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Published in:
Organohalogen Compounds

Publication date:
2010

Document Version
Publisher's PDF, also known as Version of record

[Link back to DTU Orbit](#)

Citation (APA):
Fromberg, A., Granby, K., Højgård, A., & Fagt, S. (2010). Food sources of non dioxin-like PCBs (NDL-PCBs). *Organohalogen Compounds*, 72, 1064-1067. <http://www.dioxin20xx.org/pdfs/2010/10-1403.pdf>

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FOOD SOURCES OF NON DIOXIN-LIKE PCBs (NDL- PCBs)

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Introduction

Due to their potential health hazardous effect on humans monitoring programmes for contaminants in food often include investigations of persistent organochlorine contaminants such as PCB (polychlorinated biphenyls)¹. The compounds are slowly degradable in the environment and tend to accumulate in biota and to biomagnify up through the feed and food chain. Today they are found in all kind of fatty food e.g. fish, pork, and cattle and milk. As a consequence almost all kind of fatty foods are sources of the human's intake of NDL-PCBs. In this paper intake estimates have been made for the compounds by combining occurrence data in foods with data on the food consumption and the sources of the exposure of NDL-PCBs have been assessed.

Methods and Materials

Samples: In order to investigate the levels in foods on the Danish marked 1395 samples of animal origin including poultry, beef and pork and 234 samples of different kind of fish samples collected at retailers have been analysed.

Compounds: All samples were analysed for their content of the following non dioxin-like PCB congeners (NDL PCBs) also known as indicator PCBs: PCB28, PCB52, PCB101, PCB105, PCB118, PCB138, PCB153, PCB156, PCB170 and PCB180.

Sample clean-up: Fat was extracted from the samples and about 0.6 gram of fat was added to a Florisil column deactivated by water and eluted with dichloromethane:pentane (1:4). The eluate was carefully evaporated and the sample dissolved in isooctane. The final sample was analysed by gas chromatography using two different columns and electron capture detectors.

GC-ECD parameters: Perkin Elmer autosystem gas chromatograph. Column: 50 m CP-Sil-5CB (Chrompack) and 60 m DB-17 (J&W), 0.25 mm i.d., 0.25µm film thickness. Carrier gas: Helium, 15 psi (CP-Sil-5CB) or 37 psi (DB-17). 2 µl injected splitless, splitless time 2.5 min. Injector held at 220°C. Temperature programme: 90°C for 1 min., 30°C/min. to 180°C in 10 min., 2°C/min. to 240°C, 10°C/min. to 280°C in 20 min. (CP-Sil-5CB) or 30 min. (DB-17). Detector temperature 320°C. PCB congeners and organochlorine pesticides were quantified by comparing responses with those of standard mixtures.

Results and discussion

Intake estimates are based on the dietary intake data collected in the Danish nationwide food consumption survey 2000-2002². The food consumption data were sampled throughout the 3 years in order to take into account any possible seasonal variation in dietary habits. The representative sample of Danes included a total of 4120 respondents (2167 female and 1953 male) aged 4-75 yr. The food consumption survey used a seven-day prospective food record with a pre-coded (semi-closed) questionnaire that included answering categories for the most commonly eaten foods and dishes in the Danish diet. Composite foods (e.g. dishes) were split up into ingredients by means of standard recipes. Due to the simplified design of the questionnaire, the total diet could be represented by the intake of a reduced number of food items. The final result of these conversions was then

recalculated and expressed as the daily mean intake for the seven-day food register of each participant in the survey.

Based upon the data of the individuals, it was possible to describe the intake distribution of chemical contaminants from the different food categories. Individual-level mean consumptions of each of the food items were multiplied with mean contaminant content in that particular food.

