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Residues of Organochlorine Pesticides and Polychlorinated Biphenyls (PCBs) in Adipose Fat of Geese and Turkeys from the Region of Varmia and Mazuria (1996)

A. Zasadowski

Department of Veterinary and Environmental Toxicology,
University of Agriculture and Technology, Olsztyn, Poland

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Abstract

This paper presents the results of studies on the levels of organochlorine pesticides (HCH, DDT, DDE, DDD) and polychlorinated biphenyls (PCBs) in the adipose tissue of geese and turkeys in Varmia and Mazuria. The birds were slaughtered in summer 1996. Average level of ∑DDT residues in adipose fat of geese was 89.3 μg/kg and of γ-HCH 0.8 μg/kg, while turkey fat contained 13.6 μg/kg and 2.5 μg/kg, respectively. Average residues of PCBs in goose adipose fat amounted to 5.1 μg/kg, and in turkey fat - to 4.9 μg/kg. DDT dominated in both, goose and turkey fat, DDE percentage was twice higher in turkey fat than in geese, while DDD levels were a little lower in turkeys than in geese. These results add to the inventory of residues of these xenobiotics in the tissues of domestic birds bred in Northeastern Poland.

Keywords: geese, turkeys, fat, organochlorine pesticides, polychlorinated biphenyls, Poland

Introduction

Organochlorine pesticides and polychlorinated biphenyls (PCBs) belong to the xenobiotics which have polluted the natural environment for many years [1-5]. These substances are persistent, accumulating in the food chain and having a negative effect on living organisms [1, 2, 6-8].

Birds exposed to these xenobiotics exhibit disturbances of egg laying and hatchability [1,9,10]. Changes have also been observed in the biochemical parameters and functioning of internal organs, leading to a variety of diseases or even to bird death [1,2,11-15]. The intensity of these changes usually depends on the degree and lenght of bird intoxication.

A ban on free use of organochlorine pesticides and limits imposed on the use of polychlorinated biphenyls in the industry has resulted in significant decreases in concentrations of these substances in the natural environment and food products [16, 17, 18]. Nevertheless, their residues are still being found, though in small amounts, both in living organisms and in food products (mostly of animal origin).

In view of the need to inventory the ecological dangers in particular regions as well as on a national scale, it was decided to determine the degree of contamination of some poultry with the discussed substances in the region of Varmia and Mazuria.

The aim of the study was to determine the contents of organochlorine pesticides (HCH, DDT, DDE, DDD) and polychlorinated biphenyls (PCBs) in adipose fat of geese and turkeys bred in the region of Varmia and Mazuria and designated for human consumption.

This paper is a continuation of a series presenting data on the residues of organochlorine pesticides and polychlorinated biphenyls in fat of animals bred in Varmia and Mazuria.

Material and Methods

Examinations were performed on adipose fat collected from 52 geese and 50 turkeys. All birds were bred in the region of Varmia and Mazuria and were slaughtered in July-August 1996 in the "Indyk-Pol" S.A. poultry enterprise in Olsztyn, Poland. Fat from the adipose tissue was rendered in 60°C, and extracted using the method described by Stec and Juszkiewicz [19]. Organochlorine pesticides and polychlorinated

Table 1. Residue levels of organochlorine pesticides and polychlorinated biphenyls (PCBs) in adipose fat of geese and turkeys (in μg/kg of fat; arithmetic mean and range of concentrations).

Species	n	Body weight (kg)	γ-HCH	pp'-DDE	pp'-DDD	pp'-DDT	∑DDT	PCBs
Geese	52	5.72 4.82 - 6.68	0.8 traces - 3.1	12.0 traces - 57.1	8.6 traces - 50.3	68.7 traces - 508.4	89.3 2.0 - 601.3	5.1 2.1 - 28.0
Turkeys	50	11.85 8.12 - 15.03	2.5 traces - 11.2	4.4 1.0 - 25.8	1.0 n.s. - 18.2	8.2 n.s. - 73.0	13.6 1.0 - 90.2	4.9 n.s. - 14.1

n.s. - undetected by the used method

biphenyls were separated using the method described by Amarowicz et al. [20]. Separation and all determinations were carried out using gas chromatography in the conditions as required for the analyzed substances. Identification of organochlorine pesticides was based on comparisons of peak retention time with standard peaks, and identification of PCBs - compared with standard solution Aroclor 1260.

