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EVALUATION OF PURITY OF CERTAIN PAEDIATRIC PREPARATIONS OF PLANT ORIGIN AND ITS SIGNIFICANCE FOR THE SAFETY OF PHARMACOTHERAPY

Part 2. Contamination with organochlorine pesticides of paediatric preparations of plant origin

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INTRODUCTION

Among numerous factors of chemical hazards, special significance is attributed to substances with high biological activity and a wide range of potential harmful effect on human beings and other forms of life. This group of substances includes pesticides. Pesticides are a group of synthetic compounds which do not occur in nature, but are introduced to biocenosis as a result of intentional action of man. They have become the main weapon against pests and diseases of plants.

However, with time their presence in all the elements of the ecosystem, accumulation in animal and human organisms, biological concentration in the alimentary chain and weakening of expected effect associated with

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rapidly developed resistance in pests have resulted in the limitations in their use and production (Nameśnik 1995).

The potential hazards associated with organochlorine insecticides are best characterized by their prolonged presence in the soil. Duration of their persistence in the soil ranges from 5 years in case of lindan to about 12 years in case of DDT. On the other hand, as the compounds are able to spread, they contaminate plants, drinking water and animals and hence food products long time after being used. Resistance to technological and culinary processes provides favourable conditions for the residues of pesticides to penetrate human organisms (Nameśnik1995, Seńczuk 1999, Młodecki et al. 1982, Zakrzewski 1997).

Single ingestion of a high dose of pesticides may result in acute poisoning with acute clinical symptoms often resulting in lethal outcome. The course and severity of poisoning depend not only on the properties of the toxic substance, but also on the somatic properties of the organism, age, sex and condition of health. Not less dangerous are chronic poisonings resulting from accumulation of organochlorine pesticides in the tissues of the organism.

Children are especially exposed to the effect of pesticides and their residues, not only through direct contact, but also as a result of indirect ingestion with mother's milk or food and also in the form of herbal teas and other therapeutic products of plant origin (Pluta 1988, 1989, 1990).

The aim of the study was to evaluate the level of organochlorine pesticides contamination of certain paediatric preparations of plant origin. The investigations involved both tea bags used to prepare infusions as well as granulated instant teas and teething gels. The degree of transfer of the pesticides to prepared infusions has also been assessed.

MATERIALS AND METHODS

Materials

The material included eleven teas of different kinds in tea bags manufactured in Poland, eleven granulated teas from Impress, Kruger and Plantex series, as well as two gels for difficult teething manufactured by Dentinox and Hasco-Lek. Tea bags included either single herbs or a mixture of different herbal raw materials.

Moreover, infusions prepared according to the manufacturer's instruction on tea boxes were analyzed chemically and the degree of pesticides transfer to the form designed for direct intake was assessed.

All the preparations were designed for the youngest patients – infants and small children and were purchased in Wroclaw's pharmacies.

Methods

Weighed exact 10g tea samples were fragmented in a mortar and extracted with methanol and hexan. The purified eluate was analyzed chromatographically (PLUTA 1990). Infusions were prepared according to the manufacturer's instruction on tea box. Water extract was evaporated on water bath at about 90˚C to obtain the volume of 10 ml and next treated in the same way as dry mass.

Identification and quantitative assessment of pesticide content

Quantitative and qualitative assessment was performed using N-503 Gas Chormatograph manufactured in Poland with the use of recombination detector with Ni 63 radiation source. Partition was performed on a column filled with a mixture of silicone oils 15% QF-1 and 10% DC-200 in 1:1 ratio, on Gas Chrom Q 80/100 msh vehicle. Glass columns with the length of 2 m and diameter of 1 inch were used. The compounds were identified by comparison of retention times of the components of the investigated mixture with retention times of the model mixture.

Model mixtures were prepared by dilution from crystalline compounds of pp'DDT; pp'DDD; pp'DDE; DMDT; HCH; aldrin; dieldrin.

The assessment of the amount of the remaining organochlorine compounds in a given sample was five times repeated and the calculated average was accepted as the final result.

Accuracy of the method was determined on the basis of recovery coefficient. The results of analysis of 5 samples enriched with the investigated organochlorine compounds were taken into account.

