

PCB Contamination of Italian Human Milk: The Contribution of Toxic Congeners.

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The contamination of human milk by organochlorine compounds (OCs) raises the question of the content of toxic substances in this important food matrix. Due to their tendency to bioaccumulate, OCs reach quite a high concentration in organisms at the top of the food-chain. Determinations of PCBs and chlorinated pesticides have long been performed¹⁻³, and, more recently, PCDDs and PCDFs have also been determined^{1,3,4}. The analytical methods widely employed for PCB determination do not generally allow for an isomeric-specific quantitation of the planar congeners, which are present in very low concentrations. Consequently, there is a scarcity of data concerning these compounds, some of which have toxic characteristics which may be expressed in terms of "Toxicity Equivalents" (TE) of 2,3,7,8-Tetrachlorodibenzo-p-dioxin⁵.

Samples of human milk were collected in the cities of Florence, Milan, Pavia and Rome according to the 1987 World Health Organization (WHO) protocol³ for the determination of PCDDs and PCDFs. Both individual and pooled samples were analyzed for isomer-specific determination of PCBs in two different laboratories. The analytical procedure is described elsewhere⁶. Briefly, it involves isotopic dilution of samples (only for GC-MS analyses), solvent extraction of fat, concentrated H₂SO₄ treatment, high-resolution GC determination, either with EC or with MS detection.

The correlation coefficient (r) of the results obtained in the two laboratories when the same samples were analyzed was 0.97; identification of the analytes performed by ECD was also confirmed by MS.

The figure shows the mass chromatogram of the determination of hexachlorobiphenyls in one of the samples analyzed. The results of total PCB determination of the pooled samples

from the four Italian cities are reported in Table 1. They show that there are no substantial differences between pooled samples from the different cities; however, significant differences exist between individual samples⁶. For each toxic congener, Table 2 reports the mean concentration obtained by averaging the results of the pooled samples from the four cities; the concentrations are expressed also as toxicity equivalents of 2,3,7,8-TCDD, with the "Toxicity Equivalency Factors" (TEFs) proposed by Safe⁵.

As far as the major components are concerned, levels of PCB contamination of Italian human milk samples do not differ greatly from those of other European countries^{3,6}. Even though planar PCB contamination levels are not reported in the 1989 study by WHO, it can reasonably be assumed that they also are similar. We found indeed similar contamination patterns in different samples with similar contamination levels.

WHO³ reported that, for a 5 kg baby, consuming 0.7 l/d of milk from Northern European countries, containing 3.5% fat, the Weekly Intake from PCDDs+PCDFs would be 600 pg TE (Nordic)/kg bw. For the same baby feeding on the same amount of milk fat from milk with the same PCB contamination levels that we measured, the Weekly Intake from the toxic PCBs would be higher (3,200 pg TE^{1*}/kg bw).

Therefore it seems strongly advisable that toxic PCB congeners also be considered when assessing the human exposure to PCDDs and PCDFs, even considering that the TEFs for toxic PCBs are still only proposed values. Moreover, analytical procedures also should allow for determination of toxic PCBs together with PCDDs and PCDFs.

1) Jensen, A. A. Polychlorobiphenyls (PCBs), Polychlorodibenzop-dioxins (PCDDs) and Polychlorodibenzofurans (PCDFs) in human milk, blood and adipose tissue. *Sci. Total Environ.*, 1987, 64:259-293.

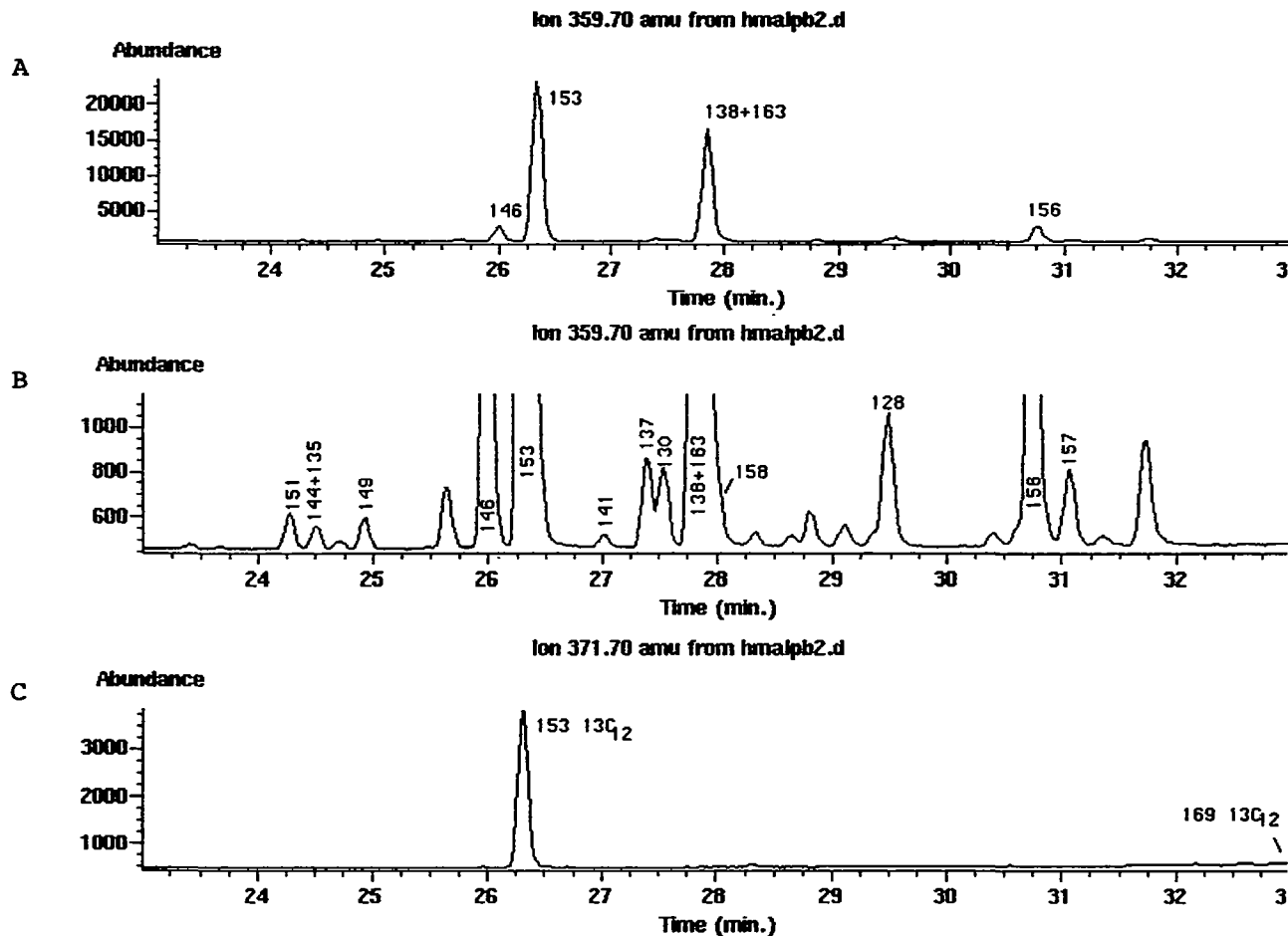
2) Dommarco R, Di Muccio A, Camoni I, Gigli B. Organochlorine pesticide and polychlorobiphenyl residues in human milk from Rome (Italy) and surroundings. *Bull. Environ. Contam. Toxicol.* 1987, 39:919-925

