

PCDD/PCDF Intake of Humans - a Duplicate Study in a Contaminated Area

M. Grün^A, O. Pöpke^B, M. Weißbrodt^A, A. Lis^B, M. Ball^B, A. Schubert^C

^A Agrar- und Umweltanalytik GmbH, Saalbahnhofstraße 24, D-07743 Jena, Germany

^B ERGO Forschungsgesellschaft mbH, Albert-Einstein-Ring 7, D-22761 Hamburg

^C Kreisverwaltung Wernigerode, Veterinäramt- und Lebensmittelüberwachungsamt, Am Fischerhof 6, D-38855 Wernigerode

1. Introduction

The distribution of PCDD/PCDF in the environment has been excessively studied in the last 15 years. On the contrary only a few investigations dealt with the daily dietary intake (BECK et al. 1987², 1991³, FÜRST et al. 1990⁴, SCHECTER et al. 1994⁵, THEELEN 1991⁶). The aim of this study was to determine the uptake with the use of the duplicate method.

2. Materials and Methods

2.1 Sample collection

The study has been carried out in a known PCDD/PCDF contaminated area exposed to emissions of a copper reclamation plant. The plant had been closed three years before the begin of the study. The determinations of the daily PCDD/PCDF intake were carried out with the use of the duplicate method. The persons involved in the study had to collect a second portion of the meals consumed (so called "duplicates") including snacks and beverages. To allow for reliable results the WHO (1985)⁷ recommended for this kind of studies a number of seven male and seven female volunteers. In this study duplicate samples from seven men and seven women were collected of which six were analysed for PCDD/PCDF after a thorough reliability examination. The participants had not to change their consumption behaviour during the course of investigation. All persons had to give notes on the meals consumed in a special written report. To record different diet habits the sampling was effected on seven consecutive days in spring, summer, fall and winter of 1994. The contribution of both - the self-produced foodstuffs as well as food originating from the contaminated area - could not be exactly estimated but was relatively small.

2.2 Experimental

All diet samples were homogenised immediately with the use of meat grinder and Ultraturrax. For the PCDD/PCDF tests mixed week-samples were elaborated and analysed. The samples were stored at -18°C and then freeze-dried and crushed with the Warring

HEX

blender prior to analysis. The extraction was effected in Soxhlet with hexane/acetone 1:1 (20 h) after spiking with following ¹³C-labelled internal standards:

2,3,7,8-	TCDF	2,3,7,8-	TCDD
1,2,3,7,8-	PCDF	1,2,3,7,8-	PCDD
2,3,4,7,8-	PCDF	1,2,3,4,7,8-	HxCDD
1,2,3,4,7,8-	HxCDF	1,2,3,6,7,8-	HxCDD
1,2,3,6,7,8-	HxCDF	1,2,3,7,8,9-	HxCDD
1,2,3,7,8,9-	HxCDF	1,2,3,4,6,7,8-	HpCDD
1,2,3,4,6,7,8-	HpCDF	1,2,3,4,6,7,8,9-	OCDD
1,2,3,4,7,8,9-	HpCDF		
1,2,3,4,6,7,8,9-	OCDF		

The recoveries of the internal standards exceeded 60 %. The clean-up was effected on a multicolumn system including Carbopak-Celite 545. The samples were analysed with HRGC/HRMS using 60 m DB5/SP2331 columns and the VG AutoSpec mass spectrometer. The determinations were carried out according to the isotope dilution method.

3. Results and Discussion

The mean dry matter intakes of the volunteers are presented in Table 1. As expected men consumed on average about 30 % more dry matter than women.

Table 1 Mean daily dry matter intakes of the volunteers (g dry matter/day)

		Winter	Spring	Summer	Fall	Whole Year
Female	\bar{x}	293	266	282	286	282
	S	51	47	57	67	-
	Xmin	233	199	183	193	-
	Xmax	348	330	339	355	-
Male	\bar{x}	369	352	387	384	373
	S	53	70	68	88	-
	Xmin	315	260	331	283	-
	Xmax	441	473	507	506	-

PCDD/PCDF in 48 mixed week-samples were determined congener specifically. The average dioxin intake of persons involved in the study reported expressed both as the total PCDD/PCDF and as I-TEQ is shown in Table 2. It amounted within the whole study to 54 and 69 pg I-TEQ/day (women and men respectively) that corresponds to 0.79 and 0.91 pg I-TEQ/kg body weight and day.

Table 2 Mean daily PCDD/PCDF intakes of the volunteers

		Total PCDD/PCDF pg/day	I-TEQ pg/day	Total PCDD/PCDF pg/d kg*	I-TEQ pg/d kg*
Male					
Winter		3904	51	53.5	0.68
Spring		2839	63	39.1	0.84
Summer		2498	77	33.8	1.03
Fall		4021	83	53.4	1.11
Whole Year	\bar{x}	3316	69	44.9	0.91
	S	761	14	10.1	0.19
	Xmin	712	19	12.1	0.2
	Xmax	14400	176	188.9	2.23
Female					
Winter		758	30	18.7	0.44
Spring		1685	53	26.8	0.78
Summer		2065	67	33.1	0.99
Fall		2455	64	34.4	0.94
Whole Year	\bar{x}	1741	54	28.2	0.79
	S	727	17	7.2	0.25
	Xmin	250	10	4.4	0.13
	Xmax	3614	152	72.3	3.04

* expressed as kg body weight

The intake of the male participants was on average abt. 30 % higher than that of the female ones that reflects the difference in dry matter intake (see Table 1) and can be attributed to this fact. The PCDD/PCDF (I-TEQ) of both men and women was at its highest in summer and fall. This cannot be explained generally with a higher dry weight intake and could possibly result from consumption of self produced foodstuffs from this area, such as fruit, vegetables or mushrooms.

The mean daily dioxin intake in the investigated area amounted to < 1 pg I-TEQ/kg body weight. The intake limit of 1 pg I-TEQ/kg body weight set by the German Federal Health and Environment Offices (BGA 1985¹) was not exceeded even in this PCDD/PCDF contaminated area that can be related to a high contribution of the non-local foodstuffs to the goods basket.

4. Summary

Using the duplicate method the PCDD/PCDF intake of six male and six female volunteers was investigated on seven consecutive days in winter, spring, summer and fall of 1994. The dioxin determinations were carried out in mixed week-samples resulting from duplicate samples collected daily. The mean daily PCDD/PCDF intake of women and men amounted to 54 and 69 pg I-TEQ resp. that corresponds to 0.79 and 0.91 pg I-TEQ/kg body weight.

5. References

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