

PCDD/PCDF Levels in Rainbow Trout and Carp from South Germany

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Introduction

The consumption of fish is one of the main routes of daily intake of polychlorinated dibenzo-p-dioxins and dibenzofurans (PCDD/PCDF)^{1,2}. Although freshwater fish contributes only about 10 % to the total fish consumption in the federal republic of Germany³ these foodstuffs may play a significant part in the nutrition of people who like to eat fish. Most of the consumed freshwater fishes, mainly rainbow trouts and carps, are produced in fish cultures. Here we present some data of PCDD/PCDF levels in the edible portion of rainbow trouts and carps from fish farming and of free living trouts and carps that were caught in rivers and lakes in South Germany.

Materials and Methods

All samples were analyzed within the framework of official food monitoring in the federal state of Bavaria in South Germany. Rainbow trouts (*oncorhynchus mykiss*) and carps (*cyprinus carpio*) were collected directly at fish cultures, frozen Danish and Spanish rainbow trouts were purchased in supermarkets. Free living rainbow trouts, trouts (*salmo trutta fario*, *salmo trutta lacustris*) and carps were caught in Bavarian rivers and lakes from background sites or from sites close to the outlets of municipal purification plants. Skinless fillets of either single or composites of several individuals (see Table 1) were homogenized and freeze-dried. Fat separation and determination of fat content was performed by extraction with n-hexane/acetone (2+1). After addition of ¹³C₁₂-labeled standards a clean-up with three or four chromatographic steps was carried out. Finally the determination of PCDDs and PCDFs was performed by HRGC/HRMS.

Results

Table 1 shows a summary of sample data and I-TEQ results. I-TEQ values of rainbow trouts and trouts were very similar and not dependent on the origin of the samples. Large rainbow trouts from farming (mean weight: 990 g) showed slightly elevated I-TEQ values on wet tissue weight basis due to higher fat contents compared to fishes with smaller weights. In consideration of the distribution of I-TEQ results (figure 1) it is evident that increased mean values in table 1 are caused by single samples with elevated contamination. All samples with increased PCDD/PCDF levels on fat basis (T1, C1, C2 in figure 1) had relatively low fat contents and, consequently, no increased PCDD/PCDF levels could be observed in the edible portion of these fishes. The highest I-TEQ values on wet tissue weight basis (4.5 and 5.3 pg/g wet tissue) were determined in free living carps with elevated fat contents (21.4 and 17.2 %).

Table 1: PCDD/PCDFs in rainbow trouts, trouts and carps

fish species, origin of sample	ind. ^{a)}	number of samples	weight ^{b)} [g] mean (range)	fat [%] mean (range)	I-TEQ [pg/g] mean (range)	
					fat basis	wet tissue basis
rainbow trout, Bavaria, farming	1	9	990 490 - 1930	8.0 3.7 - 10.5	6.8 3.6 - 11.1	0.55 0.13 - 1.06
	2-4	14	320 230 - 473	4.9 2.0 - 8.9	5.8 2.1 - 11.9	0.28 0.09 - 0.7
	12	3	266 252 - 282	3.3 3.1 - 3.4	7.2 6.1 - 7.8	0.24 0.19 - 0.27
rainbow trout, spain, denmark	4-8	6	168 158 - 184	5.2 3.7 - 8.5	6.5 1.0 - 17.4	0.29 0.06 - 0.69
trouts, Bavaria, free living	1-4	16	465 224 - 1057	3.8 0.8 - 8.1	11.8 2.9 - 48.9	0.32 0.16 - 0.74
carp, Bavaria, farming	1	4	1972 838 - 2765	3.5 1.8 - 5.8	21.2 6 - 51.1	0.73 0.11 - 1.58
carp, Bavaria, free living	1-2	11	2250 932 - 6098	6.8 0.2 - 21.4	22.3 3.5 - 30.6	1.34 0.03 - 5.26

a) number of individuals that were pooled and analyzed as one sample

b) fish without guts

Characteristic PCDD/PCDF homologue profiles are presented in figure 2. In almost all samples 2,3,7,8-TCDF was the predominant congener followed by 2,3,4,7,8-PeCDF. In addition to the 2,3,7,8-substituted congeners a number of non-2,3,7,8-substituted congeners could be detected (mainly TCDFs and PeCDFs). Remarkably, the homologue profiles were not influenced by the contamination levels (A, B, C in figure 2). Only a few samples with relatively low I-TEQ values revealed profiles with increased levels of high chlorinated dioxines (D in figure 2). PCDD/PCDF homologue profiles of carps were similar to the profiles of trouts, but in general the relativ TCDF contents were lower as in trouts compared to PeCDFs (E in figure 2). Three carp samples showed homologue profiles with PeCDF contents exceeding the contents of TCDFs and with increased levels of dioxins (F in figure 2).

