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Some Persistent Organic Pollutants Levels in Mothers Milk and their Correlation with Different Sources of Environment and Food in Egypt

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6. SUMMARY

In our investigated study, forty-eight (48) breast milk samples collected from the period of 2016 to 2018 from Qalyubia governorate, Egypt. All the participants provided an informed consent and asked to complete a questionnaire concerning some available information data like mother age, baby age and number of deliveries.

Samples were analyzed in the Central laboratory of Residue Analysis of Pesticides, Agricultural Research Center (QCAP-Egypt) which was accredited by the Finnish Accreditation Services (FINAS) according to the requirements of International Organization for Standardization (ISO/IEC) 17025 (2005). Additionally, the method performance used was assessed through successfully participation in specific inter laboratory studies organized by European Union Reference Laboratory for Dioxins and PCBs.

Characteristics of the study participants

The average age of participating women was 27 years old and ranged from 20 to 35 years. The mean lipid percentage of the forty-eight (48) breast milk samples was 3.2g and ranged between (0.6 to 7.9 g).

6.1 Levels of PCDD/Fs and dl-PCBs without TEF in collected breast milk samples.

The recovery of all standards is within the required range, which is in accordance with the requirements of the EPA 1613 and 1668 method. All the 29 congeners of PCDD/Fs and dl-PCBs were detected in all samples even the most toxic congener TCDD and PCB-126.

The mean summation of PCDD/Fs + dl-PCBs (ΣPCDD/Fs+dl-PCBs) was 9290.32 pg/g fat ranged between of 1878.39 to 43477.7 pg/g lipid. The

dl-PCBs accounted of 99.33%, while PCDD/Fs accounted of 0.67 % from ΣPCDD/Fs+dl-PCBs. As pattern, the most abundant congeners was mono-ortho PCBs in which accounted of 98.07 %, non-ortho PCBs accounted of 1.26 %, followed by PCDDs accounted of 0.37 % and PCDFs accounted of 0.3 % from ΣPCDD/Fs+dl-PCBs.

The mean summation of 17 PCDD/Fs was 62.19 pg/g fat ranged between of 17.41 to 179.77 pg/g fat. The concentrations of individual congeners ranged from 0.03 pg/g fat for 1,2,3,7,8,9-HxCDF (the lowest concentration) to 52.38 pg/g fat for 1,2,3,4,6,7,8,9-OCDD (the highest concentration).

∑PCDF concentrations accounted of 44.8%, while ∑PCDD concentrations accounted of 55.2% from the total PCDD/Fs concentration. OCDD was the predominant congener in all breast milk samples with a mean concentration of 24.93 ranging between of 15.4 to 52.38 pg/g fat and represent a mean contribution percentage of 40.08 % from ∑PCDD/Fs followed by 2,3,4,7,8-PeCDF (21.92%).

The mean summation of 12 dl-PCBs was 9228.13 pg/g fat ranged between of 1789.54 to 43359.75 pg/g fat. The concentrations of individual congeners ranged from 1.8 pg/g fat for PCB 81 (the lowest concentration) to 17893.76 pg/g fat for PCB 118 (the highest concentration).

∑non-ortho dl-PCB concentrations accounted of 1.26%, while the ∑mono-ortho dl-PCB concentrations accounted of 98.74% from the total PCBs concentration.

PCB 118 was the predominant congener in all samples with a mean percentage contribution of 43.58% with a concentration range between 701.09 to 17893.76 pg/g fat from ∑PCBs, followed by PCB 156 (20.95%), PCB 105 (13.86%) and PCB 167 (8.84%). These four congeners accounted of 87.23% from ∑PCBs.

6.2 Levels of PCDD/Fs and dl-PCBs with TEF in collected breast milk samples.

The mean total TEQ (ΣTEQ-PCDD/Fs/dl-PCBs) was of 16.74 pg TEQ/g fat, ranged between 4.73 to 36.98 pgTEQ/g fat. PCDD/Fs accounted of 59%, while dl-PCBs accounted of 41% from ΣTEQ.

The mean TEQ of mono-ortho PCBs, PCDDs, PCDFs and non-ortho-PCBs was of 0.27 pgTEQ/g fat (1.61%), 4.59 pgTEQ/g fat (27.42%), 5.27 pgTEQ/g fat (31.48%) and 6.61 pgTEQ/g fat (39.49%), ascending respectively from ∑TEQ. Which means that non-ortho PCBs had the highest contribution to the total TEQ (∑TEQ).

The total TEQ concentration of 17 PCDD/Fs ranged from 0.7 to 30.44 pg WHO-TEQ/g fat with a mean concentration of 9.86 pg WHO-TEQ/g fat. The mean concentrations of individual congener ranged from 0.0001pg WHO-TEQ/g fat for OCDF (the lowest concentration) to 4.09 pg WHO-TEQ/g fat for 2,3,4,7,8-PeCDF (the highest concentration).

PCDF congeners and PCDD congeners contributed of 53.46% and 46.57% to ∑TEQ-PCDD/Fs in breast milk samples, respectively. By TEQ concentration, 2,3,4,7,8-PeCDF made the highest contribution to ∑TEQ-PCDD/Fs followed by 1,2,3,7,8-PeCDD. These two congeners contributed 41.02% and 31.06% to ∑TEQ-PCDD/Fs, respectively.

