

BfR 2 GO

The Science Magazine
of the German Federal Institute for Risk Assessment
Issue 2/2020



Vegan diet

A question of values

Coronavirus

**Have we got
used to it?**

Straws

**Alternatives
to plastic**

Without animal experiments

**Testing substances
for hormonal effects**

Dear Readers!

Those who want to point the way would do well to study the terrain thoroughly. If mountains and valleys are bathed in bright sunshine, predictions are no problem. If, on the other hand, there is too much darkness and dense fog, even headlights are of little use. Then no one knows where the journey will lead.

Which brings me to Covid-19, the domineering pandemic caused by a novel coronavirus. In spring 2020, the world wanted to know how deadly the virus would be. The predictions provided by renowned research teams predicted many hundreds of thousands of victims for countries like Germany. As we now know, these extrapolations were, fortunately, far from accurate. Prominent Berlin psychologist, risk researcher and author Gerd Gigerenzer explains why this might have been the case in a detailed interview in this issue: there was too little conclusive information. The uncertainty was simply too great.

As a person and as a scientist, I can – and must – live with uncertainty. Having said that, I want to determine any risk as accurately as possible. The articles in this issue show how this can be achieved. For example, in our main topic veganism, we look at the benefits and downsides of this increasingly popular diet. Naturally, our emphasis is more on risk.

A hotly debated perennial issue are health risks from plant protection products. How dangerous are residues in food, which the media repeatedly discusses? In this issue, we give a response and provide information about how a limit is determined and how compliance with it is monitored.

A completely different kind of monitoring is needed when it comes to detecting adulterated food, such as adulterated wine or feta, which turns out to be herder's cheese. The BfR has contributed to a chemical "fingerprint" for food, which can be compared with sample material. Are hard cheese or cooking oil genuine? More on this in this issue of BfR2GO.

You will see: the BfR helps to clear things up. We will ensure a clear view!

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

Professor Dr. Tanja Schwerdtle
Vice President of the BfR



Traces of iodine

For centuries, seawater has been evaporating in the sun of the French Camargue coast in white and red shimmering pools to form salt crystals – sea salt. Salt is indispensable in the kitchen. And not just there. It also plays a role in our health: it provides us with iodine, which is an essential trace element for us. Table salt has been iodised in Germany since the 1980s because a lot of food does not contain enough of it. Fleur de sel and sel gris also end up partly in enriched forms on supermarket shelves, since little of the iodine from the sea remains during the extraction process. This enrichment aims to prevent deficiency diseases. What about iodine supply in Germany? In comparison to requirements, part of the population ingests too little of the element via food. This was recently confirmed by the BfR in its MEAL Study. The study team analysed the most frequently eaten foods as prepared meals and compared this with how much we eat on average. According to the study, pregnant women and breastfeeding mothers are identified as risk groups because they have higher requirements, as do young people and vegetarians because of their diet. Therefore, iodised table salt is and will remain indispensable in the kitchen and in food production.

More information:

www.bfr-meal-studie.de/en/meal-home-page.html



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VEGAN DIET

A question of values

More and more people in Germany are giving up food of animal origin. Their motives for doing so are both of an ideological and health-related nature. The BfR has researched the topic from different perspectives in several studies. What happens in the head – and in the body?





At first glance, vegetarian and vegan diets appear to offer health benefits: for example, there is discussion that physical complaints and diseases, such as obesity, high blood pressure, diabetes, and – especially in men – death from cardiovascular diseases, occur less frequently.

However, in today's society, nutrition is far more than just a necessary means of survival. The food we eat, where it comes from and how it affects our bodies is being discussed more passionately and contentiously than ever before. The BfR has approached the topic of a vegan diet from different specialist perspectives. The results allow an integral view of the completely “animal-free” diet with all its advantages and disadvantages. Both the perceived ones and the real ones.

All just a question of attitude?

Health is an important aspect, but there is more to it. “Eating also means enjoyment, lifestyle and identity; it is emotionally charged with moral, ethical and social issues that can influence what we eat and why,” says

PD Dr. Gaby-Fleur Böhl, Head of Risk Communication at the BfR. Two studies in her department broach the issue of the attitudes and values of people following a vegan diet (see interview, page 12). The first looks at how a vegan diet is discussed on social media platforms like Instagram, Facebook and Twitter as well as in other places on the internet, such as forums or blogs.

For the second study, BfR social scientists interviewed more than 1,500 people in an online survey. They answered a total of 97 questions on their opinion, attitude and lifestyle. What unites the results of both studies are the recurring convictions and attitudes towards a vegan diet. The main motives for veganism involve health improvement, ethical considerations, such as animal husbandry, and ecological reasons, such as environmental protection and sustainability.

The counterargument to veganism most frequently mentioned on the internet and second most frequently in the large survey study is a very scientific one in essence: the insufficient nutrient supply, especially with children.



Serious deficiency: scientific data

What is the real situation when it comes to nutrient supply? What happens in the metabolism when we give up food of animal origin? Do vitamins and minerals come off badly when it comes to vegan food or is everything scaremongering? “For a long time, these kinds of questions in detail were a blind spot for science; there were only a few in-depth studies,” says Professor Dr. Cornelia Weikert from the Food Safety Department at the BfR. In 2017, her team started the comprehensive study project “Risks and benefits of a vegan diet (RBVD)” to tackle these and other open questions regarding the vegan diet of adults.

72 men and women aged between 30 and 60 took part in the study and were equally divided between two groups: one group followed a vegan diet for at least one year, the other regularly ate food of animal origin. The volunteers were measured and weighed, and had their blood pressure, waist size and BMI assessed. They also completed detailed lifestyle questionnaires in addition to a diet diary in which they recorded the weight of

their food and they donated blood, urine and stool samples for laboratory analysis.

The values show a mixed picture

Its findings contradict the fear of a general lack of nutrients in connection with veganism. Compared to a mixed-food diet, people who follow a purely plant-based diet do not have an ubiquitous deficiency when it comes to important vitamins and minerals. “The individual values showed that sometimes the vegan and sometimes the mixed-food group had an advantage,” says Iris Trefflich, a co-author of the study.

The vegan test subjects had lower values than the mixed-food group for the minerals zinc, selenium and calcium. Calcium deficiency in particular is considered to be a risk in a vegan diet due to the lack of consumption of products containing cow’s milk. Urine samples also revealed lower calcium excretion in one in three vegans. However, a general deficiency of the three minerals was not observed in the vegan group. This also applies to iron, of which the mixed-food volunteers



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It depends on the choice of food consumed.

Does food change our intestinal microbiota?

Around one and a half kilogrammes of diverse bacteria populate our body. A significant number of them is found in the intestinal microbiota. Does our diet influence our bodies' bacterial composition? Does the intestine adapt its "bacterial tools" to the pre-digested food that ends up there? In light of the scientific literature and analyses of stool samples, the BfR's conclusion is: no clear "vegetarian or vegan" intestinal microbiota can be identified based on previous studies.

There are exceptions

The German Nutrition Society (DGE) recommends that pregnant women, breastfeeding mothers, infants, children and young people should not follow a vegan diet. A sufficient supply of critical nutrients is particularly important for them. B₁₂ in particular should be taken as a permanent supplement. The BfR's surveys conducted in 2017 and 2020 show that respondents are not extensively aware of this health risk, especially with regard to children's supply (see interview on page 12).



Successful teamwork: head of the vegan diet study project Professor Dr. Cornelia Weikert (left) and co-author Iris Trefflich

had about the same amount in their blood. In both diets, about one in ten people had a deficiency. Vegans ingest significantly more iron in their diet; however, it can be harder to dissolve out of plant-based foods than animal-based ones. This is why not as much finds its way into the metabolism.

Vitamin B₁₂ is well supplemented, iodine is the problem child

A critical case is the trace element iodine – for both investigation groups. The majority of the participants had a deficiency. In the vegan group, almost everyone was affected, and what's more, their values were also significantly lower than in the mixed-food group – one third of the vegan group had values below 20 micrograms per litre (µg/L). Anything below this value is considered to be a severe iodine deficiency according to the World Health Organisation (WHO). This suggests that in mixed and especially vegan diets, it is even more crucial to ensure that a sufficient amount of this vital trace element is consumed. Since iodised table salt is notably found in industrially produced meat and dairy products that are not on the vegan menu, the BfR recommends obtaining a medical assessment as to whether ingesting iodine as a food supplement might be a possible solution.

Both groups were equally well supplied with vitamin B₁₂, often the most prominent nutrient when speaking about veganism and nutritional deficiencies. B₁₂, which is rarely contained in a plant-based diet, was taken by the vegans participating in the study via appropriate dietary supplements as an alternative source. Almost all the vegans and one third of the mixed-food group took different supplements. "As long as those following a vegan diet keep this supplement in mind, vitamin B₁₂ supply is guaranteed," says nutritionist Trefflich.

Vegans scored points with lower cholesterol levels (LDL and total cholesterol). Moreover, they ingested signif-

icantly more vitamin C, E and K as well as folate and fibre with their diet. The mixed-food group had the edge when it came to vitamins B₂, B₃ and D and also zinc.

Diet is only one element

The BfR has also investigated other issues in the RBVD study, such as whether lower inflammation values can be measured in vegans' blood. It is also still being analysed whether there are differences in bone health.

Since the RBVD study was comparatively small and the participants came from the Berlin area, the study results cannot be transferred to all adults in Germany. However, they do provide initial indications as to which nutrients require action. Further and more comprehensive studies are therefore needed to better answer questions about the health benefits and disadvantages of a vegan diet.

But which diet is better now? "With its many metabolic processes, the human body is very complex. Furthermore, a special need may exist," says Weikert, hinting not least to the situation of pregnant women, breastfeeding mothers and children (see infobox, page 10). Diet is an important factor for health, but not the only one. "Following a vegan diet can yield health benefits. But ultimately, as with a mixed-food diet, it depends on the choice of foods consumed and a balanced supply of macronutrients as well as vitamins and trace elements." Nutrition is – like so many things in life – often also a question of conduct, attitudes and values. ■

More information:

Weikert, C. et. al. 2020. Vitamin and Mineral Status in a Vegan Diet. *Dtsch Arztebl Int.* 117: 575-82.
DOI: 10.3238/arztebl.2020.0575

www.bfr.bund.de/ > FAQ: Iodine intake and the prevention of iodine deficiency

Dr. Mark Lohmann supervises projects at the BfR that analyse the German population's attitudes and values towards a vegan diet.