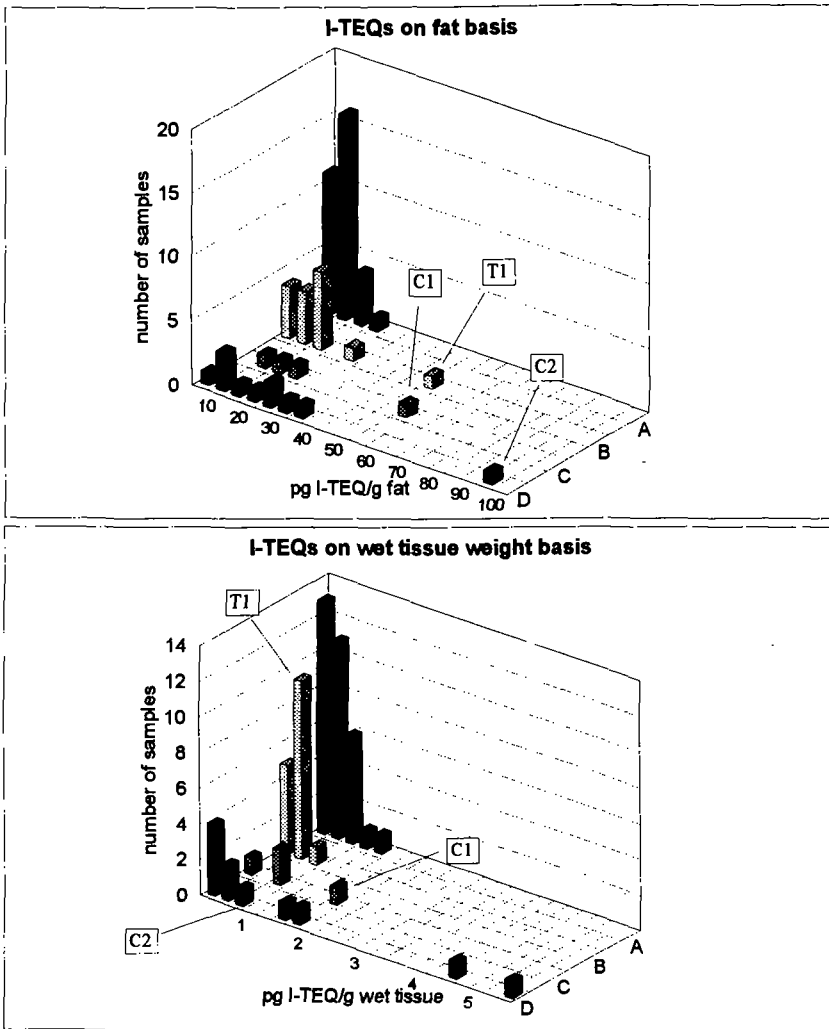
Conclusions

PCDD/PCDF levels in the edible portion of rainbow trouts and carps from fish farming were relatively low (mean values: 0.34 and 0.73 pg I-TEQ/g wet tissue) and contribute only little to the daily intake of toxic equivalents via food. The average consumption of freshwater fish from culture of 2.7 g fillet/day (calculated from 3) would result in a daily intake of 0.6 to 2.0 pg I-TEQ (0.01 to 0.03 pg I-TEQ/kg body weight/day). Remarkably the contamination levels of most analyzed free living trouts and carps from rivers and lakes in Bavaria were not elevated compared to fishes from farming. Only a few fishes from rivers showed increased PCDD/PCDF levels.

