small piece of information in the list of ingredients: “with iodine”. Iodine is a vital trace element that must be ingested with food.

Why iodine?

Shaped like a butterfly, the thyroid is located directly below the larynx. Its most important task is to produce the hormones thyroxine and triiodothyronine. These thyroid hormones play a key role in metabolism and are necessary for our growth, bone formation and the development of our nervous system. If we are not sufficiently supplied with iodine, the thyroid may not produce enough hormones, leading to hypothyroidism. Those affected often suffer from excessive fatigue, weight gain and concentration difficulties.

Unnecessary as a goiter

In the effort to compensate for the continuing iodine deficiency, the walnut-sized thyroid can grow to the size of a grapefruit. Presently in Germany, disease progression is mostly mild and barely visible. The enlarged thyroid is known as a struma or more commonly as a “goiter”. If the goiter produces insufficient amounts of hormones, this leads to hypothyroidism. However, if it produces more than required, this can lead to hyperthyroidism. The symptoms then range from weight loss and increased appetite to insomnia.

Foods rich in iodine include



Sea fish

including herring, pollack, cod and plaice



Algae

Iodine concentrations in Algae can be particularly high and fluctuate, which is why the information on the package regarding iodine concentrations and maximum consumption amounts must be taken into account.



Milk, cheese, yoghurt



Bread, sausage and ready-to-eat products

Pay attention to iodised salt (list of ingredients!)



Iodised salt

Low iodine intake possible

Iodine supply in Germany has improved since the mid-1980s. An important reason for this is the measure taken to enrich table salt with iodine. However, current data from the Robert Koch Institute (RKI) show that iodine intake in Germany is still not optimal. Nearly 30 % of adults and 44 % of children and adolescents are at risk of an insufficient iodine intake.

One possible cause: in this country, manufacturers can decide for themselves whether or not they use iodised table salt in their products. A study conducted by the Justus Liebig University Giessen indicates that fewer and fewer bakeries and butchers have been using iodised salt in the last ten years. Currently, only about 30 % of industrially and artisanally produced foods contain the fortified salt. But according to the BfR’s model calculations, a good iodine supply is only possible if around 40 % of these foods are produced with iodised salt.

Good sources of iodine

We may consciously select foods containing iodine to be well supplied with the trace element. However, fruit, vegetables and cereals, for example, are low in iodine because our soils contain very little iodine. Only few foods naturally contain the element in relevant quantities. Iodised table salt is one of the few sources rich in iodine. From the BfR’s point of view, this is the salt of choice, both in our own kitchens and in food production. With that in mind: if you use salt, then use iodised salt! ■

More information:
www.bfr.bund.de/en > A-Z-Index: Iodine



Hip fashion accessory

“Chokers” have made a comeback on the catwalks – they are historically part of many traditional costumes. In their original function, they were not only intended to adorn women’s necks: struma bands. These were wide shawls or pieces of jewellery that fit tightly around the neck and were used to hide a goiter.



Allergy black box

Allergenic substances in everyday products are abundant and the mechanisms in the body to deal with them are complex. There is a great need for research.

Vienna, 1902 at St. Anna's Children's Hospital: Clemens von Pirquet, paediatrician and hospital director, discovers side effects in individual children after injecting a vaccine serum against diphtheria. He observes harmless rashes and itching, but also dizziness, breathing problems and fainting. A few children die. Von Pirquet observes that the adverse effects of the second injection do not appear after several days as with the first, but within a few minutes. The Viennese paediatrician coins the term "*allergy*", which is still used today to describe various clinical scenarios.

Substances are varied

Whether in eggs and nuts or in creams and earrings, numerous substances in food and everyday products, such as cosmetics or jewellery, can trigger an allergy in certain individuals. "Allergies represent a serious and increasing health problem. This notably applies to industrialised countries," says senior lecturer Dr. Hermann-Josef Thierse. About 15 to 25 percent of the population in Germany suffer from allergies. Thierse, an immunologist and biochemist, has been working on allergic diseases for more than 20 years. At the BfR, he supervises complex risk assessments and toxicological research on the safety of consumer products, for example, latex components in textiles or preservatives, such as methylisothiazolinone.

Immune system reactions

Clinical medicine is typically aware of four types of reactions (see box p. 32), which are the body's responses in the event of an allergy. For most types of allergy (types I to III), *antibodies* are produced in response to a substance. These antibodies, together with the specific T-lymphocytes (T-cells), form a crucial component of the acquired immune system and normally fight against infections caused by viruses and bacteria. In the case of a type I allergic reaction, IgE antibodies in particular react to a foreign substance. They can trigger a rapid and powerful immune response. Type IV reactions are different: delayed-type skin allergy symptoms may occur many hours or days after secondary contact with an allergen. After the initial contact, allergen-specific T-lymphocytes can form special T-cells (memory cells) that "remember" the foreign substances so that they are able to fight them more effectively and quickly, after repeated contact. These T-cells may contribute to triggering a clinically visible allergic reaction, such as a rash.

