Background Contamination of Humans with Dioxins and Dioxin -like PCBs

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Introduction

Polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated Dibenzofurans (PCDFs) are unwanted by-products in a variety of industrial and thermal processes while polychlorinated biphenyls (PCBs) are a family of components produced commercially by direct chlorinating of biphenyl. Depending of the number and position of the chlorine in the molecules the maximum number of PCDD/Fs and PCBs is 210 and 209 respectively.

Dioxins have been found in environmental samples of ancient origin /1/2/. First findings for these components have been reported for human ancient samples /3/4/. In all samples the concentration were found to be quite low. The beginning of the chlorine industry induced a strong increase of these substances in the environment as presented by Hagenmeier et al. /5/ in sediment cores from the Lake Constance.

In contrast to environmental samples, in humans only a limited number of PCDD/Fs and PCBs are found. First analyses in human tissue were performed by Baughman and Meselson,1973 /6/, Miyata et al.,1977 /7/, and Langhorst and Shadoff, 1980 /8/. Rappe et al.,1984 /9/ reported on the finding of only 2,3,7,8-chlorine substituted PCDD/Fs in human milk samples originating from Europe. The values reported demonstrated that a PCDD/F-background contamination for the general population has to be assumed. Humans may become contaminated with PCDD/Fs through environmental (background), occupational or accidental exposure. In this overview only environmental exposure will be reported at.

It is generally agreed that for the normal population food represents the main route of environmental exposure to PCDD/Fs and PCBs. Usually more than 95 % of the total intake of these contaminants derive from food. In contrast, exposure via other roots, such as inhalation of particles from air, ingestion of contaminated soil and dermal absorption, normally contributes less than 10 % of daily intake. Because humans are at the high end of the food chain, it becomes obvious that human tissue contains relatively high amounts of PCDD/Fs and PCBs. Because of the lipophilic nature of these three classes of environmental contaminants, foodstuffs of animal origin are of special importance. Due to a lack of data for dioxin like PCBs,, the main emphasis will be given to the PCDD/Fs.

Results

The intake of between 0,5 and 3 pg I-TEQ/kg body weight via food results in environmental or background contamination of adults. To recognize human background contamination it is possible

to analyze adipose tissue, milk or blood. Blood is easy to obtain from humans and is therefore the preferred tissue to be investigated.

The correlation between serum and adipose tissue, whole blood and adipose tissue and whole blood and human milk for 2,3,7,8-TCDD and other PCDD/Fs was demonstrated by Patterson et al./10/, Schecter et al. /11/ and by Päpke /12/. The I-TEQ- values for the compared pairs were quite similar whereas the Hepta - and Octa congeners indicated some differences.

Looking at the pattern of a typical human tissue sample the concentration is dominated by Octa-CDD. When looking at the contribution of the different congeners to the whole TEQ, 2,3,4,7,8-PentaCDF, PCB 126 and PCB 156 are of special importance as reported by Liem and Theelen /13/ for human milk The contribution to the total toxicity of these 3 congeners is more than 50 %. The same authors reported for the contribution of PCDD/Fs, non-ortho PCBs (77, 126, 169) and other PCBs (105, 118, 156, 157, 167, 180, and 189) to the total level of 2,3,7,8-TCDD equivalents (TEQs) 53 %, 20 % and 27 % respectively.

The human body burden of PCDD/Fs and PCBs can be influenced by a number of factors including eating habits, severe weight loss or weight increase, influence of age; for women nursing, for babies nursed or not nursed .

Because of the importance of mothers milk for infants, mothers milk is of public concern. In 1984, the first measurements for background contaminated milk were reported for Sweden and Germany. WHO induced large measurement champagnes in 1988 and 1993 worldwide. The results of this investigation will be given. Until now, in Germany more than 2000 samples of mothers milk have been analyzed by different groups. In table 1, the intake situation of nursed infants is shown by results from Fürst et al /14/.

