DEBATE

Food contamination with polychlorinated biphenyls and dioxins in Belgium. Effects on the body burden

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J Epidemiol Community Health 2002;**56**:828–830

The core paper of this debate shows that persistent organic pollutant residues of the 12 chemicals targeted for a phase out under the Stockholm Convention are present in almost all categories of food in the US food supply. For dioxins, the study does not use measured data, but is based upon potential dioxin residues in selected food items. Polychlorinated biphenyls are not included in the study. In this paper we discuss selected data of polychlorinated biphenyl and dioxin concentrations in Belgian food. Some of these exposures are chronic, others are attributable to incidents. Both result in high body burdens in Belgium. The paper also compares the current concentrations in food with the recent standards launched by the EU for dioxins in food, and discusses whether these values adequately protect European citizens.

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CHRONIC EXPOSURE

Background emissions of dioxins in Belgium are high. Although the emissions of primary sources are decreasing, concentrations in the food chain remain among the highest worldwide. In 1995, 1.151 g I-TEQ of dioxins were emitted in Belgium.[1] A comparison of dioxin and furan inventories for 15 countries[2] shows that the per capita emission in Belgium is the second highest after Japan. Sixty per cent of this value is attributable to emissions into the air.

Quantitative data on PCB fluxes for the country as a whole are not available, but some data point to an important diffuse chronic background contamination of these foodstuffs with polychlorinated biphenyls (PCBs).

In a study that aimed at monitoring Belgian chicken and pork intended for export, produced by farms not suspected of being involved in the PCB/dioxin crisis in early 1999,[3] seven marker PCBs (IUPAC numbers 28, 52, 101, 118, 138, 153, and 180) were analysed in 1850 samples. It was found that in 88% of the samples concentrations of PCBs were below 50 ng PCBs/g fat, while 12% of these chicken or pork samples contained more than 50 ng PCBs/g fat. Some 1.2% of the samples even contained more than 200 ng PCBs/g fat. Two per cent of the samples exceeded the limit set by the Belgian authorities.

ACUTE EXPOSURE

To these background emissions are added PCBs and dioxins, which are incidentally admixed to the food chain. During the period 1998–2001, three incidents of contamination of the Belgian food chain through PCB/dioxin contamination of animal feed were reported. The most dramatic one occurred in 1999. In January that year, approximately 50 kg of mineral oil containing PCBs and almost 1 gram of dioxins (the most likely source being discarded transformers originating from a waste recycling centre) was admixed to the fat delivered to 10 animal feed producers. The resulting 500 tons of contaminated animal feed were distributed to poultry farms and, to a lesser extent, also to rabbit, calf, cow, and pig breeding and raising farms, mostly in Belgium, but also in the neighbouring countries. Through the animals the PCBs and dioxins spread over the whole food chain. Chicken, pork, and eggs were the most contaminated products. The authorities only started to act convincingly on the issue after 27 May, when the media made the incident known to the public. One of the actions taken was a large scale monitoring project of PCB and dioxins in food. During the period May to August 1999, 20 491 food samples were analysed. During the period after August 1999, over 40 000 samples were analysed as a direct response to the incident.[4]

The highest dioxin concentrations were found in poultry fat and eggs. In 6.5% of the poultry samples and 8.1% of the egg samples, concentrations above 200 ng PCBs/g fat were found. For dioxins, concentrations above 2 pg/g fat were found in 41.9% of the poultry and 63.6% of the egg samples.[4] Of core importance is whether these types of separate incidents have an effect on the body burden of the population. Table 1 shows the results of measurements of three marker PCBs in bloodfat for three groups of Belgian women. One group was monitored before the 1999 incident. The two other groups were studied after the crisis. The data suggest that the crisis caused an important increase in PCB body burden. Although these figures need to be interpreted with caution (for example, because the three groups are not directly comparable), any increase is worrisome as body burdens of PCBs and dioxins of the magnitude found in Belgium have been associated with adverse effects both in animals and in humans.[3]

NEW EU STANDARDS

As a partial response to the 1999 PCB/dioxin incident in Belgium, the Health and Consumer

Abbreviations: POPs, persistent organic pollutants; PCBs, polychlorinated biphenyls

Table 1 PCB body burdens in Belgium women before and after the contamination crisis early in 1999