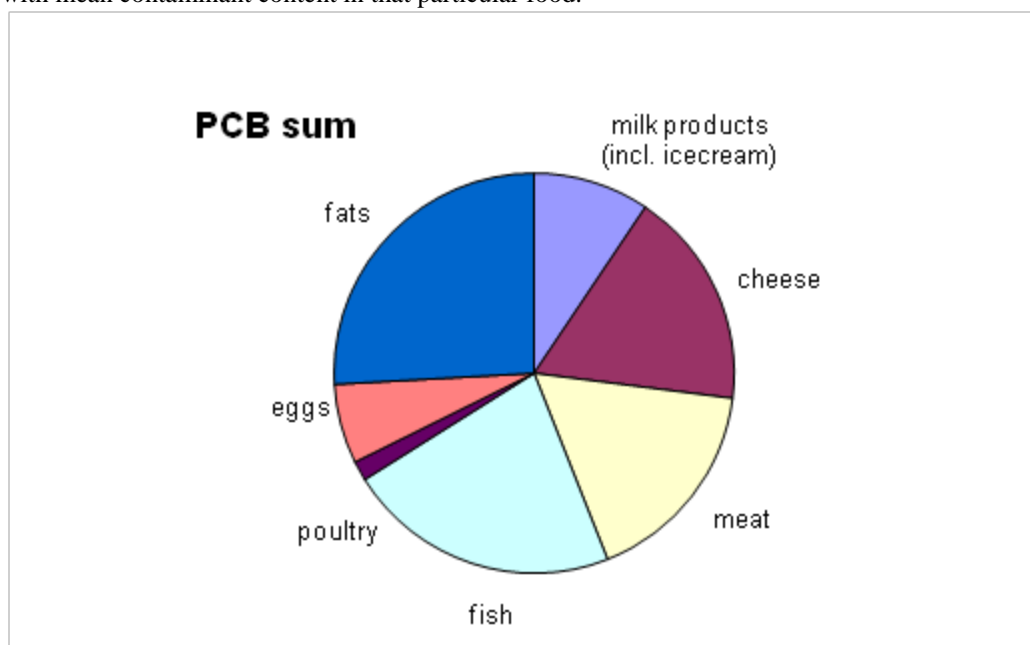


Figure 1. Estimated intake of NDL-PCBs from various foods.

The result of contaminant intake among adults displayed in figure 1 show that the main foodstuffs contributing to exposure of NDL-PCBs are fats including butter, cheese, meat and fish; however the cause for the large contribution from these foodstuffs differ. Whereas the high fraction of NDL-PCBs intake from fat, cheese and meat originate from a high consumption of food items with low levels of NDL-PCBs the NDL-PCB intake of fish originate from a relative low consumption of fish with a relative high content of NDL-PCBs. In table 1 the fat contents and the NDL-PCB levels in fish are presented, sorted from the lowest to the highest levels of NDL-PCBs. As a main trend, the levels of NDL-PCBs correlate to the levels of fat in the fish; however it is noteworthy that this is not always the case. For examples for cod and garfish the lipid content is low, whereas the level of NDL-PCBs is relative high. On the other hand for butterfish and mackerel the fat content is relative high; however the corresponding NDL-PCBs content is relative low. As a consequence replacing consumption of fish with a high NDL-PCB level with fish species with lower levels of NDL-PCBs will influence the intake considerable and fish as a source of NDL-PCB will be reduced.

Table 1. Fat content and related NDL-PCBs content in different fish species

Fish	N	Consumption [g/day]	Fat content [%]	NDL-PCBs content [ng/g]		
Tuna	4	2.8	7.7	2.0	±	1.1
Swordfish	7	n.r.	6.6	2.9	±	3.1
Caviar and cod roe	12	0.002/0.7	3.4	3.0	±	1.3
Trout	11	0.5	4.0	3.0	±	0.7
Butterfish	5	n.r.	18	3.8	±	4.5
Mackerel	38	0.8	20	6.0	±	5.2
Sardine	7	n.r.	12	10.0	±	8.0
Halibut	7	n.r.	12	10.9	±	9.8
Kippers	4	n.r.	16	11.2	±	5.3
Cod	6	2.5	1.1	11.6	±	1.7
Herring	50	3.3	14	11.8	±	8.4
Salmon	56	2.5	14	18	±	11
Lumpsucker	11	n.r.	13	21	±	7.5
Garfish	5	0.2	0.8	29	±	20
Eel	11	0.3	26	33	±	40

n.r.: not recorded

Looking at one of the other main contributors to the intake of NDL-PCBs namely meat products it is notable that even though the levels are generally low there are considerable differences in the mean levels of NDL-PCBs for the different meat types as presented in figure 2. However due to the relative large standard derivation only a few of the mean levels differ statistic significantly from each other. This is e.g. the case for the organic versus the conventional feed hens and chickens samples. The meat products with the highest NDL-PCB level are meat types which are consumed with less frequency than the meat types with the lowest mean levels of NDL-PCBs as a consequence meat as a source of NDL-PCB may realistic only be reduced by reducing the consumption of meat.