“Vegans have a conscious approach to their diet”

Mr. Lohmann, a complete change of diet sounds like a serious step that requires some time to think it over. Does that also apply to switching to a vegan diet?

Those people who are considering going vegan often have a basic ethical motivation. Our studies show other influencing factors that support changing to a vegan diet. Almost three quarters of vegan respondents had already been on a vegetarian diet. This clearly supports the decision for a vegan lifestyle – which is plausible, as vegetarians have already extensively adjusted their diet and have given up meat. According to the majority of statements, documentaries on conventional livestock farming were the most important trigger for changing

the diet. These reports are shocking. The ethical decision is not based on direct, personal experience, but rather on animal suffering conveyed by the media.

Veganism and a mixed-food diet – there are two camps behind this which perceive the benefits of their diets differently, aren't there?

People following a vegan diet see numerous health benefits from their diet, from general health to positive effects on performance and appearance through to a reduced risk of future diseases. Furthermore, they believe that they contribute to animal welfare and that their type of diet has a positive impact on the climate and environment. People who also eat animal

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Veganism is overwhelmingly positively regarded on the internet.

products appreciate that their choice of meals contains variety and balance, and that it contains all the necessary nutrients.

And what about the disadvantages?

A drawback for vegans is practical feasibility in everyday life – because some foods are only available on a limited basis. They also consider having to ensure that the intake of nutrients is sufficient as a disadvantage. What's more, there is the more particular problem of social pressure that some feel when they get into discussions and conflicts with their social environment because of their diet. Interestingly, those following a mixed diet do not attribute much significance to the obvious advantage of easier food choice and nutrient supply. Many of them say that they eat an unbalanced diet. Negative health effects and unhealthy ingredients are other mentioned issues.

What differences between dietary groups do you see in your studies?

Notably that significantly more vegans indicate that they take food supplements than those following a mixed diet. Apart from that, the groups are similar in their health-related behaviour. For example, they are on a par when it comes to everyday exercise and alcohol consumption; only with regard to smoking do the mixed-diet group reach for cigarettes more often. Other than that, vegans subjectively evaluate their health status as “very good” more often and the majority believe that their dietary change has brought them health benefits. At the same time, they approach their diet more consciously than the mixed-diet group. This fits the bill because they state that they are much more likely to actively seek information about nutrition, notably on the internet.

Speaking of which, the BfR has analysed more than 1,000 entries on social media, forums and blogs, where people talk about a vegan diet. What sentiment can be observed there?

Veganism is overwhelmingly positively discussed on the internet, although this does depend on the channel. 92 % of the entries analysed drew a favourable picture. Most of the critical comments can be found on Twitter, where remarks are still more likely to be positive (42 %) than negative (30 %). Veganism is not hailed without question – even 40 % of neutral and positive entries show a recognisable risk awareness. Possible nutrient deficiencies and how to prevent them are topics that are discussed. A considerable number of people, that consider their diet to be good, are therefore both critical and reflective about the associated risks.

Nutrient deficiency is the major topic when it comes to veganism. Even if vegans are aware of it, how can it be addressed, for example, in a circle of friends – without polarising?

By changing their diet, vegans have experienced overwhelmingly positive health effects. When veganism is generally communicated as being unhealthy, this contradicts their experience. To maintain a dialogue, you should communicate in a way that is pro-vegan or at least neutral. Otherwise, you risk being unheard. Stigmatisation is – of course – taboo.

The BfR conveys information about health risks and also addresses vegans. Where are the problem areas?

The majority of vegans are aware of the risks associated with their specific diet. However, from their perspective, a balanced diet and vitamin B₁₂ supplementation fully address these risks. They are uncertain when it comes to health risks during pregnancy and for children. However, our investigation shows that many vegans believe that, both a vegan diet during pregnancy and a vegan diet for infants or young children is not associated with any significant health risk. They consider regular medical examinations and taking food supplements to be effective preventive measures, but put this into practice with children only to a small extent. These findings are important for addressing the issue of pregnancy and the diet of infants, children and adolescents in particular, and for conveying specific recommendations for action. ■

Have we got used to the coronavirus?

Since the beginning of the pandemic in Germany, the BfR has been examining how people are living with the risk of “corona”.



How great is the concern among the general public? How do people assess the measures prescribed to contain the spread of the coronavirus? The BfR-Corona-Monitor has been providing an answer to this since March 2020. The long-term, representative study measures how the population in Germany perceives the risks associated with the novel coronavirus. Other studies on this topic focus, among other things, on psychological aspects, socio-economic factors and consequences of the pandemic.

At the beginning, 500 randomly selected people were interviewed by telephone every week for the Corona-Monitor; from June onwards it was 1,000 people every two weeks. The results are published on the BfR website shortly after each survey. An overview of the developments over time is also provided. Among other things, participants are asked how concerned they are about the impact on their physical health and their own economic situation, how they protect themselves and their families, what measures they think are useful and how well informed they feel.

Broad acceptance of social distancing, hygiene measures and face masks

“The vast majority of the population has recognised that they can protect themselves against the virus,” says psychologist Dr. Fabian Kirsch. Kirsch heads the BfR-Corona-Monitor together with Dr. Ann-Kathrin Lindemann. Both work in the BfR’s Risk Communication Department and are interested in the population’s risk perception of the novel coronavirus. Communication scientist Lindemann adds: “Since the pandemic reached Germany, approval of the state-ordered measures regarding distancing, hygiene and masks has been at a relatively high level.” Shortly after the nationwide introduction of mandatory masks,

this measure was rated as appropriate by 86 % of respondents in the survey dated 21 April 2020. “This is a remarkably high level of acceptance, considering that this was a measure prescribed that directly interferes with everyday life of many people,” says Kirsch.

Lindemann and Kirsch have observed changes in acceptance as the pandemic has progressed: Initially, 92 % rated contact restrictions as appropriate, whereas at the beginning of May, this value was just 67 %. After the measure was eased during the summer, acceptance increased again. At the end of November, 79 % considered the contact restrictions as appropriate.

The pandemic as part of everyday life

“To some extent, the population has now become accustomed to living with the pandemic. The usual protective measures have now become routine for many,” explains Lindemann. In the summer, at least 90 % of respondents already said that they wore covers for their mouth and nose, kept their distance and washed their hands more thoroughly. In autumn, most of the population still complies with these measures. The majority also regularly look for information about what is happening regarding the novel coronavirus. “This shows that the coronavirus has found its way into everyday life,” comments Kirsch on the results.

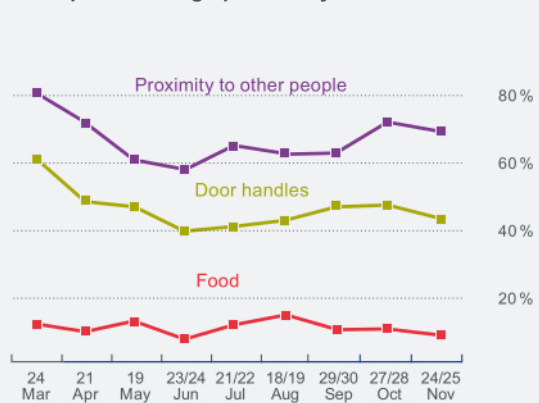
The BfR-Corona-Monitor is intended to accompany the population until the end of the pandemic in Germany. “Until, for example, the vaccine is approved and we can get used to a life after the pandemic again,” says Lindemann. ■

More information:
www.bfr.bund.de/en > Risk communication > BfR-Corona-Monitor

Infection via door handles?

In the beginning, the population was concerned about an infection via door handles. In the first survey dated 24 March 2020, 61 % of respondents rated the probability of becoming infected via door handles as high or very high. Coronaviruses can reach surfaces through an infected person sneezing or coughing directly on them and remain infectious there for some time. A smear infection to another person appears to be possible if the virus is transmitted shortly afterwards via the hands to the mucous membranes of the nose or eyes. However, it is almost impossible to scientifically trace this transmission route. The BfR is not aware of any infections via this route. According to the Robert Koch Institute, the novel coronavirus is mainly transmitted via droplets and aerosols.

Perception of a high probability of infection*



* How high or low do you estimate the probability of being infected with the novel coronavirus via the following paths? – Shown: response category “(very) high”, figures given in percentages, basis: 499–509 (March-May), 981–1,030 (since June) respondents

Professor Gerd Gigerenzer

© Arne Sattler

“Fear is a poor basis for decision-making”

“The coronavirus pandemic should teach us to deal rationally with uncertainty,” says psychologist Professor Gerd Gigerenzer. He is the director of the Harding Center for Risk Literacy at the University of Potsdam, director emeritus at the Max Planck Institute for Human Development in Berlin and was a member of the BfR’s Scientific Advisory Board.

At the beginning of the pandemic, it was estimated that hundreds of thousands could die in Germany. This is far from the actual figures. Mr. Gigerenzer, why did the predictions miss the mark?

When it comes to statistical predictions, a distinction must be made between situations where the risks can be calculated and those in which this is not possible because there is too much uncertainty. This uncertainty has played a major role during the coronavirus pandemic, as it did during the last financial crisis. It is not possible to reliably predict the upcoming months in such cases. However, the models in which the number of coronavirus victims were too high, such as those compiled by Imperial College London in March, have ignored this and have not clearly communicated the uncertainty.

Was publishing such alarming predictions a mistake then?

They were based on assumptions, not on facts. But the public was riveted by the immense number of victims. The number of intensive care beds needed in Germany and the USA was also greatly overestimated. At the end of May, Andrew Cuomo, Governor of New York, frustratedly said about the predictions: “They were all wrong.” Yet we could have learned from the past: using similar models, the British health authorities predicted up to 65,000 deaths from swine flu in 2009. Ultimately, there were fewer than 500. So much for the models. They are interesting intellectual games, but they should not be confused with reality.

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The coronavirus predictions were based on assumptions, not on facts.

Is there a kind of faith in numbers because numbers appear to be something specific, tangible?