The recovery rate of investigated pesticides was from 80% to 93%.

RESULTS AND DISCUSSION

The results of the investigations are presented in Tables 1–4. Table 1 contains data from measurements of the content of organochlorine pesticides in tea bags.

The investigations have shown that the residues of organochlorine pesticides were found in the majority of analyzed samples. The most commonly occurring compounds were HCH, aldrin, DDE and DMDT.

The findings revealed that DDT with its metabolites and DMDT were most abundant in herbal material.

The highest content of DDT and metabolites was found in Fructus Myrtylli – 0.665 $mg \cdot kg^{-1}$, Inflorescentia Tiliae – 0.386 $mg \cdot kg^{-1}$ and Folium Menthae piperitae – 0.312, and also in Bobofen tea – 0.276 $mg \cdot kg^{-1}$.

Table 1
Tabela 1

The content of organochlorine pesticides in tea bags (means ± SD)
Zawartość pestycydów chlorowcopochodnych w herbatach ekspresowych

Name of preparation Nazwa preparatu	Batch and manufacturer Nr partii	The content – Zawartość ($mg \cdot kg^{-1}$)							
		HCH	ALDRIN	DIELDRIN	pp'DDE	pp'DDD	pp'DDT	DDT + metabolites	DMDT
Fructus Myrtylli	7003002 Herbalux	0.005 ±0.0017	0.005 ±0.0015	0.017 ±0.0083	0.033 ± 0.0163	0.177 ±0.0075	0.455 ±0.1785	0.665±0.1446	0.333 ±0.1556
Inflorescentia Tiliae	00242292 PhytoPharm	0.312 ± 0.0063	-	-	0.386 ±0.0266	-	-	0.386±0.0134	0.666 ± 0.1223
Folium Menthae pip.	4032003B Herbapol	0.327 ±0.1628	-	-	0.191 ±0.0450	-	0.121 ±0.005	0.312±0.0127	0.222 ± 0.0335
Bobofen	021202L Herbapol	0.316 ± 0.1570	0.016 ±0.0056	-	0.027 ±0.0005	0.193 ±0.0345	0.056 ±0.0254	0.276±0.0365	0.167 ±0.0746
Nervinum	2022002L Herbapol	-	0.013 ±0.0075	-	0.114 ±0.0495	-	-	0.114±0.0365	-
Fructus Foeniculi	1012002L Herbapol	0.015 ±0.0006	0.385 ±0.0164	0.047 ±0.0163	-	-	0.091 ±0.0069	0.091±0.0182	0.259 ±0.0085
Flatuvit	902420032 PhytoPharm	0.018 ±0.0093	0.163 ±0.055	0.039 ±0.0084	0.091 ±0.0137	-	-	0.091±0.0136	-
Fructus Rubi idei	S-11-L Herbapol	0.001 ±0.0007	0.003 ±0.0005	0.008 ± 0.0011	0.002 ±0.0007	0.009 ±0.0005	0.025 ±0.002364	0.036±0.00429	0.074 ±0.0015
Bronchial	31002L Herbapol	0.005 ±0.0022	-	-	0.006 ±0.0005	-	-	0.006±0.0029	0.011 ±0.0015
Anthodium Chamomillae	234282 PhytoPharm	0.055 ±0.0055	0.673 ±0.0245	-	-	-	-	-	-
Fito - mix 9	2022002L Herbapol	0.003 ±0.0005	-	-	-	-	-	-	-

Table 2
Tabela 2

The content of organochlorine pestcides in instant granulated teas and teething gels
Zawartość pestycydów chlorowcopochodnych w herbatach granulowanych rozpuszczalnych i żelach na ząbkowanie

