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PFAS maximum levels in feedstuffs: BfR recommends improved analytical methods

BfR opinion No 037/2021 of 24 November 2021

Per- and polyfluoroalkyl substances (PFAS) are industrial chemicals. They are widely used in industrial processes and numerous consumer products, such as paper, textiles, non-stick pans and cosmetics. PFAS are persistent and can be found in the environment, in the food chain and in human blood. In September 2020, the European Food Safety Authority (EFSA) re-evaluated the risk to human health from PFAS in food and established a tolerable weekly intake (TWI) of 4.4 nanograms (ng) per kilogram (kg) body weight per week. Consequently, the European Commission is proposing PFAS maximum levels in foods of animal origin. BfR examined whether compliance with the proposed maximum levels is possible considering background levels of PFAS in feedstuffs. The assessment of the maximum possible PFAS levels in feedstuffs that prevent exceedance of the proposed maximum levels in foods of animal origin shows that the current analytical detection limits in feed should be significantly improved. BfR therefore recommends, as a first step, the development of more sensitive PFAS analytical methods, on which basis PFAS background levels can be estimated from feed monitoring as a pre-requisite for the derivation of maximum levels.

1 Subject of the Assessment

The background of this opinion is the introduction of EU maximum levels for per- and polyfluoroalkyl substances (PFAS) in foods of animal origin, as planned by the European Commission. The German Federal Institute for Risk Assessment (BfR) has been asked by the German Federal Ministry of Food and Agriculture (BMEL) for a statement on the following questions:

1. To what extent are the maximum levels for foods of animal origin, as proposed by the European Commission (COM), currently feasible, if the background levels of per- and polyfluoroalkyl substances (PFAS) in feedstuffs are considered?

2. Under these requirements, and considering feedstuffs originating from regions with higher PFAS levels as a result of an environmental event, what are the maximum possible PFAS levels for feed to still be used for animal feeding purposes?

2 Result

No background levels of PFAS in feedstuffs can be established on the basis of the available data from feedstuff investigation programmes and the present resolution of the PFAS analytical methods for feedstuffs. Nevertheless, data on PFAS background levels in feedstuffs are required in the derivation of maximum levels in foods of animal origin. The assessment of the maximum possible PFAS levels in feedstuffs that prevent exceedance of the proposed maximum levels in foods of animal origin shows that the current analytical limits of quantification are inadequate and should be significantly reduced below the range of 0.05 micrograms per kilogram (µg/kg). Only then will it be possible to assess the extent to which feedstuffs are safe, even if they contain low levels of PFAS.

3 Rationale

Reply to question 1: To what extent are the maximum levels for foods of animal origin, as proposed by the European Commission (COM), currently feasible, if the background levels of per- and polyfluoroalkyl substances (PFAS) in feedstuffs are considered?

At the second meeting of the German Federal State Working Group "PFAS in feed" in June 2021, BfR evaluated various studies on PFAS in feed. The results showed that PFAS were occasionally detected only in risk-oriented feed samples. In the case of non-risk-oriented feed samples, PFAS levels were always below the detection and quantification limits. To date, there are no validated analytical methods for PFAS in feedstuffs. Moreover, because of the use of different methods of analysis, there is wide variability for the different feedstuff matrices and individual PFAS among the laboratories, with detection limits of 0.1-5 µg/kg dry matter (DM) and quantification limits of 0.4-10 µg/kg DM.

BfR has reviewed the results on the status survey of PFAS in roughage samples of grass, grass silage, hay and maize silage, which were subsequently analysed for PFAS as part of the "status survey on dioxins and PCB in feed and foods of animal origin." These samples contained a mean concentration of 3.2 µg/kg DM of perfluorooctanoic acid (PFOA) and 1.7 µg/kg DM of perfluorooctanesulfonic acid (PFOS) (Stahl and Gäth 2012). This represents the only study available to BfR that describes a non-risk-based sampling and could quantify levels of PFOA and PFOS. On the basis of the BfR study on the PFAS transfer in dairy cows (Kowalczyk et al. 2013, van Asselt 2013), an exposure scenario was calculated for dairy cows with a milk yield of 30 kilograms per day (kg/day) which received roughage with the above-mentioned PFAS levels at a proportion of 60% in the diet. The BfR concludes that the maximum level of 0.02 µg/kg, as suggested by the COM for PFOS in milk, would be reached within one week (6-7 days) (fig. 1). Because of the long half-life of PFOS in animals, the PFOS content in the milk would continue to increase until the end of lactation.

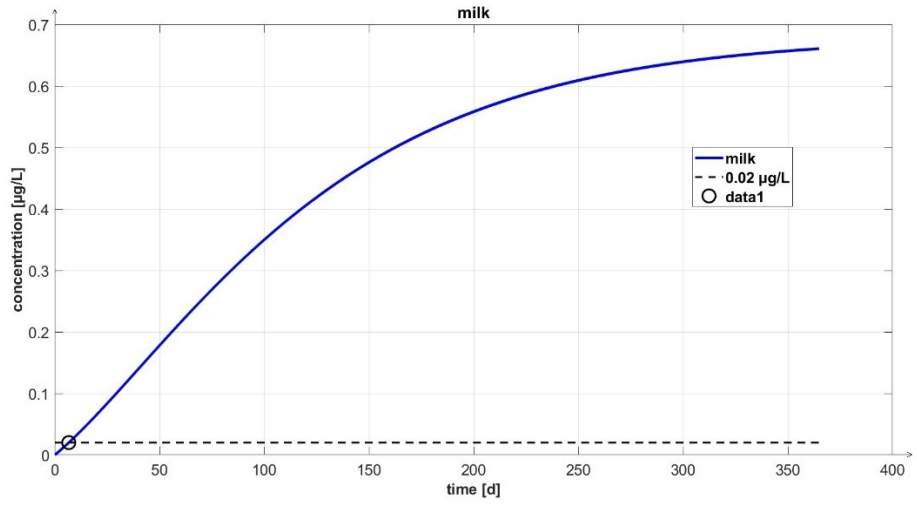

Fig. 1 Concentration progression of PFOS in the milk when feeding 20 kg feed/day with a proportion of 60% roughage with PFOS content of 1.7 µg/kg dry mass; the dotted line corresponds to the proposed maximum level of 0.02 µg PFOS per kg milk.