Number blindness also comes into play. If we look at the work of scientists, we see that they usually also specify confidence intervals, meaning a range of fluctuation for an estimate. In the case of swine flu, these were between 3,000 and 510,000 presumed deaths, a huge uncertainty. But this was not reported. The actual victims, fewer than 500, were then still outside of the entire estimated range. There is an illusion of certainty in which numbers are believed without considering that they are based on assumptions. The distinction between calculable risks and situations in which risks cannot be calculated is crucial. For example, viruses can mutate and human behaviour is difficult to calculate – these kinds of uncertainties must be taken seriously. This is why it is sensible for governments to make short-term plans and revise decisions.

Can the public endure this kind of uncertainty?

It is important to raise awareness here. In this world nothing can be said to be certain, except death and taxes, as United States' founder Benjamin Franklin already knew. We must learn to live with uncertainty and deal with it rationally.

There is no absolute certainty. But exactly this is what is being demanded in the case of the coronavirus. Many people want the virus to be eradicated so that we are once again completely protected.

We have been in contact with coronaviruses for many years already, albeit with different variations than SARS-CoV-2. But this has never concerned anyone. These kinds of virus are part of a normal flu season.

There have always been epidemics. What is different now?

First and foremost, the greater number of fatalities compared with many other epidemics. Covid-19 is a serious threat. But there is also a psychological principle at work here: the fear of shock risks. These are situations in which many people die or could die in a relatively short time. Fear of these kinds of events can be triggered relatively easily.

An example?

Many people are afraid of flying. In a plane crash, the worst-case scenario is that several hundred people die at the same time. What many people forget: there are significantly more fatalities in cars – but spread out over the year. Yet not many people are afraid to get into a car. Our reaction to normal waves of flu is similar to that of car accidents. Who remembers that three years ago, an estimated 25,000 people died of flu in Germany?

After the terrorist attacks of 11 September 2001, many Americans switched to cars. This risk avoidance claimed many victims, namely in fatal road accidents, as you determined in a study at that time.

This was precisely the fear of shock risks that had hit people. In the year after the attacks, around 1,600 Americans lost their lives attempting to avoid the risk of flying.

Would this kind of analysis also be appropriate for the coronavirus? Does avoiding risks also lead to significant victims here?

This is a legitimate question. There are reports that patients are avoiding hospitals despite acute symptoms because they are afraid of the coronavirus – just as Americans avoided airports back then. Initial analyses show that the number of stroke patients in German hospitals has declined by a quarter and the number of heart attack patients by a third. That has not yet been systematically investigated, but this is my intention. Then it can be estimated how many lives the fear of danger – Covid-19 in this case – has cost. Fear is a poor basis for decision-making; thinking can save lives.

What can we learn from the coronavirus?

The coronavirus crisis has a special characteristic. It is not so much the pictures that frighten us, but the bare figures, more than with bird flu, swine flu or mad cow



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It is the bare figures that scare us. But do we understand what they mean?

disease. Changes in the number of new infections or the reproduction number R scare us or give us hope. But do we understand what these figures mean? The crisis would be our big opportunity to do something about widespread number blindness. Statistical thinking should already be taught in school. But not as a dry mathematical discipline but rather using the example of Covid-19 and other realistic uncertain situations.

In other words?

What do the new infection rates that are reported every day mean? These figures are not the actual rates of newly infected people. They are people who have tested positive for Covid-19. Therefore, the reported numbers are uncertain on two counts. For one thing, not all people are tested, which leads to the real number of newly infected people being underestimated. On the other hand, positive does not necessarily mean infected, but rather people can either test as true positive or false positive. False positive test results lead to the real rate of new infections being overestimated. Only the interaction of these factors makes it possible to understand what lies behind the seemingly clear figures.

Coronavirus tests are considered to be an important weapon against the virus.

They are, but the possibilities and limitations of the tests still have to be understood. Let's assume that you are having an antibody test with the hope of a positive result and, therefore, of being immune. And the test really is positive. Can you now go to parties without any fear of getting infected and infecting others? No, and not just because repeated infections are possible.

Are you hinting at the possibility that the tests have an uncertain success rate?

Let's assume that two percent of people have antibodies. The test correctly identifies 99 percent of people with antibodies and 98 percent of those who do not have

antibodies. You can, therefore, expect that for every 100 people who are tested, two people will test true positive, but two people will also test false positive. This means that your chance that the test is correct and that you actually have antibodies after a positive result would only be about 50:50. Therefore, if you get a positive antibody test result, especially if you have no symptoms, the test should be repeated immediately. However, the figures in the example are only approximate since we still know little about the reliability of the tests.

The crux is that when there are few antibody positives – in this case two percent – the false positives, meaning people without antibodies but with a positive test result, become a problem?

Exactly. The high number of false positive results also speaks against nationwide antibody tests in Germany, because then tracking hundreds of thousands of false positives and their contacts would overstrain the health care system and tie up capacities that are urgently needed elsewhere.

What do you think is the BfR's role in this situation?

The BfR can be a voice of sanity in the hubbub from conspiracy theorists, those blinded by figures and Covid-19 deniers. With its voice, it could definitely enter the public discussion in an even more audible way. Of course, the BfR will then – and it would not be the first time – be attacked by these groups. That is to be expected – but those without critics have never shown any backbone. That is the price of truth. ■

More information:
www.hardingcenter.de/en

Something is wrong here!

Adulterated wine, Moroccan olive oil with an Italian label or feta that turns out to be herder's cheese – adulterated food is illegal, can endanger lives and is therefore relevant for consumer health protection. The BfR has asked experts for an assessment.



Allie Icons: © Freepik FlatIcon.com

A trend?

77 % of experts expect food manipulation to increase in the future. Particularly affected: food supplements (74%), fish (70%) as well as fats and oils (66%).



Suspects?

In the experts' opinion, the manipulations are performed mainly in food processing (78%) – followed by food refining (70%) and gastronomy (66%).



© Le_Moni/shutterstock.com

A danger to health?

The majority of experts (81%) see the greatest health risk in manipulated food supplements. Adulterations here are notably expected to be caused by erroneous content information (71%) and unauthorised ingredients (68%).

Underlying study:

Two-stage Delphi study with online survey of experts from Germany who focus on adulterated food. The values shown are based on the second survey round (131 respondents between February and April 2020).



Echo chambers and polarisation

Communicating information on Covid-19 is a major challenge. Dr. Fabiana Zollo from Ca' Foscari University of Venice on the "infodemic": the new term coined by WHO refers to the circulation of an excessive amount of information, often unverified.

Scientific communication in Europe

The EU H2020 research project QUEST, headed by Dr. Fabiana Zollo, focuses on scientific communication in Europe. Initial research results show a fractured opinion and information landscape, and the necessity for a dialogue-based approach. To improve communication on disputed scientific issues, the QUEST project has established 12 core indicators. These can be summarised under three pillars: trustworthiness and scientific rigour, presentation and style, and connection to society.

More information:

<https://questproject.eu>

The Covid-19 outbreak shows, maybe as never before, the importance of scientific communication and its crucial role in the information system. The spreading of lots of information on the coronavirus, often unverified or unreliable, can destabilise the public and make it difficult to form a clear opinion. This uncertainty might have an impact on the epidemic process and divide society. Therefore, it is important to understand how people get informed and form their opinions, and how this can influence their choices.

The “infodemic” on social media

Our research group at Ca' Foscari University has analysed the evolution of the public debate on Covid-19 since the first weeks of this emergency. We measured the now famous R_0 factor for the infodemic on different social media platforms. In an epidemic, R_0 is the number of individuals that can be infected after being in contact with a contagious individual. When R_0 is greater than 1, there is the possibility of a pandemic. In our study, this means the possibility of an infodemic. This value was supercritical for all investigated social media platforms, thus showing the high engagement of users in the public debate on the coronavirus.

Echo chambers and cognitive bias

Despite the abundance of information, its quality is often poor. There can be many reasons for this: from paid quality content to a decline in investment in news production and distribution. Subsequently, traditional media lose respect and trust, and this may encourage many people to rely on alternative sources of information, which are not always qualified. Furthermore, it has been demonstrated that people tend to process scientific findings along their own system of belief. They tend to be biased when selecting and interpreting information. This means: information outside their circle of family and friends is ignored (“echo chambers”) and correction attempts from outside are rendered ineffective and counterproductive (“backfire effect”).

Tailored communication strategies

Our research group uses techniques from computational social science to analyse information spreading as well as individuals' and group dynamics. The aim is to identify communication strategies that smooth extreme polarisation and facilitate a civil debate.

Together with the London School of Economics and journalists from Corriere della Sera, Italy's largest daily newspaper, we have, for example, examined which journalistic techniques were more effective to engage users on the social media platform Facebook in a constructive and civil debate. We showed that impartial and accurate reporting leads to less criticism of the source of information. Conversely, stories of general human interest provoke strong negative reactions. Infographics, fact checks and a data-based approach also lead to strong public resistance to certain topics. Depicting strong opinions and political guidelines to polarise the issues inevitably leads to rejection and an often toxic debate.

Taking these findings into account, the major communication challenge triggered by the Covid-19 pandemic, after all, can be a great opportunity to improve the effectiveness and the quality of information and scientific content for the public. A deep understanding of social dynamics in the public debate is thus necessary to develop appropriate information strategies. ■



Dr. Fabiana Zollo is an assistant Professor at Ca' Foscari University of Venice in the Department of Environmental Sciences, Informatics, and Statistics, member of the “Data Science” task force established by the Italian Authority for Communication. Her research focuses on information and misinformation spreading, social dynamics and the evolution of collective narratives on social media.



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It looks genuine but it's not

Chemical fingerprints can be used to check food and feed composition. The respective methods should protect consumers from health risks.

In 2008, the issue of food adulteration gained huge publicity when around 300,000 babies in China needed medical treatment because of adulterated powdered milk. At least six infants died. The cause was infant formula to which melamine was added to feign higher quality. Melamine is a basic substance for synthetic resin and damages the kidneys.

Adulterated food and feed can also be found in Europe. For this reason, the BfR has been addressing authenticity issues for several years. Are substances added to a paprika spice to enhance the colour? Does a forage maize really originate from Ukraine? Does the wine really contain what the label promises? "Food

authentication plays an important role in consumer protection," says Dr. Carsten Faul-Hassek, who heads several research projects on authentication at the BfR. It is about deception – nobody wants cheap sparkling wine from expensive champagne bottles – and health risks, as in the infant formula case.