T-cells react to nickel

There are over 4,000 known substances that can trigger a contact allergy in products that we use every day. These include nickel. The immune system reaction to this metal is regarded to be of type IV. For example, when the

Allergy

(Greek: *allos* – different; Greek *ergon* – work, reaction) A normally innocuous, non-invasive substance triggers an allergic reaction in predisposed persons after repeated contact. This is sometimes referred to as a misdirected or exaggerated immune response.

Antibody

This is an immune defence protein (protein molecule, immunoglobulin, such as IgG, IgE) that can specifically bind to an extraneous or endogenous structure – an antigen. Within the context of an allergy, the antigen is an allergen.



skin repeatedly comes into contact with jewellery, jeans buttons, or piercings that contain nickel, the result can be skin inflammation. In the process, T-cells respond to nickel ions, which can be released from the products through oxidation. "Of the more than 100 million different T-cells that every human being has, each has a unique docking site, which is known as a "T-cell receptor". Through them, all kinds of allergenic pathogens or substances can be recognised and fought off," says Dr. Katharina Siewert, biochemist in the Department Chemicals and Product Safety at the BfR and one of the two heads of the Dermatotoxicology Study Centre. "At the BfR, we have now been able to shed light on certain mechanisms of how nickel is recognised by the body." Siewert and her team examined blood and skin samples in the laboratory. They discovered that a large proportion of the T-cells



that bind nickel have the amino acid histidine at the corresponding docking site and that nickel is presumed to bind to this location. Furthermore, a surprisingly large number of T-cells reacted to the metal with a very specific receptor. According to Siewert, this is an important indication in explaining why so many people develop a nickel allergy. Another research success: “Our research method does not use animal experiments and produces results relatively quickly.”

Hair dyes as allergy triggers

Similar to nickel, hair dye ingredients can also trigger a type IV allergy. The BfR has assessed the substance *para*-phenylenediamine (PPD) to be of particularly high-risk. This substance can be found in higher concentrations in hair dyes. In particular to PPD, it is important to mention that it not only can it trigger type IV skin inflammations in predisposed allergic persons, but also type I allergic reactions – in very rare exceptional cases with symptoms that may culminate in a life-threatening reaction. “All the more reason to explicitly reject the suggestion (as proposed by some companies) that consumers do a self-test on their skin before dyeing their hair,” says allergy expert Thierse.

Ban on methylisothiazolinone

Another critical substance is methylisothiazolinone (MI), which is used, among other things, as a preservative in cosmetics, liquid detergent and wall paints. Since the mid-2000s, research teams in Europe have observed that allergic skin reactions caused by MI were increas-

Types of allergic reaction (mixed forms exist)

TYP I

The type I reaction

is the most common form of allergy and is known as an immediate type reaction. Examples are quick IgE-mediated hypersensitivity reactions to certain substances from food, pollen, bee venom or animal hair. In addition to wheals and localised itching, a life-threatening reaction (anaphylactic shock) may occur in rare individual cases.

TYP II

The type II reaction

is also known as cytotoxic (cell-destructive) and usually leads to damaged antigen-binding blood cells, in a process mediated by antibodies. Examples are adverse reactions to drugs caused by analgesics or antibiotics.

TYP III

Type III reactions

are caused by immune complexes (consisting of antigen and antibody). These include allergic vasculitis triggered by antibiotics or infections.

TYP IV

The type IV reaction

is known as a delayed type hypersensitivity reaction (with reactions occurring 48 to 72 hours after exposure) and includes T-cell dependent contact allergies of the skin, reactions to drugs, and transplant rejections.



ing. A regulatory ban, based on extensive studies, was introduced in the EU in 2017 for use in hand creams and body lotion, for example. MI is still allowed in shampoos or shower gels since it does not remain on the skin for a longer period and is washed off again immediately. According to the EU Commission's Scientific Committee on Consumer Safety (SCCS), a concentration of 0.0015 percent is considered safe for these kinds of products to avoid an allergic reaction.

Legal regulations are necessary

Research on substances like PPD or MI shows that legal regulations are necessary to improve consumer protection. This requires internationally agreed rules, such as the Globally Harmonised System of Classification and Labelling of Chemicals (GHS) developed by the United Nations or the European Chemicals Regulation on the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH).

Another example is the constantly evolving Regulation (EC) No 1223/2009 of the European Parliament and of the Council on Cosmetic Products ("Cosmetics Regulation"). This provides precise information on permitted, restricted, or forbidden substances in cosmetics, which the SCCS has previously identified as part of its assessment. These assessments also help regulate allergenic substances. The BfR assists in these international committees. Moreover, the BfR develops recommendations, independent of the law, on how the allergy risks from everyday products can be minimised. For example, corresponding professional associations follow these recommendations, such as when dealing with potentially allergenic latex components in textiles.

Challenges for risk assessment

There remains however, a fundamental problem: the general public often wants to have clear and explicit specifications, especially limit values, although it is not always possible to determine these. According to Hermann-Josef Thierse, it is important that potentially allergenic substances are always assessed individually because of the variety and chemical diversity of allergens and the highly variable reactions of consumers to these allergens. This also means that individual differences and uncertainty factors must be considered, similar to modern, personalised medicine. It is also necessary to see to which extent allergens are released (if at all) from products that come into contact with the skin.

