

2 August 2024

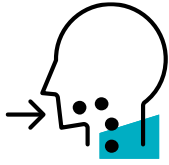
## **The consumption of wild boar liver contributes to a high intake of PFAS**

### **In brief**

- Per- and polyfluoroalkyl substances (PFAS) are widespread and very persistent industrial chemicals that are distributed in the environment. The substances also enter the human body via food, among other things.
- The European Food Safety Authority (EFSA) has derived a value of 4.4 nanograms (ng) per kilogram (kg) of body weight (bw) as the tolerable weekly intake (TWI) for the sum of four PFAS. The value applies to the sum of the following four compounds: Perfluorooctane sulfonic acid (PFOS), perfluorooctanoic acid (PFOA), perfluorononanoic acid (PFNA) and perfluorohexane sulfonic acid (PFHxS).
- In this opinion, the German Federal Institute for Risk Assessment (BfR) has assessed possible health risks from the intake of PFAS through the consumption of wild boar liver. The background for the opinion was data from Schleswig-Holstein: all of the twelve wild boar liver samples analysed there exceeded the applicable EU maximum levels for PFOS or the sum of the four PFAS.
- In its risk assessment, the BfR concludes that the estimated long-term exposure based on the reported PFAS concentrations in wild boar liver (mean value, consumption of one portion once a year) leads to the TWI being exceeded. Accordingly, people who eat wild boar liver with a concentration at the reported level (mean value) have a medium likelihood of impairments to health.
- In the assessment of possible health consequences, it must be taken into account that consumers ingest PFAS through a variety of foods. Compared to the total long-term exposure to the sum of the four PFAS through the consumption of foodstuffs as a whole, the consumption of one portion of wild boar liver per year already contributes significantly to the intake of PFAS.
- The BfR recommends continuing efforts to reduce PFAS levels in food. The use of PFOS has been largely banned since 2006 and that of PFOA since July 2020. Since the beginning of 2023, work has been underway at EU level on a proposal for a differentiated restriction on the use of the PFAS group. The underlying technical

dossier was submitted by the competent authorities from five countries, including Germany..

#### How do PFAS from wild boar liver enter the body?



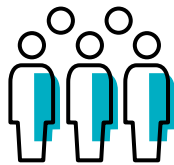
The intake of PFAS occurs orally through the consumption of wild boar liver.

#### Is there a health-based guidance value?



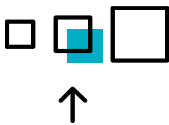
The European Food Safety Authority (EFSA) has set a tolerable weekly intake (TWI) of 4.4 nanograms (ng) per kilogram (kg) of body weight (bw) for the sum of four PFAS. Health impairments are not to be expected if this amount is complied with.

#### Is there a health risk?



According to the present estimate of long-term exposure to the sum of the four PFAS, there is a medium likelihood of impairments to health for **people who eat wild boar liver** once a year with a concentration at the reported level (mean value).

#### How high quality is the data?



The quality of the data is **medium**. There is a lack of reliable consumption data on wild boar liver and there are also uncertainties regarding the total amount of PFAS ingested by humans via food (exposure). The available data on concentrations in wild boar liver from Schleswig-Holstein may not be transmissible to the whole of Germany.

#### How can the health risk from PFAS in food be reduced?



**The state** can use regulations and laws to help reduce the entry of PFAS chemicals into the environment and thus into the food chain and/or limit their occurrence in food on the market. On 1 January 2023, EU maximum levels (Regulation (EU) 2023/915) came into force for PFAS in certain foods, including game offal. Some PFAS are already banned, such as PFOS and PFOA. A technical dossier for an EU-wide differentiated restriction of substances in the PFAS group was published last year, prepared by the authorities from five European countries.



Consumers can hardly control their exposure through food, as PFAS are widespread in the environment and the food chain.

## 1 Subject of the assessment

The German Federal Institute for Risk Assessment (BfR) has carried out a health risk assessment regarding concentrations of per- and polyfluoroalkyl substances (PFAS) in wild boar liver from Schleswig-Holstein. The background to this is data on concentrations collected by the Ministry of Agriculture, Rural Areas, Europe and Consumer Protection (MLLEV) in Kiel on perfluorooctane sulfonic acid (PFOS), perfluorooctanoic acid (PFOA), perfluorononanoic acid (PFNA) and perfluorohexane sulfonic acid (PFHxS) as well as the sum of these four PFAS in wild boar liver. Maximum levels for PFOS and the sum of the four PFAS were found to be exceeded in 12 out of 12 samples. In order to be able to assess a possible health risk to consumers from the consumption of wild boar liver (especially among self-caterers), the BfR assessed the data with regard to possible health risks.