A distinctive profile is created

Reliable methods have been developed to detect melamine and other substances that have been used in the past for adulteration. The problem is that you can only find what you are looking for. You can only search for known means of adulteration. The challenge is

detecting adulterations without knowing what they are beforehand. Scientists at the BfR are conducting research on precisely these non-targeted analytical methods (see BfR2GO 1/2017).

The three-year research project “FoodAuthent”, which ended in December 2019, provided a scientific approach. The BfR and its partners put the chemical-analytical method here to the test with hard cheese, edible oil and spirits, collecting up to 100,000 pieces of individual information per sample. The data were used to generate a unique, distinctive profile comparable to a fingerprint. According to the concept, it can then be compared with other food samples (reference data). If the images do not match, this indicates an adulteration. The next step involves checking the tracing documents or an analysis for known substances.

Complex IT infrastructure needed

For the fingerprint approach to work unequivocally, reliable food and feed profiles must be collected in databases. Here, fluctuations must be taken into account since the same types of food may differ slightly in their composition. Likewise, laboratories provide slightly different profiles, even if the same instruments are used. For this reason, it is important to standardise analytical methods, says Fauhl-Hassek. “Only then can the data sets be compared and stored in inter-laboratory data collections.”

Creating adequate databases also involves purely practical challenges: “We generate a lot of data that has to be collected, managed and analysed in a structured way,” says Dr. Susanne Esslinger, project manager of “FoodAuthent”. Databases, software and servers are required. In the future, it should be possible to store the information securely and exchange it between institutions, such as manufacturers, laboratories, retailers and authorities. “FoodAuthent” has demonstrated how this can be done in practice with a concept for open source software: “fAuthent”. It might be easier to detect unknown adulterations perspective in the future with the help of these kinds of databases and the profiles stored in them. However, it is unclear when they will be ready to be put into practice. “We will definitely need another ten years,” expects Fauhl-Hassek.

Illegal animal additives

Besides this, the BfR is conducting research on authenticity in other projects. An interdisciplinary junior research group has been working on this topic for five years. In the completed EU project “FoodIntegrity”, the BfR collected and assessed various analytical methods. With “Animal-ID”, the BfR focuses on developing and validating tests for tracing and authenticating animal proteins. In doing so, the corresponding additives in food and feed can be better identified.



The challenge is in detecting adulterations without knowing what they are beforehand

Other activities at the BfR

Within the framework of the EU MEDIFIT project, which began in June 2020, Carsten Fauhl-Hassek's research group is focusing on developing routine-capable fingerprint procedures. It is focusing on traditional Mediterranean food. In the course of this, issues relating to the authenticity of honey, such as the unauthorised addition of sugar syrup or a false declaration of origin, are examined. ■

More information:

www.bfr.bund.de/en

> FAQ: Food fraud and authenticity testing

www.foodauthent.de/en

They are everywhere

Antibiotics promote the spread of resistant bacteria. But there are also other influences.

Bacteria that cannot be harmed by antibiotics can threaten the health of humans and animals. This is particularly problematic for antibiotics that are only used once all other substances have failed. These antibiotics of last resort are, according to the specialist jargon, the “last choice”. Carbapenems belong to these groups of agents.

Although carbapenems are not licensed for treating livestock, bacteria resistant to these agents (such as *Salmonella* and *E. coli*) have been isolated in some pig and poultry flocks in recent years. These bacteria produce enzymes (carbapenemases) that render carbapenem antibiotics ineffective.

Antimicrobial resistance is encoded in the genetic material of the bacteria. This genetic programming is due to selection, among other things: pathogens come into contact with the agents. The resistant bacteria

survive. However, studies show that bacteria can carry resistance genes, even though they have not been exposed to certain antibiotics. How can that be?

The “information” on resistance is in fact not only found on the chromosome of a bacterium, but also on transmissible mobile genetic elements, such as plasmids. These DNA molecules make it possible for resistance to creep into populations where these agents have never been used. The plasmids can be exchanged between different bacteria and, in doing so, spread resistance. ■

More information:

Hadziabdic, S. et al. 2019. The bla_{NDM-1} carrying IncA/C2 plasmid underlies structural alterations and co-integrate formation in vivo. *Antimicrobial Agents and Chemotherapy* 63(8). DOI: 10.1128/AAC.00380-19



Dr. Sead Hadziabdic
from the BfR EFFORT Team

Resistance road trip

Dr. Sead Hadziabdic, veterinarian and scientist at the BfR, has set out to see how plasmids carrying genes that encode the production of carbapenemase change and spread. This work was part of an international EU research project (EFFORT).

Describe your work in a Tweet!

In experimental studies with broiler chickens, we found bacteria in which plasmids carried carbapenemase-encoding genes during the entire fattening period – even though no relevant antibiotic had been used before.

How does this knowledge benefit humans, animals and nature?

It shows just how complex this is. Resistance can be introduced via plasmids from the environment or game animals and transmitted to livestock bacteria. Once in the food chain, they potentially reach humans. Therefore, it is important to prevent the introduction of these plasmid-carrying bacteria into a livestock population.

Your most important tool?

We have examined the genetic material using whole genome-sequencing and then analysed it using bioinformatics. Moreover, an experienced team was needed to carry out the animal experiments and for the subsequent laboratory work.



High-dose vitamin D preparations unnecessary

Taking daily vitamin D supplements in doses of 50 micrograms (μg) or 100 μg is not necessary from a nutritional point of view. Although occasional consumption is unproblematic from the BfR's point of view, the current study data indicate a possible risk of overdosing if such high-dose preparations are taken on a daily basis and in the long term. Consequences may include increased calcium levels in blood serum (hypercalcaemia), which can manifest as fatigue and muscle weakness, vomiting and constipation or cardiac arrhythmia and vascular calcification. Persistent hypercalcaemia can lead to deposits and calcification in the kidneys and, ultimately, to a decline in their function. According to the BfR, given an adequate length of time spent outdoors with corresponding exposure of the skin to sunlight, plus a balanced diet, individuals can attain sufficient supply of vitamin D without any preparations. People who are comparatively more likely to develop severe vitamin D deficiency should seek medical advice before taking these kinds of preparations.

More information:
BfR Opinion No. 035/2020 of 31 July 2020

Do plasticisers make you fat?

Every day, consumers ingest many different potentially harmful substances, particularly through food, including those that can disturb the hormonal balance. These kinds of chemical compounds are referred to as endocrine disruptors and can, for example, interfere with growth, developmental- or reproduction processes. Moreover, recent studies suggest that they also affect metabolic processes, such as lipid or energy metabolism, and that they might be associated with diseases like obesity and diabetes. Given the lack of validated test methods to determine metabolic endocrine disruption, researchers at the BfR are conducting experiments with human liver cells as part of the collaborative project EDCMET (Metabolic effects of Endocrine Disrupting Chemicals: novel testing METhods and adverse outcome pathways), funded by the EU Commission. The project aims to characterise metabolic effects and develop validated test methods.

More information:
Küblbeck, J. et. al. 2020. The EDCMET Project: Metabolic Effects of Endocrine Disruptors. *Int. J Mol Sci.* 21(8): 3021. DOI 10.3390/ijms21083021



Assessing risks in the cloud

Mathematical models and simulations are becoming increasingly important in risk assessment. A research team at the BfR has developed a first standardised exchange format for risk assessment models. The Food Safety Knowledge Exchange (FSKX) format allows experts to exchange risk assessment models and simulation results between different software solutions and online platforms. Behind this is the international research project AGINFRA+ (AGricultural INFRAstructure Plus), funded by the EU Commission, within the framework of which a cloud-based online platform was developed between 2017 and 2019. So-called "virtual research environments" enable scientists to share mathematical models with others and use them online. The platform therefore functions as a central access point for developing and using risk assessment models.

More information:
<https://aginfra.d4science.org>



Food production: hygiene can be tricky

**Disinfectants help to keep infectious agents in check along the food chain.
However, using them does not come without risks.**

Cleaning and disinfection are just as much a part of the hygiene concept in animal husbandry as well as food production and processing as they are in healthcare. Antimicrobial agents are used in disinfectants and antiseptics – and this also harbours risks. These biocides can select less sensitive microorganisms if they are exposed to only low concentrations of these substances. Furthermore, bacteria could develop antibiotic resistance through non-lethal concentrations of disinfectants (see box on page 27). Certain antibiotics are then no longer effective against these bacteria, and infectious diseases can only be medically treated with great difficulty.

Disinfectants can promote antibiotic resistance

BfR scientists, in cooperation with Jena University Hospital and Freie Universität Berlin, are conducting research on how disinfectants can be used without health risks. The research project (BioZAR – “Impact of biocides on the dissemination of antibiotic resistance

in *Escherichia coli*”) is funded by the German National Research Platform for Zoonoses and the Federal Ministry of Education and Research (BMBF). The experts analyse three possible “adverse effects” of disinfectants (see box).

***E. coli* as an indicator**

The main focus lies on the risk of the spread of antibiotic resistance, using the example of the indicator germ *E. coli*. The research team examines the pathogen, which has been isolated from livestock for meat production, from food, from sick people during and after being admitted to hospital as well as from healthy individuals. It is specifically about its sensitivity to disinfectants, antiseptics and antibiotics.

Preliminary studies put BfR researchers on the right track: together with cooperation partners at Jena University Hospital, they had isolated *Klebsiella pneumoniae* from samples from a hospital outbreak, which



How disinfectants promote antibiotic resistance

Cross-resistance

Cross-resistance occurs when a resistance mechanism makes microorganisms insensitive to several antimicrobial agents at once. So called "efflux pumps", among others things, can be responsible for this: they transport biocides and antibiotics out of the bacterial cells.

Co-selection

Several resistance genes are frequently found together in bacteria on mobile genetic elements, such as plasmids. Different resistances can then be transmitted to a bacterium at the same time and co-selected, or enriched, by biocides.

