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Organochlorine Pesticide Residues in Breast Milk in the Republic of Belarus

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Intensive application of organochlorine pesticides (OChP) in agriculture and medical parasitology and also a high stability of these pesticides to the action of the environment resulted in their spreading all over the globe. In many countries, Commonwealth of Independent States included, application of OChP except lindane is forbidden, however in a number of countries they are being used at present OChP are able to dissolve in fats and thus to be accumulated in adipose tissues of animals and men (Waliszewsky et al. 1995).

In spite of food products OChP content being decreased during last 10-20 years, breast milk pesticide value as shown in literature of different countries is still high (Alawi et al. 1992). The present work gives research results of eight residues OChP (α,β,γ - hexachlorcyclohexane, heptachlor, aldrin, p,p'-DDE, p,p'-DDD and p,p'-DDT) in breast milk from different regions of Republic Belarus. This is the first study in the Republic.

MATERIALS AND METHODS

We've investigated breast milk from 6 regions of Belarus with different ecology (Table 1). A small town of Vitebsk region Dokshitsy is considered to be the cleanest from ecological point of view. Samples of breast milk from ecologically clean Kopyl district of Minsk region were also investigated.
These regions have been chosen as control zones free from chemical and other industries, not influenced by radionuclides. All the other samples were taken in the regions with various large industries, chemical ones in the first place. Svetlogorsk and Mozyr besides chemical contaminants are influenced by radionuclides, being situated on the territoty contaminated after Chernobyl catastrofhe.

Sample preparation was done by the following technique. 8ml concentrated sulfuric acid was added to 3 ml milk, and after mixing, cooled OChP were extracted two times, using 20 ml hexane for each extraction. Hexane extracts were cleaned with sulfuric acid and evaporated on rotary evaporator. Extracts were injected into the chromatograph, Perkin Elmer 8700 with electronic capture detector. A quartz capillary column of 20m length and inner diameter of

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Table 1. Investigated regions of Belarus.

Ecology zone	Region	Industries	Number of samples
I-ecologically clean regions	Dokshitsy	Small town	14
	Kopyl district	————	18
II–contaminated industrial regions	Minsk	The capital of Belarus, different industries	32
	Soligorsk	Potassium fertilizers industry	84
III – chemical and radionuclide contaminated regions	Svetlogorsk	Synthetic fibres industry	13
	Mozyr	Large oil refineries	85

0.22 mm with silicon liquid phase BP-1 was used. A range of programmed was from 180 to 230° C, speed 30/min. The injector temperature was 210° C, that of the detector was 300° C. Carrier gas was argon.

Qualitative analysis was carried out by an absolute calibration method on peak heights and squares. For all the samples 3 tests were investigated. Standard deviation of OChP determination didn't exceed 15%.

RESULTS AND DISCUSSION

In all investigated milk tests DDT metabolite-DDE was detected. Under natural conditions, in a living organism, DDT is usually transformed into its more stable metabolite DDE. DDT was detected in Soligorsk in 1.2 % and in Kopyl district in 11.1% tests. Hexachlorcyclohexane (HChCH) was detected as β-isomer in almost all tests (87.5-100%).

Sometimes besides β-HChCH, α-HChCH was detected (16.7% tests from Kopyl district) or γ-HChCH (18.8% tests from Minsk). Heptachlor, aldrin and DDD were not detected in tests. Qualitative characteristics of research are given in Tables 2 and 3. Data analysis of the Tables 2 and 3 show, that HChCH-isomers sum and metabolites DDT sum values in breast milk samples from ecologically clean Byelorussion regions (zone I in Tables 2,3) practically don't differ from OChP concentration in contaminated industrial district (zone II, Tables 2,3). Moreover, OChP concentrations in samples of Minsk and Soligorsk (zone II in Tab. 2,3) subjected to industrial and chemical contaminants and OChP concentrations in samples from Svetlogorsk and Mozyr subjected besides chemical to radionuclide contamination of the environment (zone III in Tab. 2,3) don't differ much.

However one can't exclude aggravation of OChP negative influence on mother's and infant's organism in the regions with chemical and radionuclide contamination samples from Svetlogorsk (average HChCH isomer sum for them is 22±14 μg/l milk, twice as greater as in Dokshitsy) somewhat differ from the rest.

Tables 2 and 3 also give data on breast milk contamination in other countries. Some countries, Russia for example, and Spain give data on total HChCH isomer content in milk corresponding to our results, others- Jordan -some times more, than in Belarus. In Norway HChCH isomer sum is the tenth order less than in milk samples in our work.

In DDT metabolite sum in breast milk Belarus keeps pace with Spain, but its contamination is sometimes more than in Norway but the tenth order less than in Jordan.

