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GLOBAL ENVIRONMENTAL MONITORING AS A TOOL FOR COOPERATION TO SOLVE REGIONAL PROBLEMS

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Abstract

Using the example of the Global Monitoring of Persistent Organic Pollutants (POP) network structure, we show directions for successful cooperation in various regions of the world to address the fundamental and applied scientific aspects of regional environmental problems, as well as the existing shortcomings and limitations in interaction between countries. It shows the participation of the Russian Federation in global environmental projects, the prospect of their development and the impact on the current state with the implementation of global monitoring in the country using the example of the special monitoring process for high-toxic organic pollutants (GMP). GMP database as a part of POP in breast milk in the Russian Federation was used, which was supplemented with data from scientific literature and own research. Russia's participation in international studies of POP in biological samples, including breast milk and/or blood, organization of national programs to study population exposure to POP, continued participation in World Health Organization (WHO) and others to mark the level of pollution and its trends for the Russian population are required in comparison with other regions of the world. Presentation of data on POP in human biological fluids into international databases and the organization of biosample storage banks will allow filling information gaps from Russia and assess the results of Stockholm Convention actions.

Keywords: Breast milk, organic pollutants, world databases.

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1. Introduction

Environmental monitoring - integrated monitoring of the state of the environment, including components of the natural environment, natural ecological systems, the processes, phenomena occurring in them, assessment and forecast of environmental changes. Integrated monitoring is multi-media, which means that the results of observations and measurements characterize the content of the pollutant in various environments, including biota, including biological fluids and human tissues, in comparable time scales, and are supported by geo-information and meteorological parameters in order to interpret the results and forecast the situation in the long term.

Global monitoring involves environmental studies of the interaction of human and nature across the biosphere. Regional implies the organization of monitoring within one state or its part. The goal of the global environmental monitoring system is environmental problems of a global scale, such as global climatic changes, large-scale atmospheric, hydrospheric and lithospheric phenomena, the pollution of the atmosphere and hydrosphere whose danger only increases over time.

It is possible to assess the degree of damage by background monitoring, when organizing research in areas not exposed to localized large anthropogenic sources of pollution. Long-term levels of measured substances for such territories are formed from natural sources and/or as process of moving for a long time from other groups of anthropogenic sources distributed in space, as is the case with POP. An example is the CLRTAP and its assessment tool - the EMEP program, which provides a basis for long-term environmental impact assessments of pollution with a wide range of participants - 28 countries in Europe, the USA and Canada. (Gusev et al., 2018).

An example of global monitoring implemented at the present stage using data warehouses that are open for use with a clear goal - tracking the results of the efforts of many countries after the implementation of joint decisions of the Stockholm, Basel and Rotterdam conventions is the GMP- POP. (Sebková, Gregor, Boruvkova, Kalina, & Klanova, 2015).

2. Problem Statement

A world monitoring process was adopted at the special meeting in 2007 where results were discussed on the frame of the Stockholm Convention on POP four last 6 years. Such an assessment is carried out on the basis of many aspects (scientific, environmental, technical and economic), including reports on other levels of POP in the environment in various regions of the world (Guidance on the Global Monitoring Plan for Persistent Organic Pollutants, 2013).

The purpose of assessments was to obtain from all five UN regions (All European parts, Latin America and the Mediterranean, Africa) common data on the levels of POP in atmosphere and biotissues (human milk or human blood) for use as baselines in subsequent assessments.

Adequate data on the basic levels of POP on the atmosphere and in human blood and breast milk, both with information about current trends, are available for national and international programs. In several countries in which large data gaps were identified, initial monitoring data for breast milk content was obtained through partnerships with existing monitoring programs and support from the global environmental fund.

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The Russian Federation, in accordance with the UN typology, is a group of 23 countries in the region of Central and Eastern Europe. Currently, POPs are not produced in the region, but in some countries organochlorine pesticides are produced and polychlorinated biphenyls are used. The main sources of pollution with POP are obsolete and unused pesticides in agriculture, equipment containing persistent organic pollutants, the use of industrial technologies leading to unintentional emissions of dioxins and furans, and the formation of dioxins and furans in open combustion. The main sources of atmospheric pollution are volatilization from old open systems (colorful and woody protective layers, softeners), from dump sites and incinerators, from operating or discarded transformers, condensers, hydraulic systems containing POP. Biomatrices for assessing the toxic load of POP on land are human biological tissues; in aquatic systems, mollusks and marine mammals.

In this work, the task was set - to evaluate the information data set of the Russian Federation on monitoring POP in breast milk, to identify shortcomings and gaps in information, the potential of GMP in the country at the present time. An attempt is made to consider the effectiveness of measures of the countries participating in the Stockholm Convention to regulate and remove POP to change the content of POP in breast milk during the monitoring period 1998-2015 years and compare with them the Russian data (Sergeyev, Shelepchikov, & Denisova, 2008).