Name of preparation Nazwa preparatu	Batch and manufacturer Nr partii	The content – Zawartość ($mg \cdot kg^{-1}$)							
		HCH	ALDRIN	DIELDRIN	pp'DDE	pp'DDD	pp'DDT	DDT + metabolites	DMDT
Sedative HIPP	L-187861	0.163 ±0.0891	0.046 ±0.0056	-	0.027 ±0.0066	-	0.008 ±0.0054	0.035 ±0.0042	0.02 ±0.0045
Digestive HIPP	L-181932	-	-	-	-	-	-	-	-
Chamomile HIPP	L-181771	-	-	-	-	-	-	-	-
Foeniculi HIPP	L-181731	-	-	-	-	-	-	-	-
Foeniculi Impress	L-93142	-	-	-	-	-	-	-	-
Chamomile Impress	L-92651	-	-	-	-	-	-	-	-
Herbal Impress	L-00041	-	-	-	-	-	-	-	-
Lemon with vit. C Impress	L-91472	-	-	-	-	-	-	-	-
Orange with vit. C Impress	L-92771	-	-	-	-	-	-	-	-
Fruit with vit. C Impress	L-00731	-	-	-	-	-	-	-	-
Plantex	0753806A	-	-	-	-	-	-	-	-
Bobodent	11003	0.003 ±0.0011	0.016 ±0.0036	-	0.002 ±0.0009	0.007 ±0.0006	-	0.009 ±0.0011	0.039 ±0.0045
Aperisan	1001	-	-	-	-	-	-	-	-

Table 3
Tabela 3

The content of organochlorine pesticides in brewed teas (mean ± SD)
Zawartość pestycydów chlorowcopochodnych w naparach

Name of preparation Nazwa preparatu	The content – Zawartość ($mg \cdot kg^{-1}$)							
	HCH	ALDRIN	DIELDRIN	pp'DDE	pp'DDD	pp'DDT	DDT + metabolites	DMDT
Folium Menthae pip.	0.1300 ±0.0144	-	-	0.1820 ±0.0159	-	-	0.1820 ±0.0758	-
Inflorescentia Tiliae	0.0800 ±0.0095	-	-	0.1010 ±0.0095	-	-	0.1010 ±0.0884	0.4900 ±0.0612
Nervinum	-	-	-	0.0900 ±0.005	-	-	0.0900 ±0.0721	-
Flatuvit	0.0300 ±0.0326	0.0200 ±0.0052	0.0200 ±0.0105	0.0800 ±0.0052	-	-	0.0800 ±0.008	-
Bobofen	0.0100 ±0.0030	0.0100 ±0.0163	-	0.0200 ±0.0052	-	-	0.0200 ±0.0055	-
Fructus Myrtylli	0.0010 ±0.0005	0.0030 ±0.0008	0.0080 ±0.0012	0.0100 ±0.0060	-	-	0.0100 ±0.0013	-
Bronchial	0.0030 ±0.0003	-	-	0.0050 ±0.0028	-	-	0.0050 ±0.0005	-
Fructus Foeniculi	-	-	-	-	-	-	-	-
Fructus Rubi idei	-	-	-	-	-	-	-	
Anthodium Chamomillae	-	-	-	-	-	-	-	-
Fito -mix 9	-	-	-	-	-	-	-	-

The assessed contents mean that the allowance for pesticides, 0.2 $mg \cdot kg^{-1}$, was exceeded (WHO and Ministry of Health and Social Welfare RP). Out of 11 investigated preparations in which the residues of organochlorine pesticides were identified, only two were free from DDT and its metabolites: Anthodium Chamomillae and Fito-mix 9.

Contamination of the investigated material with DMDT was found to be equally high: 0.666 $mg \cdot kg^{-1}$ in Inflorescentia Tiliae and 0.333 $mg \cdot kg^{-1}$ in Fructus Myrtylli, 0.259 in Fructus Foeniculi and 0.222 in Folium Menthae piperitae.

Taking into account lower toxicity of this compound, the level of contamination may be considered relatively safe, and the obtained results were affected by the fact that some of the investigated herbs contain volatile oils which dissolve and accumulate organochlorine pesticides.

A similar assumption can be made in case of the content of aldrin in Anthodium Chamomillae – 0.673 $mg \cdot kg^{-1}$ and in Fructus Foeniculi – 0.385$mg \cdot kg^{-1}$, in which the presence of volatile oils may contribute to the increase of the contamination.