Stimulating transmission

Low, non-lethal concentrations of biocides can increase the transmission rate of plasmids and, in doing so, possibly directly encourage the spread of resistance genes.

not only showed reduced sensitivity to the antiseptic chlorhexidine, but also cross-resistance to the antibiotic colistin. In another research project, some of the *Listeria monocytogenes* isolates from food production tested demonstrated tolerance to the biocide benzalkonium chloride used in disinfectants. However, cross-resistance to clinically relevant antibiotics was not found.

Within the BiozAR project, the BfR team now uses modern molecular biological techniques, such as whole genome sequencing, advanced statistical methods and machine learning applications. The analyses should provide information for new and improved hygiene guidelines and create more safety for consumers. ■

More information:

Stein, C. et al. 2019. Carbapenem-resistant *Klebsiella pneumoniae* with low chlorhexidine susceptibility. *The Lancet Infectious Diseases*, Volume 19, Issue 9, 932–933. DOI 10.1016/S1473-3099(19)30427-X0

Rödel, A. et al. 2019. Biocide-tolerant *Listeria monocytogenes* isolates from German food production plants do not show cross-resistance to clinically relevant antibiotics. *Appl Environ Microbiol* 85: e01253–19. DOI 10.1128/AEM.01253-19



Bacteria can develop antibiotic resistance due to underdosed disinfectants.

Bye-bye, plastic straws

From July 2021, straws will be a disposable plastic product that can no longer be sold in the EU. There are plenty of alternatives that can be used as food contact materials and, therefore, also for straws.

A picnic in the park without plastic utensils, cocktails at the bar without a plastic straw – this has been determined in the “EU Directive on the reduction of the impact of certain plastic products on the environment”. Germany has already implemented this directive into national law, with effect from 1 July 2021. In doing so, frequently used everyday products, such as straws, which until now have been predominantly made of plastic, will have to be made from other materials.

Metal, paper, glass, etc. – what should consumers look out for? First things first: regardless of the material, straws used repeatedly must be thoroughly cleaned

before initial use and also every time between uses. If possible, use a thin glass brush under warm, running water or wash in the dishwasher at 60 degrees Celsius. If thorough cleaning of the straws is not possible, the BfR recommends that multiple-use straws are not used for reasons of hygiene. Furthermore, straws should not have any sharp edges and should also be replaced if there are initial signs of material damage (signs of wear and tear).

BfR2GO presents the most important alternatives to plastic straws at home.

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“Straw straws”

Straws made of straw as an alternative? An obvious option. However, the natural material may contain invisible germs, mycotoxins, such as deoxynivalenol (DON), or other undesirable substances, such as residues from plant protection products. These could enter the body when drinking and make you ill.

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Paper straws

Paper straws can also be a suitable disposable alternative to plastic straws. To make sure that they remain robust and do not immediately become soft in the drink, epichlorohydrin-based resins are often added to them during the manufacturing process. These resins can release potentially harmful substances into the drink, such as chloropropanol. For this reason, companies should follow BfR recommendations for the manufacturing process – then there will be no health risks when enjoying your favourite drink with a paper straw.

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Stainless steel straws

This material is a very suitable alternative to plastic. It can be reused as often as required, does not rust and can be used for both cold and hot drinks. Stainless-steel straws should be cleaned after each use, for example, with a brush or in the dishwasher. The Council of Europe's requirements for metals and alloys are important for manufacturers of this kind of straw. They determine maximum limits for the release of chemical elements, including 21 metals such as nickel, chromium and lead. The aim of the requirements is to release as few undesirable substances as possible.

© Studio GOOD



Macaroni or similar pasta

If a straw is only used once, then there is no argument against the use of durum wheat (e.g. raw macaroni pasta) from a health perspective. Only industrially produced noodles that do not contain egg as an ingredient should be used. The extent to which this tastes good or whether the pasta becomes soft in hot drinks and then makes the drink taste a bit like pasta is something you have to decide for yourself.

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Bamboo straws

Uncoated straws made of bamboo are a natural material just like straws made of straw. An advantage of bamboo is its stability. In comparison to straw, it is significantly more durable and can be used several times. However, special attention must be given to cleaning since bamboo drinking straws have a rougher surface than glass or stainless-steel straws, for example. Germs can stick to it and enter the body unseen when drinking.

© Pooh Yuphayao/shutterstock.com



Silicone straws

This soft material is a suitable for food contact. However, silicone straws should be thoroughly cleaned after each use. It is best to use a thin cleaning brush or similar. This is important so that no germs stick to the inside of the straw, which you would then drink the next time you use it. Manufacturers should follow BfR recommendations for silicone as a food contact material. Specifically: at the end of production in particular, heat the straws up to a high temperature once to remove volatile substances before the products are put on the market.

© VDB Photos/shutterstock.com



Glass straws

Watch the liquid go up the straw when drinking – this is possible with glass straws. The material has been used in the food sector for many centuries without any problems. Glass straws are reusable because they are easy to clean. You can see if they are clean on the inside. The disadvantage: glass is fragile and there can be sharp-edged fragments. This is why glass straws are not suitable, especially for small children. However, you can now get shatterproof glass. ■

More information:
www.bfr.bund.de > Press > Mediathek (in German)

“Not all studies are usable”

Biologist Dr. Johanna Kaltenhäuser assesses plant protection products studies at the BfR. An interview about how to sort the wheat from the chaff.

Mrs. Kaltenhäuser, you evaluate scientific studies for the approval of active substances in plant protection products. What are the standards you use for this?

Comprehensible and reliable studies are crucial. This means that we place great importance on a precise description of experiments. What material was used, which methods were employed? The results have to be transparent, the study has to be statistically valid and, at the same time, individual data should be available to enable a detailed evaluation.

Responsible authorities, such as the BfR, are often criticised for only including industry studies in their assessment and not independent, potentially burdensome studies.

This is not the case. In addition to the data we have received from applicants, we use all the information we can find. Here, the main focus is on a thorough search of the scientific literature.

Then how do you explain the allegation?

On the one hand, the media sometimes present a distorted picture; on the other hand, this allegation is probably based in part on the fact that we cannot always use all the published studies for a particular active substance in our evaluation.

Why is that?

Firstly, because we have very specific properties of a substance in mind for the health risk assessment. For example: is it acutely toxic, in other words, is it poisonous when inhaled, when it comes into contact with the skin or is ingested with food? Can it trigger allergic reactions or does it irritate the skin or eyes? And then there are the

long-term effects: is the substance carcinogenic, does it affect genes or impair fertility? These are questions that are crucial in the assessment. In contrast, independent studies often focus on fundamental scientific questions, like how a substance affects certain proteins in a cell culture. Of course, it is scientifically interesting to explore these issues, but it is difficult or currently even impossible to use such studies for a health risk assessment. There is also the fact that some of these studies use methods that are new and not yet sufficiently scientifically established.

What about the quality of independent studies?

Sometimes there are problems here, such as missing or inadequate information about the substances that were actually tested or the methods used. Or an insufficient number of laboratory animals, which may result in the statistical validity of the study being too low. These kinds of deficiencies do not mean that we ignore the study, but we must take weaknesses and uncertainties into account when weighing the results.

One accusation is that industry studies are not objective and only serve their interests.

Internationally standardised methods are used to ensure that industry studies are also objective. In addition, GLP standards have been developed. “GLP” stands for “good laboratory practice”. GLP is required by law, e.g. for the safety assessment of plant protection products and other substances subject to authorisation, such as medicinal products.

What does that mean specifically?

Laboratories that work according to GLP standards are monitored. There is an obligation to document experiments and experimental protocols must be



defined from the start. Changes must be documented precisely. The data in the study reports must be noted in detail and in the case of animal experiments, the results of each individual mouse or rat must be disclosed. This allows us to see whether studies are conclusive.

What does that mean?

We do not always come to the same conclusion as the authors of the study report. We recently had a case where a carcinogenicity study was submitted for an active substance, in other words, whether a substance can cause cancer. This was negated. We re-evaluated the data and concluded that, on the contrary, certain carcinogenic effects were present. This result was of course included in our assessment.

For some time now, there have been discussions about the fact that study results cannot be reproduced by other laboratories. Has this reproducibility crisis in safety assessments reached plant protection products?

Of course, we are experiencing this too. This can even lead to a study being excluded from the weight of evidence analysis, in which the limitations of a study are weighted, and exclusion from our assessment.

How often does the problem occur?

They are isolated cases, fortunately. There is one important point that I would like to mention: results that are not published. Unfortunately, negative results do not often get published. These are experiments in which an expected effect did not occur. These would be of great interest for getting a good overall picture of the effects caused by a substance. We are interested in a re-think of this.

How can the quality of independent studies be improved?

Good documentation standards are immensely important to us. And there are already criteria for “good scientific practice”, or “GSP”, which form an ideal basis for an assessment. The GSP includes working in a transparent and comprehensible way, e.g. documentation of results and storage of primary data. Many scientific journals now require these kinds of standards of the authors. It is also very useful if the raw data on which a publication is based can be accessed. ■

More information:

Kaltenhäuser, J. et al. 2017. Relevance and reliability of experimental data in human health risk assessment of pesticides. *Regulatory Toxicology and Pharmacology*. 88: 227-237. DOI 10.1016/j.yrtph.2017.06.010



Watch out for the apple?

Many people are afraid of “toxic” plant protection product residues in fruit and vegetables. This is not justified because a comprehensive control and authorisation system ensures food safety.

Red and round, the apple rests in the fruit bowl, its scent tempting you to take a bite. If it wasn't for these headlines running through your head. “Sprayed up to 31 times with pesticides – cancer risk in apples?!”: a major tabloid's headline; an economic journal reports: “90 percent of German apples contaminated with pesticides.” Two of many examples conjuring dangers posed by plant protection products (pesticides) – and that can ruin your appetite for fresh fruit and vegetables. But what is the real health risk?

“Many consumers believe that pesticide residues on or in food are banned no matter what,” says Dr. Britta Michalski, chemist and the BfR's responsible expert on the topic. “But this is not the case, nor is the allegation that traces of these plant protection products are always harmful to health.”