3. Research Questions

Intelligence of POP in milk or blood is contained in two global GMP reports. The last of these was reported to the 8th Conference of the Parties in 2017. During 3 years scientists collected and analyzed data from some territories - Pacific Islands, African (West Africa and South-Eastern Africa), and Latin America Caribbean regions (Mamontova, Tarasova, & Mamontov, 2017).

Some analytical potential has already been accumulated in the countries and, if targeted work is carried out on the training of personnel and the modernization of laboratory equipment, it can be brought to a level that meets current needs for global monitoring and evaluation. This also applies to Russia.

The World Health Organization (WHO) has collected a lot of information about POP. The main directions are: 1) POP in human milk as risk factor for infantshealth, 2) POP distribution in some countries and geoareas, 3) risk management actions, including epidemiological follow-up studies; 4) create education system with information about POP (Van den Berg et al., 2017). (Table 01).

Table 01. Overview of participating countries in different human milk surveys

Round	Years	Organization	Number of countries
1 st Round	1987-1988	WHO	12 countries
2 nd Round	1992-1993	WHO	19 countries
3 rd Round	2000-2003	WHO	26 countries
4 th Round	2004-2007	WHO/UNEP	13 countries
5 th Round	2008-2011	WHO/UNEP	45 countries
6 th Round	2012-2015	UNEP	17 countries

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Primary data on POP levels in breast milk in Eastern and Central Europe were collected from 1998–2008 and are available for 11 of 28 countries including Bulgaria, Hungary, Latvia, Poland, Russian Federation, Romania, Slovenia, Uzbekistan, Ukraine, Croatia and Czech Republic.

The main source of data is the third level of the WHO-coordinated assessment of the concentrations of PCDDs, PCBs, PCDFs in breast milk. As part of this study, the content of some high toxic POPs in breast milk samples from Bulgaria, Russian Federation, Ukraine and the Czech Republic was also assessed. The Czech Republic, Hungary and Slovakia continued research in the fourth round. Countries participating in these projects applied the global protocols and sent their samples for analysis to the WHO/UNEP Reference Laboratory (Lippold & Malisch, 2016).

The upper levels of indicator PCB were fixed in milk samples taken in the Czech Republic and Slovakia during the third and fourth rounds (Figure 1). The highest dioxin concentrations were found in milk from Ukraine, although the levels of PCB-markers were several times lower than in samples from the Czech Republic and Slovakia. Information on Russia on the WHO program is limited to data up to 2008. Another array of information was presented to the GMP as a result of an international study on the pollution of the Russian Arctic (Arctic Monitoring and Assessment Programme (AMAP), 2004).

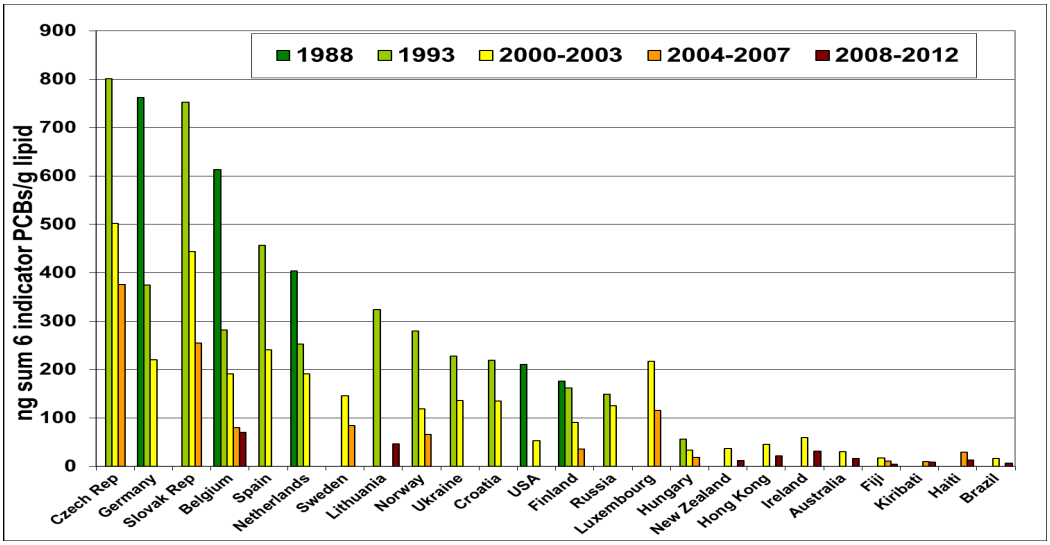

Figure 01. The average values of the content of 6 indicator PCBs in breast milk from various countries (Lippold & Malisch, 2016)

4. Purpose of the Study

The goal of the present work is to analyze an available data on the content of POP in breast milk of the population of Russia, to identify and present data that meets the goals of the Global Monitoring of the POP, including the results of our own research.

