

DIOXIN MONITORING 2005 TO 2007: LEVELS OF DIOXINS AND dl-PCBs IN AUSTRIAN FOODSTUFFS AND EXPOSURE ASSESSMENT OF AUSTRIAN CONSUMERS

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Introduction

According to Commission Recommendations on the monitoring of background levels of dioxins and dioxin-like polychlorinated biphenyls (dl-PCBs) in foodstuffs (2004/705/EC, 2006/794/EC) random monitoring of the presence of dioxins and dl-PCBs in foodstuffs was performed in Austria in the last three years^{1,2}.

The aim of the monitoring is to get more reliable data on the presence of dioxins and dl-PCBs in foodstuffs in order to have a clear picture of the background presence of these substances in foodstuffs². The term “dioxins” refers to the sum of polychlorinated dibenzo-para-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs).

Materials and methods

In all nine provinces of Austria retail samples of foods were taken by the official food inspectors. All samples were selected randomly from Austrian retail sources considering the recommended minimum frequency.

Analysis was conducted by the Federal Environmental Agency. A total of 140 samples were tested for dioxins and dl-PCBs. After Soxhlet-extraction and ASE-extraction samples were spiked with 17 ¹³C₁₂-labeled PCDD/PCDF congeners and with 12 ¹³C₁₂-labeled PCBs, cleaned-up by column chromatography and coupled with a standard through an injection system. Qualitative and quantitative determination of dioxins and dl-PCBs was done by isotope dilution-gas chromatography/mass spectrometry (ID-GC/MS).

Estimates of alimentary exposure to dioxins and dl-PCBs for the Austrian population were based on Austrian consumption data using the median of users from three population groups (preschoolers, adult females and males)³. User data reflect dietary habits of consumers, who actually consume these particular food items. For further calculations body weights of 20 kg for preschoolers aged 3-6 years, 60 kg for adult females aged 19-65 years and 70 kg for adult males aged 19-65 years were assumed.

Medians of daily consumption of different foods were combined with the analysed concentrations of dioxins and dl-PCBs in corresponding food groups using lower and upper bound of median levels. Median consumption and median concentration levels are supposed to represent median exposure by consumers. However, it has to be noted that estimates of dietary intakes are limited because of lack of food consumption data and because of uncertainties related to existing consumption data.

Results and discussion

Levels of dioxins and dl-PCBs in foods

Results of monitoring 2005 to 2007 are summarised in Table 1 and 2. Levels of dioxins in different foodstuffs are presented in Table 1 and compared to maximum levels regulated in Commission Regulation (EC) No 1881/2006 and to action levels according to Commission Recommendation 2006/88/EC^{4, 5}. Table 2 gives an overview of levels of dl-PCBs and of the sum of dioxins and dl-PCBs in the same foodstuffs, also comparing to action levels and maximum levels. Regarding the results of three years' monitoring it is obvious that Austrian products are contaminated only to a minor degree. Comparison to maximum and action levels shows that analysed levels of dioxins and dl-PCBs in foodstuffs are well below the current EC limits. Only in the case of one sample of vegetable oil the analysed level exceeded the EC maximum level. In one sample of animal fat from pigs and one sample of vegetable oil analysed levels of dioxins were higher than the action level. Considering levels found for dl-PCBs most of the samples did not reach EC action levels. Nevertheless six samples of beef, one sample of pork and one sample of beef liver were above the action levels. Summing up

levels found of dioxins and dl-PCBs no sample exceeded EC maximum levels. All exceeding values are marked in bold in the tables. Four samples of baby food were also tested for dioxins and dl-PCBs. Levels found in these commodities were very low (up to 0.07 pg/g fresh weight of the sum of dioxins and dl-PCBs).

It must be noticed that the mentioned exceeding concentration levels of dioxins arise due to the limit of detection of the analytical method and assuming concentrations of non-detected congeners equal the limits of determination. Due to this fact there is need for improvement of analytical methods.

Dietary exposure assessment

On basis of median concentration levels and median of Austrian food consumption data dietary intakes of dioxins and dl-PCBs were estimated. Results of assessed median alimentary exposure to dioxins and dl-PCBs for Austrian preschoolers, adult females and males are summarised in Table 3.