The complex mechanisms that trigger allergies are still a black box for science in many cases. When, why, and how strongly does someone react to certain substances? How do genes and environmental conditions influence allergy development? What role do they play in tolerance mechanisms in healthy individuals or therapeutically in desensitisation? There is still a great need for research in this field. ■

More information:

Aparicio-Soto M. et al. 2020. TCRs with segment TRAV9-2 or a CDR3 histidine are overrepresented among nickel-specific CD4+ T cells. *Allergy*. 75(10): 2,574-2,586. DOI: 10.1111/all.14322

Thierse H.-J. et al. 2019. Consumer protection and risk assessment: sensitising substances in consumer products. *Allergo J* 28(6): 22-41. DOI: 10.1007/s15007-019-1901-2

BUZZ TALK

Here to stay

PFAS make some products functional. However, they accumulate in the environment and in the body.

They actually aim to make our lives easier. They protect outdoor clothing from water, oil and dirt. They make frying in coated pans easier. And they prevent fast-food packaging from becoming weak and falling apart. They are per- and polyfluoroalkyl substances (PFAS), industrially-produced substances that are not found in nature. Professor Dr. Tanja Schwerdtle, Vice President of the BfR, on the challenges posed by PFAS risk assessments.



Professor Dr. Tanja Schwerdtle,
Vice President of the BfR, knows all about the challenges posed by PFAS risk assessments: she was chair of the PFAS working group at the European Food Safety Authority (EFSA) for several years.

Ms. Schwerdtle, PFAS have fantastic properties – they can repel dirt, oil and water at the same time. What are the disadvantages of these chemicals?

PFAS are extremely stable. It is almost impossible to get rid of them once they get into the environment, which is, unfortunately, unavoidable. This is why the use of some PFAS is banned in the EU. Nonetheless, they can be detected in water, soil, plants and animals around the world. Humans ingest PFAS mainly through drinking water and food, such as fish and shellfish. But other animal-based products, such as offal, may also contain relevant concentrations. Based on current information, it is not yet possible to conclusively determine which foods mainly contribute to intake. Some PFAS are also very slow to break down in the human body. One possible consequence: the substances accumulate. However, concentrations of PFAS in the blood and the relative amounts of individual PFAS can differ significantly from person to person. Science lacks reliable figures on this.

What facts about PFAS are established with regard to their harmful properties?

Very few, unfortunately. One thing is certain: certain PFAS that are ingested remain in the body for a long time. But what happens then is still not completely clear. We have evidence of lower antibody production after common vaccinations in children when they have higher PFAS concentrations in their blood serum. Animal experiments have shown that some PFAS damage the liver and are immunotoxic. The information on cancer risk is also uncertain. This means that we in risk assessment also have to deal with scientific uncertainties in this respect. The new health-based guidance values from the European Food Safety Authority (EFSA) take this into account to protect people's health as much as possible.

What challenges are there in assessing the detrimental health potential of PFAS?

Two points are important: we are talking about a huge group of substances here. There are more than 4,700 different compounds. We have to find out whether all these compounds pose a danger to our health. Are there differences or can we adopt a one size fits all approach? Secondly, we still have to fill large gaps in our knowledge for many PFAS. There are too few valid studies for some representatives to reliably assess the health risk. For this reason, we are still pretty much in the dark when it comes to a few PFAS. ■

More information:

www.bfr.bund.de/en > A-Z-Index: Per- and polyfluoroalkyl substances



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Heavy metals from tableware

Coloured plates, patterned cups – the coatings and decorations on porcelain or stoneware tableware can contain heavy metals such as lead, cadmium and cobalt. When these are released from the ceramics, they pass into food. Data from monitoring authorities show that high amounts can be released from plates with colourful decorations. For this reason, the BfR has assessed whether the released quantities pose an increased health risk. Scientists derived this from toxicological studies. They then calculated the tolerable area-specific release quantities for lead, cadmium and cobalt. For lead and cadmium, these are much lower than the existing EU limits. Therefore, the BfR recommends lowering these limits and introducing a limit value also for cobalt. The released quantities depend on factors such as the quality of the glaze, the firing temperature, the type of decoration, the food and the contact duration. For example, more heavy metals pass into acidic foods, such as tomato sauce.

More information:
BfR Opinion No. 043/2020 of 21 September 2020

Enjoyment without plastic

The sale of single-use plastic products, such as plates, cutlery, straws, cups and fast-food packaging made of plastic will be banned in Germany as of July 2021. This has been set out in the “EU Directive on the reduction of the impact of certain plastic products in the environment”. This now calls for reusable materials. But which ones can consumers switch to without any worries? Whether glass, metal or silicone – the following applies regardless of the material: straws and tableware that are used repeatedly should be thoroughly cleaned before the first use and between each use. If possible, clean them under warm running water or wash in the dishwasher at 60 degrees Celsius. The BfR also provides regular information regarding the possible health risks of materials and their components that come into contact with food on its website. For packaging material manufacturers will find specific production recommendations in a BfR database.