Pesticides protect plants – and harvests

Let us begin with the first assumption: food must be free of pesticides. The first purpose of these chemicals is to protect crops in the field from fungi, insects and other pests. Less well known is the fact that they are also useful for safely transporting and storing the harvest afterwards. “In countries with a warm and humid climate, such as India, 20 to 30 percent of the yield can be lost after the harvest, for example, due to a fungal infestation or insects,” says Michalski's colleague, Michael Herrmann. “Simply put, if you don't protect the harvest, a large part of it will rot – or is only good for animal feed.”

Finding residues of plant protection products and their degradation products in or on food is almost inevitable. “And now more than ever, since high-precision analytical methods can detect even the smallest traces,” explains Michalski. “These kinds of ‘leftovers’ are permitted by law provided that they are kept within limits and do not pose a health risk.”

Permitted residue: what level is allowed?

But where is the limit? This is where the maximum residue level comes into play. This specifies the maximum amount of a pesticide that a food is allowed to contain. The maximum content is specified as a concentration, for example, one milligram (mg) of active substance per kilogramme (kg) of food (1 mg/kg). If the maximum residue level of an active substance is exceeded, the food is no longer marketable. It may not enter the market at all or must be withdrawn from the market.

Maximum residue levels (MRLs) are standardised for the European Union; the process involves experts from the member states and the European Food Safety Authority (EFSA). The BfR also makes proposals for MRLs. The principle for this is that the active substance quantities that a food may contain should be as low as can be reasonably achieved..

MRLs are established based on residue crop field trials. The trials determine how much of an active substance can be found in the edible parts of the plant after



Whether a substance is toxic depends significantly on its dose.

harvesting. These experiments are usually carried out by plant protection products' manufacturers. Only if there are no indications that the residues pose a health risk to consumers, will the BfR propose an MRL.

But what if food controls reveal that the MRL of an active substance has been exceeded – does the contaminated product then have adverse effects for consumers? This brings us to the second widespread assumption: are pesticides not toxic as such, even in the smallest doses?

The dose makes the poison

From a toxicological (toxicology is the science of poisons) perspective, this is not the case. Whether a substance is toxic depends significantly on its dose. This is the “basic law” of toxicology, which can be traced back to the physician Paracelsus. It generally says that even a dangerous substance can barely harm the body if it only enters the organism in extremely small quantities. Conversely, a generally harmless (and vital) substance, such as table salt, can be deadly if taken in excess.

Extensive (and statutory) scientific studies are carried out to determine how hazardous a pesticide is to the human organism. Each active substance is closely examined before being approved in the EU. This involves looking at whether a substance can damage genetic material, cause cancer or impair reproduction. “The active substances in plant protection products are among the most thoroughly examined chemical substances when it comes to health risks,” says Herrmann, an agricultural scientist.

Risk assessment authorities, such as the BfR, “distil” two important toxicological limit values for a substance from the test data. Firstly, there is the acute reference dose or “ARfD” for short. This indicates the quantity of a substance that a person can ingest on one day without any discernible health risk. Therefore, the ARfD is a measure of the short-term (acute) occurring quantity of a substance which does not pose any adverse effect to the body.

Two limit values for risk assessment

The ADI refers to the long-term (chronic) intake of a substance. ADI stands for “acceptable daily intake”. The ADI indicates the amount of a substance that a consumer can ingest every day for a lifetime without any discernible health risk.

The ARfD and the ADI value are the “crash barriers” on which the pesticide risk assessment is based. The risk assessment also takes into account which foods are consumed in this country and in which quantities. Information about this is provided by consumption studies in which the eating habits of consumers for different age groups are identified. “If, for example, it can be predicted that residues of an active substance ingested with apples will exceed the ARfD or the ADI value, use of the plant protection product in question will not be authorised for apples,” explains Michalski.

Food sellers must guarantee compliance with MRLs. The food monitoring authorities of the German federal states (“Laender”) check whether this is the case as part of extensive control programmes (monitoring). Some of the data obtained here are included into an EU-wide monitoring programme, the results of which are published annually. In 2018, more than 90,000 samples were evaluated as part of this programme.

The MRL was exceeded in 4.5 percent of the EU-wide measurements. However, this is not synonymous with a health risk because the MRL is usually well below the toxicological threshold. This is marked by the ARfD and the ADI value. EFSA's report published this year on the monitoring results from 2018 comes to the conclusion that these exceedances are not a cause for concern.

Back to the apple. Headlines such as “pesticide pollution” or even “cancer risk” attract attention, but on closer inspection they turn out to be less conclusive. Therefore, there is no good reason not to enjoy a piece of fruit! ■

More information:
 20th BfR Consumer Protection Forum: “Plant protection products - a cause for concern?” 20/21 April 2021 in Berlin (programme and registration at www.bfr-akademie.de)

Our daily mix of aluminium

Food, water and cooking utensils can contain aluminium. Also certain cosmetics. Are we taking in too much aluminium?

Our body does not need aluminium. If too much enters the body it eventually can have damaging effects on the nervous system, kidneys and bones. This is why the BfR has carried out a risk assessment, estimating for the first time the total aluminium intake of the German population. Among other things, intake from food, cosmetics, cooking utensils and packaging was taken into account.

The current BfR study shows that, depending on dietary habits, teenagers and adults already consume up to 50% of the acceptable healthy amount through food and beverages. Adding on contributions from packaging, cooking utensils and cosmetics, the health-based guidance value can be exceeded.

Mindfulness with aluminium products

Aluminium is soluble in acids, bases or saline solutions. Beverage cans or yoghurt pot lids, for example, are coated on the inside to block aluminium from migrating into especially acidic or salty foods. Otherwise as with some aluminium pans, cooking spoons, grill trays or for take-away meals, aluminium can easily migrate into food, such as tomato sauce, onions, fruit, salted herring or marinades. Certain cosmetics, such as toothpastes claiming a “whitening effect” or antiperspirants, can also contain aluminium compounds and contribute to the overall intake.

Tips for minimisation

Giving up certain food is impractical since aluminium occurs in similar quantities in many foods. The general recommendation here is for diversity and variety. Those wanting to reduce their aluminium intake should use coated aluminium trays, reusable BBQ trays made of stainless steel, for example, and they should avoid aluminium baking trays and aluminium foil for acidic or salty food. The sparing use of Al-based whitening toothpastes can also significantly reduce aluminium intake, as the BfR’s study showed. Aluminium espresso makers are not a problem because a protective layer forms when the coffee is prepared. However, one should not put it into the dishwasher as this destroys the protective layer.



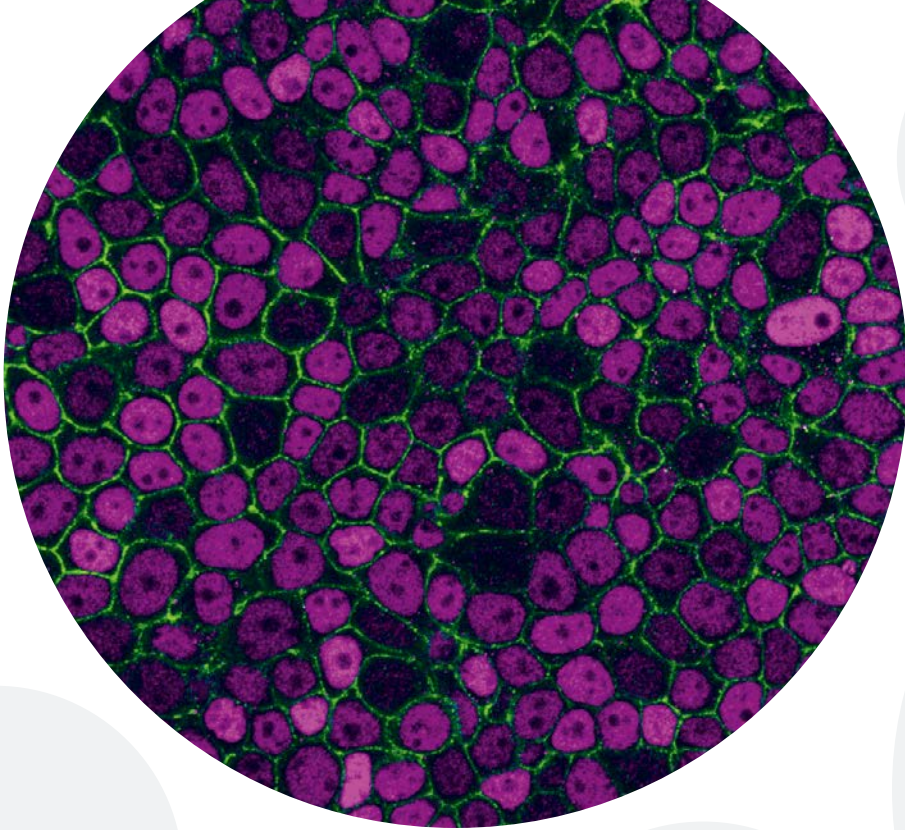
© George Rudy/shutterstock.com

Health risks from using antiperspirants containing aluminium chlorohydrate everyday are unlikely based on current information.