References

- 1) Beck H., A. Droß and W. Mathar, Chemosphere **25**, 1539-1550, 1992
- 2) Fürst P., Chr. Fürst and W. Groebel, Chemosphere **20**, 787-792, 1990
- 3) Fischwirtschaft, Daten und Fakten 1993, Fischwirtschaftliches Marketing Institut, Bremerhaven, 1993

Figure 1: PCDD/PCDFs in freshwater fish

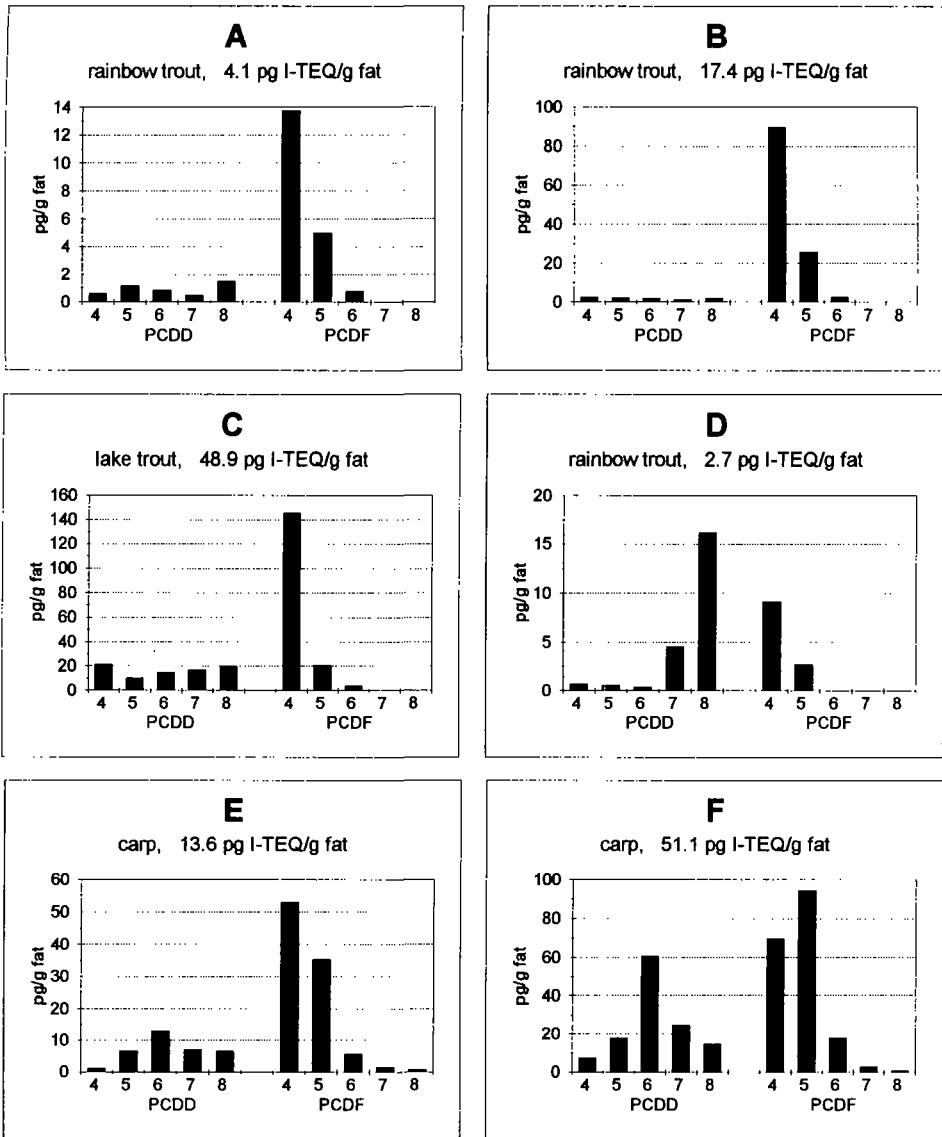


- A: rainbow trouts from farming (Bavaria, Denmark, Spain)
- B: rainbow trouts and trouts from rivers and lakes in Bavaria, South Germany
- C: carps from farming (Bavaria)
- D: carps from rivers and lakes in Bavaria, South Germany

Each I-TEQ value represents one analyzed sample irrespective of the number of pooled individuals.

Labels T1, C1, C2 designate selected samples as described in the text.

Figure 2: PCDD/PCDF homologue profiles in trouts and carps



PCDD: 4: sum TCDD 5: sum PeCDD 6: sum HxCDD 7: sum HpCDD 8: OCDD
 PCDF: 4: sum TCDF 5: sum PeCDF 6: sum HxCDF 7: sum HpCDF 8: OCDF