Bull. Environ. Contam. Toxicol. (2003) 70:41–45

DOI: 10.1007/s00128-002-0153-z

Bulletin of Environmental Contamination and Toxicology

Polychlorinated Biphenyl (PCB) Levels in Human Milk Samples from Turkish Mothers

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Received: 8 February 2002/Accepted: 17 August 2002

Polychlorinated biphenyls (PCBs) are one of the important members of persistent organic pollutants (POPs) and have been used worldwide since 1929 and despite restrictions on their production, use and disposal which have been force for many years, they continue to persist in the environment. PCBs have been used in heat exchangers and as a dielectric fluid; as stabilizers in paints, polymers and adhesives; and as lubricants in various industrial processes. The high lipophilicity and the resistance to biodegradation of PCBs allow the bioaccumalation of these chemicals in fatty tissues of organisms and their biomagnification through food chains. Because humans are located at the top of the most food chains, relatively high levels of these compounds have been found in human adipose tissues and breast milk fat. Because of the bioaccumulation and toxicity, usage of the PCBs for different purpose have been restricted or banned since the begining of the 70's in most of the countries.

In Turkey, organochlorine pesticide residues have been monitored in the Turkish population by carrying out regional surveys at given time intervals since 1976 (Karakaya et al. 1987; Burgaz et al. 1994; Cok et al. 1997; Cok et al. 1998). But there have been no national documentation for PCB contamination for several environmental compartments (air, drinking water, sediment, foods, fish, human milk, adipose tissue) except one study (Cetinkaya et al. 1983) which has very limited information on PCBs contamination. Because of this reason, the results of the present study are very important to provide baseline data on the concentrations of PCB contaminants in Turkey.

MATERIALS AND METHODS

Human milk samples were obtained from the Ankara University, School of Medicine, Department of Obstetrics and Gynecology, between April 1999 and February 2000 from 32 mothers who were living in Ankara area for at least 5 years. All mothers participated in the study voluntarily. Milk samples (15-30 ml) were taken from one of the breasts by manual expression at the end of the feeding, and between 5^{th} and 30^{th} day of postpartum. Total collection duration of a sample did not exceed 24 hours. Milk samples were kept frozen at -80 °C until analysis. The age of mothers ranged from 17 to 39 (mean age 24.5±5.4).

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Seven PCB congeners (IUPAC Nos. 21,52,101,118,138,152,180) in human milk were extracted according to the method by Krauthacher et al. (1986). For extraction of milk samples a chloroform/methanol mixture 1:1(v/v) was used and after fat content determination the hexane fat solution was cleaned with conc.sulphuric acid. Quantification was carried out using aldrin as an internal standard.

Gas chromatographic analyses were carried out on a Hewlett-Packard Model 5890 Gas chromatograph equipped with a ^{63} Ni electron capture detector and a HP 3396 integrator. Chromatographic determination of PCBs was carried out using a 50mx0.2mmx0.33μm fused silica capillary column Ultra-2 from Hewlett-Packard. The operating conditions were as follows: injector temperature 260 °C; detector 320 °C; column 80 °C initial with 1 min. hold; 10 °C/min to 280 °C; 1/10 split ratio. The mobile phase was helium. Peak areas were used as the basis for quantification. Residue levels are expressed as ng/g extracted fat.

Standards of PCB congeners were obtained from Accustandarts, Inc., USA. All samples were run in duplicate. Detection limits for all PCB levels quantified in milk are approximately 1 ng/g lipid.

RESULTS AND DISCUSSION

In this study, seven PCB congeners (IUPAC Nos. 28, 52, 101, 118, 138, 153, 180) were selected, as many European governments and regulatory bodies use them as marker compounds to monitor occurrence and distribution (Schoula et al. 1996; Pauwels et al. 2000). Table 1 presents the mean concentrations of PCBs in breast milk fat samples from 32 women.

In order to reflect the real levels of exposure, our study group was composed of primiparous women because such a study was being conducted in Turkey for the first time.

Mothers were classified arbitrarily according to their age into two groups: 17-27 (n: 22), and 28-39 (n: 10) year. No correlations were found between the concentrations of the PCBs and age, except PCB congener No 153 ($p<0.05$). Because all subjects had their first birth, relationship between differences in PCB levels and number of births have not been considered.

Fatty diet and consumption of fish are main sources of PCB exposure (Mes et al. 1991). Human milk samples were taken from people who lived in Ankara. Ankara is an industrial city, in the central of Turkey, quite far away from the sea and big lakes. Nevertheless all subjects had a mixed died including fish.