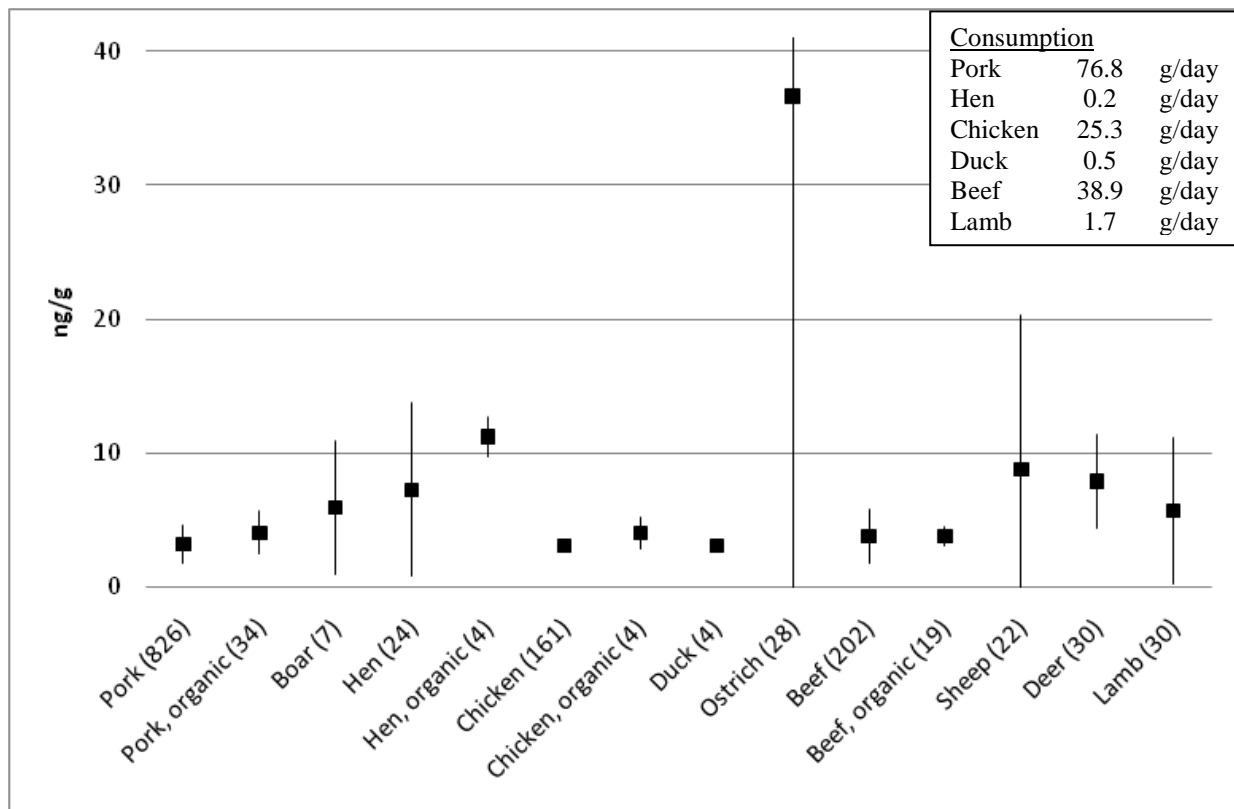


Figure 2. Mean NDL-PCBs contents (ng/g fat) in meat from different animals

Conclusions

The highest contributions to the dietary intake of the organochlorine contaminants are from fish, cheese, fats and meat and the sources are multifarious. Fish as a source of dietary NDL-PCBs intake revealed markedly differences between the species not only correlating with the lipid content of the fish. However looking at meat products as a source of NDL-PCBs differences in levels were observed but with low levels of NDL-PCBs in the meat products most commonly eaten.

Acknowledgments

I like to thank the chemists and technicians from the regional laboratory for the analysis of NDL-PCBs in the samples and chemists and technicians from Department of Nutrition for cooperation concerning the Danes dietary habits.

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