## 2 Result

The BfR has carried out an Exposure assessment for the sum of the four PFAS (PFOS, PFOA, PFNA and PFHxS) through the consumption of wild boar liver based on the analytical data from Schleswig-Holstein.

The concentrations measured in Schleswig-Holstein are in the same order of magnitude as concentrations in previous studies in Germany for wild boar liver. Among the PFAS analysed, PFOS contributes the largest share to the exposure to PFAS from the consumption of wild boar liver. The TWI of 4.4 ng/kg body weight (bw) per week for the sum of the four PFAS (EFSA 2020) was used to categorise the exposure. Due to the long half-lives of the four PFAS included in the TWI in the human body, a single consumption of a 125 g portion of wild boar liver containing PFAS at the reported level per year can result in long-term exposure in the range of the TWI of 3.6 ng/kg bw per week (minimum concentration) or above that of 16.2 ng/kg bw per week (mean concentration).

With regard to the health risk assessment of the long-term intake of PFAS, it must be taken into account that PFAS are also ingested through a variety of other foods besides wild boar liver.

According to the BfR's exposure assessment, the long-term total exposure to the sum of the four PFAS through consumption of food as a whole (excluding drinking water) for adults in Germany at mean concentrations is in the range of the TWI (median of consumption) or corresponds to about two to five times (mean or 95th percentile of consumption) the level of the TWI (BfR 2021). The estimate of the total exposure to PFAS is associated with large

uncertainties. The present exposure assessment confirms that the consumption of wild boar liver can contribute significantly to exposure to PFAS.

A consideration of the internal exposure shows that already a single consumption of 125 g of wild boar liver with mean concentrations would result in an additional plasma concentration of 5.6 µg/L for the EFSA PFAS sum in a 70 kg person. The TWI corresponds to a plasma value of internal exposure of 6.9 µg/L for the EFSA PFAS sum. Based on the data of the GerES V study of the German Federal Environment Agency (median value approx. 4.2 µg/L for the EFSA PFAS sum of 12-17-year-olds, Duffek et al. 2020), the one-time consumption mentioned would lead to more than a doubling of the plasma concentrations.

According to the present estimate of long-term exposure to the sum of the four PFAS, there is a medium likelihood of impairments to health for consumers of wild boar liver with a concentration at the reported level (mean value).

## 3 Rationale

### 3.1 Risk assessment

#### 3.1.1 Hazard identification and characterisation

For information on the hazard potential of the substance group, please refer to the BfR opinion "PFAS in food: BfR confirms critical exposure to industrial chemicals" from 2021 (BfR 2021).

In its current opinion, EFSA has derived a tolerable weekly intake (TWI) for the sum of the four PFAS of 4.4 ng/kg bw. It was not possible to derive a health-based guidance value for the other PFAS detected in food to date, as the data currently available, particularly on toxicology, was insufficient (EFSA 2020).

#### 3.1.2 Exposure assessment

##### 3.1.2.1 Data basis and methodology

###### *Occurrence data*

The wild boar liver samples from Schleswig-Holstein showed concentrations of between 105 and 1,332 µg/kg for the sum of the four PFAS with a mean value of 472 µg/kg (n=12). For game offal such as wild boar liver, a maximum level for the sum of the four PFAS of 50 µg/kg has applied since 1 January 2023 according to Regulation (EU) 2023/915. This maximum level was clearly exceeded in all twelve samples from Schleswig-Holstein. The current concentrations are in the same range as the concentration data from the monitoring programmes of the German federal states from 2007 - 2020 for PFAS in wild boar liver, which were available to the BfR for its opinion on the occurrence of PFAS in food (2021): With a sample size of 89 samples, the mean value was 381 µg/kg and the 95th percentile was 808 µg/kg (BfR 2021).

