An experimental study on the excretion of PCDDs, PCDFs and PCBs in milk from the Sprague-Dawley rat

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Introduction

Human exposure to highly toxic environmental organohalogen pollutants, such as polychlorinated biphenyls (PCBs), polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCFDs), occurs mainly via contaminated food. Application of present risk assessments to actual exposure levels demonstrates that there are groups of people in the general population, which actually exceed the recommended tolerable daily intake-level of these compounds. It cannot be excluded that present exposure of the general population results in developmental deficits in children exposed *in utero* and through breast-feeding. The toxicity of individual PCB/PCDD/PCDF congeners is known to be highly structure dependent, but little is known about the congener specific transfer of these compounds from the mothers food to the fetus and to the offspring during lactation. To increase the knowledge on how these compounds are transferred via mothers milk under experimental conditions, a method to measure these compounds as well as the fat content in small volumes of rat milk was developed.

Materials and methods

Four PCBs, four PCDD and six PCDF congeners (table 1.) were given individually as single oral doses to the dams within 24 hours of delivery, i. e. post natal day (PND) 0. The litters were normalized to 6 male pups at the time for administration. Milk was collected from several nipples under reduced pressure into plastic vials on PND 5 and 12. The dams were briefly anaesthetised with fluanisone (3 mg/kg i.p.) and fentanyl (0.07 mg/kg i.p.) and oxytocin (2.5 IE s.c.) was administered to induce milk production. The milk samples (75 µl) were taken up into haematocrit tubes and were centrifuged for 15 min. The relative length (creamatocrit) of the fat layer was used to calculate the fat content in the milk against calibration standards made from commercially available milk and cream-products that contained from 2.5% up to 28% fat. Chemical analysis of milk samples taken on PND 5 and 12 from two individual dams from each exposure were made by HRGC-MS or HRGC-HRMS.

Results

The mean milk volumes collected after 30 minutes of milking were 0.8 ± 0.3 ml and 1.0 ± 0.3 ml on PND 5 and 12, respectively. There was no relationship between the fat content and the milk volume collected. The fat content in the milk on PND 5 was 20.4 ± 5.3% as compared with 17.0 ± 4.3% on PND 12. These fat levels are much higher than in human and cows milk. The chemical analysis of the PCBs, PCDDs and PCDFs showed that the toxicokinetic behaviour varies considerably between the congeners even though they belong to the same class of substances. Estimated half-lives calculated on milk levels ranges from 4 days for lower chlorinated congeners up to 90 days for the octachlorinated dibenzofuran.

Table 1. Concentrations of PCDDs/PCDFs/PCBs in milk collected from female Sprague-Dawley rats 5 and 12 days after oral administration of the congeners.

	Dose	concentration ng/g fat	
Congener	µg/kg	Day 5	Day 12
2,3,7,8-TCDD	0.1	0.20	0.08
2,3,7,8-TCDD	1	1.95	1.29
2,3,7,8-TCDD	10	11.51	5.54
2,3,7,8-TCDF	10	1.47	0.44
1,2,3,7,8-PeCDD	10	18.07	6.97
2,3,4,7,8-PeCDF	10	1.41	1.11
1,2,3,6,7,8-HxCDF	80	2.36	1.09
1,2,3,4,6,7,8-HpCDD	80	22.26	10.73
1,2,3,4,6,7,8-HpCDF	80	11.92	9.66
OCDD	500	18.54	16.84
OCDF	500	28.62	27.13
2,3,6,7-TCDF	500	3.46	1.04
3,3',4,4'- TCB	10000	696	191
2,3,3',4,4'-PeCB	10000	19400	8990
3,3',4,4',5-PeCB	50	124	81
3,3',4,4',5,5'-HxCB	2000	3390	2430

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