Using median lower bound concentrations and median consumption of all foods resulted in median exposure by preschoolers to dioxins of 2 pg/d and to dl-PCBs of 21 pg/d, in median exposure by adult females to 5 pg/d of dioxins and 47 pg/d of dl-PCBs and by adult males to 5 pg/d of dioxins and 49 pg/d of dl-PCBs. As a result total median exposure for preschoolers to dioxins and dl-PCBs is 22 pg/d corresponding to approximately 1.1 pg/kg bw/d. Total median exposure to dioxins and dl-PCBs for adult females and males is 52 pg/d and 54 pg/kg bw/d, respectively, equivalent to approximately 1 pg/kg bw/d.

Median upper bound levels and median consumption of all foods lead to median exposure by preschoolers to dioxins of 35 pg/d and to dl-PCBs of 24 pg/d. Estimated median dietary intakes by adult females are 80 pg/d of dioxins and 56 pg/d of dl-PCBs and by adult males 85 pg/d of dioxins and 58 pg/d of dl-PCBs. Total median dietary intake of dioxins and dl-PCBs for preschoolers is 59 pg/d corresponding to approximately 3 pg/kg bw/d, for adult females 136 pg/d and for adult males 143 pg/d being equivalent to approximately 2 pg/kg bw/d.

The major foods contributing to dioxin exposure and to dl-PCB exposure for preschoolers, adult females and males are milk and dairy products, fish and fishery products, meat and meat products.

Furthermore, as mentioned above there are uncertainties related to analytical methods and to methods used to estimate the dietary intake. In cases of results which are non-detectable for specific congeners, using the upper bound estimates may overestimate concentration levels and exposure. Additionally, the results or estimates are often not representative because of the small number of samples collected.

Risk characterisation

Median exposure was compared to the tolerable weekly intake (TWI) of 14 pg World Health Organisation toxic equivalent (WHO-TEQ)/kg bw for dioxins and dl-PCBs which was fixed by the Scientific Committee on Food⁶. Calculated median upper bound dietary intake of dioxins and dl-PCBs is close to the TWI for adult females and males. For preschoolers the median intake is approximately 50 % above the TWI. On basis of lower bound levels median alimentary exposure to dioxins and dl-PCBs is well below the TWI for all three population groups.

In characterising risk associated with dioxin alimentary exposure, uncertainties and limitations in many aspects of data have to be taken into account, both in relation to determination of the TWI, as well as in relation to occurrence and consumption data.

Upper bound levels of dioxins and dl-PCBs of most samples were within the relevant existing EC limits and action levels with only a few exceptions. When using lower bound levels exposure of all three population groups is well below the TWI. Only dietary intake of preschoolers calculated with upper bound concentrations exceeds the TWI. To ensure safety of the Austrian population controls and further efforts need to be continued to keep dioxin and dl-PCB concentrations in food as low as possible.

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References

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Table 1: Median and maximum concentration levels of dioxins in Austrian food samples in comparison to EC maximum and action levels

Food group	Number of samples tested	Median concentration levels found of sum of dioxins (WHO-PCDD/F-TEQ), LB ^a / UB ^b	Maximum concentration levels found of sum of dioxins (WHO-PCDD/F-TEQ), UB ^b	Number of samples above EC maximum level	EC maximum level of sum of dioxins (WHO-PCDD/F-TEQ) ⁵	Number of samples above EC Action level	EC action level for dioxins (WHO-PCDD/F-TEQ) ⁴	Units
Meat and meat products:								
- Ruminants (bovine animals, sheep)	19	0.03 / 0.55	1.22	0	3.00	0	1.50	pg/g fat
- Poultry and farmed game	9	0.04 / 0.4	0.85	0	2.00	0	1.50	pg/g fat
- Pigs	13	0 / 0.46	0.90	0	1.00	3	0.60	pg/g fat
Liver and derived products	4	0.64 / 1.02	2.02	0	6.00	0	4.00	pg/g fat
Muscle meat of fish and fishery products and products thereof	18	0.05 / 0.08	0.40	0	4.00	0	3.00	pg/g fw ^d
Milk and milk products, including butter fat	19	0.01 / 0.42	1.11	0	3.00	0	2.00	pg/g fat
Hen eggs and egg products	26	0.01 / 0.57	1.29	0	3.00	0	2.00	pg/g fat
Animal fat from pigs	3	0 / 0.45	0.83	0	3.00	1	0.60	pg/g fat
Vegetable oil	6	0 / 0.44	1.04	1	0.75	1	0.50	pg/g fat
Marine oil intended for human consumption	6	0 / 0.4	1.02	0	2.00	0	1.50	pg/g fat
Fruits	4	0 / 30	50.00	-	ne ^c	0	400.00	pg/kg prod ^e
Vegetables	5	0 / 30	60.00	-	ne ^c	0	400.00	pg/kg prod ^e
Cereals	4	0 / 205	280.00	-	ne ^c	0	400.00	pg/kg prod ^e
Baby food	4	0 / 0.03	0.04	-	ne ^c	-	ne ^c	pg/g fw ^d