The total TEQ concentrations of 12 PCBs ranged from 2.52 to 10.34 pg WHO-TEQ/g fat with a mean concentration of 6.88 pg WHO-TEQ/g fat. The mean concentrations of individual congener ranged from 0.0003 pg WHO- TEQ/g fat for PCB77 (the lowest concentration) to 9.41 pg WHO-TEQ/g fat for PCB126 (the highest concentration).

The 4 non-ortho dl-PCB congeners accounted of 96.03% from the total PCBs (∑TEQ-dl-PCBs), while the 8 mono-ortho dl-PCB congeners accounted of 3.97% from ∑TEQ-dl-PCBs. PCB 126 was the predominant congener in all samples with a mean percentage contribution of 88.54 % with a concentration ranging from 1.72 to 9.41pg/g TEQ fat.

6.3 Correlation with number of deliveries

The mean total TEQ concentration of PCDD/Fs and dl-PCBs in breast milk samples of primiparous mothers was 11.3 and 7.41 pgTEQ/g fat respectively, while for multiparous mothers were and 8.5 and 6.62 pgTEQ/g fat, respectively. This means that the levels of PCDD/Fs in breast milk samples tended to decrease with the increase of number of deliveries.

6.4 Effect of age

Donors were divided into groups considering aging (age groups lower than 25, from 25 to 30 and higher than 30 years). PCDD/Fs and dl-PCBs concentrations were significantly related to age of mother, where older mothers had higher level of PCDDs/Fs and dl-PCBs in their milk than younger mothers (8.26, 10.05 and 12.28pg TEQ/g fat, respectively).

6.5 Estimating daily intake (EDI) of PCDD/Fs and PCBs for infants

The mean EDI was 69.06 pgTEQ kg^{-1}bw day^{-1}, ranged from 21.03 to 212 pg TEQ kg^{-1}bw day^{-1}. The PCDD/Fs daily intake contribution to the total daily intake found to be higher than the contribution of PCBs daily intake. The mean EDI of PCDD/Fs was of 56.8%, while the mean EDI of dl-PCBs was of 43.2% from the total EDI.

The most contributed congeners to the total daily intake are PCB126, 2,3,4,7,8- PeCDF and 1,2,3,7,8- PeCDD with account of 38.22%, 22.93% and 18.28%, as respectively from the total daily intake. These three congeners accounted of 79.43% while all other congeners accounted of 20.57% from the total daily intake.

6.6 Interpretation of results

Qalyubia governorate is considered one of the governorates that is famous for its agricultural and industrial activities which means it includes the industrial and non-industrial sources of these contaminants, because of its location in the middle of Delta. Therefore, it has represent a meeting point for all pollutants from many neighboring governorates, especially Greater Cairo Governorate.

Among the sources of pollution; the municipal waste incinerators, which include the plastic and solid waste, are the main sources of PCDD/Fs and dl-PCBs in the environment. This source is characterized by greater presence of OCDD, 2,3,4,7,8-PeCDF and 1,2,3,4,7,8-PeCDD. In addition, portion dl-PCBs formed in combustion processes in presence of carbon source and chlorine. Coal power and industrial of plastic and metals emissions, where dominated by the congeners of OCDD, PeCDF, and

HpCDF. In addition, these congeners and higher levels of dl-PCBs were the common undesirable pollutants in the production of cement.

On the other hand, the emission levels of PCDD/Fs and dl-PCBs from non-industrial sources mostly influenced by the degree of social awareness of the population. These emissions were difficult to qualify and quantify because they can proceed from several diffuse focuses, where the combustion and generation process is generally uncontrolled. Accidental fires, diesel engines, release of PCDD/F from pentachlorophenol-treated wood products, and illegal incineration of household wastes were the most important non-industrial sources.

As general, consumption of contaminated food is the major route of human exposure to PCDD/Fs and dl-PCBs, and accounted up to 90%. When comparing PCDD/Fs and dl-PCB congener profiles for human milk samples and foodstuffs of animal origin with high fat content such as meat, egg and fish, since these lipophilic contaminants accumulate in fatty tissues. The pattern of dl-PCBs is quite similar to the various matrices. All the twelve congeners of dl- PCBs detected in all breast milk samples. The most abundant congener was PCB-118 (4021.78pg/g fat), accounting of 43.58% from Σdl-PCBs, followed by PCB-105 (13.86%) and PCB-156 (20.95%); these three congeners contributed 78.4% from Σdl-PCBs in the breast milk samples. For poultry, egg, meat, liver, milk and fish, these three congeners contributed 85.6%, 82.1%, 73%, 80.8%, 75.5% and 82.1% from Σdl-PCBs, respectively. The PCB congener fingerprints was similar for human milk samples and the foodstuffs evaluated; although our food samples does not represent all the food categories, these results seem to imply that dietary intake is the main

source for human dioxins and PCBs exposure. For PCDD/F, OCDD was dominant in all matrices and gradually increased with the lipid content.