

Dioxins and PCBs in German meat and meat products – Results of a monitoring study

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Abstract

Since November 2006 new maximum levels for dioxins (PCDD/F) and dioxin-like polychlorinated biphenyls (PCBs) in animal fats from ruminants, poultry and pigs entered into force in the European Union. The new EU regulation lists maximum levels for the sum of dioxins and furans (WHO-PCDD/F-TEQ) and maximum levels for the sum of dioxins, furans and dioxin-like PCBs (WHO-PCDD/F-PCB-TEQ). In order to get a representative overview of the contamination levels of these toxicologically relevant substances about 300 representative samples of German meat and meat products were analysed. Samples were collected in consideration of the different geographic regions and the actual food pattern in Germany. Contaminations with dioxins and dioxin-like PCBs in German meat and meat products were in median definitely below the maximum levels. The median contents of the WHO-PCDD/F-PCB-TEQ in pork and poultry meat were about a factor of 10 below the maximum levels. In beef the median content of the WHO-PCDD/F-PCB-TEQ was about a factor of 5 below the maximum levels. The contamination level of meat products was in the range of poultry meat (0.1 to 0.2 ng WHO-PCDD/F-PCB-TEQ/kg fat). In comparison to a representative dioxin study in Germany about 10 years earlier the dioxin concentrations especially in poultry and beef decreased significantly.

Introduction

Since 4 November 2006 new maximum residue levels (MRLs) for dioxins and dioxin-like PCBs in animal fats from ruminants, poultry and pigs entered into force in the European Union [1]. The new EU regulation lists maximum residue levels for the sum of dioxins and furans (WHO-PCDD/F-TEQ) and maximum levels for the sum of dioxins, furans and dioxin-like PCBs (WHO-PCDD/F-PCB-TEQ). Furthermore since the beginning of 2008 the European Commission is discussing maximum levels for the sum of the 6 marker PCBs in meat [2].

Because of a lack of representative data concerning the actual contents of dioxins (17 WHO-PCDD/Fs), dioxin-like PCBs (12 WHO-PCBs) and non-dioxin-like PCBs (6 marker PCBs) in feed and food originating from animals in Germany a project financially supported by the Federal Ministry of Food, Agriculture and Consumer Protection (BMELV) was carried out at the Max Rubner-Institut – Federal Research Institute of Nutrition and Food (MRI). In the location of the MRI in Kulmbach, which coordinates the project, more than 200 samples of feed and about 300 samples of meat/meat products and about 200 samples of eggs were analyzed. In the MRI locations in Kiel and Hamburg milk/milk products and fish were investigated.

In order to get a representative overview of the contamination levels of these toxicologically relevant substances about 300 representative samples of German meat and meat products were analysed in the years 2005 and 2006. Samples were collected in consideration of the different geographic regions and the actual food pattern in Germany. Approximately 50 percent of the samples were meat and 50 percent were meat products.

Materials and methods

Meat samples of beef, pig and poultry were taken in small butcheries in Germany. Samples of meat products (pork sausage, liver sausage, salami and bacon) were taken at quality competitions of the German Agricultural Society (DLG). The analytical procedure for the determination of the contents of dioxins (17 WHO-PCDD/F), dioxin-like PCBs (12 WHO-PCBs) and marker PCBs (PCB 28, 52, 101, 138, 153 and 180) followed the method described by Kleinhenz et al. [3].

In brief, the following clean-up steps were applied for meat and meat products: Accelerated solvent extraction (ASE), gel permeation chromatography (GPC), chromatography with florisil and a final chromatography on activated charcoal. Separation, identification and quantification of dioxins and PCBs were performed by gas chromatography/high resolution mass spectrometry (GC/HRMS).

Results and discussion

In the European Union the following maximum residue levels (MRLs) (see Table 1) for dioxins and the sum of dioxins and dioxin-like PCBs are regulated in Commission Regulation (No 1881/2006) [4]. Separate MRLs for dioxin-like PCBs are not existing. In addition MRLs for the sum of the 6 marker PCBs are discussed.