^a lower bound, ^b upper bound, ^c not established, ^d fresh weight, ^e product

Table 2: Median and maximum concentration levels of dl-PCBs in Austrian food samples in comparison to EC action levels and maximum concentration levels found of the sum of dioxins and dl-PCBs in comparison to EC maximum levels

Food group	Number of samples tested	Median concentration levels found of dl-PCBs (WHO-PCB-TEQ) LB ^a / UB ^b	Maximum concentration levels found of dl-PCBs (WHO-PCB-TEQ), UB ^b	Number of samples above EC action level	EC action level for dl-PCBs (WHO-TEQ) ⁴	Maximum concentration levels found of sum of dioxins and dl-PCBs (WHO-PCDD/F-PCB-TEQ), UB ^b	Number of samples above EC maximum level	EC maximum level of sum of dioxins and dl-PCBs (WHO-PCDD/F-PCB-TEQ) ⁵	Units
Meat and meat products:									
- Ruminants (bovine animals, sheep)	19	0.78 / 0.79	1.45	6	1.00	2.67	0	4.50	pg/g fat
- Poultry and farmed game	9	0.05 / 0.21	1.36	0	1.50	1.72	0	4.00	pg/g fat
- Pigs	13	0.04 / 0.16	0.74	1	0.50	1.25	0	1.50	pg/g fat
Liver and derived products	4	1.54 / 1.73	7.56	1	4.00	9.05	0	12.00	pg/g fat
Muscle meat of fish and fishery products and products thereof	18	0.37 / 0.37	1.21	0	3.00	1.34	0	8.00	pg/g fw ^d
Milk and milk products, including butter fat	19	0.52 / 0.52	1.13	0	2.00	2.02	0	6.00	pg/g fat
Hen eggs and egg products	26	0.07 / 0.18	1.24	0	2.00	2.41	0	6.00	pg/g fat
Animal fat from pigs	3	0.05 / 0.17	0.42	0	0.50	1.00	0	1.50	pg/g fat
Vegetable oil	6	0.01 / 0.05	0.18	0	0.50	1.07	0	1.50	pg/g fat
Marine oil intended for human consumption	6	1.47 / 1.47	3.24	0	6.00	4.11	0	10.00	pg/g fat
Fruits	4	0 / 0	10.00	0	200.00	50.00	-	ne ^c	pg/kg prod ^e
Vegetables	5	0 / 0	10.00	0	200.00	70.00	-	ne ^c	pg/kg prod ^e
Cereals	4	0 / 30	40.00	0	200.00	300.00	-	ne ^c	pg/kg prod ^e
Baby food	4	0.005 / 0.02	0.03	-	ne ^c	0.07	-	ne ^c	pg/g fw ^d

^a lower bound, ^b upper bound, ^c not established, ^d fresh weight, ^e product

Table 3: Estimated median alimentary exposure of Austrian preschoolers, adult females and males to dioxins and dl-PCBs

Population group	<i>Lower Bound</i>		<i>Upper Bound</i>	
	Estimated median exposure (pg/d)	Estimated median exposure (pg/kg bw/d)	Estimated median exposure (pg/d)	Estimated median exposure (pg/kg bw/d)
<i>Dioxins</i>				
Adult females	5	0.1	80	1
Adult males	5	0.1	85	1
Preschoolers	2	0.1	35	2
<i>dl-PCBs</i>				
Adult females	47	0.8	56	1
Adult males	49	0.7	58	1
Preschoolers	21	1	24	1
<i>Sum of dioxins and dl-PCBs</i>				
Adult females	52	0.9	136	2
Adult males	54	0.8	143	2
Preschoolers	22	1.1	59	3