PCDD/F IN MEAT SAMPLES FROM DOMESTIC FARM ANIMALS AND GAME

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Introduction

In the German state of Baden-Württemberg (south-western Germany), 313 samples of meat and meat products were collected between 1994 and 1998. The PCDD/F content was determined for edible tissues from domestic farm animals and game. The results of this large surveillance study are presented in this paper. One sample of game (pheasant) was found to contain very high PCDD/F concentrations with an unusual congener profile. Co-operation between German and English scientists led to possible identification of the source of the contamination.

Materials and methods

Meat samples were collected as part of an official programme of food inspection between 1994 and 1998. They were analysed using methodology which performed well in collaborative studies for determination of PCDD/Fs in eggs [1], kale [2] and milk [3] with optimisation of the extraction for meat. Briefly, meat samples were freeze-dried and the fat extracted with cyclohexane/toluene in a Soxhlet extractor. An aliquot of the extracted fat was spiked with all 2,3,7,8-substituted $^{13}C_{12}$-labelled PCDD/F congeners. The clean-up procedure included gel chromatography, chromatography on a sulfuric acid- and NaOH-impregnated silica column; on a florisil column and a Carbopack B/Celite column. As a recovery standard, $^{13}C_{12}$-labelled 1,2,3,4-TCDD was used. GC/MS-detection was performed on a VG Autospec at 10,000 resolution using a 60 m DB-5MS column. The A200S autosampler injected 5 µl into the Multinjector of a Carlo Erba Mega GC. Usually, a 5 point-calibration curve was acquired in duplicate.

Results and discussion

It is well known that PCDD/Fs accumulate in adipose tissue over time. Thus, different kinds of meat show different PCDD/F concentrations depending on the kind of feedstuff, the age of the animal at slaughtering, the typical amount of adipose tissue and the influence of environmental factors (*e.g.* breeding animals kept in cages or game living on soil).

Table 1 summarises data for 211 meat samples from breeding animals. In general, pork contains the lowest levels of PCDD/Fs. This is probably because pigs are slaughtered at the age of about 6 months and have a high proportion of adipose tissue, thus diluting the PCDD/F content. It is surprising that the PCDD/F content of beef is generally lower than for veal. One might assume that the greater lifespan of beef cattle would lead to higher lifetime exposure to PCDD/Fs. However, the diet of veal calves generally contains a high proportion of milk, whereas beef cattle eat predominantly vegetation. As PCDD/Fs tend to be concentrated in the milk, calves may accumulate higher tissue concentrations. The horsemeat sample follows the general trend in which older herbivorous animals reach steady state tissue concentrations, with the oldest animals having accumulated the highest body burden.

These data are higher than those from Hecht and Blüthgen [4] which reported as median (in pg I-TEQ/g) fat for pork 0.073, for poultry 0.22 and for beef 0.46. For pork, Mayer [5] found roughly the same range in Bavaria (21 samples of untreated pork: mean 0.31, median 0.31 pg I-TEQ/g fat) as was found in Baden-Württemberg. A collaborative study is being conducted between all official food control laboratories in Germany to assess the comparability of methods.

A specific dioxin source was detected in 1998: the use of contaminated citrus pulp from Brazil in feeding stuffs for beef and dairy cattle. As a direct result of the use of contaminated citrus pulp, milk, beef and veal contained significantly elevated PCDD/F concentrations [6]. These data are not included in table 1.

In Germany, there are no legal limits for the PCDD/F content of meat. In 1993 the Federal Health Office (formerly the Bundesgesundheitsamt) and Federal Office for the Environment (Umweltbundesamt) recommended guideline and action limits for the PCDD/F content of milk and milk products [7]. These orientation values should guarantee a harmonized valuation of all dioxin results for these products in Germany. These guidelines do not apply to meat samples. The results of this study could help to inform the debate about the need for recommended guidelines and action limits for different types of meat samples.

Table 2 shows that game generally accumulates higher tissue PCDD/F levels from the environment. It is assumed that additional uptake is caused by the ingestion of soil and other materials during feeding. Elevation above concentrations found in other animals is obvious even for the animals which live in areas with normal “background” PCDD/F concentrations.

A sample containing elevated levels of contamination gave cause for concern. This was a pheasant imported from the UK which was found to contain 235 pg I-TEQ/g fat. After checking the results, the data were discussed with the UK Ministry of Agriculture, Fisheries and Food (MAFF). By reference to the labelling on the packaging in which the pheasant was sold, it was possible to identify the plant at which the bird was processed. The plant was located in an area of north Derbyshire, very close to Bolsover. In 1991, elevated concentrations of PCDD/Fs were discovered in cow’s milk from some farms in the Bolsover area, near to a point source of emission. The potential emission source, a waste chemicals incinerator used in the destruction of chlorinated phenolic wastes, ceased operation in November 1991 [8 - 9]. The profile of PCDD/F contamination in the soil in the area is known to be unusual compared with typical UK urban sites.