Concentrations of the analyzed xenobiotics were calculated according to the usual procedures.

Results and Discussion

The results of determinations of the content of organochlorine pesticides (HCH, DDT, DDE and DDD) and polychlorinated biphenyls (PCBs) in adipose fat of geese and turkeys, expressed in μg/kg, are presented in Tables 1-4 and Figure 1.

Data in Tab.1 comprise mean values and range of concentrations. In order to make the interpretation easier, Tab. 2 presents percentage distribution of the content of organochlorine pesticides, Tab. 3 gives percentages of DDE, DDD and DDT in goose and turkey fat (DDE+DDD+DDT=100%), and Tab.4 - percentage distribution of polychlorinated biphenyls (PCBs)

Average level of ∑DDT residues in goose fat was 89.3 μg/kg, and of γ-HCH 0.8 μg/kg. The respective values in turkey fat were 13.6 and 2.5 μg/kg (Tab. 1, Fig. 1). The majority of collected fat samples contained determinable levels of organochlorine pesticides, with DDE present in the highest number of samples

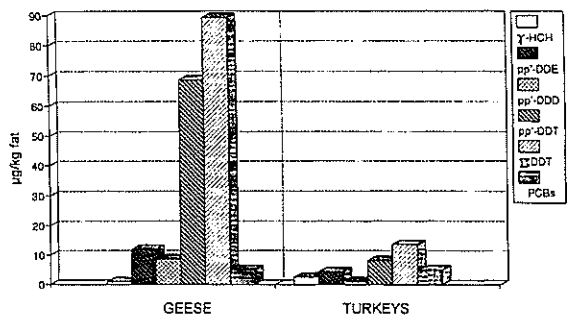


Fig. 1. Mean concentrations of the residues of organochlorine pesticides and polychlorinated biphenyls PCBs) in adipose fat geese and turkeys from the region of Varmia and Mazuria (1996)

(Tab.2): 98.1% in geese and 100.0% in turkeys. Levels of this metabolite were higher in geese (12.0 μg/kg of fat) than in turkeys (4.4 μg /kg). Residues of DDT and its metabolites were much higher in geese than in turkeys (Tab. 1, Fig. 1). An opposite trend was observed with respect to γ-HCH residues. Average levels of γ-HCH in turkey fat was 3 times higher than in geese (Tab. 1). The percentage of positive samples was also higher in turkeys (Tab. 2). Single samples of goose adipose fat contained higher maximal levels of DDT, DDE and DDD compared to turkeys. DDT dominated in fat of geese as well as turkeys, DDE percentages were twice higher in turkeys than in geese, while DDD percentage was slighly lower in turkeys than in geese (Tab.3). The higher DDE percentage in turkey fat compared to geese fat was probably due to DDT biotransformation in the bird organism and/or to higher content of this metabolite in turkey feed.

Data presented in Tabs. 1 and 4 reveal that the degree of turkey contamination by PCBs in Varmia and Mazuria is relatively low. The mean level of PCB residues in goose adipose fat was 5.1 μg/kg, and in turkey fat - 4.9 μg/kg (Tab.1, Fig1). PCBs were found in all samples of goose fat; their determinable concentrations varied from 2.1 to 28.0 μg/kg. In the case of turkeys, 2 samples did not contain PCBs (in levels determinable with the method used), and the remaining 48 samples contained from 1.0 to 14.1 μg/ kg. The vast majority of goose fat samples contained less than 5.0 μg/kg PCBs (Tab.4), while turkey samples usually contained about 10.0 μg/kg. There were no turkey fat samples containing more PCBs than 15.0 μg/kg, and only 2 samples of goose fat which contained such high levels (28.0 μg/kg in one bird and 17.0 μg/kg in the other).

Residues of organochlorine pesticides and polychlorinated biphenyls found in the samples of goose and turkey adipose fat are much lower than the values observed in 1985-1995, both in Poland and abroad [4, 5, 21-23], and lower than the levels noted in earlier periods in the same birds from the same region [4, 17, 22-24]. They do not represent a hygenic or toxicologic danger and are decisively lower than permissible levels [25, 26].

