

# Natural defences

Representative surveys sometimes show a high level of public concern about health risks from man-made chemicals in food. Nature's kitchen of poisons is often overlooked.

**T**here it is – ragwort. It appears innocent and inconspicuous with its green leaves, yellow flowers and slender stem rising no more than a metre from the ground. If a predator were to pass by in search of food, the plant would appear to have nothing to offer at first glance. No thorns or optical tricks to confuse or command respect. Yet ragwort is greatly feared by farmers because it can kill adult horses and cattle if they eat it in the field or if it is fed to them in their troughs in the form of contaminated feed. This is because

of the pyrrolizidine alkaloids it produces, which can damage the liver and cause cancer, even in humans. But more on that later.

## **SMALL BUT MIGHTY**

Welcome to the vast maze of “secondary plant ingredients”. These are all substances that plants produce but do not need for their own nutrition. Yet they are essential for their survival. On the one hand, plants have to use attractants and messenger substances or bright signal colours





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The plant kingdom offers a huge repertoire of substances, many of which are used by humans.

to invite insects to visit, take their pollen and spread it. On the other hand, they have to defend themselves against various attackers with bitter substances or poisons. This can only be done on the spot because of their roots, so they have to come from the plants themselves. A wide variety of substances have developed in the course of evolution. Science provides insights into this exciting world.

#### **HARD TO KEEP TRACK OF VARIETY**

The plant kingdom offers a huge repertoire of substances, many of which are used by humans. They are said to improve circulation and metabolism, for example, or act as antioxidants to neutralise free radicals in our cells.

Nutritional science also generally refers to health-promoting properties – a varied, predominantly plant-based diet is recommended. This is easy today, given the abundance of plant-based foods from many regions of a globalised world.

Whether jackfruit from India or avocados from Peru, everything is always within reach simply by visiting the local supermarket or through home delivery with just a few clicks. However, considering this great diversity, only very few substances from the global plant kingdom can be comprehensively studied for their health risks. It is often helpful to know whether a particular food has been used as a safe food in a third country. For example, the European Novel Food

**New trends, often fuelled by social media, can lead to health problems.**



Ragwort: can cost the lives of adult cattle and horses.

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Regulation requires that foreign foods have been used in at least one third country for at least 25 years as part of the customary diet of a significant number of people (more on the toxicological assessment of plant ingredients in the interview with Dr Benjamin Sachse on page 14).

**INTOX INSTEAD OF DETOX**

Some nutrition trends are not always covered by experience and research, for example, smoothies. Depending on the recipe, they contribute to a healthy nutrient supply with vitamins, minerals and fibre. However, new trends, often fuelled by social media, can lead to health problems. For example, when unusual plant parts, such as leaves, stems, peel, or seeds, end up in the blender along with the traditionally consumed plant parts. The plant ingredients are not homogenously distributed





within it; concentrations can differ significantly; for example, while apricot and plum flesh can be enjoyed without any worry, the seeds contain cyanogenic glycosides that release highly toxic prussic acid in the digestive tract and can even lead to fatal poisoning in larger quantities.

Concentrated intake of a substance in a quantity that is usually not reached through normal consumption can also be problematic. Certain plant extracts that can be used in food supplements, among other things, are an example of this. Food supplements are legally considered to be food and as such do not require approval, even if they sometimes look similar or exactly the same as medicines. In contrast to food supplements, medicines have to go through an extensive approval

procedure before they can be used. A reliable health risk assessment is not easy if a food supplement contains highly concentrated extracts of plant ingredients: do they interact with each other or with certain medicines? Is even short-term intake a health risk or only long-term consumption? Delayed effects are often difficult to detect and there are usually large gaps in the data. One example is quercetin, a plant pigment widely found in fruits and vegetables. People consume only a few milligrams per day as part of a normal diet. However, quercetin is also used as an ingredient in food supplements, where the amount consumed can be several grams per day, depending on the preparation. Whether this really supports the immune system, as advertised, or rather has a negative impact on the body, is still largely

## BfR-survey: Plant ingredients



Online survey of 1,012 people in Germany, survey period: 7-11 August 2023

**8 %**

rate their awareness of naturally occurring plant poisons in food as (very) good. 37 % answered "neutral/neither nor", while the majority (53 %) feel (very) poorly informed.

**4 %**

have heard of pyrrolizidine alkaloids, but most are completely unaware of the substances, which can damage the liver and are carcinogenic.

**25 %**

have never heard of plant toxins. Another quarter of respondents had, but did not know what it meant. 47 % were familiar with the term and meaning.

## However, toxic ingredients can also sometimes be useful for plants, humans and animals.

open, as is the case with most substances of this kind.