More information:
www.bfr.bund.de/en > A-Z-Index: Plastic
BfR2GO 2/2020 “Bye-bye, plastic straws”



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Avoiding future risks today

Printable electronic components, lightweight elements for cars or nanocarriers in medicine, cosmetics and food – these kinds of innovative materials are known as “advanced materials”. The term describes materials that have been specifically designed as regards their chemical composition and structure and consequently have innovative properties and functions. They have great potential for application in many areas of science, technology and medicine. The BfR chairs the newly established “Advanced Materials” working group with experts from 15 authorities, institutions and federal ministries. The working group deals with potential health and environmental risks at an early stage, meaning it develops criteria and concepts for early risk detection. From the many different materials, the group aims at identifying those that give cause for concern based on specific scientific criteria. This work will support subsequent decisions regarding regulation.

Off the field

Sprayed, evaporated and blown away:
Do “drifted” plant protection products
pose a health problem?





Critics say they are everywhere. Plant protection products (PPP) plague people on land, at sea and in the air. One of the main causes is spray drift: PPP evaporate when they are sprayed; they evaporate from the treated plants and soil or are blown away with the dust. Subsequently, the active substances are also found far away from the field and can be detected in tree bark or the atmosphere. Organisations that reject chemical plant protection products claim that the result can be “PPP poisoning”, which includes headaches, nausea, rashes and respiratory problems.

But is this really true? Can “drifting” PPP actually lead to poisoning? “It is almost impossible to avoid that some of the PPP does not go where it is supposed to,” says Dr. Bernd Stein from the BfR. “However, the relevant question is how high the dose is – this is crucial for assessing any potential health hazard.”

• **Strict regulation, high level of protection**

Chemist and agricultural scientist Bernd Stein and his team at the BfR are responsible for assessing the human health risk of active substances prior to their European approval and authorisation of PPP. Strict regulations ensure a high level of protection. A PPP is only authorised if it is not a hazard to the health of people who come into contact with it. In line with this remit, experts also take into account processes such as the drifting and evaporation of substances.

Sprayed PPP or their active substances can come into contact with the skin and can be subsequently absorbed or farm workers or other people nearby can inhale them. Depending on the scenario in question the respective risk assessments will always assume the worst case. Models based on data from field measurements are used to assess whether human health risks may occur. Absorption via the skin and the lungs (inhalation) is taken into account to assess the risk for bystanders and residents near treated areas. A PPP is only authorised if under these circumstances harmful effects are not expected.

• **Fewer unnecessary studies, more animal welfare**

Possible long-term health effects of inhalation of active substances are also assessed. This is done based on results from animal experiments in which absorption via the airways is examined. Data from studies on short-



Plant protection product can evaporate. However, based on current information, there is no reason to worry about the health of local residents.

term (acute) and long-term toxicity (chronic) effects by oral intake are also included in the overall evaluation. If there is reason to assume that the repeated inhalation of a substance is more critical than its oral intake, further studies and assessments must be carried out to verify that the risk is acceptable. The tiered approach also helps animal welfare since it avoids unnecessary animal studies.

Concerns are frequently raised that PPP active substances spread over long distances, also via particle drift of soil dust. “The possible risks of this kind of ‘long-distance transport’ are usually covered by the scientific assessment’s on worst-case assumptions,” says Bernd Stein. “This is because the concentrations of an active substance in the immediate vicinity of treated areas, on which our assessment is based, are much higher than those occurring at greater distances.”

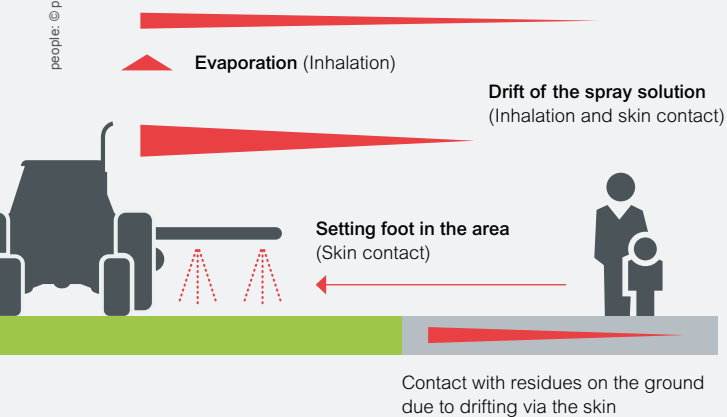
In this context it has to be noted that not all studies and publications on the “evaporation of plant protection products” are suitable for health risk assessment. Simply detecting active substances in tree bark does not allow any conclusions on possible health effects. It does not say anything about where the respective substances come from nor how often they were released into the air. In consequence it is therefore not possible to assess if and to which extent people were exposed to the product when it was applied.

Detectable in the air

The picture is different with measurements such as those published by the Province of Bolzano’s Environment Agency (South Tyrol). There air concentrations of PPP active substances were reported in the areas of Auer and Bolzano, an intensively used fruit and wine-growing region. The results show that many of the PPP active substances used in the region evaporate and can also be detected at some distance from the areas treated with PPP. However, the concentrations detected are so low that any resulting health impairment is very unlikely.