5. Research Methods

Data analysis revealed some features. Today, there is information on POPs in breast milk of several levels.

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Level 1. The data obtained in the framework of the WHO and AMAP programs were performed in reference laboratories such as the CVUA in Germany, corresponding to all types for analyzers of POPs in human milk (Malisch, Malisch, & Fiedler, 2017). These data are presented in reports, published and form the basis of databases and conclusions on evaluating the effectiveness of the POP conventions for Russia and comparisons with other regions of the world, identifying the most problematic areas.

Level 2. The results of the analyzes were performed in certified laboratories in Russia that meet the requirements of UNEP regarding the quality control system of analysis and management for the trace analysis of organochlorine pesticides and supertoxicants of the group of dioxins and toxic PCB. Laboratories confirm their results in international studies. The work was performed, as a rule, according to regional programs, grants from the RFBR and the RSF, money from foreign funds. Results are presented in reports and most published. The disadvantage is the incomplete presentation of information about the methods of sampling and availability, an adequate description of the group of donors, the time and place of selection, the characteristics of the laboratory and the details of the equipment and methods used. The data is scattered in the scientific literature and is not yet included in the global database being formed.

Level 3. Individual studies results carried out on regional, municipal programs, grants of various levels, research work of various teams, including environmental society organizations. The results were published in the scientific press, however, they require confirmation of the implementation of the quality control system, details of the presentation of information, descriptions of sampling and analysis methods, detailing on congeners and homologues of individual POP groups.

There is little data from Russia (POP in breast milk) listed in GMP database. This is a survey of breast milk according to the UNEP program, as part of the 2nd round of research in 2002, and also on the AMAP program (Figure 02). Total for the period 1987-2012. Five rounds of milk research under the auspices of WHO (Russia participated in 2001-2002) have already passed. The stage of selection and research of POP in breast milk, currently underway (2016–2019), is carried out without the participation of the Russian Federation. Samples from Russia on the content of the most persistent and toxic POP (dioxins and PCBs) demonstrate average values, also applies to other POP, but Russia does not belong to the background areas of the world.

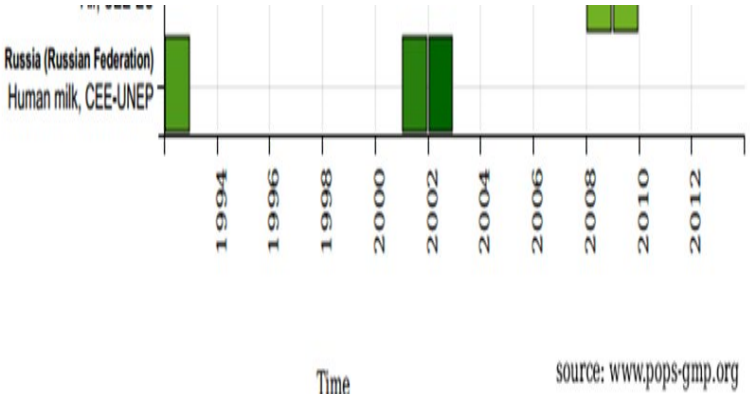

Figure 02. Chart of availability of data from Russia to the GMP data warehouse (Sebková, Gregor,Boruvkova, Kalina, & Klanova, 2015)

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6. Findings

Studies of breast milk from some cities of Russia were carried out in GBU RB BREC–Ufa (accreditation certificate No. ROSS RU 0001.510275, a list of UNEP laboratories of level 1 POP analysis). The quality of analysis for the POP content has been confirmed by international studies of biological samples. Milk sampling was conducted by Russian medical institutions in accordance with the WHO-UNEP guidelines (Malisch, Malisch, & Fiedler, 2017).

The main guidelines include the following: 1) mothers must be primiparous; 2)women must be under 30 years old (this item may vary with respect to the maximum age in accordance with national statistics); 3) ladies should breastfeed only one baby (not twins); 4) ladies should live on of the territory last 10 years; 5) ladies should not live in the POP emission zone; 6) mothers will have to collect a sample between 3 and 8 weeks after childbirth.

