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Feed is key to compliance with maximum PFAS levels in food of animal origin

→ Updated opinion no. 37/2021 of November 24, 2021. Following the establishment of maximum levels for PFAS in animal feed, the calculations on the maximum PFAS levels in feed were updated. New findings from animal studies were taken into account.

Per- and polyfluoroalkyl substances, PFAS for short, are chemicals that are used in many industrial processes and are processed in numerous consumer products. They are difficult to break down and accumulate in the environment, for example in water and soil. This has earned them the name "Forever Chemicals". As plants can absorb PFAS from the soil as they grow, livestock can accumulate these compounds through feeding, which then enter the human body when food of animal origin is consumed.

Since January 2023, maximum levels have applied in selected food of animal origin in the EU : for perfluorooctane sulfonic acid (PFOS), perfluorooctanoic acid (PFOA), perfluorononanoic acid (PFNA) and perfluorohexane sulfonic acid (PFHxS) as well as for the sum of these four PFAS. In this opinion, the German Federal Institute for Risk Assessment (BfR) has determined the maximum concentration of individual PFAS in complete feed for various livestock in order to comply with the maximum levels in food. PFAS levels in feed for cattle, sheep, fattening pigs and laying hens were modelled.

According to the BfR's assessment, feed with a PFAS level below the calculated values does not lead to the maximum levels in food of animal origin being exceeded. Until the (intended) establishment of maximum levels in feed, the values can serve as consumer protection-based guidance values for various players in the environmental and agricultural sectors.

The BfR points out that the data available on the PFAS level in various feed materials is currently limited and recommends to collect representative feed data. If an assessment of the health risks posed by PFAS is to be made for the transfer of PFAS from feed to food of animal origin, other sources of PFAS intake by livestock such as soil or drinking water must also be taken into account.

1 Subject of the assessment

Against the background of the discussion on the introduction of EU maximum levels for per- and polyfluoroalkyl substances (PFAS) in food of animal origin in the European Union, the BfR was asked by the Federal Ministry of Food and Agriculture (BMEL) in 2021 to comment on questions regarding the level of PFAS in feed. The aim was to examine whether, based on the background contamination of PFAS in feed, the proposed maximum levels in food of animal origin can be complied with or up to which PFAS concentrations feed from contaminated areas is still suitable for feeding purposes under these requirements. (Opinion no. 037/2021 of November 24, 2021). Based on the discussion proposals at EU level in 2021, the BfR had estimated maximum possible PFAS levels in feed for various livestock species at which the proposed maximum levels in the corresponding food of animal origin would not be exceeded.

Since January 1, 2023, maximum levels for perfluorooctane sulfonic acid (PFOS), perfluorooctanoic acid (PFOA), perfluorononanoic acid (PFNA) and perfluorohexane sulfonic acid (PFHxS) as well as for the sum of these four PFAS, which have been adopted in Commission Regulation (EU) 2023/915 of April 25, 2023 on maximum levels for certain contaminants in foodstuffs, have been applicable in certain food of animal origin. No maximum levels have been set for milk; instead, guidance values for the four individual compounds are recommended in Commission Recommendation (EU) 2022/1431 of August 24, 2022 on the monitoring of perfluoroalkyl substances in food.

The maximum levels for PFAS in food of animal origin laid down in Regulation (EU) 2023/915 differ slightly from the maximum levels that were under discussion at EU level in 2021. Discussions are currently underway with the European Commission to regulate maximum levels of PFAS in feed. A timely setting of maximum levels for PFAS in feed is not expected due to the current insufficient data situation, among other things. However, the BfR believes that there is an increasing need for consumer protection-based guidance values for PFAS levels in feed for various stakeholders in the environmental and agricultural sectors. For these reasons, the BfR has updated its opinion on PFAS maximum levels in feed.

2 Result

The BfR has used toxicokinetics modeling to estimate PFAS levels in complete feed for which it can be assumed that the currently applicable maximum levels or indicative values for food are complied with. The modeling is based on the results of scientific studies on the transfer of PFAS from feed to food of animal origin. PFAS levels were modelled for complete feed for cattle, sheep, fattening pigs and laying hens. For feed with an actual PFAS content below these recalculated values, the BfR assumes that it is unlikely that the maximum level in food will be exceeded.