	PCB 138 (ng/g fat)	PCB 153 (ng/g fat)	PCB 180 (ng/g fat)
1996–1998			
106 infertile women (aged 24–42) (mean age 31.9)[9]	69.9	94.5	72.0
Second half of 1999			
120 girls (mean age 17.4)[10]	75.9	101.6	55.5
197 women aged 50–65 (mean age 58.5)[10]	125.4	171.1	123.1
Body burden increase in 1999, after correction for age*, as percentage of the body burden found during 1996–1998 in infertile women	33.6	33.5	10.2

*Correction for age was performed through linear extrapolation based on the measurements done in 1999. This linear extrapolation can be expected to underestimate the body burden at age 31.9 years, as it is likely that a proportionally greater increase in body burden with age will occur between age 17.4 and age 31.9 than between age 31.9 and age 58.5. The real age corrected increase between the two periods might thus be higher than the one shown in the table.

Table 2 Maximum daily intake, stemming from an average Belgian diet, of PCDD+PCDF, tolerated according to the new European Council regulation (EC) no 2375/2001 of 29 November 2001 (in pg WHO-PCDD/F-TEQ)

Food item	Average daily intake in Belgium (g)	Amount of fat (g fat/100g product)*	Average daily consumption of fat from corresponding food item in Belgium (g)	EU standard (PCDD+PCDF) (pgWHO-PCDD/F-TEQ/g fat of product)[5]	Maximum daily intake of PCDD+PCDF tolerated according to new regulation (pgWHO-PCDD/F-TEQ)
Bovine meat	54	3.3	1.8	3/g fat	5.4
Pig meat	56.6	10.7	6.1	1/g fat	6.1
Poultry meat	53	9.4	5.0	2/g fat	10
Fish	30			4/g fresh weight	120
Hen eggs and egg products	30	10.6	3.2	3/g fat	9.6
Milk	200	3.5	7	3/g fat	21
Butter	20	83.4	16.7	3/g fat	50.1
Cheese	30	31.5	9.5	3/g fat	28.5
Edible (mixed) animal fat	10	100	10	2/g fat	20
Edible vegetable oils	10	100	10	0.75/g fat	7.5
Total					278.2

*The value for a popular food item of the corresponding type was taken; as to edible oils and edible fats, the intake of which is 20 g/day, it is assumed that 50% stems from a vegetable source.

Protection division of the European Commission has established new maximum limits for dioxins in food.[5] The regulation entered into force on 1 July 2002. Maximum levels range between 0.75 pg WHO-PCDD/F TEQ/g fat (for vegetable oil) to 6 pg TEQ/g fat (for liver and derived products). For fish and fishery products, the standard is 4 pg TEQ/g fresh weight. Through this expression of concentration per gram fresh weight, the sum of dioxins TEQs in fish will exceed 10 to 20 times the maximum residual limits set for animal meat (expressed per gram fat). These new regulations do not take into account the dioxin-like PCBs for which TEQ values have been set.[6] These PCBs account respectively for 69% and between 41% and 74% of the total TEQ load of fish[7] and Belgian meat or dairy products.[8] Recent measurements show that mean PCDD plus PCDF TEQ levels (not taking into account dioxin-like PCBs) in Belgian meat and dairy products are below the limits set by the new regulations (beef: 1.84 pg TEQ/g fat; pork 0.22 pg TEQ/g fat; chicken 0.35 pg TEQ/g fat; butter 0.80 pg TEQ/g fat; milk 0.34 pg TEQ/g fat). Table 2 provides the data that enable the calculation of the maximum daily intake of dioxins taking into account the new EU standards and an average Belgian diet. The calculation shows that up to 280 pg WHO TEQ per day, corresponding to 4 pg/kg body weight per day or to 28 pg/kg body weight per week can be taken in. This is well above the 1 pg/kg body weight per day that is set by the WHO as a limit for the future, and twice the tolerable weekly intake for dioxins and dioxin-like PCBs set by the Scientific Committee for Food at 14 pg WHO-TEQ/kg body weight.[5]

Standards aimed at regulating maximum residual limits of dioxins in foodstuffs show several limitations, including: the high levels permitted in fish; the lack of standards for dioxin-like PCBs; the intakes they permit, which can be above WHO recommendations; the high levels that are tolerated for pesticides (for example, for DDT, the European Council limit is 1000 ng/g fat); the lack of standards for more recently introduced persistant organic pollutants (POPs) such as polybrominated biphenyl ethers (PBDEs); and the current incapability of standards to protect for synergistic effects of these endocrine disrupters.

Much more drastic measures are required to decrease exposure to dioxins, PCBs, and other POPs.

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