Table 1. Maximum residue levels (MRLs) for dioxins, dioxin-like PCBs (dl-PCBs) and marker PCBs (discussed MRLs) in different types of meat in the European Union (EU)

	dioxins (WHO-PCDD/F-TEQ)	sum of dioxins and dl-PCBs (WHO-PCDD/F-PCB-TEQ)	sum of PCB 28,52,101, 138,153 and 180 (discussed MRLs) [2]
Meat and meat products of:			
– beef and sheep	3.0 ng/kg fat	4.5 ng/kg fat	50 µg/kg fat
– poultry	2.0 ng/kg fat	4.0 ng/kg fat	30 µg/kg fat
– pork	1.0 ng/kg fat	1.5 ng/kg fat	15 µg/kg fat

Within the representative study 169 meat samples (56 pork, 49 poultry, 59 beef and 5 sheep samples) were analysed according to their contents of dioxins. The median contents of dioxins in poultry and pork (0.1 ng WHO-PCDD/F-TEQ/kg fat each) were significantly lower than in beef (0.24 ng/kg fat) and sheep (0.19 ng/kg fat). The maximum levels (without outliers and extreme values) for meat of pigs and poultry were 0.2 ng WHO-PCDD/F-TEQ/kg fat and about 1.3 ng WHO-PCDD/F-TEQ/kg fat for meat of cattle. The MRLs for dioxins (see Table 1) for pork, poultry meat, beef and sheep were not exceeded for all types of meat.

The analysed meat products (43 pork sausages, 17 bacons, 41 liver sausages and 24 salamis) showed median contents of the WHO-PCDD/F-TEQ in the range of 0.05 to 0.09 ng/kg fat and therefore were more than a factor of 10 below the MRL for dioxins in pork (1.0 ng/kg fat). Maximum contents (without outliers and extreme values) were in the range of 0.1 to 0.2 ng/kg fat.

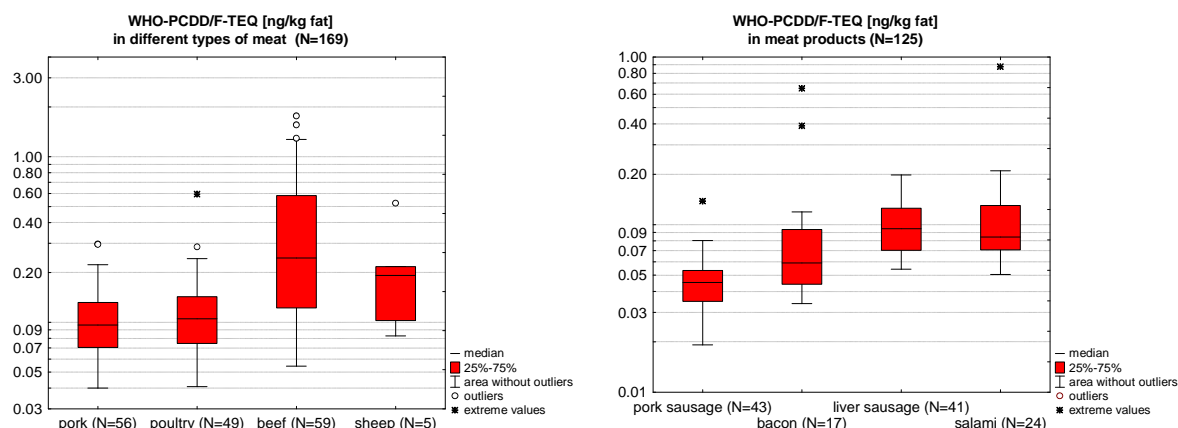


Figure 1. WHO-PCDD/F-TEQ [ng/kg fat] in meat and meat products.

Considering the contents of dioxin-like PCBs beef showed the highest contamination levels again (Fig. 2), followed by sheep, poultry and pork. The median content of the WHO-PCB-TEQ for beef was 0.9 ng/kg fat. Poultry showed a median of 0.11 and pork a median of 0.06 ng WHO-PCB-TEQ/kg fat.

The analysed meat products showed median contents of the WHO-PCB-TEQ in the range of 0.06 to 0.13 ng/kg fat. Maximum contents (without outliers and extreme values) were in the range of 0.2 to 0.3 ng/kg fat.