“According to the current knowledge, there is no reason for any health concerns due to possible PPP drifts”, says Bernd Stein. That is, provided that the products are used properly and in accordance to regulations. “That being said, we take concerns seriously and regularly evaluate any reports on suspected case of poisoning.” However, any relevant evidence of real cases of poisoning and, therefore, of hidden, previously undiscovered and underestimated human health risks do not exist yet. This doesn’t exclude the fact that PPP in the might cause unpleasant smells upon application. This surely is not nice, but not harmful for health. ▣

How local residents and bystanders come into contact with plant protection products



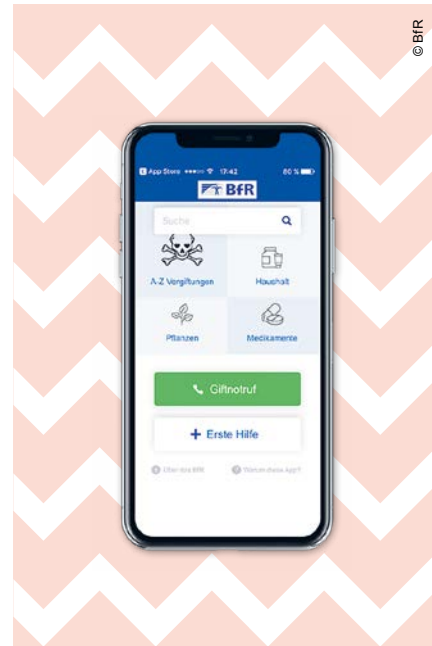
More information:
BfR Communication No. 054/2020 of 23 November 2020

Electrically charged throat

If button batteries are swallowed by children, they can suffer serious damage of their mucous membrane. Parents should keep them far away from their offspring.



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© BfR

It is something that terrifies many parents: a small child swallowing a coin or a marble. Devices that are operated with button cell batteries may also be a source of hazard. If a child swallows a button cell, this can have serious health consequences. Complications are rare if it passes through the oesophagus – in this case, natural excretion under medical supervision is usually sufficient. However, if the battery gets stuck in the oesophagus, parents have to act quickly: contact with the moist mucous membranes causes electrical current to flow. Hydroxide ions formed at the interface between the button cell and the mucous membrane can lead to severe chemical burns. The more electric charge the battery has, the more severe the damage. Lithium button cells are of particular concern since they have comparatively high voltages. Large button cells (over 20 millimetres) also pose a greater health risk as they are more likely to get stuck in the oesophagus.

Off to the children's hospital

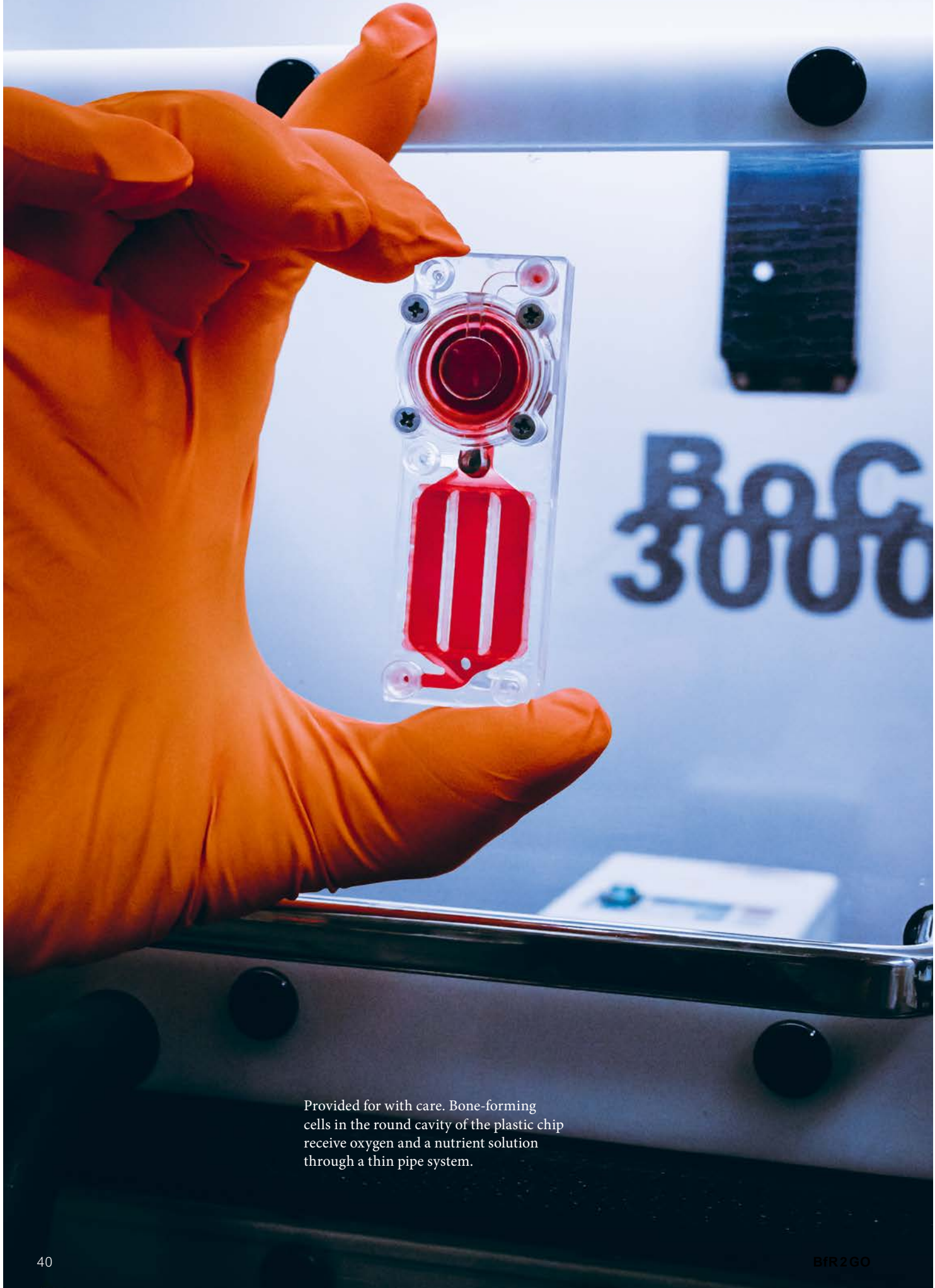
How can parents tell if their child has a battery stuck in their throat? At first, those affected often develop no symptoms or show only mild discomfort. After a few hours, vomiting, loss of appetite, fever or coughing occur. The BfR advises immediate examination at

