The influence of nutrition on the dioxin and PCB content in human milk

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ABSTRACT

Six mothers living in Vienna participated in a study where their milk was collected according to a specially designed protocol for their food intake. The coded milk samples have been analyzed for PCDDs and PCDFs without breaking the code, and the conclusion could be drawn that the diet seems only to have a marginal influence on the PCDD and PCDF levels in the milk.

INTRODUCTION

In 1984 it was first reported that human milk was contaminated by PCDDs and PCDFs. The exposure to a nursing child was calculated to exceed 10 pg TEQ/kg bw /day, but in spite of this, the expert group collected by WHO/EURO strongly encouraged breast feeding. Hundreds of human milk samples have now been analyzed, but until now no data is available to show the influence of the diet on the contamination level of the milk.

However, in a survey organized by WHO/EURO it was found that there is a geographical trend in the levels (1). The highest levels (30-40 pg TEQ/g milk fat) were found in samples from Belgium, The Netherlands, UK and Germany. The lowest levels (10-20 pg TEQ/g milk fat) were found in samples from Austria, Hungary and Yugoslavia, while levels in the range 20-30 pg TEQ/g milk fat were found in samples from Scandinavia, Poland, Japan, USA and Canada.

MATERIALS AND METHODS

Six mothers, living in Vienna, participated in the study. They were 23-26 years old, they had been breast feeding for > 3 month and the breast feeding was well established. The weight of the mothers was stable, $\pm$ 2 kg during the four weeks studied, and the mothers as well as the children were in good health.

EXP

Milk samples were collected according to an experimental design protocol. The first sample was collected during day one, a day with no specific food diet (start up sample). The second sample was collected after 24 hours of fasting (hunger day sample). The caloric intake was < 500 kcal and no animal or fish fat was allowed. Thereafter, four weeks followed where the mothers received alternatively high animal/fish fat diets or low fat (mainly vegetarian) diets weekly according to Table 1.

Table 1

Mother	week 1	week 2	week 3	week 4
1	high	high	low	low
2	high	low	high	low
3	high	low	low	high
4	low	high	low	high
5	low	high	high	low
6	low	low	high	high

One milk sample was collected every diet week. Consequently, including the "start up sample" and the "hunger day sample", each mother collected 6 milk samples.

The breast milk samples, about 100 ml, were collected during maximally two days and transferred into prewashed bottles, and thereafter they were stored in freezer.

Prior to extraction a number of ^{13}C-labelled PCDD/Fs, non-ortho PCBs, and mono-ortho PCBs were added to the samples. Thereafter the samples were extracted by liquid/liquid extraction using ethanol/ diethyl ether/ n-hexane (2/1/2) and n-hexane (2).

To the extracts a small amount of tetradecane was added as a keeper, and then the solvent was evaporated. Lipid removal was performed in two steps. First polyethene film dialysis in cyklopentane eliminated the major part of the lipids (3) and then a multi-layer silica column (H_2SO_4- / neutral / KOH-SiO_2), was used to remove further lipids.

To separate mono-ortho PCBs from non-ortho PCBs and PCDD/Fs two consecutive columns, one basic alumina and one Carbopack C/Celite, were used (3). Prior to the instrumental analysis ^{13}C-labelled recovery spikes were added to the samples.

Every seventh and eighth samples were blank samples, which followed the clean up procedure from the extraction step or from the dialysis step respectively. Glass destilled solvents were used in all moments.

The instrumental analyses were performed on a high resolution gas chromatograph (HRGC), HP-5898 equipped with a 60 meter PTE-5 capillary column, coupled to a high resolution mass spectrometer (HRMS), VG 70-250S, operating in electron impact mode (EI) at a resolution of 8000 Daltons.

RESULTS AND DISCUSSION

The code will be broken when all the samples have been analyzed. The results of the samples from one of the mothers are given in Tables 2 and 3. Due to problems in the fat determination, the results from sample D2005 are only given on the milk basis. Without breaking the code the conclusion could be drawn that the levels of PCDDs and PCDFs seem to be only marginally influenced by the diet.

Table 2 pg/g milk

Code	D2001	D2002	D2003	D2004	D2005	D2006
Analyzed amount (g)	82	90	74	109	70	88
2378-TCDD	0.08	0.06	0.12	0.08	0.09	0.05
Rec. TCDD (%)	54	58	43	45	37	49
23478-PeCDF	0.89	0.73	1.3	0.76	0.98	0.69
Rec. PeCDF (%)	62	67	50	56	42	57
123678-HxCDD	0.48	0.40	0.89	0.55	0.41	<0.4
Rec. HxCDD (%)	27	27	30	23	16	11
1234678-HpCDD	1.4	1.1	2.1	1.2	1.3	0.86
Rec. HpCDD (%)	49	46	37	45	29	29
OCDD	5.1	4.1	7.5	4.4	4.7	3.5
Rec. OCDD (%)	49	47	34	44	28	39

Table 3 pg/g fat

Code	D2001	D2002	D2003	D2004	D2005	D2006
Analyzed amount (g)	6.1	5.2	5.5	6.6	1.3	4.7
2378-TCDD	1.1	0.96	1.6	1.3		0.87
23478-PeCDF	12	13	17	13		13
123678-HxCDD	6.4	6.8	12	9.1		<10
1234678-HpCDD	19	19	28	20		16
OCDD	68	70	100	73		67
Rec. (%) see Table 2						

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