This work has added new data to the inventory of the residues of organochlorine pesticides and polychlorinated biphenyls in poultry. The data constitute a

Table 2. Percentage distribution of the content in positive samples of organochlorine pesticides and polychlorinated biphenyls (PCBs) in adipose fat of geese and turkeys from the region of Varmia and Mazuria (1996).

Species	n	Compound	min - max concentration	% positive samples
Geese	52	γ - HCH	0.00 - 3.0	57.7
		pp'- DDE	0.00 - 57.1	98.1
		pp'- DDD	0.00 - 50.3	75.0
		pp'- DDT	0.00 - 508.4	65.4
		PCBs	2.10 - 28.0	100.0
Turkeys	50	γ - HCH	0.00 - 11.0	92.0
		pp'- DDE	1.00 - 25.8	100.0
		pp'- DDD	0.00 - 18.2	36.0
		pp'- DDT	0.00 - 73.0	44.0
		PCBs	0.00 - 14.1	96.0

Table 3. Percentage of DDE, DDD and DDT in adipose fat of geese and turkeys (DDE+DDD+DDT=100%).

Species	%DDE	%DDD	%DDT
Geese	13.44	9.63	76.93
Turkeys	32.35	7.35	60.30

Table 4. Distribution of content of PCBs in adipose fat of geese and turkeys from the region Varmia and Mazuria (1996).

Distribution of concentration (µg/kg)	Geese (n)	%	Turkeys (n)	%
n.s	0	0	2	4.0
1 - 5	31	59.6	22	44.0
5 - 10	17	32.8	25	50.0
10 - 15	2	3.8	1	2.0
15 - 30	2	3.8	0	0
> 30	0	0	0	0

n.s. - undetected by the used method

reference for subsequent studies and environmental monitoring, as well as illustrate the degree of bird exposure, and thus indirectly of human exposure, to these xenobiotics.

To obtain a complete picture of the contamination of poultry with the discussed xenobiotics in the region of Varmia and Mazuria it is advisable to continue similar studies. Food products of animal origin should also be examined.