a children's hospital even if there is only a reasonable suspicion that a button cell has been swallowed. This is because as the situation progresses, the tissue in the oesophagus can become increasingly damaged. This leads to bleeding and tissue destruction. Long-term effects may include the oesophagus becoming scarred and narrowed. Swallowing button cells even results in death on rare occasions.

National poisoning register

The number of such cases among children in Germany so far cannot be precisely estimated. According to valuation from poisons centres, several hundred children are affected in Germany each year. Eight poison centres as well as the BfR collect data on poisoning incidents in Germany. The aim in the future is to compile these data in the form of a national poisoning register. Regular comprehensive statistics on poisoning accidents will then make it possible to identify new risks more quickly and to gain a national overview of poisoning incidents. ■

More information:
Press release 43/2018 of 23 November 2018



Provided for with care. Bone-forming cells in the round cavity of the plastic chip receive oxygen and a nutrient solution through a thin pipe system.

Miniature bones

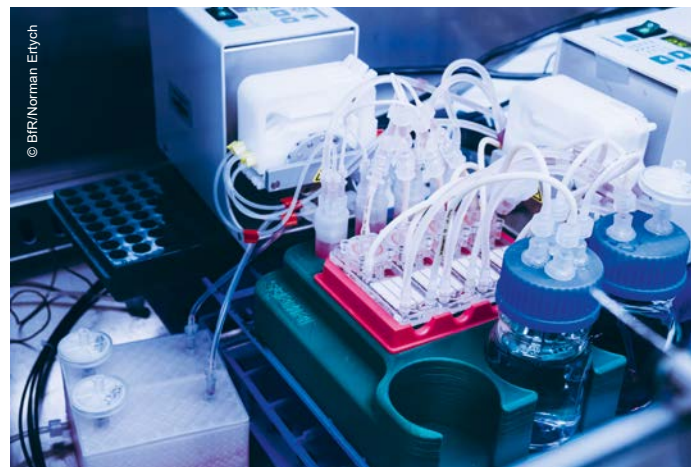
Dr. Frank Schulze grows bone-forming cells on plastic chips. These “organoids”, which are only a few millimetres in size, can help replace animal experiments.

Rows of vials containing reddish nutrient fluid, from which tubes lead to small pumps, plus measuring instruments, containers with nutrient solution and chips made of transparent plastic with round cavities. Each chip is about the size of a microscope slide. What looks like a small-scale biochemical factory is an experimental set-up for growing and researching bone tissue – a “bone-on-a-chip”. The bone cells, which are supplied with liquid nutrition and oxygen, are kept in the cavities on the plastic chip, which are called culture chambers. Here they are carefully monitored, kept at the right temperature and provided with the exact conditions they are exposed to in humans.

A bone-on-a-chip? How does that fit together? And what is it all for? We are in the laboratory of biotechnology engineer Dr. Frank Schulze at the German Centre for the Protection of Laboratory Animals, which is part of the BfR at the Berlin-Marienfelde site. Schulze’s miniature bone model was conceived and built by him and his team. The chip they designed was manufactured by a specialised company in Jena and the team produced other parts of the system themselves using a 3D printer. However, the technology to grow tiny organs – be it bones, liver, brain or kidneys – is uncharted territory that will need tinkering for further development.

No shoulder blade to order

However, we have to abandon the idea that a small shoulder blade or coccyx will grow on a semiconductor chip. The notion that it will soon be possible to grow an entire organ, whatever the size, is unrealistic. An organ-on-a-chip can only ever mimic structure and function in a very limited way. This is why it is also known as an organoid, which means organ-like structure.





Culture with a low germ count: the cells are monitored and grown by Frank Schulze and his team in a sterile workbench.