Table 1: I-TEQ values in mother's milk, North Rhine-Westphalia 1994, and daily intake by infants, Fürst at al. /14/

Errore. Il segnalibro non è definito. Mother's Milk, n = 50			Daily Intake of I-TEQ					
pg/g lipid based			Total pg			pg/kg BW/Day		
Med	Min	Max	Med	Min	Max	Med	Min	Max
16,1	4,9	30,3	386	118	727	77	24	145

Basis: Bodyweight (BW) 5 kg
Milk amount: 800 ml
Lipid content: 3 %

The result of this table demonstrates, that nursed infants have a daily intake of only dioxins of about 77 pg I-TEQ/kg body weight and day. Consequently, the average daily PCDD/F- intake for

a breast - fed baby is approximately 50 times higher than the average daily PCDD/F-intake for an adult.

For most of the PCDD/Fs and PCBs, long half lives have been observed in humans. The half-life of 2,3,7,8-TCDD has been studied most comprehensive. Most of the studies found a half live for TCDD at about 7 years. At this conference Geusau et al. /15/ report on a case of poisoning of two woman with 2,3,7,8-TCDD. The first measurements – probably 5 to 6 months after the poisoning , values of 144 000 and 25 000 pg 2,3,7,8-TCDD/ g blood lipid were found , the highest values ever measured in adults. The half live studies performed on the blood of both persons resulted in the first year after the exposure at 200 and 230 days respectively.

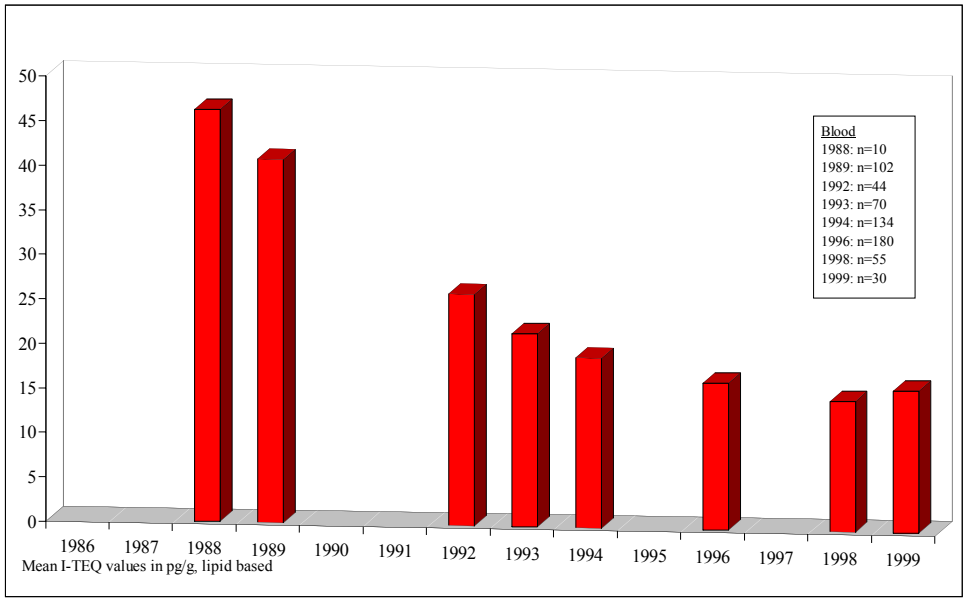

Figure 1 Time trend of PCDD/Fs in human blood

A time trend for PCDD/F in humans was first observed in German mothers milk by Fürst et al. /16/ in 1992. In figure 1, this time trend is demonstrated for human blood as well by Päpke et al /16/. Between the end of the 1980s and 1999, the reduction ranged between 50 and 70 % on I-TEQ basis. Similar effects have been observed in the Netherlands, Denmark, the United States and the United Kingdom. Theses results seem to indicate that efforts to reduce emissions in the industry have notable effects.

Despite declining PCDD/F trend, the exposure of babies during the breast - feeding period is still a matter of concern and justifies taking measures to reduce PCDD/F emissions into the environment.

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