### WHAT THE POPULATION KNOWS

What do people in Germany know about these kinds of substances? This is what the German Federal Institute for Risk Assessment (BfR) has investigated. A representative population survey paints a clear picture. Only a fraction of consumers in Germany feels well informed about plant toxins. The results were scarcely better when it came to awareness of individual substances. With the exception of morphine and opiates, which were known to 61 % of the participants – which possibly also has something to do with their prominent role in the field of medicines and narcotics – the majority of respondents said they had

not heard of any of the substances mentioned. Coumarin, which is found in cinnamon, solanine, which is found in potatoes, and oxalates, which are found in spinach are relatively well known. The least known substances, including phasin, which is found in raw beans, were in the single-digit percentage range and are thus practically unknown to the population. Overall, only slightly more than a quarter of respondents said they were “(very) concerned” about natural plant poisons. The widespread unfamiliarity does not cause as much concern about health risks here as it does with other, often well-researched food safety topics, such as plant protection product residues.

### BAD FOR HUMANS, GOOD FOR LLAMAS

However, toxic ingredients can also sometimes be useful for plants, humans or animals. The quinolizidine alkaloids produced by lupins can cause poisoning symptoms in humans, but they provide a good service to Bolivian llama breeders. They place the lupins in water containers in the sun so that the quinolizidine alkaloids they contain are transferred into the water. A few hours later, the natural shampoo with insect repellent for the llamas' fur is ready. It seems that there really is a herb for everything – you just need to know how to use it. —

#### More information



BfR information  
“Plant ingredients”



# “Natural substances are often more ruthless than artificial ones”

Dr Benjamin Sachse assesses at the BfR the health risks that can be posed by plant ingredients. He puts the topic into context in this BfR2GO interview.

**Mr Sachse, artificially produced or naturally occurring – as a scientist, do you differentiate between the two when it comes to secondary plant ingredients?**

As a toxicologist, I look at the toxicity of a substance and whether it might cause harmful effects. And natural substances are often even more “ruthless” than artificially produced ones.

**Many substances that we often consume and perceive as very positive come from the plant world. Manufacturers also like to use them in their advertising. Is this okay or should we be more sceptical?**

Not all substances that plants produce as a defence against animals or pathogens are harmful to humans. Many secondary plant ingredients are beneficial to us. Think of the bitter substances and essential oils found in spices, which are an integral part of our diet and stimulate appetite and digestion, for example.

However, we need to look at each substance individually – sometimes it is just the dose that makes the difference to health. For example, coumarin in certain types of cinnamon is harmful to the liver in high doses and may only occur in food to a limited extent.

**Since you just brought it up: it is not just artificially produced chemicals that are subject to regulations and limits. What about natural plant substances?**

In the EU, there are now legal limits for some harmful plant ingredients. In Germany and Europe, compliance with these limits is controlled not only by the monitoring authorities but also by the manufacturers. You can see this when products are recalled, for example, when increased levels of certain alkaloids are given as the reason. However, with the huge variety of naturally occurring substances, you have to rely on the history of consumption of the foods, since it is impossible to analyse every single substance.

### **History of consumption – what exactly does that mean?**

This is the wealth of experience regarding the consumption of a food. If no adverse health effects are apparent in this context over a long period of time, this is referred to as a “safe history of consumption”. The situation is different for plants that are known in other parts of the world but are still considered new to us here in Europe. To avoid any unpleasant surprises, anything that was not consumed to a significant extent in the EU before 1997 must undergo a type of authorisation procedure with risk assessment as a “novel food” before being placed on the market.

### **Are there any trends that stand out to you?**

Our work focused on pyrrolizidine alkaloids for a long time. It has now been possible to reduce their concentrations in many foods and there are maximum levels for various foods. This is also a credit to the BfR. In our opinion, it is critical that high-dose plant extracts are increasingly available, but not much is actually known about their health effects and it is therefore difficult to assess whether they pose a risk. It is also interesting that the public perception of the risk posed by natural toxins is not particularly high and that many plant toxins are largely unknown. One example is phasin, which is found in raw beans: beans should not be eaten raw, they should be cooked for a sufficiently long time to avoid poisoning. Phasin glues red blood cells together. Above a certain dose, consumption can lead to gastrointestinal problems with vomiting and diarrhoea and, in extreme cases, death if large quantities are consumed.

### **What can consumers do?**

When it comes to nutrition, the BfR generally recommends variety and diversity. This avoids one-sided exposure to potentially harmful substances, the presence of which must always be expected. A varied diet also ensures a complete supply of various nutrients. —



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**“Sometimes only  
the dose makes the  
difference to health.”**

**DR BENJAMIN SACHSE,  
BFR TOXICOLOGIST**