Results of a study of the content of various POPs in breast milk obtained outside the WHO and UNEP programs are known (Mamontova, Tarasova, & Mamontov, (2017). The most comprehensively presented is the study of PCB in breast milk of the Irkutsk region - in the cities of Irkutsk, Usolye-Sibirskoye, Shelekhov, Ust-Ilimsk, Baikalsk and a number of villages. The highest levels of PCB among urban residents were found in the breast milk of the residents of the city of Usolye-Sibirskoye, the lowest - in Irkutsk, and among the villages - in the villages of Onguren and Kachug, respectively. The extremely high concentrations of PCB found in the village Onguren (shore of Lake Baikal), are comparable only to the levels in the milk of the residents of Serpukhov, a city with an industrial history of PCB use. In addition to the results of studies on the content of POP in breast milk from Russia, included in the GMP database (WHO and AMAP programs), there are results obtained in various cities, including those obtained by one of the authors of this article (Sergeyev, Shelepchikov, & Denisova, 2008).

In addition to studies of breast milk, selected as an example of the implementation of global monitoring of POP in Russia, the determination of dioxins in human blood, in cohort groups with professional exposure in Ufa (Ryan, Amirova, & Carrier, 2002), or during long-term studies of the effects of POP on public health were also performed in Chapaevsk (Sergeyev, Shelepchikov, & Denisova, 2008).

Based on the analysis of the above references, a table 2 was compiled of the available data on the content of POP in breast milk of residents of Russian cities from 2000–2007 years.

Table 02. The results of studies of POP in breast milk of women in Russia

Cities of Russia	∑ PHB, ppb	TEQ dl-PHB, ppt	TEQ PCDD/F, ppt	GHB, ppb	ΣDDT, ppb	α-GHCG, ppb	γ-GHCG, ppb
St. Peterburg	23	13-15,6	3,47, 10-11	43	333	3,6	0,2
Ufa		12.43	18.23				
Perm		6,83	8,68				
Magnitogorsk		11,41	7,16				
Serpukhov	363		2,66	25	406	0,9	0,49

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Monchegorsk	490,5			111	1055	5,6	0,7
Arkhangelsk	191	7		58	1037	3,2	0,5
Dzerzhinsk			10,7				
Kargopol	363	22		46	1098	1	0,2
Severo–Dvinsk	349			80	804	3	1
Chahaevsk	500	10-13	15,5-6	69-83	204-244	196	115
Astrakhan	283	15,5	9,35	42	1028		
Sergiev–Posad	308		3,85	27	141	0,45	0,19
Karabash			7,64				
Grozny		2	7.95				
Murmansk	346	19,5	10	65	900	3	2
Anadyr	124	12,94	7,16	80	418	4,9	0,9
Tobolsk			7,68				
Shelekhovo	258			74	469	5,6	0,61
Irkutsk	128		5,7	63	340	3,1	0,41
Baikalsk	325			53	470	3,1	0,4
Bratsk	381			23	454	3,9	0,38
Khuzhir	173			25	442	1,7	0,34
Ongulen	2125	11.41	7.16	54	2511	3,4	0,88
Usolie–Sibirskoe	325	48	23,7	65	566	2,61	0,45
Ust–Ilimsk	337			48	687	2,0	0,4

7. Conclusion

Currently, the Russian Federation has not established a regular state system for monitoring POP, there is no regulatory and methodological framework for the functioning of state monitoring of POP, taking into account international experience in this area.

There is a plan for the Russian Federation to fulfill its obligations under the GMP - the Russian Federation National Action Plan. Objective No.5 of this Plan describes the problem of monitoring the content of POP in the environment, monitoring the state of public health due to exposure to POP. The implementation of this section is assigned to some federal services of the Russian Federation in 2021-2024 years (Mamontova, Tarasova, & Mamontov, 2017, p. 240).

The results of breast milk survey considered in this paper reflect the national level of contamination and can be used as a baseline for future assessment data. However, the available data are insufficient to provide any realistic basis for regional comparisons. Nevertheless, the possibility of comparing available non-systemic data on the contamination of breast milk in Russia with international data makes it possible to use world experience and cooperation in creating the country's potential. Strengthening and expanding the capacity of existing laboratories to analyze the main media required by the management of GMP POP (Second global monitoring report, 2017), introducing and expanding quality control procedures, raising specialists qualifications in sampling and analysis is required; laboratory training and other assistance in the analysis of PCDD/F and other POP; and conducting international and national intercalibration tests. Russia's participation in global POPs monitoring programs will allow the country to realize its potential within the framework of international cooperation and begin to address regional problems.

The problem of biomonitoring of POPs in Russia needs to be addressed at the level of government programs. At present, there is an accumulation of episodic studies requiring harmonization with international programs and methods of analysis. We express our gratitude to breast milk donors and to organizers of sampling in cities of Russia. Research in the cities of Magnitogorsk, Tobolsk, Karabash was carried out within the frame of the International project on POPs elimination IPEP “Encouragement of active and effective participation of civil society in preparation and realization of the Stockholm Convention”. Research in Perm and Ufa was carried out with support of the local executive authorities.

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