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Food Analysis at the Highest Level.

Per- and polyfluorinated alkyl compounds (PFAS) - hazards, risks and new limits

WHAT ARE PFAS?

Per- and polyfluorinated alkyl compounds (PFAS), which include PFOS (perfluorooctanesulfonic acid) and PFOA (perfluorooctanoic acid) are industrial chemicals that have been used for decades in the manufacture of a wide variety of products: It is used to make products repellent to grease, water, and dirt, but is also resistant to very high temperatures. You find it in coatings on textiles such as outdoor clothing, as waterproofing, in the non-stick coating of pans (Teflon) in ski waxes or fire extinguishers.

PFASs are resistant to environmental degradation and now are widespread throughout the environment. They can accumulate in living organisms and are often poisonous. Due to their production and usage they are also detectable in the food chain and in humans. PFAS are on the list of substances of very high concern and are linked to hormone imbalance, increased risk of cancer, and a weakened immune system.¹

PFAS CONTAMINATION

Food can be contaminated from the soil and water that are used for growing produce, from the concentrations of these compounds in animals from their feed and water, from food packaging materials that contain PFASs, or from production facilities that contain PFAS during processing.

Ironically, the urge to use less plastic results in using more food packaging made of cardboard, paper, and pressed plant fibers that are sometimes full of PFASs. These substances ensure that the "natural" packaging becomes water and grease repellent. This packaging is therefore biodegradable, but also carries a ticking PFAS time bomb.

HEALTH EFFECTS

Humans can also ingest PFASs by various means, for example via food, as these substances can most frequently be detected in drinking water, fish, fruit, eggs, and products containing eggs. According to EFSA scientists, children display the highest rates of exposure. PFAS levels in infants can primarily be attributed to exposure during pregnancy and breastfeeding.

According to the experts, the reduced immune response to vaccinations represents the most significant adverse effect on human health, which is to be taken into consideration when determining the tolerable weekly intake.²

BAN OF PFAS

The use of PFOS has been banned in Europe since 2010. Since then PFOA and substances from which PFOA can be released have been banned from use as pure substances in the EU. In mixtures and articles, maximum levels of 0.025 milligrams (mg) per kilogram (kg) or 1 mg per kg (PFOA-releasing substances) have applied since 2020. There are exceptions or longer transition periods for some special uses.

EFSA RISK ASSESMENT

The assessment from the European Food Safety Authority (EFSA) concentrated on these four PFAS subparameters:

- Perfluorooctanoic acid (PFOA)
- Perfluorooctanesulfonic acid (PFOS)
- Perfluorononanoic acid (PFNA)
- Perfluorhexanesulfonic acid (PFHxS)

Based on new research results, EFSA set new standards in 2020, for the sum of PFOS, PFOA, PFNA (perfluorononanoic acid), and PFHxS (perfluorhexanesulfonic acid). The TWI (Tolerable Weekly Intake) is set at 4.4 ng/kg body weight, which corresponds to a TDI (PFOS+PFOA+PFNA+PFHxS TDI) of 0.63 ng/kg body weight.³

This is considerably lower than the values established in 2008⁴ and 2018⁵. The EFSA chose these four PFAS compounds because they represent approximately half of the exposure to PFAS compounds. In addition to these four compounds, we are exposed to many more PFAS substances, so it is not certain yet that these four compounds are the most relevant.

SCICOM ´S ADVICE

In its emergency advice to the FAVV (Federal Agency of the Food Chain)⁶, the Scientific Committee (SciCom)⁷ recently calculated the EAC (Estimated Accepted Concentration) for various foodstuffs. The calculations were based on the TDI set by EFSA in 2020.

Table 1. EAC's calculated by SciCom

Food category	EAC (sum of PFOS, PFOA, PFNA, PFHxS) in ng/kg
Meat	70
Milk	20
Eggs	200
Fish	150
Vegetables	40
Food rich in starch, e.g. (sweet) potatoes	80

CHEMISTRY AND SYNTHESIS

PFASs (R-X) are substances consisting of a hydrophobic alkyl chain, R, of varying length (typically C4–C16) and a hydrophilic end group, X. The hydrophobic part may be fully [R=F(CF₂)_n-] or partially fluorinated. When fully fluorinated, the molecules are also called perfluoroalkyl substances. Their general structure is given in the following figure.

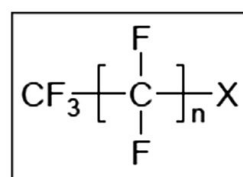


Figure 1

GENERAL STRUCTURE OF PFASs

The hydrophilic end group can be neutral, or positively or negatively charged. The resulting substances are non-ionic, cationic or anionic surface-active agents due to their amphiphilic character. Examples of substances with anionic end groups are the perfluoroalkane sulfonic acids (PFASs), which include PFOS, and the perfluoroalkyl carboxylic acids (PFCAs), which include PFOA. In cationic PFASs, the fluorinated hydrophobic part is attached to e.g. a quaternary ammonium group. Examples of neutral end groups X are: -OH, -SO₃NH₂ and include among others the fluoroteleomer alcohols (FTOHs) and perfluoroalkane sulfonamides (FASAs). Due to the strong covalent C-F bond, perfluoroalkyl substances are highly persistent.

OUTLOOK

Many issues surrounding the PFAS family have not been fully clarified yet, but one thing is sure: too much of it ends up in our bodies and this puts our health and that of our offspring at risk. More research will be done and regulations will inevitably get tighter. The EU will be in the lead, setting out the policies.

Companies in the food, packaging, and construction industry will have to watch developments closely and prepare to incorporate strict regulations into their quality systems. Tighter regulations may sometimes be difficult for companies, but they can also provide clarity by setting coherent frameworks.

PFAS ANALYSIS AT THE GBA GROUP

As part of the European Green Deal, maximum levels for Poly- and perfluoroalkyl substances (PFAS) are going to be adopted into the Regulation (EC) No 1881/2006 for certain foods, according to the proposal SANTE 11183-2018 Rev.0. PFASs exhibit toxic properties and are suspected carcinogens. That is why it is extremely important to test for them in food products.

PFAS analysis is an **accredited routine parameter of the GBA Group**, and we have developed our own method for it here. With our HPLC-MS/MS method, we can achieve a very low LOQ of 0.1 µg/kg. Our broad accreditation includes validated matrices such as meat, fish, eggs, vegetables, and milk. We will also gladly validate other matrices for you upon request.

Laboratories face the challenge of further refining their analytical methods and lowering their LOQs.

SOURCES

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ABOUT US

GBA Group is an international life science service company with a broad range of analytical, logistical and specialist services in the fields of pharmaceuticals, medical products, cosmetics, chemicals, food, drinking water and the environmental sustainability.

The range of services offered by the GBA Group includes laboratory analytics, data management, special logistical services for clinical trials, as well as consulting services for private companies and public institutions in connection with their activities in the fields of research, product development, market development, and consumer protection.

Through its work, the GBA Group makes a sustainable contribution to public health, the environment and society as a whole.

The GBA Group operates sites in Austria, Belgium, Finland, France, Germany, Poland, Spain, and the United States.

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