

PCDDS, PCDFS AND PCBs IN FARMED TROUT IN ENGLAND AND WALES.

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Introduction

Dioxins and PCBs are persistent chemicals, which are ubiquitous in the environment and generally present at low concentrations in foods, especially fat-containing foods such as fish^{1,2,3}. The consumption of fish is increasing in the UK and so a survey of PCDD/Fs and PCBs in farmed trout was commissioned by the UK Joint Food Safety and Standards Group in order to estimate the dietary intake of these chemicals from this source.

Collection of Samples

Fish Health Inspectors from CEFAS, Weymouth obtained forty samples of edible trout flesh from trout farms across England and Wales, with the co-operation of the British Trout Association. Each sample consisted of several fillets of muscle taken from different fish of similar age and size at each location.

Materials and Methods

The sample analysis procedure is described in detail elsewhere⁴.

In the current survey the 17 PCDD/F congeners substituted in the 2,3,7,8- positions and the following PCB congeners were analysed: PCBs 77, 126, 169, 18, 28, 31, 47, 49, 51, 52, 99, 101, 105, 114, 118, 123, 128, 138, 153, 156, 157, 167, 180 and 189.

The reporting limits in this survey are 0.25 ng/kg fat for dioxins, 0.3 ng/kg fat for non-ortho PCBs and 0.13 µg/kg of fat for ortho-PCBs.

Results

Detailed information about this survey is available in a MAFF/Department of Health Joint Food Safety and Standards Group Food Surveillance Information Sheet⁵.

Results for individual samples are presented in Table 1.

In summary [Note: here and throughout the concentrations as given in this paper use I-TEF and the PCB TEF of Ahlberg *et al*, 1994.⁶]:

- combined PCDD/F and PCB concentrations found in the fish samples ranged between 12 and 60 (mean 24) ng -TEQ/kg fat, or 0.29 – 3.1 (mean 1.1) ng -TEQ/kg fresh weight.
- concentrations of PCDD/Fs found in the fish samples ranged between 2.1 and 13 (mean 5.1) ng -TEQ/kg fat, or 0.06 – 0.67 (mean 0.24) ng -TEQ/kg fresh weight.
- non-ortho-PCB concentrations found in the fish samples ranged between 5.0 and 42 (mean 14) ng -TEQ/kg fat, or 0.16 – 1.85 (mean 0.65) ng -TEQ/kg fresh weight.
- ortho-PCB concentrations found in the fish samples ranged between 2.3 and 10 (mean 4.4) ng -TEQ/kg fat, or 0.06 – 0.52 (mean 0.21) ng -TEQ/kg fresh weight.

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Measured fat contents were in the range 1.8% – 6%.

The average and high level (97.5th percentile) consumption figures for trout by UK adults are 0.37 and 0.59 g/kg bodyweight/day respectively.

Estimated average and high level consumer intakes of PCDD/Fs and PCBs from the consumption of trout alone, using the mean concentrations found in this survey, are 0.41 and 0.66 pg TEQ/kg bodyweight/day respectively. Total dietary intakes of dioxins and PCBs have previously been estimated to be 2.4 and 4.2 pg TEQ/kg bodyweight/day respectively for average and high level consumers, based on the concentrations of these chemicals found in 1992 Total Diet Study (TDS) samples⁷. The 1992 TDS fish group, as analysed, was a composite of different species purchased from each of 24 locations in the UK, and cannot therefore reflect localised contamination. The dietary intakes of dioxins and PCBs by people who consistently consume trout caught from the same location could potentially be elevated if that location was affected by localised sources of dioxins and PCBs. Using the maximum concentrations found in trout during the current survey and the concentrations of dioxins and PCBs in the 1992 TDS fish group (8.0ng TEQ/kg fat basis)⁷ for the other fish species, the average and high level dietary intakes of dioxins and PCBs via the consumption of trout sourced from a single location, in combination with the rest of the diet, are estimated to be up to 2.4 and 4.3 pg TEQ/kg bodyweight/day respectively.

These figures are well below the Tolerable Daily Intake (TDI) of 10 pg WHO-TEQ/kg bodyweight/day endorsed by the Committee on Toxicity of Chemicals in Food, Consumer Products and the Environment (COT)⁸ and indicate that consumers are receiving amounts of PCDD/Fs and PCBs in line with the WHO recommendation of 1 to 4 pg WHO-TEQ/kg bodyweight/day⁹. These results do not indicate the existence of any health risk from the consumption of trout produced in England and Wales.