Aldrin was identified in 7 of the investigated herbal samples, and its allowable content (0.02 $mg \cdot kg^{-1}$, Table 5) was exceeded in three of them: Fructus Foeniculi, Flatuvit and Anthodium Chamomillae.

Another investigated compound, dieldrin, was identified in 3 samples and the assessed levels are in the range of thousandths and hundredths of $mg \cdot kg^{-1}$.

Table 4
Tabela 4

The percentage of organochlorine pesticides extraction to brewed teas
Ekstrakcja pestycydów chlorowcopochodnych do naparów(%)

Name of preparation Nazwa preparatu	Extraction – Ekstrakcja (%)						
	HCH	ALDRIN	DIELDRIN	pp'DDE	pp'DDD	pp'DDT	DMDT
Fructus Myrtylli	26.20	58.80	47.30	32.40	-	-	69.30
Inflorescentia Tiliae	24.70	-	-	26.10	-	-	73.90
Folium Menthae piperitae	39.70	-	-	95.10	-	-	-
Bobofen	3.40	61.90	-	60.40	-	-	-
Nervinum	-	-	-	78.60	-	-	-
Flatuvit	+	10.70	45.20	83.20	-	-	-
Bronchial	59.60	-	?	78.10	-	-	-

+ trace amounts – niepoliczone ilości

HCH appeared to be the most commonly occurring compound, the presence of which was identified in 10 preparations. The levels of the compound ranged from 0.001 $mg \cdot kg^{-1}$ in Fructus Rubi idei to as much as 0.327 $mg \cdot kg^{-1}$ in Folium Menthae piperitae.

As evidenced by the obtained data, the highest levels of contamination with organochlorine pesticides were observed in the following preparations: Inflorescentia Tiliae, Fructus Myrtylli, Folium Menthae piperitae, and also Bobofen. The high content of aldrin in Anthodium Chamomillae and Fructus Foeniculi speaks unfavourably about the purity of these raw materials in view of high toxicity of the pesticide.

Table 5
Tabela 5

The highest allowable residue of organochlorine pesticide (according to WHO and Ministry of Health and Social Welfare RP)
Najwyższe dopuszczalne pozostałości pestycydów chlorowcopochodnych (wg WHO i Misterstwa Zdrowia RP)

Name of pesticides Pestycydy	The level Poziom ($mg \cdot kg^{-1}$)
Aldrin together with dieldrin expressed as dieldrin	0.02
total DDT, DDE, DDA	0.2
HCH alfa	0.2
HCH beta	0.2
HCH gama (lindan)	0.1

The differences in the content of organochlorine pesticides observed among individual herbal raw materials result from various factors, such as the place from which they were harvested, level of chemicalization of the field and general pollution of the environment.

Table 2 presents the content of organochlorine pesticides in granulated instant teas. These preparations are almost completely free from pesticide contamination except for Hipp calming tea, which contained most of the investigated pesticides, the most abundant being HCH – 0.163 $mg \cdot kg^{-1}$, aldrin – 0.04 $mg \cdot kg^{-1}$ and DDT with its metabolites – 0.035 $mg \cdot kg^{-1}$.

On the basis of obtained results we can assume that technological processing of the herbal raw material decreases the level of pesticide contamination in the ready product in comparison to the raw material.

Table 2 presents also the results of measurements of the levels of pesticides in teething gels Bobodent and Aperisan. Bobodent Gel was found to contain DMDT, aldrin, DDD, DDE and HCH, but their levels were low in every case – below 0.04 $mg \cdot kg^{-1}$. Aperisan Gel was found to be completely free from these compounds.

Table 3 contains the results of measurements of the level of organochlorine pesticide contamination in infusions obtained from tea bags according to the manufacturer's instruction.

As evidenced by the data, infusions made from individual herbs in tea bags contain lower levels of pesticides in comparison to the level in herbal raw material. Only seven out of 11 investigated infusions revealed the presence of pesticides contamination: Flatuvit, Nervinum, Bronchial, Bobofen and herbs: Folium Menthae piperitae, Inflorescentia Tiliae and Fructus Myrtylli. None of the samples contained all of the investigated contaminations.