Antiperspirants containing aluminium: health risks are unlikely

But what about when aluminium is absorbed through the skin? New clinical data has prompted the BfR to re-assess the aluminium uptake from antiperspirants via the skin. Based on these data, the uptake is much lower than previously estimated. According to the current state of scientific knowledge, adverse health effects are unlikely if antiperspirants containing aluminium chlorohydrate are used on a daily basis. Their contribution to the total aluminium intake is after evaluating new data significantly less than previously calculated. ■

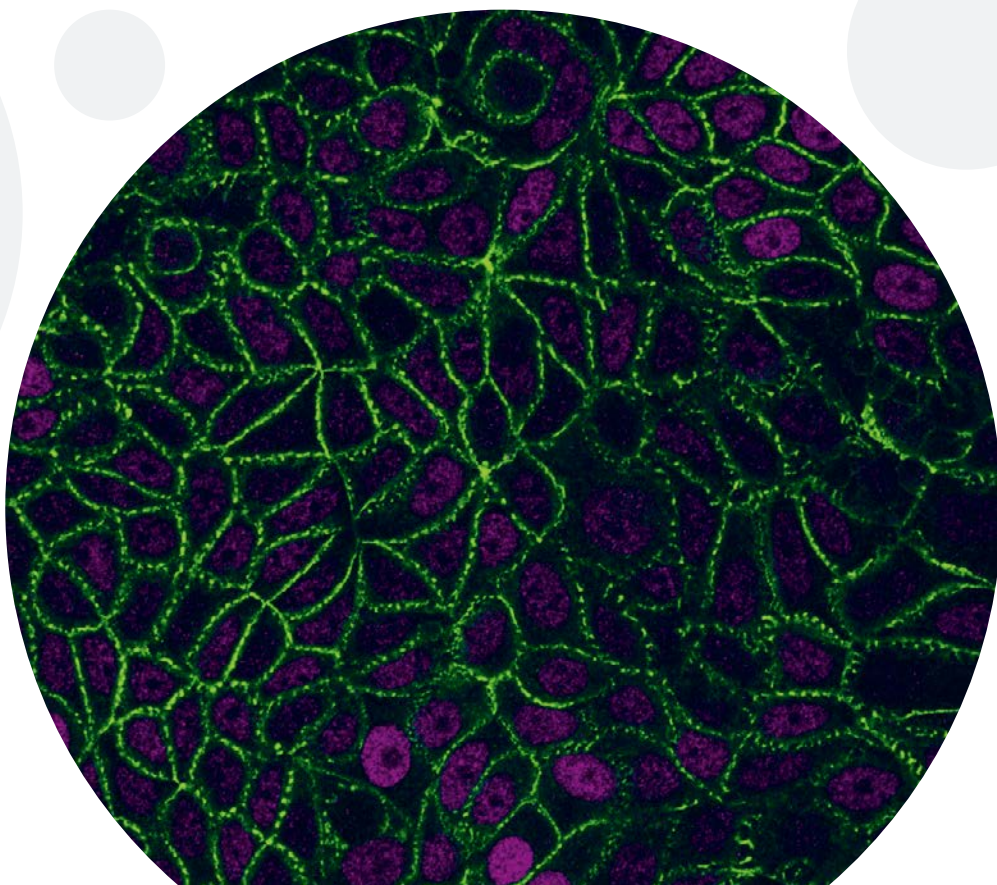
More information:
www.bfr.bund.de/en > A-Z-Index: aluminium



Shining life.
Fluorescent cells
are analyzed using
the “E-Morph” test.

Revealing bubbles

Hormones are essential, actually. But an excess can be harmful. BfR scientist Dr. Sebastian Dunst and his team have developed an animal-free test method that can detect the undesired hormonal effects of chemicals.



If you look closely, you can see them. Tiny honeycombs sandwiched between fine green shimmering lines. “The honeycombs remind me of bubbles in bubble wrap,” says Dr. Sebastian Dunst, describing the microscopic image. We are in the blacked-out microscopy room at the BfR’s German Centre for the Protection of Laboratory Animals in Berlin-Marienfelde. It is crammed with computers and modern, electronically controlled microscopes with which even the smallest details of a cell can be visualised.

A microscopic image is projected onto the screen. The fine green lines are the cell membranes, the outer envelope of human cells. Tightly packed, the cells pave the screen. They combine to form a tissue that is only interrupted by the “air cushions” between the cells. For biologist Dunst and his team, these bubble-like changes in the cell membrane are at the centre of a new test method they have developed, and which they have named “E-Morph”. E-Morph effectively checks whether the cell tissue is holding together tightly or is too loose.

Molecular ropes

To understand the principle of E-Morph, you have to dig a little deeper. The contacts between the cells are mainly mediated by the thread-like protein E-cadherin, which is evenly anchored in each cell’s membranes. Like molecular ropes, the E-cadherin proteins now bind cell envelopes of neighbouring cells tightly together. However, if the cells are brought into contact with certain chemical substances, the E-cadherin ropes change their organisation. The former even distribution turns into clusters, thereby creating those gaps in the cell membranes that appear as “air cushions” or bubbles in the microscopic image.

Surprisingly, this does not weaken the connections between the cells. “As soon as the bubbles form, the cells become more stable and stick to each other much more firmly,” says Dunst, explaining the process. “In the case of cancer cells, this can mean that in this state, the formation of metastases is hampered because the cells can no longer migrate from the tumour tissue.” The tissue, therefore, remains firmly linked.

The E-Morph test looks at how different chemicals or active substances influence cell cohesion and, in doing so, the risk of metastasis (formation of secondary tumours). Primary focus is on the female sex hormone oestrogen and substances that mimic or weaken its effects. Oestrogen makes the tissue “looser”; it can trigger the formation of metastases. Therefore, oestrogen-like substances can increase the risk to develop malignant cancer. Conversely, chemical compounds that suppress oestrogen activity reduce the risk and, for this reason, are also used to treat cancer.



Microscopic images: Dr. Sebastian Dunst and his team at the German Centre for the Protection of Laboratory Animals are investigating changes in the cell membrane.

This sounds theoretical, but it has practical significance. There are a number of man-made or natural substances found in the environment that have a hormone-like activity, sometimes with oestrogen-like effects. For example, in unfavourable cases, these substances can impair fertility or create favourable conditions for diseases such as cancer.

Tested for hormonal effects

In the EU, chemicals and pesticides must, therefore, be tested to see whether they have potentially harmful hormone-like effects. Such substances are known as “endocrine disruptors” in specialist terminology. The E-Morph test can help to detect them.

Dunst’s procedure for detecting the hormonal effects of chemicals is mostly automated. Human breast cancer cells are used. There are two reasons for this: firstly, these cells have typical characteristics of intact mammary gland cells so they are susceptible to the effects of oestrogen. Secondly, unlike healthy, “normal” tissue, cancer cells can be easily grown in the laboratory.

Oestrogen makes cells loose

The cells are initially brought into a state in which they form the characteristic bubbles between the cell membranes with the help of an oestrogen blockade using the cancer drug Fulvestrant. The substance to be tested is then added. Now it is checked whether the cell contacts loosen and the bubbles disappear as they would under the influence of oestrogen. This may suggest that the test substance has a hormone-like effect and increases the risk of tumours.

The robot-assisted test evaluation takes place quickly and facilitates the testing of many substances in a short time. Sebastian Dunst hopes that the procedure will help to use chemicals safely and to identify new substances for cancer treatment. It is no coincidence that the test has been developed at the German Centre for the Protection of Laboratory Animals at the BfR because it is a possible alternative method to the so far mandatory animal experiments for chemical and drug testing. “When we can completely replace these animal experiments is another question,” says Dunst. “We are not yet there.”

Recently, Dunst and his team filed a worldwide patent application for the E-Morph test. “The procedure provides information on how cells and tissues actually change under the influence of hormones or hormone-like substances,” says Dunst. “It therefore provides more realistic conditions than tests that only cover a few individual aspects of hormone activity under more simplified conditions.” E-Morph may be interesting for two applications – firstly, for testing new active substances in medicinal products and secondly, for testing chemicals that are expected to enter the market.

A test for pharmaceuticals and chemicals

So that the patent really becomes effective, it must still be approved separately in each individual country. This is an elaborate process because a separate patent lawyer who has knowledge of the local language and who enforces the patent claims must always be charged with the task. For this reason, it is necessary to choose where the test will be offered. “Countries with a strong chemical or pharmaceutical industry are worth considering first,” explains the scientist. This means countries like the USA, Germany, France or Japan.

Dunst has worked at the BfR for around four years; before that he studied biology in Dresden, where he also did his doctorate. He carried out research on fruit flies and, in doing so, discovered his love for microscopy. What he likes about the BfR is that his work is important for both humans and animals. “It’s not an abstract science, you can really get things moving and make a change”, he says. “It is particularly important for me to work in a team – together we can achieve a lot”. The E-Morph test is just one example of this great collaborative work. ■

More information:

BfR Communication No. 023/2020 of 20 May 2020

BETTER UNDERSTANDING OF CERVICAL CANCER

Cervical cancer is the fourth most common malignant tumour in women worldwide. To better understand the progression of the disease and to test new treatments, junior professor Peter Loskill from Eberhard Karls University of Tübingen is developing “mini organs” using human cells from the cervix. They imitate the disease and its early stages in humans on a “tissue chip” and make it possible to study immune cells that are in contact with the cancer.

BARRIER-FREE? BETTER NOT IN THE BRAIN

The brain is a sensitive organ. It is protected from harmful substances and pathogens by a biological barrier called the blood-brain barrier. Dr. Petra Hundehege and her research group from the University of Münster are investigating the disadvantages of a permeable blood-brain barrier. They develop a computer simulation model to investigate the damage to the blood-brain barrier, as it can occur after a stroke or cranial injury.

FEWER ANIMAL EXPERIMENTS, BETTER RESULTS

Inadequate statistics/biometrics bear the risk of a loss of quality of research results. Furthermore, dubious results might entail unnecessary studies also with regard to animal experiments. Professor Daniel Hofmann's team at the University of Duisburg-Essen wants to remedy this. The group develops the freely accessible software “BASTA”, which stands for “Bayes statistics for animal research”. BASTA ensures a better calculation of animal numbers and an increase in data evaluation, thereby increasing the impact for publication.

ZEBRAFISH PROTECT BRAIN DEVELOPMENT

Harmful substances can impair brain development in the womb. For this reason, chemicals and drugs must be tested to see if they are toxic to the nervous system (neurotoxic). This testing is required by law and is currently carried out on mice and rats. Zebrafish (*Danio rerio*) embryos are a possible alternative to rodents. Dr. Stefan Scholz and his research group from the Helmholtz Centre for Environmental Research in Leipzig are testing whether Zebrafish represents a suitable model organisms to analyse neurotoxicity.

FRESH AIR FOR ASTHMA RESEARCH

Asthma is a chronic inflammation of the airways often caused by allergies. To better understand the onset and progression of this widespread illness, Professor Holger Garn and his team at Philipps-Universität Marburg are developing a "miniature version" of the lung in a Petri dish, called an organoid. Tissue from the respiratory tracts of mice and humans serve as the basis for the organoids.

AGEING UNDER THE MICROSCOPE

Idiopathic pulmonary fibrosis is a chronic disease that usually leads to death after a few years. In the process, the lung is constricted due to a proliferating connective tissue (fibrosis). Premature ageing is probably involved in the occurrence of the disease. At the Helmholtz Zentrum München, Dr. Mareike Lehmann and her research group now develop methods based on microscopic tissue sections from the human lungs. On them the team wants to study premature ageing and the formation of fibrosis to develop a test and to examine substances. This may help to replace stressful animal experiments.