###### *Consumption data*

The BfR does not have any reliable consumption data on wild boar liver from the representative consumption studies for the various age groups, which is why an alternative approach is used. The long-term exposure was estimated on the assumption of a single

consumption of a portion size of 125 g per year, whereby the portion size corresponds to an average portion size of various animal livers and kidneys according to the German Food Code and Nutrient Data Base (BLS). A portion size of 250 g can be assumed for high consumers.

In order to verify the assumption of one consumption per year, the results of a telephone survey on rarely consumed foods were used. In this survey, 49.7% of participants stated that they had not consumed liver or kidney from wild boar, roe deer or red deer in the last twelve months. A further 43.4 % stated that they had never eaten these foods. 7.0 % of the respondents consumed these foods once a year or more often (Ehlscheid et al. 2014). In this respect, the assumption that wild boar liver is consumed once a year can be considered realistic for around 7% of the population. However, a higher consumption frequency may exist for special population groups, such as hunter households.

#### 3.1.2.2 Exposure assessment

The exposure was calculated on the basis of the mean concentration as well as on the basis of the minimum concentration of the reported data on PFAS. The body weight of an adult was assumed to be 70 kg.

Under the assumption that an average portion of 125 g is consumed once a year and that this portion is computationally distributed over 52 weeks of the year, the exposure for the sum of the four PFAS is 16.2 ng/kg bw per week at the mean concentration and 3.6 ng/kg bw per week at the minimum concentration. Assuming double the amount per year for high consumers (1x250 g portion or 2x125 g per year), the estimated exposure is 32.4 ng/kg bw per week at the mean concentration and 7.2 ng/kg bw per week at the minimum concentration. Among the PFAS analysed, PFOS contributes the largest share to the exposure to PFAS from the consumption of wild boar liver.

The additional consideration of other contributions, such as the proportion of wild boar liver in sausage products, would further increase the long-term exposure.

#### 3.1.3 Estimation of additional internal exposure

A single consumption of 125 g of wild boar liver with the respective mean concentrations of PFHxS, PFOA, PFOS and PFNA would result in a dose of 0.2, 0.6, 55.4 and 2.6 µg (EFSA PFAS sum 59 µg, of which 94 % PFOS). With the distribution volumes of approx. 125 ml/kg body weight (PFHxS, PFOA, PFNA) and approx. 150 ml/kg body weight (PFOS) determined by the BfR for one person, an additional plasma concentration of 0.02 µg/L (PFHxS), 0.07 µg/L (PFOA), 5.2 µg/L (PFOS) and 0.32 µg/L (PFNA) would be calculated for a person weighing 70 kg. This would result in a value of 5.6 µg/L for the EFSA PFAS sum.

#### 3.1.4 Risk characterisation and conclusion

The TWI of 4.4 ng/kg body weight (bw) per week for the sum of the four PFAS (EFSA 2020) was used to categorise the exposure. This external exposure value corresponds to a plasma value of internal exposure of 6.9 µg/L for the EFSA PFAS sum. It is almost reached with 5.6 µg/L in a 70 kg person after a single consumption of 125 g of wild boar liver with mean concentrations, if this person has never come into contact with PFAS before. Based on the data of the GerES V study of the German Federal Environment Agency (median value approx. 4.2 µg/L for the EFSA PFAS sum of 12-17-year-olds, Duffek et al. 2020), the

aforementioned single consumption would lead to more than a doubling of the plasma concentrations.

Due to the long half-lives of the four PFAS in the human body, there is a long-term internal exposure even after a single intake. If the intake is considered in relation to a single consumption per year, an average portion of 125 g results in a calculated weekly exposure for each of the 52 weeks of the year that is in the range of the TWI (minimum concentration of PFAS in wild boar liver) or exceeds it (mean concentration).

Accordingly, the calculated weekly exposure of high consumers of wild boar liver with a single consumption of a portion size of 250 g per year also exceeds the TWI. Due to the fact that the estimated exposure from a single consumption of wild boar liver alone exceeds the TWI, a more detailed consideration (e.g. consideration of the exposure via products containing wild boar liver) was omitted.

Human exposure to PFAS originates from many different sources of exposure due to the ubiquitous occurrence of PFAS in the environment and their presence in numerous consumer products. In the health risk assessment of the long-term intake of PFAS, it must be taken into account that PFAS are ingested through a variety of foods other than wild boar liver.