References

1. Word Health Organization. DDT and its derivatives. Environment Health Criteria 9. WHO, Geneva **1979.**
2. Word Health Organization. Polychlorinated Biphenyls and Terphenyls. Environmental Health Criteria 2. WHO, Geneva **1976.**
3. JUSZKIEWICZ T., STEC J., NIEWIADOWSKA A., SZPRENGIER T. Skażenia środowiska i zwierząt insektycydami chloroorganicznymi, chlorodwufenylami i rtęcią. Biul. Inst. Ochr. Roślin, **59**, 195, **1975.**
4. SMOCZYŃSKI S., SKIBNIEWSKA K., SMOCZYŃSKA K. Persistent Organochlorines in Animal Fat. Polish J. Environm. Stud., **1 (2)**, 23, **1992.**
5. FALANDYSZ J., FALANDYSZ J. Pestycydy polichlorowe i polichlorowane dwufenyle w tłuszczu zwierząt rzeźnych i zwierzyny łownej z rejonu Polski Północnej. Roczn. PZH, **37 (6)**, 487, **1986.**
6. JUSZKIEWICZ T., NIEWIADOWSKA A. Pozostałości pestycydów i polichlorowanych dwufenyli w tkankach zwierząt, mleku, jajach i środowisku w świetle 15-letnich badań własnych. Med. Wet., **6**, 323, **1984.**
7. ZASADOWSKI A. Residues of Polychlorinated Biphenyls (PCBs) in the Adipose Tissue of Domestic Animals (Pigs, Cattle) in the Region of Varmia and Mazuria. Polish J. Environm. Stud., **4 (3)**, 65, **1995.**
8. ZASADOWSKI A. Polychlorinated Biphenyls (PCBs) in the Adipose Tissue of Wild Boars and Roe-deer in the Region of Varmia and Mazuria. Polish J. Environm. Stud., **3 (2)**, 43, **1994.**
9. AX R.L., HANSEN L.G. Effects of purified polychlorinated biphenyl analpgs on chicken reproductionn. Poult. Sci., **54 (3)**, 895, **1975.**
10. HARRIS S.J., CECIL M.C., BITMAN J., LILLIE R.J. Antibody response and reduction in bursa of Fabricus and spleen weights of progeny of chickens fed PCBs. Poult. Sci., **55 (5)** 1933, **1976.**
11. HEALTH R.G., SPANN J.W., KREITZER J.F., VANCE C. Effects of polychlorinated biphenyls on birds. Reprint. from Proceedings XV International Ornithological Congress Manuscript revised December, **1970.**
12. HANSEN L.G., STRIK J.J., KOEMAN J.H., KAN C.A. Biological activity of technical Aroclor 1254 residues: swine fat residues fed to broiler cockerels. Toxicology, **21**, 203, **1981.**
13. VOS J.G. Toxicology of PCBs for mammals and for birds. Environ. Health Perspect., **1**, 105, **1972.**
14. OSWEILER G.D., CARSON T.L., BUCK W.B., VAN GELDER G.A. Clinical and Diagnostic Veterinary Toxicology. Kendall Hunt Pub. Co., Dubuque, Iowa, **1985.**
15. JONSON C.J., LUND B.O., BRUNSFROM B., BRANDT J. Toxicity and irreversible binding of two DDT metabolites - 3-methysulfenyl - DDE and o,p'-DDD in adrenal interrenal cells in birds (chickens and ducks). Environm. Toxicol. Chem., **13 (8)** 1303, **1994.**
16. JUSZKIEWICZ T., NIEWIADOWSKA A., STEC J., SZKODA J., SZPRENGIER T., ŻMUDZKI J. Xenobiotics in animal tissues and food products in Poland. Bull. Vet. Inst. Pulawy, **34, 1, 1991.**
17. FALANDYSZ J. Pestycydy polichlorowe i polichlorowane bifenyle w sadle zwierząt udomowionych na obszarze północnej części kraju. Bromat. Chem. Toksykol., **24 (3)** 207, **1993.**
18. ZASADOWSKI A. Levels of Organochlorine Pesticides and Polychlorinated Biphenyls (PCBs) in Pikeperch (Stizostedion lucioperca L.) from Selected Lakes of Varmia and Mazuria. Polish J., Environm. Stud., **5 (6)**, 75, **1996.**
19. STEC J., JUSZKIEWICZ T. Oznaczanie pozostałości insektycydów polichlorowanych w produktach zwierzęcych z zastosowaniem metody Wooda. Med. Wet., **28 (10)**, 634, **1972.**
20. AMAROWICZ R., KORCZAKOWSKA B., SMOCZYŃSKI S., BOREJSZO Z. Szybka metoda wyodrębniania polichlorowanych difenyli z tłuszczu. Roczn. PZH, **40 (1)**, 63-72, **1989.**
21. FRANK R., BRAUN H. E., STONEFIELD K.J., RASPER J., LUYKEN H. Organochlorine and organophosphorus residues in the fat domestic farm animals species, Ontario, Canada 1986-1988. Food Additiv. Contamin., **7 (5)** 629, **1990.**
22. FALANDYSZ J., CENTKOWSKA D. Pestycydy polichlorowe i polichlorowane bifenyle w tkance tłuszczowej zwierząt rzeźnych z rejonu Polski Północnej, 1986. Bromat. Chem. Toksykol. **22 (3-4)**, 176, **1989.**

23. FALANDYSZ J., KANNAN K. Organochlorine pesticides and polychlo-rinated biphenyl residues in slaughered and animal fats from the nothern part of Poland. Z. Lebensm. Unters. Forsh. **195**, 17, **1992**.

24. JAWORSKI J., SMOCZYŃSKI S., BUDSŁAWSKA H. Chlorowane węglowodory w tłuszczu ptaków domowych. II. Pozostałości chlorowanych węglowodorów w tłuszczu zapasowym młodych gęsi i indyków tuczonych. Zesz. Nauk ART Olszt. TŻ, **121** (3) 131, **1974**.

25. FALANDYSZ J. Polichlorowane dwufenyle w żywności pochodzenia zwierzęcego. Gosp. mięsna. **41** (6) 19, **1989**.

26. Rozporządzenie Ministra Zdrowia i Opieki Społecznej z dnia 8.10.1993. Dziennik Ustaw R.P. nr 104. poz. 476 z dnia 4.11.**1993**, Warszawa.