Nonetheless, these models represent a big leap forward. While a conventional cell culture remains two-dimensional – the cells form a flat lawn in the Petri dish – the organoid is a three-dimensional structure. Research is flourishing worldwide, including that on bone organoids. Bone-on-a-chip – it sounds as if electronics and life, cells and semiconductors are connected here. That is not actually the case. After all, it is a chip made of plastic and not silicon. This design makes it easier to simulate and study the life processes in the organ. Frank Schulze's bone model aims to adapt the oxygen supply to natural conditions. Moreover, the cells are exposed to a fixed mechanical strain, as is the case in real life. The bone is "under pressure" and is exposed to stress in real life, too.

Bone tissue is very much alive. It has a strong blood supply, nerves and a variety of tasks. This is how bones enable movement. They protect the internal organs, are part the mineral metabolism and the place where blood is formed. Old bone material is constantly being broken down and new bone built up.

Donor cells from bone marrow

There are different types of cells that can be cultivated in bone organoids. Frank Schulze's "bone chips" are populated with osteoblasts. Their task is to produce osteoid – the soft basic substance for new bone – and then to mineralise it, in other words, to harden it. Schulze's team obtains the cells from a hospital in Berlin. They come from donors whose bone marrow has been taken during surgery. They are osteoblasts from adults, which only proliferate to a limited extent and have a limited lifespan. "For this, we have a wide genetic range and level of realism because of the different donors,"

explains Schulze. The team is working on keeping the cells alive as long as possible under realistic conditions. Precise control of the oxygen level is important. A lot of handiwork is needed to improve the model. "As an engineer, I love it," says Schulze. "Combining technology and biology is an exciting challenge."

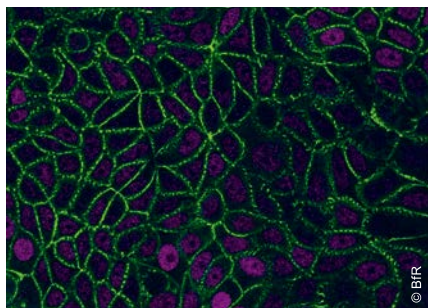
Bones atrophy in space

The principle of organoid systems is to simplify the complicated, to imitate an organ's variety of tasks in a simple system. For example, Schulze is interested in how bone reacts to mechanical stress. Generally speaking, training promotes bone formation, known as osteogenesis – but zero gravity conditions do not. Astronauts' bones waste away despite training. The bone chip can help to understand such processes.

Schulze sees future uses for the system that include testing chemical substances or potential drugs. Another topic is the wear and tear of implants, such as artificial hip joints, which react with the tissue and can lead to the implant becoming loose. "If the chip performs as intended, we can start the first substance tests this year," says the scientist. "We hope that this approach will provide a scientifically useful alternative to animal experiments." The advantage of the organoids is that they consist of human cells and, therefore, provide more realistic conditions in the organism. There's no doubt that big tasks await these little bones. ■

More information:

Schulze, F., M. R. Schneider. 2019. Hoffnung oder Humbug? Organ-on-a-chip in der biomedizinischen Forschung und als Alternative zum Tierversuch. *Deutsches Tierärzteblatt* (10) 67: 1,402-1,405 (in German)



A protein links the envelopes of neighbouring cells like a molecular rope.

How oestrogen encourages the growth of breast cancer

Breast cancer is one of the most commonly diagnosed types of cancer in the world with over two million new cases annually. High oestrogen levels can promote both the development and the migration of cancer cells from the tumour (metastasis). Research carried out by scientists at the German Centre for the Protection of Laboratory Animals at the BfR is contributing to a better understanding of the hormone's effects. The strength of the connections between the individual breast cancer tumour cells is mainly conveyed by the thread-like protein E-cadherin. It anchors neighbouring cells like a molecular rope. Findings from cell culture experiments and clinical patient samples indicate that oestrogen can permanently weaken these cell-cell connections. The hormone not only influences the number of E-cadherin connections, but also how they are arranged. This new and clinically relevant observation allows the development of novel test methods without animal experiments.

More information:

Bischoff, P. et al. 2020. Estrogens determine adherens junction organization and e-cadherin clustering in breast cancer cells via amphiregulin. *iScience* 23:101683. DOI: 10.1016/j.isci.2020.101683

Cell workshop on trial

Influences from the environment, chemicals or sunlight can damage our genetic material (DNA) and, in doing so, increase the cancer risk. Cells can counteract this damage with repair mechanisms and what are known as “cell cycle checkpoints”. Scientists at the German Centre for the Protection of Laboratory Animals at the BfR have now examined a cell cycle control mechanism in more detail exploring checkpoint protein 2 (CHK2 protein) – a protein that usually stops damaged cells from dividing further. In doing this, they are making an important contribution to cancer research. It was known that mutations in this protein lead to a twofold increased risk of breast cancer. However, this has not been observed for lung cancer. The research results show that breast cells require a functioning CHK2 protein to counteract DNA damage whereas Lung cells can compensate for a depletion of the protein. This explains why CHK2 gene mutations lead to an increased risk of breast cancer, but not lung cancer.