In case of infusions, the most commonly occurring organochlorine pesticides were HCH, aldrin and DDE, while DMDT was identified only in Inflorescentia Tiliae infusion. DDE was identified in 7 infusions, while DDD and DDT were not identified in either of them.

Generally speaking, the level of pesticide contamination of infusions can be assessed as low.

The levels of contamination of the analyzed herb raw materials and obtained from them infusions can be used as the basis for determination of the level of extraction of individual organochlorine pesticides. Obtained results have been presented in Table 4.

The pesticide with the highest degree of extraction is DDE with extraction reaching from 26.1% in Inflorescentia Tiliae to 95.1% in Folium Menthae piperitae. Such a wide range of extraction values is probable associated with the kind of raw material, degree of its fragmentation and chemical composition.

It should be stressed however than among the pesticides, mainly HCH, aldrin and DDE pass to infusions from herbal tea bags. None of the infusion contained all of the investigated pesticides, and the highest numbers were identified in Fructus Myrtylli, Bobofen and Flatuvit infusions.

Taking into consideration the highest allowable ranges of residues of the analyzed compounds, which were presented in Table 5, the norms were evidently exceeded in many of the herbal teas. Although the excess is not directly associated with hazardous effects on the organism, but it is an important risk factor, which cumulates in the organism and constitutes a dangerous deposit, that may be triggered in various pathological and physiological situations.

As evidenced by the obtained data, contamination of herbal raw material with organochlorine pesticides is still a current problem. The use of pesticides on a mass scale in the past, high physicochemical stability as well as the accumulation in the environment have all contributed to the fact that the high amounts of these compounds, once introduced to the environment, are still found there.

The presence of organochlorine pesticides in food products, including also therapeutic products, is hazardous for a weakened organism of an ill person and especially for a young patient such as a small child. Children are exposed to a number of situations in which they get in touch with pesticides present either in drugs or in food products, what may potentate their cumulative, overlapping toxic effect.

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Part 2. Contamination with organochlorine pesticides of paediatric preparations of plant origin

Keywords: organochlorine pesticides, contaminations, preparations of plant origin, gas chromatography, HCH, DDT, DMDT, aldrin, dieldrin.

Abstract

Pesticides are a group of synthetic compounds introduced to biocenosis as a result of intentional human activity. Due to their long-lasting presence in the soil, the ability to spread as well as resistance to technological processes, the remains of pesticides can transfer to the human organism, where they cause acute and chronic intoxication. Organochlorine pesticides have been identified in herbal preparations, and especially in herbal and herbal-fruit teas in bags as well as in their infusions. The most commonly identified residues of pesticides found in these preparations include HCH, aldrin, DDE and DMDH. The percentage extraction of organochlorine pesticides is differentiated and ranges from 3 to 95.1.

OCENA CZYSTOŚCI PEDIATRYCZNYCH PREPARATÓW POCHODZENIA ROŚLINNEGO I JEJ ZNACZENIE DLA BEZPIECZEŃSTWA FARMAKOTERAPII

Cz. II. Zanieczyszczenie pestycydami chlorowcopochodnymi pediatrycznych preparatów roślinnych.

Słowa kluczowe: pestycydy chlorowcopochodne, zanieczyszczenia, preparaty roślinne, chromatografia gazowa, HCH, DDT, DMDT, aldryna, dieldryna.

Abstrakt

Pestycydy są grupą związków syntetycznych, wprowadzonych do biocenozy w wyniku zamierzonej decyzji człowieka. Długi czas zalegania w glebie, zdolność rozprzestrzeniania się oraz odporność na procesy technologiczne sprzyjają przedostawaniu się pozostałości pestycydów do organizmu ludzi, gdzie są przyczyną zatruć ostrych i przewlekłych. Pestycydy chlorowcopochodne są obecne w preparatach ziołowych, szczególnie w herbatkach ekspresowych ziołowych i ziołowo-owocowych oraz w naparach z nich sporządzonych. Najczęściej występujące pozostałości pestycydów w tej grupie preparatów to: HCH, aldryna, DDE i DMDT. Ekstrakcja pestycydów chlorowcopochodnych do naparów jest zróżnicowana i wynosi od 26,1 do 95,1%.