3) WHO. *Levels of PCBs, PCDDs and PCDFs in breast milk* WHO Regional Office for Europe, FADL, Copenhagen, 1989.

4) di Domenico A, Turrio Baldassarri L. Levels of Polychlorobiphenyls (PCBs), Polychlorodibenzodioxins (PCDDs) and Polychlorodibenzofurans (PCDFs) in human milk. *Ann. Ist. Super. Sanità*, 1990, 26: 141-154

5) Safe S. Polychlorinated Biphenyls (PCBs), dibenzo-p-dioxins (PCDDs), and related compounds: environmental and mechanistic considerations which support the development of toxic equivalency factors (TEFs). *Critical Rev. Toxicol.* 1990, 21: 51-88.

1.*Safe's TEFs generally agree with Nordic TEFs.



Mass-chromatogram of hexachlorobiphenyls: A) profile of the prevalent molecular ion B) the same as A, expanded 20 times C) isotopic tracers

6) Larsen BR, Nilsson T, Facchetti S, Turrio Baldassarri L, Iacovella N, di Domenico A, Montagna M, Toxic PCB congeners and organochlorine pesticides in Italian human milk. To be submitted to *Ecotox. Environ. Safety*.

TABLE 1 Total PCB in Pooled Human Milk Samples From Four Major Italian Cities					
	ROME	MILAN	FLORENCE	PAVIA	MEAN ± SD
µg/g fat:	0.55	0.53	0.60	0.65	0.59±0.05
µg/kg milk:	19	12	20	23	19±5

TABLE 2 Actual concentrations, TEFs and 2,3,7,8-TCDD Toxicity Equivalents from Toxic PCB Congeners in Italian Human Milk			
	TEF	CONC (ng/g fat)	pg TE/g fat
Non-ortho			
PCB-77	0.01	0.007 ± 0.003	0.07 ± 0.03
PCB-126	0.1	0.098 ± 0.012	9.8 ± 1.2
PCB-169	0.05	0.047 ± 0.080	2.4 ± 0.4
<i>Sum of Non-ortho</i>			<i>12.3 ± 1.9</i>
Mono-ortho			
PCB-105	0.001	9.5 ± 1.0	9.5 ± 1.0
PCB-114	0.001	3.1 ± 0.2	3.1 ± 0.2
PCB-118	0.001	41 ± 5.0	41 ± 5.0
PCB-156	0.001	13 ± 2.8	13 ± 2.8
PCB-157	0.001	2.5 ± 0.5	2.5 ± 0.5
PCB-167	0.001	1.2 ± 0.4	1.2 ± 0.4
PCB-189	0.001	1.2 ± 0.3	1.2 ± 0.3
<i>Sum of Mono-ortho</i>			<i>71.5 ± 9.0</i>
Di-ortho			
PCB-128	0.00002	6.1 ± 0.5	0.12 ± 0.01
PCB-137	0.00002	3.8 ± 0.4	0.07 ± 0.01
PCB-138	0.00002	74 ± 11	1.4 ± 0.24
PCB-153	0.00002	122 ± 14	2.4 ± 0.24
PCB-158	0.00002	2.6 ± 0.6	0.05 ± 0.01
PCB-170	0.00002	30 ± 5.8	0.60 ± 0.12
PCB-180	0.00002	67 ± 11	1.3 ± 0.24
PCB-190	0.00002	5.6 ± 0.6	0.11 ± 0.01
PCB-194	0.00002	5.0 ± 0.7	0.10 ± 0.01
PCB-205	0.00002	5.2 ± 0.5	0.10 ± 0.01
<i>Sum of di-ortho:</i>			<i>6.3 ± 1.2</i>
TOTAL TEQ:			93 ± 11

* Mean ± SD of pools from Rome, Milan, Florence and Pavia