

## Chemical analysis and toxicity of pyrrolizidine alkaloids and assessment of the health risks posed by their occurrence in honey

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Pyrrolizidine alkaloids (PA) are secondary plant metabolites. Due to their potentially harmful effects on health they are undesirable in food and feed. In certain types of honey in particular, increased levels of pyrrolizidine alkaloids can occur in dependence of the product's origin. In the opinion of the BfR, efforts are required to reduce these levels. In addition, it is recommended that suitable measures are taken to avoid the intake of PA through food supplements, e.g. products that contain pollen of PA-containing plants. On the occasion of the contamination of a salad mix by blossoms and leaves of common groundsel (*Senecio vulgaris* L.), the BfR already recommended that special care be taken when harvesting and preparing lettuce, leafy vegetables and herbs.

Chemically speaking, pyrrolizidine alkaloids (PA) are esters consisting of a 1-hydroxymethyl-pyrrolizidine (necine base) and aliphatic mono or dicarbon acids (necic acids). Depending on the esterification of one or both hydroxyl groups, pyrrolizidine alkaloids may be present in the form of monoesters or diesters. In total, more than 500 different pyrrolizidine alkaloids and their N-oxides are known which in turn can be contained in roughly 6,000 plant species. These notably include plants of the family of the daisy family (*Asteraceae*), the borage family (*Boraginaceae*) and legumes (*Fabaceae* or *Leguminosae*). Given the large variety of individual substances, the available data on the toxicology, oral bioavailability and on the presence of pyrrolizidine alkaloids in food and feed must be seen as patchy. What is known, however, is that pyrrolizidine alkaloids have a detrimental effect in the liver in both humans and animals. They typically trigger a liver veno occlusive disease (VOD). However, experiments with animals also found pyrrolizidine alkaloids to be carcinogenic.

On the basis of the existing data, the Federal Institute for Risk Assessment (BfR) has conducted a provisional assessment of the health risk posed by pyrrolizidine alkaloids in food and especially honey. The study took into account both the acute and chronic toxic effects. Taking into consideration all currently available data, the BfR comes to the conclusion that the overall exposure of the consumer to 1,2-unsaturated pyrrolizidine alkaloids with genotoxic and carcinogenic properties found in different foods is to be kept as low as possible. A daily intake of 0.007 micrograms ( $\mu\text{g}$ )<sup>1</sup> of unsaturated pyrrolizidine alkaloids per kilogram of bodyweight should possibly not be exceeded.

The full version of this BfR Opinion is available in German on <http://www.bfr.bund.de/cm/343/analytik-und-toxizitaet-von-pyrrolizidinalkaloiden.pdf>

<sup>1</sup> 1 microgram ( $\mu\text{g}$ ) is one millionth of a gram, i.e.  $10^{-6}$  grams