More information:

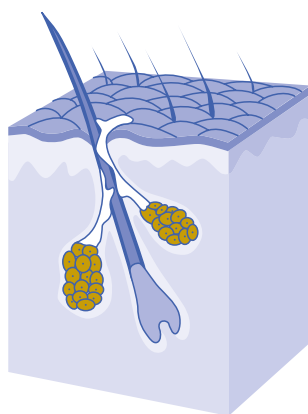
Van Jaarsveld, M. T. M. et al. 2020. Cell-type-specific role of CHK2 in mediating DNA damage-induced G2 cell cycle arrest. *Oncogenesis*. 9, 35. DOI: 10.1038/s41389-020-0219-y

Sebaceous glands improve skin models

Artificial skin models are accepted alternatives to animal experiments, for example, for testing chemicals for skin irritation. Additional skin components have to be integrated so that these models can be used to investigate additional chemical effects and other scientific questions. One major focus is on sebaceous glands, which are essential for normal skin function. Despite new findings on their regulation via the endocrine and nervous system, many properties of these glands remain insufficiently investigated. This is because their structure is complex and the “secretion process” is unique: during secretion, the gland cells, which are full of lipid droplets, disintegrate and are secreted as sebum through the hair canal. The German Centre for the Protection of Laboratory Animals at the BfR follows and supports global research on sebaceous glands – for better skin models and for the protection of laboratory animals.

More information:

Zouboulis, C.C. et al. 2020. Sebaceous gland: Milestones of 30-year modelling research dedicated to the “brain of the skin”. *Exp Dermatol*. 2020 Sep 2. DOI: 10.1111/exd.14184



INTERNATIONAL NEWS



Morocco cooperation on food safety

In the future, the BfR would like to cooperate even more closely with the National Office of Food Safety of Morocco (ONSSA) in the field of food safety. For this purpose, a joint declaration of intent was signed in February 2021. In it, the two authorities define the framework conditions for bilateral cooperation and reassert their previous cooperation. The initial focus is on the risk assessment of plant protection products.



INTERNAL AFFAIRS



Award-winning research on micro and nanoplastics

The 87th annual conference of the German Society of Experimental and Clinical Pharmacology and Toxicology (DGPT) took place at the beginning of March 2021. Dr. Holger Sieg from the BfR unit “Effect-based Analytics and Toxicogenomics” was awarded the DGPT prize for the best lecture in the “Emerging Topics” category. In the lecture “Food safety research and risk assessment of submicro- and nanoplastics”, he presented new find-

ings on the topic of micro and nanoplastics in food and their impact on the intestinal barrier.

Applying research together

How are food colourings affecting the intestinal bacteria and mucosa? How can substances be detected that trigger changes in genetic material? How does machine learning help to recognise foodstuff in photographs? These are some of the scientific questions which students from the Berlin University of Applied Sciences (HTW) have already investigated at the BfR. The BfR’s application-oriented research and the scientific focus of the HTW greatly overlap. For this reason, the BfR and the HTW concluded a cooperation agreement in December 2020. In the future they want to work together even more closely on joint projects, especially on joint student research projects and final theses in the natural sciences and computer science,

EVENTS

Agenda for more food safety in Europe

Together with member states, the European Food Safety Authority (EFSA) is planning the second Risk Assessment Research Assembly (2nd RARA) following the first event in 2018. The aim of the event is to promote food safety research and coordinate the risk assessment research agenda. With this agenda, EFSA will prioritise future work in food safety, chemical and microbiological risk assessment, nutrition and environmental risk assessment. The BfR is a member of the 2nd RARA's organising committee, which is expected to take place in Berlin in December 2021.

New META-DETECT project

As part of a joint doctoral project with its French affiliate organisation ANSES (Agence nationale de sécurité sanitaire de l'alimentation, de l'environnement et du travail), the BfR's Study Centre for Genome Sequencing and Analysis is working on developing a new genome-based method for identifying Shiga toxin-producing *Escherichia coli* (STEC) and other pathogenic *E. coli* in the environment and food. This joint research project, META-DETECT, aims to use these new investigation methods to improve analytical procedures for monitoring dairy farms in France and Germany.



BfR-Summer Academy goes digital

Since 2012, scientists from Africa, Asia, Europe and Latin America have received training at the BfR-Summer Academy each year on risk assessment and communication in the field of food safety. In 2021, the training will take place in digital form as the "BfR-Summer Academy: Lecture Series". Live lectures will be held and Q&A sessions will be offered to enable interaction between participants and lecturers during this week-long event.

Registration and further information at: www.bfr-akademie.de



Tour of the MEAL Study kitchen

Experience the BfR MEAL Study up close – this is possible thanks to the new virtual tour through the study rooms. Those who are interested can embark upon a journey of discovery by clicking the mouse and take a virtual look around in a 360° tour of the study kitchen, the receiving area, the homogenisation room or with the buyers in the BfR's group of buildings. Using the brief videos, info graphics and images, find out why the team is buying around 60,000 foods, preparing them and analysing them for almost 300 substances as part of the BfR MEAL Study.

More information: www.bfr-meal-studie.de





SUBSCRIPTION:
Consumer health protection to go



Twice a year, the compact and knowledge-packed BfR2GO Science Magazine provides up-to-date and well-founded information about research and the assessment of this research in consumer health protection and about the protection of laboratory animals.

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