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POLYCHLORINATED BIPHENYLS (PCBs), IN SOUTH BAČKA – FROM THE ENVIRONMENT TO HUMAN MILK

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Abstract:
Measurements of PCBs congeners (PCB 28, PCB 52, PCB 101, PCB 118, PCB 138, PCB 153, PCB 180, PCB 209) in 16 samples of 3rd day human colostrum were performed in 2006, using GC-ECD (HP 5890) supplied with a Quadrex fused silica column 5% Ph for PCBs. Concentrations of PCB congeners – 52, 138, 153 and 180, measured in 2006 were 2-5 times higher than concentrations of the same congeners measured in 2003 in the same region. Human milk, was once again a mirror of environmental pollution.

Keywords:
polychlorinated byphenyls, human milk, environment

1. INTRODUCTION

Our environment is under constant influence of various human activities – seldom beneficial to it, often harmful, sometimes even highly dangerous. Many chemicals are hazardous for human health. Among these, due to their ealier extensive production and worldwide use, are organochlorine contaminants (OCC). Pesticide residues and polychlorinated biphenyls (PCB) still keep the prominent position on OCC list related to human health potential hazards.

Persistent organic polutants (POPs), due to their perzistence, long live and presence in all environmental macroecosystems (soil, water, air, and their macrobiota), and in particular due to their bioaccumulation and biomagnification through the food chain, have made humans particularly exposed [9]. More than 90% of POPs daily intake in humans is via food, and of that amount, around 90% are from animal sources [4].

Breastfed human newborn, nutritionally relying only upon mothers milk, is the ultimate ring in the food chain, on our planet. As such, its level of exposure is highest for humans [12]. Therefore, continuous monitoring of POPs in human milk could point, not only to the level of exposure of very young children, but also to changes in the the environment [11].

PCBs were manufactured from 1930 around the world continued. They were extensively and broadly used in many fields of industry and it was easy for these chemicals to find their way into the environment, in the course of innumerable accidents of various levels. In spite of their restricted use which started gradually in industrialized countries since their potential hazard was anticipated, inadequate storage and disposal, even leakage and spill incidents, continued their environmental inlet. Great chemical stability, physical and chemical inertness, results in a very slow degradation, with their persistence in the environment. This, together with high mobility in the atmosphere, has put PCBs on the list of global environmental pollutants. PCBs bioaccumulated and biomagnified in a wide range of plants and animals consumed by humans, with the net effect of the greatest toxic risk for animals and humans on the end of food chain. As highly lipid soluble substances, with the K_{ow} >5, PCBs are deposited primarily in adipose tissue. In mammals, the only way to excrete in significant amounts liposoluble substances, such as PCBs, is via milk, during lactation. Since milk is the only food during

the first months of life, the exposure of breastfed neonates might be the highest of all macroorganisms, with superimposed postnatal, over prenatal exposure.

Throughout fifteen years, a series of ecologically very unfavorable events [5] - possible atmospheric transport of PCBs from UN bombarded targets in Bosnia and weeks of incinerations and fires after NATO bombardment of oil refinery and other industries in Serbia (e.g. 100 000 ng ITEQ/kg and 70-74 g/kg of PCBs in samples of soil on one location in central Serbia), not only soil and waters, were contaminated, but inevitably plants, animals and humans, amplifying its historical presence. UNEP task groups in summer 1999. identified four hot spots in the territory of Serbia, one of these being the city of Novi Sad [1].

PCBs are bioaccumulated in plants and animals consumed by humans. During delivery, a period of short term starvation, lipsoluble substances mobilized from fat reserves into the blood reach the mammary gland. Since milk is the only way for their excretion, the neonate, relying fully on mother's milk, as the only source of nutrients, may be at greatest risk of all mammals, particularly in the earliest neonatal period. Studies on PCB in early human milk (colostrum) are few [2, 3 , 7, 11].

Pollution of early human milk with POPs is being monitored in the region of South Backa since 1982 [10].

2. MATERIAL AND METHODS

Samples of colostrums

Donors of colostrum (early milk) were 16 healthy mothers living in and around the city of Novi Sad, age 28.81±4.29 years (range 23-39). They gave birth to healthy babies after a normal pregnancy and normal delivery in 2006. Questionnaires related to demographic data on mothers and their babies, as well as dietary habits, smoking and occupational and other exposure to chemicals of mothers were filled on entry into the study, when each mother consented examination of her colostrum. Mothers expressed colostrum in the amount of 21.87± 13.53 mL ($\overline{X} \pm SD$) , range 7-55 mL, into specially prepared glass containers, on the 3rd postpartal day, after the 2nd morning breastfeed. Samples were frozen at -20°C until analyzed.

Preparation of samples

PCBs were extracted from human milk using modified method of Jan [6] as described earlier [10].

PCB congeners determination

All analytical determinations of 8 key PCB congeners in human milk samples were performed at the Institute of Occupational Health in Novi Sad. Samples were analyzed using GC-ECD (HP 5890 supplied with a Quadrex fused silica column 5% Ph for PCBs (PCB 28, PCB 52, PCB 101, PCB 118, PCB 138, PCB 153, PCB 180, PCB 209)

Standards used

The system was calibrated using Pesticide Mix 33 with individual EPA standard mixture of 7 PCB congeners PCB 28, PCB 52, PCB 101, PCB 118, PCB 138, PCB 153, PCB 180, PCB 209 (Dr Ehrenstorfer Laboratories, Augsburg, Germany).