OChP value depending on age of feeding mothers was also studied. In samples from Minsk, Mosyr and Dokshitsy there was an increase of pesticides value in breast milk parallelly to changing their age from 17-21 to 40 years. This phenomenon conforms to literary data (Sikorsky et. al. 1989) and is explained by a higher contamination of mother fat depot with OChP depending on age increase. But this dependence isn't clear in milk samples from Soligorsk and Svetlogorsk. Feeding mothers in Kopyl district were mainly young (18-25 years). Only 17% samples were taken from mothers of 28-32 years so OChP value and age relation in this case wasn't considered.

During the first 3 month of life a mean infant intake of mother's milk is 120g per kilogram of body mass daily (Dogheim et al. 1981). Proceeding from this assumption for children of the age not more than 3 months we counted a daily pesticide dose per one kilogram of infant body mass.

Diagrams of daily pesticide loads per kilograms of infant body mass for Soligorsk and Mozyr are given in Fig. 1. For Minsk, Svetlogorsk, Dokshitsy and Kopyl district a daily HChCH isomer sum and DDT metabolites ranged within 0.4-3.6 and 0.6-7.2; 0-3.0 and 0.4-3.1; 0-5.8 and 0.2-12.0 μg/kg of infant mass respectively. HChCH isomer and DDT metabolite value change ranges in all regions investigated were 0-7.8 and 0. l- 14.4 μg/kg of infant mass.

Let's compare our data with literary ones. In Dogheim's et al. 1981 article a daily HChCH isomer load per kilogram of infant mass was 2.03 μg (3.3 times less our maximum value) and DDT metabolite sum was 6.9 μg (2.1 times less our maximum value). In Alani's et al. 1992 article for maximum daily dose value of HChCH isomer sum and DDT metabolite per kilogram of infant mass they give 10.9 μg (12.7 time more than our maximum value) and 218.2 μg (15.2 times more our maximum value). As is seen from FAO/WHO regulations permissible daily value for γ-HChCH and DDT sum is 10 μg/kg and 20 μg/kg of human body mass respectively.
The data received by us for pesticides daily doses coming with breast milk per kilogram of infant mass are less than permissible standards of FAO/WHO.

Table 2. HChCH-isomer sum in breast milk in different regions of Belarus and other countries.

Ecology zone	Region	HChCH-isomer sum in breast milk, μg/l of milk				HChCH-isomer sum in breast milk, μg/kg of milk fat			
		Min	Max	Aver	Med	Min	Max	Aver	Med
I	Dokshitsy	2	30	11±8	7	59	885	325±236	206
	Kopyl district	2	48	14±8	8	64	1548	423±244	258
II	Minsk	3	30	14±8	11	107	915	418±232	350
	Soligorsk	0,5	35	10±7	8	14	991	289±201	227
III	Svetlogorsk	2	80	22±14*	17	56	2253	631±386	479
	Mozyr	2	65	14±8	10	59	1929	415±249	297
IV	Russia (Sofina, 1993)	20	93						
	Jordan (Alawi, 1992)					220	2470		750
	France (Bordet, 1993)					36	1342		
	Norway (Johansen, 1994)							36	
	Spain (Hernandes, 1993)							279	

*)- It's pointed out the trustworthhiness of differences between the values in the investigated and control groups (zone 1) for $p<0.05$

I - ecologically clean regions
II - contaminated industrial regions
III - chemical and radionuclide contaminated regions
IV - other countries

Thus in breast milk of Republic Belarus out of 8 organochloric pesticides studied, P-HChCH (sometimes α and β-HChCH) and p,p'-DDE (sometimes p,p'-DDT) were detected.

Table 3. DDT-metabolite sum in breast milk in different regions of Belarus and other countries

Ecology zone	Region	DDT-metabolite sum in breast milk, µg/l of milk				DDT-metabolite sum in breast milk, µg/kg of milk fat			
		Min	Max	Aver	Med	Min	Max	Aver	Med
I	Dokshitsy	8	58	27±15	26	236	1711	796±442	767
	Kopyl district	2	100	20±14	13	64	3226	623±440	419
II	Minsk	5	60	19±12	16	152	1829	594±375	396
	Soligorsk	0.4	120	22±16	17	11	3399	612±442	482
III	Svetlogorsk	3	50	19±14	17	84	1408	538±394	479
	Mozyr	2	125	29±17	23	59	3709	872±501	682
IV	Jordan (Alawi, 1992)					820	22100		3310
	France (Bordet, 1993)					178	18665		
	Norway (Johansen, 1994)							338	
	Spain (Hernandes 1993)							659	