According to the BfR's exposure assessment, the long-term total exposure to the sum of the four PFAS through consumption of food as a whole (excluding drinking water) for adults in Germany is in the range of the TWI (median of consumption) or corresponds to about two to five times (mean value or 95th percentile of consumption) the level of the TWI (BfR 2021). The estimate of the total exposure to PFAS is associated with large uncertainties. The present exposure assessment confirms that the consumption of wild boar liver can contribute significantly to exposure to PFAS.

According to the present estimate of long-term exposure to the sum of the four PFAS, there is a medium likelihood of impairments to health for consumers of wild boar liver with a concentration at the reported level (mean value).

### **3.2 Risk management options, recommended measures**

The available data for PFAS in wild boar liver give no reason to assume that the analytical results in question from one German federal state indicate a regional peculiarity. The PFOS levels in wild boar liver are generally many times higher than the concentrations in other, comparatively highly contaminated foods.

Consumers can hardly influence their exposure to PFAS as ubiquitous environmental contaminants. The occurrence of PFAS in food can mainly be influenced by the avoidance and closure of sources of entry into the environment. Efforts to reduce the concentrations in food should be continued.

#### **Further information on the BfR website on PFAS in food**

FAQ: Here to stay – Per- and polyfluoroalkyl substances (PFAS) in food and the environment

<https://www.bfr.bund.de/cm/349/here-to-stay-per-and-polyfluoroalkyl-substances-pfas-in-food-and-in-the-environment.pdf>

BfR opinion, PFAS in food: BfR confirms critical exposure to industrial chemicals

<https://www.bfr.bund.de/cm/349/pfas-in-food-bfr-confirms-critical-exposure-to-industrial-chemicals.pdf>

## **4 References**

BfR (2021). PFAS in Lebensmitteln: BfR bestätigt kritische Exposition gegenüber Industriechemikalien.

Duffek A, Conrad A, Kolossa-Gehring M, Lange R, Rucic E, Schulte C, Wellmitz J. Per- and polyfluoroalkyl substances in blood plasma - Results of the German Environmental Survey for children and adolescents 2014-2017 (GerES V). *Int J Hyg Environ Health*. 2020 Jul;228:113549. doi: 10.1016/j.ijheh.2020.113549. Epub 2020 Jun 2. PMID: 32502942.

EFSA (European Food Safety Authority) (2020). Scientific Opinion on the risk to human health related to the presence of perfluoroalkyl substances in food. *EFSA Journal* 18 (9) 6223, 391 pp. <https://doi.org/10.2903/j.efsa.2020.6223>

Ehlscheid N, Lindtner O, Berg K, Blume K, Sommerfeld C, Heinemeyer G (2014). Selten verzehrte Lebensmittel in der Risikobewertung. Ergebnisse einer Telefonbefragung in Deutschland. Presented at Proceedings of the German Nutrition Society. Abstractband zum 51. Wissenschaftlichen Kongress: Proceedings of the German Nutrition Society - Volume 19, 19, 100. Retrieved from [https://www.openagrar.de/receive/openagrar\\_mods\\_00015696](https://www.openagrar.de/receive/openagrar_mods_00015696)

## About the BfR

The German Federal Institute for Risk Assessment (BfR) is a scientifically independent institution within the portfolio of the Federal Ministry of Food and Agriculture (BMEL) in Germany. The BfR advises the Federal Government and the States ('Laender') on questions of food, chemicals and product safety. The BfR conducts independent research on topics that are closely linked to its assessment tasks.

*This text version is a translation of the original German text which is the only legally binding version.*

### Legal notice

Publisher:

**German Federal Institute for Risk Assessment**

Max-Dohrn-Straße 8-10

10589 Berlin, Germany

T +49 30 18412-0

F +49 30 18412-99099

[bfr@bfr.bund.de](mailto:bfr@bfr.bund.de)

[bfr.bund.de/en](https://bfr.bund.de/en)

Institution under public law

Represented by the president Professor Dr Dr Dr h.c. Andreas Hensel

Supervisory Authority: Federal Ministry of Food and Agriculture

VAT ID No. DE 165 893 448

Responsible according to the German Press Law: Dr Suzan Fiack



valid for texts produced by the BfR

images/photos/graphics are excluded unless otherwise indicated

**BfR** | Identifying Risks –  
Protecting Health