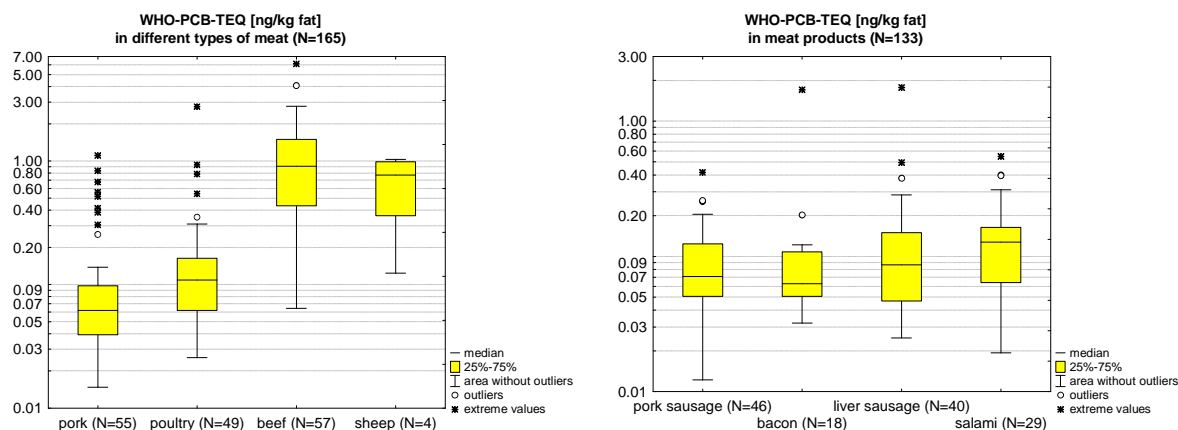


Figure 2. WHO-PCB-TEQ [ng/kg fat] in meat and meat products.

In the present study for meat of pig and poultry median sum contents for the 6 marker PCB (Fig. 3) in the range of 1-2 $\mu\text{g/kg}$ fat were found, for beef about 5 $\mu\text{g/kg}$ fat. Only a few extreme values showed contents above the discussed MRLs. Within the group of meat products (mainly produced of pork) the median contents were in the range of 1-3 $\mu\text{g/kg}$ fat and therefore in the same range as pork.

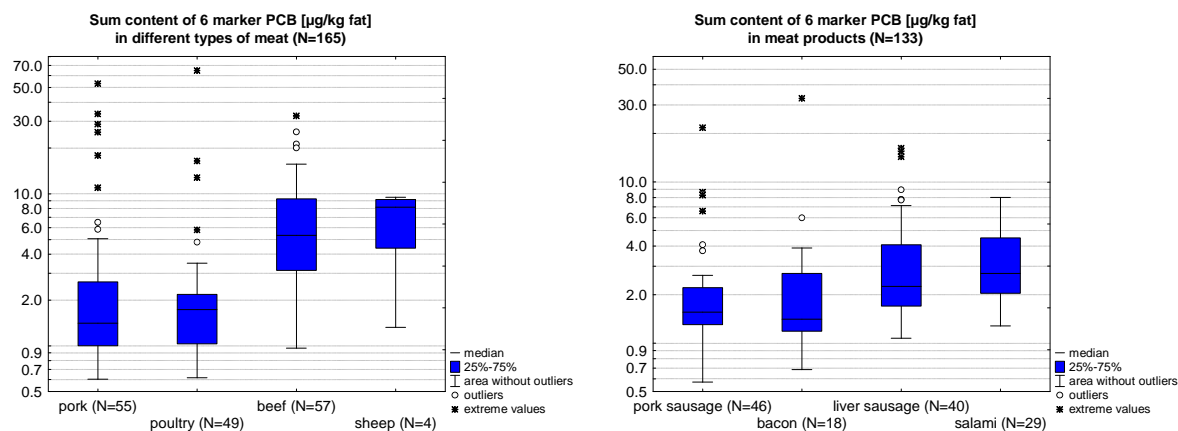


Figure 3. Sum content of 6 marker PCB [$\mu\text{g/kg}$ fat] in meat and meat products.

Conclusions

Within the presented study it was shown that the levels of dioxins and dl-PCBs in all investigated types of meat were significantly below the MRLs in the EU. Also the contents of the sum of the 6 marker PCBs were all far below the discussed MRLs. In comparison to a representative dioxin study in Germany about 10 years ago the dioxin contents especially in poultry and beef decreased significantly. This shows, that the legal regulations to reduce the emission of dioxins were successful. The contents of dl-PCBs in feed and food originating from animals were included in the representative study for the first time. In a further study in about 10 years temporal trends of dl-PCBs should be investigated.

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