The region has been regularly monitored by MAFF in its annual surveillance programme for environmental contaminants.

The PCDD/F congener profile in the pheasant sample and the profiles of contamination found in the other game bird samples analysed and in samples of cows' milk, meat and hens' eggs from the Bolsover region were compared. Contamination profiles in the different tissue samples are likely to be influenced by species differences in feeding habits and the rates of transfer of individual congeners from feed and/or soil to animal or bird. No consistent patterns were observed which could enable the source of the contamination to be conclusively identified, although a Bolsover origin for the pheasant could not be ruled out. It is not known what proportion of game, if any, processed by the plant was reared close to the known contaminated area and all other samples from the plant which were analysed were found to contain "normal" concentrations of PCDD/Fs. MAFF continues to monitor the PCDD/F content of milk from farms in the Bolsover area.

Statement

The views expressed are those of the authors and not those of the organisations by which they are employed.

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: 1: PCDD/F content of meat samples from breeding animals (in pg/g fat; here reported only most important
ɛners)

	I-TeQ	fat %	2378 TCDD	12378 PeCDD	123478 HxCDD	123678 HxCDD	123789 HxCDD	1234678 HpCDD	OCDD	2378 TCDF	23478 PeCDF	123478 HxCDF	123678 HxCDF	234678 HxCDF	1234678 HpCDF	OCDF
y (23 samples)																
	0.72	17.7	0.16	0.26	0.15	0.35	0.17	1.44	6.95	0.79	0.42	0.25	0.15	0.12	0.31	0.41
n	0.52	12.8	0.10	0.19	0.12	0.28	0.14	1.08	4.25	0.54	0.26	0.16	0.10	0.08	0.19	0.23
	0.24	0.7	0.04	0.07	0.04	0.05	0.04	0.19	1.11	0.18	0.10	0.05	0.03	0.04	0.05	0.05
	2.30	55.0	0.60	0.81	0.39	1.52	0.48	3.89	34.52	3.01	1.91	1.11	0.72	0.53	1.11	2.48
77 samples)																
	0.30	13.5	0.08	0.18	0.17	0.22	0.14	2.21	15.40	0.12	0.14	0.15	0.08	0.07	0.63	0.37
n	0.20	11.3	0.05	0.07	0.09	0.11	0.06	1.05	6.35	0.08	0.11	0.11	0.06	0.04	0.25	0.18
	0.05	1.5	0.03	0.03	0.03	0.03	0.03	0.24	1.83	0.04	0.03	0.03	0.02	0.02	0.08	0.06
	2.29	36.3	0.44	1.77	2.15	2.55	1.94	28.47	212.88	0.88	0.84	0.89	0.58	1.04	9.38	5.98
24 samples)																
	0.94	11.4	0.18	0.37	0.26	0.59	0.24	2.04	5.45	0.13	0.67	0.44	0.27	0.26	0.50	0.18
n	0.81	6.8	0.13	0.30	0.21	0.43	0.20	1.44	4.07	0.11	0.56	0.42	0.23	0.23	0.37	0.16
	0.35	1.3	0.04	0.09	0.09	0.18	0.09	0.74	1.75	0.05	0.25	0.22	0.13	0.15	0.17	0.05
	2.76	53.4	0.51	1.34	1.19	2.79	0.91	9.67	22.60	0.44	2.01	0.96	0.63	0.68	2.09	0.48
73 samples)																
	0.63	7.9	0.11	0.21	0.17	0.45	0.15	1.54	3.55	0.13	0.48	0.33	0.21	0.22	0.33	0.19
n	0.59	5.8	0.09	0.19	0.15	0.40	0.13	1.01	2.54	0.10	0.43	0.29	0.19	0.21	0.23	0.14
	0.05	0.7	0.03	0.03	0.03	0.03	0.03	0.19	0.96	0.03	0.03	0.03	0.02	0.02	0.05	0.04
	2.05	29.7	0.54	0.96	0.52	1.90	1.07	5.09	15.42	0.85	1.26	1.46	0.82	0.78	2.86	0.98
mutton (13 samples)																
	0.52	17.9	0.11	0.28	0.20	0.36	0.11	0.50	1.92	0.10	0.39	0.32	0.14	0.12	0.11	0.10
n	0.50	12.8	0.10	0.21	0.16	0.32	0.11	0.48	1.54	0.10	0.36	0.26	0.14	0.10	0.09	0.09
	0.04	7.7	0.08	0.11	0.05	0.04	0.07	0.18	1.13	0.06	0.02	0.03	0.02	0.03	0.03	0.06
	1.49	46.9	0.21	0.78	0.36	0.95	0.17	0.96	3.90	0.15	1.19	0.69	0.29	0.31	0.19	0.23
meat (1 sample)																
	3.76	2.9	0.25	1.22	2.24	5.42	0.88	49.85	69.01	0.59	1.80	2.05	1.66	0.72	5.06	0.80