I - ecologically clean regions
II - contaminated industrial regions
III - chemical and radionuclide contaminated regions
IV - other countries

Data for daily pesticides doses coming with breast milk per kilogram of infant mass received from the results of our experiments, are lower than FAO/WHO standards. Contamination level of feeding women breast milk of Republic Belarus can be compared to breast milk contamination of other countries. Feeding women breast milk from ecologically clean and contaminated with industrial wastes and radionuclides districts practically don’t differ in OChP concentration. However, even small highly toxic OchP concentrations in breast milk negatively influence mother and infant health. Besides, a combined

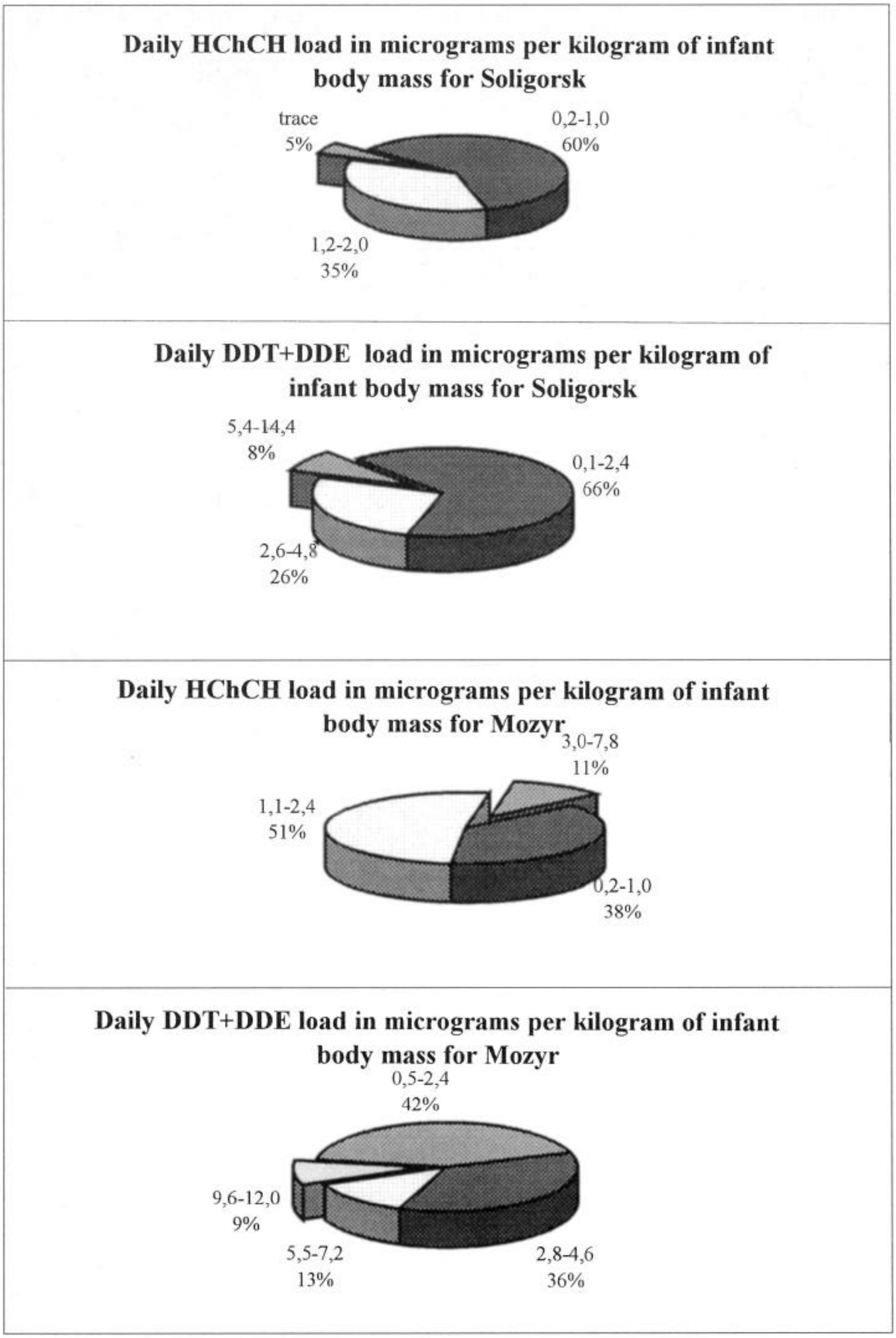

Figure l. Diagrams of daily pesticide loads per kilograms of infant body mass influence of pesticides and other chemical contaminants and radionuclides shouldn't be excluded.

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