German Federal Institute for Risk Assessment

Interview

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"The myth of the poisonous apple"

Article by BfR President Professor Andreas Hensel in the magazine "Land", published by Familienbetriebe Land und Forst

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How plant protection products (PPPs) are tested for health risks – and why they are safe when used as intended, despite all the criticism

In the fairy tale “Snow White”, it is the evil stepmother who poisons her stepdaughter using an apple. In modern perception, it is PPP residues that pose a hazard to unsuspecting consumers at the fruit section in the supermarket. Well, I'm exaggerating a little. But only a little. Because recently, people in this country seem to have few fears greater than that of the aforementioned pesticide residues. The "Consumer Monitor" of the German Federal Institute for Risk Assessment (BfR) consistently finds in its surveys that two-thirds of the population are concerned about these residues.

Professor Dr Dr Dr h. c. Andreas Hensel

Veterinarian, microbiologist and hygienist. In 2003, he was appointed President of the German Federal Institute for Risk Assessment (BfR), which had been founded the previous year, from his position as a lecturer at the University of Leipzig. Since then, Hensel has also been the German representative on the Advisory Forum of the European Food Safety Authority (EFSA).

Are these concerns justified? And where do they originate?

"Toxic substance on your plate", "Pesticides: which foods to be wary of", "Hazard in your shopping basket" and "140 dangerous pesticides discovered in food" are common headlines in widely read consumer media.

Given the alarming reports, it is no wonder that some people feel a shiver down their spine.

As a rule, however, something entirely commonplace is behind such news stories . Even when used as intended, it is not unusual for traces of plant protection products (PPP) or their degradation products to be detected in or on fruit and vegetables and other foods. The decisive factor in determining whether a substance is harmful is not whether it is present, but how much of it is present.

The dose makes the poison

The physician Paracelsus recognised this around 500 years ago when he said: The dose makes the poison. This means that a very small dose of a substance that is toxic in itself (such as the atropine contained in belladonna) does not necessarily cause any impairment to health. On the other hand, a high dose of a harmless or even essential substance (such as table salt) can be dangerous. And when the media "discovers" pesticides in food, it is almost always in very small (and therefore harmless) amounts.

What makes you so sure?, some may ask at this point. The reason is that pesticide active substances are comprehensively tested for possible health impairments. Only when these tests do not reveal any impairments is a pesticide active substance approved at EU level. The German Federal Institute for Risk Assessment (BfR) is also involved in this risk assessment.

For the relevant assessment, an applicant must submit, among other things, studies in which the substance has been tested in animal experiments. Based on this information, toxicological guidance values (sometimes also called limit values) are determined for the substance. These indicate the maximum amount of the substance that does not cause any detectable harmful changes in the human body.

Once a substance has been authorised, it can become a component of a plant protection product (PPP). PPPs are commercially available preparations that may contain one or more substances and additives in a mixture. Unlike the EU-wide authorisation of the substance, the authorisation for a PPP is granted at the national level in the country where it is to be marketed or used.

The BfR conducts an assessment of plant protection products in terms of human and animal health, the prevention of damage to health as a result of soil contamination, and methods of analysis for residues. All potentially affected groups of people are taken into account: consumers, users, workers, residents and bystanders (such as ramblers). The substance in connection with the proposed use of the PPP is thoroughly examined once again for authorisation. It is not authorised across the board, but only for use on a specific crop, such as apples, grapes or tomatoes.

Maximum residue level (MRL): what is still allowed

It must be ensured that residues of active substances in or on foodstuffs cannot harm health, either through daily intake over a lifetime or through the consumption of large quantities of food on a single occasion. To this end, the BfR carries out a comprehensive

health risk assessment of PPPs as part of the authorisation process and, on this basis, draws up proposals for maximum residue levels (MRLs). These are the maximum permitted concentrations of pesticide active substances and their degradation products that may remain in food. Compliance with a maximum residue level (MRL) determines whether a food product is marketable or must be withdrawn from the market.

How does the BfR determine a maximum residue level (MRL)? Two factors are taken into account: Firstly, the aforementioned guidance values for the intake of the pesticide active substance in the plant protection product. An important example of this is the ADI. This stands for "Acceptable Daily Intake". The ADI refers to the amount of a substance that a person can ingest daily throughout their lifetime without any discernible health risk. The acute reference dose (ARfD) is also significant. This is the amount of a substance that a person can ingest with food over the course of a day without any discernible health risk.

On the other hand, it is important to consider the amount of a substance that a consumer ingests via food. This amount is referred to as "exposure". After all, it makes a big difference whether a food is frequently eaten, such as tomatoes or potatoes, or more rarely, such as Brussels sprouts or peas. Consumption studies provide information about consumption in Germany.

As much as necessary, as little as possible

Consumer exposure is determined from the amount of food normally consumed and the level of residues in the food. The latter can be determined from studies in which PPPs were used under realistic conditions. When determining the dosage of a substance and its maximum residue level (MRL) in the product, the ALARA principle ("As Low As Reasonably Achievable") applies. A substance must be effective, of course, but at the same time it must not cause any impairment to health.