PCB IUPAC No.153 was a high contributor of the congener occupying 41% of the total PCB content, and together with No.180 of 23% and No.138 of 20 % were the most prevalent members, which seem to be parallel to studies conducted in other countries. Because of the very long biological half-lives of these

Table 1. Concentration of 7 PCB Congeners in Human Milk of Residences of Ankara (ng/g on a lipid wt.basis).

STRUCTURE	**IUPAC NO**	**MEAN±SD**	**RANGE**	**%**
2,4,4'Triclorobiphenyl	28	5,7±16,8	0,0-36.5	18.8
2,2,5,5'Tetrachlorobiphenyl	52	10,3±21,3	0,0-85	25
2,2',4,5,5'Pentachlorobiphenyl	101	6,6±25,2	0,0-71	9.4
2,3,3',4,4'Pentachlorobiphenyl	118	18,9±48.4	0,0-202	18.8
2,2',3,3',4',5Hexachlorobiphenyl	138	54.3±124.4	0,0-568	46.9
2,2',4,4',5,5'Hexachlorobiphenyl	153	110±141.1	0,0-556	56.3
2,2',3,4,4',5,5'Heptachlorobiphenyl	180	59,8±101.5	0,0-266	46.8

chemicals concentrations of PCB congeners 138,153 and 180 in body fat are expected to increase with age (Brown et al. 1989). In table 2, the levels of seven PCBs in human milk found in the present study are compared with that of those of some other countries.

In a study conducted in Germany by Cetinkaya et al. (1983), in human milk samples, provided from Turkish mothers who had lived in Germany, total PCB has been found as 1.28 mg/kg. On the other hand, in samples of five human milk samples provided from Ankara region, no PCB congener has been found. These results indicate the role of industrialization. Since 1983 there has been a variety of uses of PCB as a result of industrialization. So it is very probable to see differences between this study and our study.

PCBs were used as coolant/dielectrics in electrical transformers capacitors and other electrical equipment in several countries including Turkey. However, no statistical data on use of PCBs (in million kg) in Turkey is available. After 1977, PCBs are almost entirely restricted for use in closed systems in most countries. In Turkey, after 1993, PCBs are restricted for use in closed systems and banned after 1996 to the Toxic Substances Control Act. It is also known that combinations of transformer oil and Lindane (γ-HCB) (48+4 %) are widely used as a pesticide in Turkey between 1970 and 1982. Because PCBs are used in nominally closed applications such as in heat-transfer and hydraulic fluids, exposure can still occur through refilling and repair activities. Moreover, there are no strict regulations addressing the disposal of PCBs and controlling PCBs still in use in Turkey.

Further research needs to be conducted in the coastal region which is highly

Table 2. Comparison of level of indicator PCBs in human milk from Turkey (Ankara) with the similar studies from some other countries¤

COUNTRY	**28**	**52**	**101**	**118**	**138**	**153**	**180**	**ref**
Great Britain (1991) (n=32)	31,5	26,2	15	28,6	68,1	85,9	74,9	1
Czech Rep. (1996) (n=17)	nd	nd	nd	28,5	289	379	240,2	2
Germany (1995) (n=68)	17	13	14	*	168	240	173	3
France (1993) (n=20)	31	68	30	37	99	80	103	4
Norway (1994) (n=28)	7,8	*	1,1	26,2	86,8	114,4	50,6	5
Canada (1995) (n=497)	4.75	0,87	*	16,6	28	38,3	20,9	6
Ukraine (1999) (n=197)	$14^{\#}$	$18^{\#}$	$23^{\#}$	$93^{\#}$	$134^{\#}$	$149^{\#}$	$55^{\#}$	7
Turkey (2001) (n=32)	5,7	10,3	6,6	18,9	54,3	110	59,8	**

(1) Duarte-Davitson et al. 1991; (2) Schoula et al. 1996; (3) Georgii et al. 1995 ;(4) Bordet et al. 1993; (5) Jahansen et al. 1994 ;(6) Newsome et al. 1995 ;(7) Gladen et al. 1999.
Nd: below the limit of quantification, #Median, *not analyzed, ** Present study, ¤ ng/g fat bs

industrialized and polluted by chemicals, focusing to indicate PCB values both in humans and the ecosystem.

*Acknowledgments.*We thank all subjects who volunteered to participate. This research was financially supported by the Research Fund of Gazi University (Grant No: G.Ü A.F 02/2000-08).

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