The concentrations of dioxins in trout found in the current survey are lower than those (44 ng TEQ/kg fat) found for brown trout taken in 1993 in a survey of five freshwater fish species in UK lakes by other workers¹. None of these lakes were in the vicinity of potential sources of dioxins and PCBs. However the surveys are not directly comparable. The ages of the trout are not specified in that survey, and whole fish (including the possibility of sediment in the gut) were analysed as opposed to just the edible portions as in the MAFF survey.

In various freshwater species in Lake Ontario (from an area in the vicinity of potential sources of dioxins) concentrations of 2,3,7,8-TCDD (the only congener reported) exceeding 5 ng/kg were found in 30 out of 98 samples of edible tissues² compared with the highest measured concentration of 0.09 ng/kg in the MAFF survey, assuming the US data are fresh weight concentrations. The age of the fish is unclear and no further comparison is possible due to the high limit of detection in the US survey. In a survey of various species of freshwater fish in Taiwan, concentrations of dioxins and PCBs were in the range 0.12-0.65 ng TEQ/kg dry weight, or approximately 0.5-2.5ng TEQ/kg fresh weight. Most of these samples were taken from the vicinity of an incinerator and were either of single fish or composites of a number of smaller fish³.

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Sample code	2448	2449	2450	2451	2452	2453	2454	2455	2456	2457
PCDD/Fs	6.16	9.25	7.93	4.24	3.78	3.43	6.22	8.28	4.97	3.87
Non-ortho-PCBs	16.61	20.67	22.76	12.7	12.95	10.41	42.42	21.13	29.09	5.01
Ortho-PCBs	4.55	8.31	5.03	2.29	3.67	2.88	7.99	4.38	5.45	4.54
Total WHO-TEQ	27.32	38.23	35.72	19.23	20.4	16.72	56.63	33.79	39.51	13.42
Total WHO-TEQ (ng WHO-TEQ/kg whole)	0.93	1.61	1.61	0.69	1.66	1.36	1.03	1.09	1.74	0.80
Sample code	2458	2459	2460	2461	2462	2463	2464	2465	2466	2467
PCDD/Fs	3.15	13.12	5.17	5.09	4.44	5.01	4.78	4.26	6.72	5.34
Non-ortho-PCBs	8.89	36.36	18.58	16.87	15.6	10.78	10.19	14.37	13.35	20.53
Ortho-PCBs	3.12	10.31	4.24	3.18	4.35	6.42	4.18	4.93	5.77	4.95
Total WHO-TEQ	15.16	59.79	27.99	25.14	24.39	22.21	19.15	23.56	25.84	30.82
Total WHO-TEQ (ng WHO-TEQ/kg whole)	0.77	3.04	1.03	0.84	1.75	1.05	1.16	1.06	1.86	1.13
Sample code	2468	2469	2470	2471	2472	2473	2474	2475	2476	2477
PCDD/Fs	4.99	5.8	4.33	4.04	5.8	3.25	2.11	4.65	4.9	3.8
Non-ortho-PCBs	11.41	10.78	7.61	12.72	11.48	6.97	7.42	9.2	11.18	8.39
Ortho-PCBs	4	4.85	3.4	4.95	4.41	2.97	2.62	3.6	4.07	3.21
Total WHO-TEQ	20.4	21.43	15.34	21.71	21.69	13.19	12.15	17.45	20.15	15.4
Total WHO-TEQ (ng WHO-TEQ/kg whole)	1.21	1.18	0.79	0.93	1.25	0.56	0.36	0.73	1.49	0.65
Sample code	2478	2479	2480	2481	2484	2485	2486	2487	2488	2489
PCDD/Fs	4.46	5.63	4.74	5.76	4.92	2.75	5.04	3.65	3.24	4.3
Non-ortho-PCBs	9.54	12.5	15.08	11.72	10.62	6.43	14.58	9.06	8.26	13.76
Ortho-PCBs	3.61	4.46	5.15	4.1	4.06	2.37	4.92	3.19	2.93	3.27
Total WHO-TEQ	17.61	22.59	24.97	21.58	19.6	11.55	24.54	15.9	14.43	21.33
Total WHO-TEQ (ng WHO-TEQ/kg whole)	0.63	0.90	0.91	1.14	0.57	0.29	0.97	0.81	0.94	1.82

Table 1. Contributions from PCDD/Fs and PCBs to total TEQs (ng TEQ/kg fat) in edible tissue samples from farmed trout.