Micro-organ instead of animal experiment

COMBATTING KIDNEY DISEASE WITH THE FRUIT FLY

The kidneys clean the blood. However, too much circulating insulin, the hormone that lowers blood sugar (as in type II diabetes or adult-onset diabetes), can damage the kidneys' filter systems (glomeruli) and facilitate kidney failure. To better understand these processes and prevent kidney failure, Dr. Lucas Kühne and his team at Cologne University Hospital now study the kidney cells of the common fruit fly (*Drosophila melanogaster*). This not only has scientific benefits since the animals are easy to breed and reproduce quickly, it can also help to reduce the number of laboratory animals used thus far, such as mice or rats.

Whether fruit flies, cell culture or software, there are many approaches to reduce conventional experiments on animals. An overview of projects that received funding from the German Centre for the Protection of Laboratory Animals at the BfR in 2019.

EMBRYO 2.0

The embryo grows up hidden from the outside world. This makes it challenging to understand its development in detail. However, Dr. Jesse Veenvliet and his team at the Max Planck Institute for Molecular Genetics in Berlin are convinced that embryonic stem cells from mice can shed more light on the matter. Embryonic stem cells are able to form all kinds of embryonic tissue. Under certain conditions, they can grow into entities that resemble early embryos. Modern research methods will be used to trace the plethora of underlying developmental processes.

Tinkering mice

How clever are rodents? Knowing the answer can also improve the welfare of laboratory animals.

“Honestly, they are not always the brightest,” says Professor Lars Lewejohann, when asked how intelligent mice are. There is some disillusionment involved because Lewejohann has spent a lot of time observing mice. Looking at them solving “lockboxes”. These are little mechanically locked plastic boxes that hide rewards for rodents, such as oat flakes. Many of the small mammals need a certain amount of time to open the locks and reach their goal, as biologist Lewejohann

discovered after many hours of waiting in front of the laboratory animal’s enclosure.

Not all that bright? This assessment may be legitimate from the perspective of Homo sapiens, but it is not fair to the animals, says Lewejohann, limiting his statement. Like us, mice are creatures of evolution. Like us, they have made it to the present day. Their cunning was at least adequate for this. Human intelligence would not



have served them well. The ability to solve differential equations is not very helpful or even cumbersome when fleeing from foxes, snakes and hawks. To survive, mice need an intelligence tailored to their needs.

Intelligence from many perspectives

“Science of Intelligence” is the name of the research network (cluster of excellence) established in 2019. Lewejohann (German Centre for the Protection of Laboratory Animals, BfR) is working with Professor Christa Thöne-Reineke (Freie Universität Berlin) together with their respective teams. The joint project of Berlin’s universities and other research partners aims to help understand the principles of intelligence from many different scientific perspectives. Researchers from very different domains have joined together here: from philosophy to robotics and educational science to biology and psychology.

But what exactly is intelligence? According to a provisional definition by the “Science of Intelligence” research group, an intelligent being is characterised by four properties: it adapts its behaviour to the situation, follows certain rules and acts in a goal-orientated and “economical” way (for instance, it does not waste energy unnecessarily). “This means that an intelligent animal understands, for example, how a lockbox works,” says Lewejohann. “It has understood the principle.”

Learning machines

The extent to which mice are intelligent based on this standard is being investigated by Lewejohann and his team in two projects. Firstly, the animals have to solve lockboxes and are closely observed and filmed while doing so. “Their behavioural patterns can be used as a blueprint for learning machines,” hopes Lewejohann.

A second approach focuses on how social signals – for example, a certain facial expression – influence thinking and action. Mice have mimic muscles and can use them to communicate feelings to their companions, such as joy or frustration when opening a lockbox, therefore influencing their actions. If the mouse’s body language signals disappointment, for example, an observing conspecific may conclude that they should take their paws off the lockbox and, in doing so, save time and energy. “Emotions can help with thinking and make learning easier,” says Lewejohann.

How is the mouse doing?

What does this research have to do with the protection of laboratory animals, to which Lewejohann’s team is dedicated? “A great deal,” says the scientist. For one thing, there are the elaborate observation methods with high-resolution cameras and statistical evaluations of the animals’ behaviour. “Hopefully, we can also figure out if the mouse is doing well or not in this way,” explains Lewejohann.



Professor Paws.
A mouse has “cracked” a lockbox.

Secondly, the tricky lockboxes are an interesting challenge and distraction for the rodents. According to current research, the boxes are an “enrichment” in the everyday life of laboratory animals. This can counteract boredom. “You get the impression that they are excited when they get a new puzzle box”, reports Lewejohann. “It is not – or not only – about the reward in the box; they also have fun playing with the lockbox.”

The aim is, at the end of the “Science of Intelligence” project, to create something new; a piece of intelligent technology based on the research project’s findings. How about a robot mouse? That would be pretty bright. ■

More information:
www.scienceofintelligence.de

INTERNATIONAL NEWS

Iran cooperation on nano-safety research

Together with the Tehran University of Medical Sciences, the BfR is working on intelligent test strategies for the characterisation and health risk assessment of nanomaterials. In doing so, researchers from both institutions are intensifying scientific and technical cooperation between Iran and Germany. The project (“Nano-RiskSD”), funded by the Federal Ministry of Education and Research as a mobility measure, started in September. Guest scientist visits are planned in addition to workshops in Tehran and Berlin.

New EFSA framework partnership agreement

In a second framework agreement over four years, the BfR and the European Food Safety Authority (EFSA) have agreed on six areas of activity for closer cooperation to boost the exchange of methods, tools and databases in order to develop and efficiently use existing scientific findings. The agreement is the basis for specific projects, for example, in food tracing.

“One Health” European partnership

Several committees met at the BfR in October at the halfway point of the “One Health European Joint Programme (EJP)”, which is scheduled to run for five years. The aim was to exchange the results achieved so far and, notably, to consolidate the measures. European institutions from medicine, veterinary medicine and consumer health protection in the food sector cooperate to keep foodborne zoonoses, antibiotic resistances and novel infectious diseases in check.

More information: www.bfr.bund.de/en > Research > Third-party projects: One Health EJP



Cooperation agreement with Japan

The BfR and the Japan Food Research Laboratories (JFRL) concluded a cooperation agreement in spring to work together in the domain of marine biotoxins. The JFRL has been conducting research in this field for decades and is looking into the toxins responsible for ciguatera poisoning, among other things. In addition to exchanging information and guest visits, the work focuses on scientific collaboration for further developing methods and exchanging various samples and reference materials for analysing biotoxins. Studies for validating analytical methods or for comparing chemical and cell biological analytical methods are also planned (see BfR2GO 01/2020).

More information:

BfR press release 26/2019 of 18 July 2019

Better risk assessment of chemicals

The BfR is involved in the further development of regulatory consumer protection for the risk assessment of chemicals in Europe. The planned “Partnership for the Assessment of Risk from

PERSONNEL

The BfR’s Pesticides Safety Department under new management

Dr. Tewes Tralau has been the new Head of the Pesticides Safety Department since 10 August 2020. With a doctorate in biology, he has many years of international research experience in the domains of biochemistry and toxicology of xenobiotics (with stays in the UK, FR, CN) and extensive regulatory expertise in the risk assessment of chemicals. He is providing initial scientific ideas with an increased focus on the effects and assessment of mixtures as well as a junior research group for research into substance-induced toxicological interactions between humans and microbiomes.

INTERNAL

Chemicals – PARC”, part of the EU’s new framework programme “Horizon Europe”, aims to identify gaps in knowledge for risk assessment and identify new hazards. The French Agency for Food, Environmental and Occupational Health & Safety (ANSES) is responsible for coordination and other European authorities from environmental, occupational and consumer protection are involved.

Consolidating consumer protection in Tunisia

The BfR and the Federal Office of Consumer Protection and Food Safety (BVL) are conducting a project to consolidate consumer health protection in Tunisia as part of the German government’s development cooperation. The applicable state structures will be sustainably developed as part of the five-year project, which will start at the beginning of 2021. Focus is on monitoring the implementation of the new Tunisian food safety law, which stipulates the consolidation of official responsibilities, the technical and organisational development of the Tunisian food safety authorities and the development of employees in the sector.

2019 Latin American Symposium: report online

The report from the first Latin American Risk Assessment Symposium (LARAS), which took place in August 2019, is now available online. The report was written by the BfR and the Uruguayan Ministry of Livestock, Agriculture and Fisheries. LARAS aimed to create a new approach to food safety in Latin America based on trust, cooperation, multidisciplinary and the latest scientific knowledge.

More information: www.bfr.bund.de/en > The Institute > Cooperations > International cooperation > Uruguay



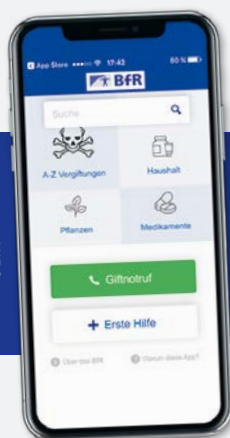
The BfR universe comes to life

Packing complex science and dry politics into clear messages: this is the aim of the new visual communication line that is being created in the Risk Communication Department of the BfR. With the support of Claudio Canales Rios, administrative expert and illustrator for the Chilean Food Safety and Quality Agency (ACHIPIA), figures and mascots representing BfR topics have come to life in the BfR universe. Figures such as the Tuby Brothers, Riskina and Petra Petrischale were already used during Green Week.

BfR commissions 2022–2025: call

As voluntary and independent expert bodies in the domains of food and feed, chemical and product safety, a total of 14 BfR commissions advise the BfR. Interested experts can apply from January 2021 up to and including 31 March 2021 for what is now the fifth period of appointment (term: 1 January 2022–31 December 2025.)

Application platform from January 2021 at: www.bfr.bund.de/en



BfR app “Poisoning accidents among children”

Good to know: In the BfR’s free “Poisoning accidents among children” app, you will find information on preventing poisoning accidents with children and on first aid measures. You can call a poison information centre directly from the app in an emergency.

Download for Android and iOS: www.bfr.bund.de > Press > BfR apps (in German)



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