PFOA has a comparatively short half-life in the lactating ruminant; the equilibrium phase (steady state) is thus achieved within one to two days, with an estimated transfer rate of 0.23% (Kowalczyk et al. 2013). In a scenario for dairy cows with a milk yield of 30 kg/day that consume

12 kg raw feed per day with an average PFOA content of 3.2 µg/kg DM, the maximum level of 0.01 µg/kg, as suggested by the COM for PFOA in milk, would not be exceeded.

The data for the total of four PFAS in milk and dairy products determined for Europe by the member states and reported to the European Food Safety Authority (EFSA) as well as the data for Germany from surveillance programmes of the federal states show very low mean levels (EFSA 2020, BfR statement no. 020/2021 dated 28th June 2021). In light of this and of the aforementioned exposure scenario, it may be concluded that the mean levels of PFOA and PFOS in roughage reported by Stahl and Gäth (2012) cannot be representative of background levels of PFAS in feed.

No background levels of PFAS in feedstuffs can be established on the basis of the available data from feedstuff investigation programmes and the present performance of the analytical methods for PFAS in feedstuffs. However, data about background levels are urgently needed for the derivation of maximum levels in foods of animal origin. In this respect, BfR recommends the implementation of a monitoring program for feed to collect data on PFAS background levels. In order to identify meaningful values, BfR recommends as a first step the adaptation of the analytical methods to reduce the detection and quantification limits.

Reply to question 2: Under these requirements, and considering feedstuffs originating from regions with higher PFAS levels as a result of an environmental event, what are the maximum possible PFAS levels for feed to still be used for animal feeding purposes?

Using data from the available transfer studies on livestock, BfR has developed toxicokinetic models for the laying hens (Kowalczyk et al. 2020), dairy cows (Kowalczyk et al. 2013, van Asselt et al. 2013) and fattening pigs (Numata et al. 2014). These models are used to estimate the maximum PFAS levels that would prevent exceedance of the COM-proposed maximum levels in foods of animal origin. For reliable estimation of PFAS levels in feed, we used only datasets in which the transfer was determined experimentally with quantitative data in foods of animal origin. This pertains to PFOA and PFOS for all the aforementioned livestock species, as well as to perfluorohexanesulfonic acid (PFHxS) for fattening pigs. For the calculations it was assumed that the animals were exposed to PFAS solely through the feed and over one entire farm period (laying period, lactation period, fattening period), with no exposure to PFAS prior weaning (e.g. for the piglet when suckling). The maximum possible PFAS content of the feed, as identified by BfR, relates to the total diet (expressed in µg/kg DM) per day for the livestock species laying hen, dairy cow or fattening pig as shown in Table 1 below.

Table 1 Maximal possible PFAS levels in feed for laying hens, dairy cows and fattening pigs that does not lead to an exceedance of the maximum levels proposed by the EU Commission for eggs, cow's milk, pork and pork liver when feeding.

	PFOS	PFOA	PFHxS
Laying hen			
Eggs (µg/kg fresh weight)*	0.70	0.30	0.30
Feedstuffs (µg/kg dry mass)	**0.31**	**0.27**	**n.d.**
Dairy cow			
Cow's milk (µg/kg fresh weight)*	0.02	0.01	0.05
Feedstuffs (µg/kg dry mass)	**0.03**	**6.5#**	**n.d.**
Fattening pig			
Pork (µg/kg fresh weight)*	0.10	0.80	0.10
Pork liver (µg/kg fresh weight)*	6.0	0.70	0.50
Feedstuffs (µg/kg dry mass)	**0.04**	**0.07**	**0.04**

*Maximum level proposed by the EU Commission in accordance with annex 1 of the present ministerial request
#Calculation with limited dataset
n.d.: No data, owing to inadequate data situation

The assessment of the maximum possible PFAS levels in feedstuffs that prevent exceedance of the proposed maximum levels in foods of animal origin shows that the current analytical limits of quantification are inadequate and should be significantly reduced below the range of 0.05 µg/kg. Only then will it be possible to assess the extent to which feedstuffs are safe, even if they contain low levels of PFAS.
Moreover, the current data are insufficient to assess the contribution of individual feed components to the total PFAS concentration in the animal diet. This requires collection of representative feed data and subsequent evaluation by feed category, so that the feed components in the compound feed can be assessed individually. This especially applies to feed components from regions with a higher PFAS content due to an environmental event.
The knowledge base concerning the transfer of PFAS from the feed should be expanded, so that reliable statements can also be made in the future for substances other than PFOS and PFOA.

Further information on per- and polyfluoroalkyl substances (PFAS) is available from the BfR website

https://www.bfr.bund.de/de/a-z_index/per__und_polyfluoralkylsubstanzen__pfas_-8102.html#fragment-2

BfR "Opinions app"

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About BfR

The German Federal Institute for Risk Assessment (BfR) is a scientifically independent institution within the portfolio of the German Federal Ministry of Food and Agriculture (BMEL). BfR advises the German federal government and federal states on questions of food, chemical and product safety. BfR conducts its own research on topics that are closely linked to its assessment tasks.