Statistical analysis

Statistical analyses were performed using Statistica for Windows, version 7.1, from StatSoft (Tulsa, OK, USA). Concentrations of 8 PCB congeners in human milk were summarized using arithmetic means, standard deviation, median, minimum and maximum values. Pearson correlation was used to assess association between age of mothers and of PCB congeners in their milk.

3. RESULTS

PCB congener 138 was the only one detected in all examined samples; congeners 52 and 153 and 180 were detected in all but one sample (153 and 180 in the same sample, 52 in diferent sample); congener 209 was detected in two samples; and 101 in only one sample; while congeners 28 and 118 were not detected in any of 16 examined samples of colostrum (Table 1). Average values of 5 PCB congeners, detected in more than one of 16 examined human colostrum samples are presented in Table 2.

4. DISCUSSION

Concentrations of 4 PCB congeners – 52, 138, 153 and 180, measured in 2006 were 2-5 times higher than concentrations of the same congeners measured in 2003 in the same region [6]. To our knowledge, no ecological accident occurred in this region at the time of pregnancy of these mothers or earlier.

Table 1. Concentrations (ng/g wet) of 8 EPA PCB congeners in 16 individual samples of human colostrum

Sample of colostrum	Age of mothers	Parity of mothers	PCB congeners						Sum of congeners
			52	101	138	153	180	209	
1	23	1	0.19	-	0.14	0.20	0.10	-	0.63
2	33	2	0.42	0.12	1.27	1.27	1.94	0.12	5.14
3	39	7	0.17	-	0.07	0.09	0.05	-	0.38
4	23	1	0.3	-	0.11	0.16	0.15	-	0.72
5	30	1	0.23	-	0.27	0.29	0.48	-	1.27
6	31	4	0.05	-	0.03	0.04	0.03	-	0.15
7	24	2	0.19	-	0.14	-	-	-	0.33
8	25	1	0.57	-	0.58	0.7	1.12	-	2.97
9	26	2	0.83	-	0.22	0.34	0.4	-	1.79
10	29	2	-	-	0.04	0.06	0.06	-	0.16
11	25	1	0.39	-	0.14	0.14	0.07	-	0.74
12	32	3	0.29	-	0.11	0.15	0.13	-	0.68
13	29	1	0.11	-	0.04	0.04	0.03	-	0.22
14	30	3	0.25	-	0.06	0.08	0.05	-	0.44
15	31	3	0.07	-	0.03	0.04	0.02	-	0.16
16	31	3	0.21	-	0.05	0.21	0.16	0.12	0.75

- not detected

Table 2. Concentrations (ng/mL) of 5 EPA PCB conegeners detected in more than 1 of 16 samples of 3rd day human colostrum. $\overline{X} \pm SD$, median value, range.

	PCB congeners					
	52	138	153	180	209	Sum
Mean	0.29	0.21	0.26	0.32	0.09	1.17
SD	0.20	0.32	0.33	0.53	0.04	1.42
Median	0.23	0.11	0.15	0.10	0.09	0.68
Range	0.05 - 0.83	0.03 - 1.27	0.04 - 1.27	0.03 - 1.94	0.07 - 0.12	0.05 -5.43

Correlation of organochlorine contaminants in milk and age of mothers, together with higher levels in milk of primiparous than of multiparous mothers, was found by others [13]. In this study, the only correlation was found between PCB congener 153 and the age of mothers (p=0.019). This could be attributed to greater proportion of multiparous than primiparous mothers (10:6) than in previous study (7:11) on the same territory, in which no correlation was found [13]. Occupation and dietary habits of mothers did not imply any known exposure to chemicals.

Comparing these latest results with the results from the earlier periods [11] for the same geographic area, the fall of total PCBs in early human milk from 1982 (mean value 40.08 μg/L whole milk) till 1993 (mean value 10.95 μg/L whole milk), was observed. The assumed total PCBs in 2003 (10.25 ng/g whole milk) suggest that their unchanged levels in early human milk over 10 years are the result of continued inlet into the environment. These determinations in Serbia are very scarce and till now, performed only by this group of authors.

5. CONCLUSIONS

Last measurements of PCBs congeners (PCB 28, PCB 52, PCB 101, PCB 118, PCB 138, PCB 153, PCB 180, PCB 209) in 16 samples of 3rd day human colostrum were performed in 2006, using GC-ECD (HP 5890) supplied with a Quadrex fused silica column 5% Ph for PCBs.

PCB congener 138 (0.21±0.32, $\overline{X} \pm SD$) was detected in all examined samples; congeners 52 (0.29±0.20), 153 (0.26±0.33) and 180 (0.32±0.53) in all but one sample; congener 209 (0.09±0.04) in two samples; and 101 in only one sample; while congeners 28 and 118 were not detected in any of 16 examined samples. The only correlation found was between PCB congener 153 and the age of mothers (p=0.019). Mothers, donors of colostrums, did not have any known occupational or dietary exposure to chemicals.

Concentrations of PCB congeners – 52, 138, 153 and 180, measured in 2006 were 2 - 5 times higher than concentrations of the same congeners measured in 2003 in the same region. Total PCBs in human colostrums, in the same region, showed a four time decrease from 1982 till 1993; mostly

unchanged levels till 2003; followed by the rise in this last measurements. Human milk, was once again a mirror of environmental pollution.

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