To summarise briefly once more: the BfR only authorises the use of a plant protection product if the residues that may remain on food after intended use are harmless to health and if suitable analytical methods exist to monitor the residues. Ultimately, this is the main reason why, despite so much worrying news, we can still bite heartily into an apple.

Hazard or risk: the subtle difference

At this point, it makes sense to discuss the difference between the terms "hazard" and "risk". In everyday language, both words are used synonymously. However, in toxicology – the science of toxic substances – they have different meanings. Hazard refers to the (theoretical) possibility that something could cause harm. Risk, on the other hand, refers to the (practical) probability that this will actually happen.

Example: A tiger is dangerous, no question about it. That is an inherent property. But it only becomes a real threat and thus a risk when it is running around freely. Only then will the media report on it. A tiger in a cage, on the other hand, is of no interest to anyone, no matter how loudly it roars. The same applies to the dose of a substance, as already mentioned. The dose determines whether something is a toxic substance, whether there is a real risk. A high dose is synonymous with high exposure. Many high-profile publications and press reports fail to take this connection into account. They report on pesticides "in the shopping basket" – and fail to mention the all-important dose. The focus is always on the hazard, not the risk.

The glyphosate controversy

You may remember the heated debate surrounding the herbicide glyphosate. Here, too, the focus was on "hazard" and "risk". At the centre of the debate was the classification of glyphosate as "probably carcinogenic to humans" by the International Agency for Research on Cancer (IARC) in March 2015. This classification was primarily based on the fact that the IARC only classifies hazards. Such an assessment (which is controversial in the case of glyphosate) identifies the property of a substance that can cause cancer. However, the IARC classification does not take into account the probability of cancer actually being caused, as this depends on the amount ingested. It should also be noted that the European Chemicals Agency (ECHA) has already twice deemed it unnecessary to classify glyphosate as carcinogenic.

In contrast, the BfR carries out a risk-based assessment in the approval process for pesticide substances. In addition to the hazard-based analysis of a substance, this assessment also takes into account the estimated intake of the substance. It uses this information to determine the risk of developing cancer. After reviewing its assessment of the health risk, the BfR concluded that, based on current knowledge, it is not possible to derive a carcinogenic risk to humans when glyphosate is used as intended. All assessment authorities worldwide that had access to the original data reached the same conclusion. In a word: The gap between hazard and risk can be very large.

So why are so many people still concerned? I think there are several factors to consider here. On the one hand, there is an instinctive fear of poisoning that is inherent in all of us. The idea of ingesting a toxic substance through an apple is, of course, alarming. The fact that our food is safer today than ever before does little to alleviate this fear. Fear is a powerful emotion that, in cases of doubt, is stronger than reason. This is especially true when combined with mistrust of the "agricultural industry".

The myth of benevolent nature

"Agricultural industry" is a good keyword. The term is often associated with a deep-rooted suspicion of modern, technology-based agriculture with its machines, the use of artificial fertilisers and pesticides, and the apparent "sterility" of the fields. This human-made and human-controlled world is contrasted with untouched nature, which is wild and primitive. I call this the myth of "benevolent nature". It is a cliché that is widely used in advertising. It revels in romantic images of an idyllic country life. Understandable, but far removed from reality.

It is a conceptual framework that is full of contrasts. "Nature" and "humanity" collide. "Organic" crosses swords with "chemical", the "natural" with the "artificial", the "pure" with the "impure", the "healthy" with the "harmful", the "soulful" with the "mechanical". Of course, on closer inspection, these are only apparent contradictions. After all, humans are part of nature, all life is also chemistry, and Mother Nature brews the strongest toxic substances, so she can certainly make us sick.

The apple essence

The fact that such a "divided" view of things is nevertheless very influential is due to what psychologists call "essentialism". This is the tendency of humans to assign a specific, unchanging "essence" to everything. In the case of "natural" objects such as an organically

grown apple, this essence is pure, authentic and unspoiled. If the apple has been sprayed with "chemicals", however, its aura is impure, suspicious and of inferior quality. It does not matter that both apples are probably identical in every detail in terms of their substance. Their essence distinguishes them, and this even has a moral undertone – innocent nature encounters "spoilt" civilisation shaped by humans. The cards of "good" and "evil" are clearly distributed.

The real world is not as black and white as these attributions suggest. One of the BfR's key tasks is to inform the public about health risks. In doing so, we strive to paint a nuanced picture. A picture that is more grey – or colourful – than black and white. And we do not hide where this picture still has gaps – as it must, because science never comes to an end. The great interest of many citizens and the media in our work suggests that fact-based education is more important than ever. Let us enjoy the apple from the tree of knowledge!

About the BfR

The German Federal Institute for Risk Assessment (BfR) is a scientifically independent institution within the portfolio of the German Federal Ministry of Agriculture, Food and Regional Identity (BMLEH). It protects people's health preventively in the fields of public health and veterinary public health. The BfR provides advice to the Federal Government as well as the Federal States ('Laender') on questions related to food, feed, chemical and product safety. The BfR conducts its own research on topics closely related to its assessment tasks.

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