3 Rationale

The BfR has created toxicokinetics models for laying hens (Kowalczyk et al 2020), dairy cows and beef cattle (Mikkonen et al. 2023), sheep (Kowalczyk et al. 2012, Zafeiraki et al. 2016, Drew et al. 2021) and fattening pigs (Numata et al. 2014) using the transfer studies on

livestock available to it. For the calculations, it was assumed that the exposure of the animals to PFAS occurs exclusively via the feed and over an entire period of use (e.g. laying period, fattening period) without prior exposure to these compounds (e.g. in piglets/lambs during the suckling period). As all four PFAS compounds have different toxicokinetics in the individual animal species, the calculation of PFAS concentrations in complete feed is limited to the individual substances PFOS, PFOA, PFNA and PFHxS.

Table 1 shows the PFAS levels determined by the BfR in complete feed for various livestock species in micrograms per kilogram of dry matter ($\mu\text{g}/\text{kg DM}$), the feeding of which does not exceed the maximum levels in food according to Regulation (EU) 2023/915 on average.

Table 1: Maximum PFAS levels in food of animal origin according to Regulation (EU) 2023/915 and modelled maximum possible PFAS levels in complete feed for laying hens, fattening cattle, sheep and fattening pigs, for which the maximum levels according to Regulation (EU) 2023/915 for eggs or meat/offal are not exceeded on average when fed

Food*	PFOS	PFOA	PFNA	PFHxS
	$\mu\text{g}/\text{kg}$ fresh weight			
Eggs	1,0	0,30	0,70	0,30
Meat of bovine animals, pigs and poultry	0,30	0,80	0,20	0,20
Meat of sheep	1,0	0,20	0,20	0,20
Offal of bovine animals, sheep, pig and poultry	6,0	0,70	0,40	0,50
Complete feed	PFOS	PFOA	PFNA	PFHxS
	$\mu\text{g}/\text{kg}$ dry matter			
Laying hens	0,42	0,25	0,29	0,17
Cattle	0,14	n.a.**	n.a.	1,0
Sheep	0,21 [#]	n.a.	n.a.	n.a.
Fattening pigs	0,07	0,05	n.a.	0,06

* Maximum levels according to Regulation (EU) 2023/915; ** The transfer of PFOA in cattle is very low; # Calculation with limited data set; n.a.: not available due to insufficient data

Table 2 shows the PFAS levels in the complete feed for dairy cows in the daily ration ($\mu\text{g}/\text{kg DM}$) at which the indicative level for PFAS in milk according to Recommendation (EU) 2022/1431 are complied with.

Table 1: PFAS concentrations in complete feed for dairy cows which, when fed on average, do not lead to the indicative level for milk in accordance with Recommendation (EU) 2022/1431 being exceeded.

	PFOS	PFOA	PFNA	PFHxS
Milk ($\mu\text{g}/\text{kg}$ fresh weight)*	0,02	0,01	0,05	0,06
Complete feed for dairy cows ($\mu\text{g}/\text{kg}$ dry matter)	0,07	6,5**	n.a.	3,7

* Indicative level according to Recommendation (EU) 2022/1431; ** The transfer of PFOA in cattle is very low; n.a.: not available due to insufficient data available

When estimating PFAS levels in complete feed, there are differences between animal species and production categories, which can be attributed, for example, to differences in weight gain, feed intake of the animals and the accumulation and excretion behaviour of the compounds.

The current data are not sufficient to estimate what proportion of the total PFAS concentration in the ration individual feed components may have in order to ensure that food of animal origin has PFAS concentrations that do not exceed the applicable maximum levels. The PFAS levels in feed shown in Table 1 and Table 2 were therefore based on the complete feed. For the improvement of the data set and future recommendations for possible options for action in the composition of rations, the BfR recommends the collection of representative data for PFAS in various feed materials from different origins as part of monitoring programs.

PFAS are industrial chemicals that are ubiquitous in the environment. For this reason, livestock can be exposed to PFAS not only via feed, but also via e.g. soil or drinking water. Accordingly, all PFAS sources relevant to the food-producing animal must be taken into account in a risk assessment.

Further information on PFAS on the BfR website

FAQ: Here to stay: Per- and polyfluoroalkyl-substances (PFAS) in food and in 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: Exposure assessment for the intake of PCDD/Fs and dioxin-like PCBs as well as PFAS through the consumption of different fish species

<https://www.bfr.bund.de/cm/349/exposure-assessment-for-the-intake-of-pcdd-fs-and-dioxin-like-pcbs-as-well-as-pfas-through-the-consumption-of-different-fish-species.pdf>

4 Referenzen

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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.

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