DIOXIN IN EGG SAMPLES FROM THE GERMAN DIOXIN INCIDENT 2011 - CONGENER PROFILE AND EXCRECION TIME.

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Introduction

Contaminated feed was the cause of the German dioxin incident in December 2010 and January 2011[1]. A Danish egg producer and chicken breeder unconsciously gave his hens some of the contaminated feed. Afterwards the Danish Veterinary and Food Administration gave him the choice either to cull all the hens or to keep the hens and feed them with fresh feed until the eggs were below the action level of 2 pg PCDD/F-TEQ/g fat [2]. In the meantime the contaminated eggs had to be destroyed. The farmer chose the last option and sent samples of eggs to our lab at regular intervals to follow the excretion of dioxins from the hen into the egg. The hens were fed with the contaminated feed for the last time in the middle of December 2010. The content of PCDD/F and PCB were followed from December 2010 until March 2011.

Materials and methods

Pools of 12 eggs collected on the same day were used[3]. For the analysis of dioxins and PCB in egg we only use the yolk and discard the egg white. 10 g of yolk is mixed into an ASE300 extraction cell. The fat is extracted with pentane/acetone (88/12) at 100 °C. Clean-up of the extracted fat is done on a Power Prep system from FMS on prepacked multilayer silica, alumina and carbon columns. The final extract is analyzed on a MAT95 from Thermo at a mass resolution of at least 10000. TEQ-values are based on WHO-1998-TEF values.

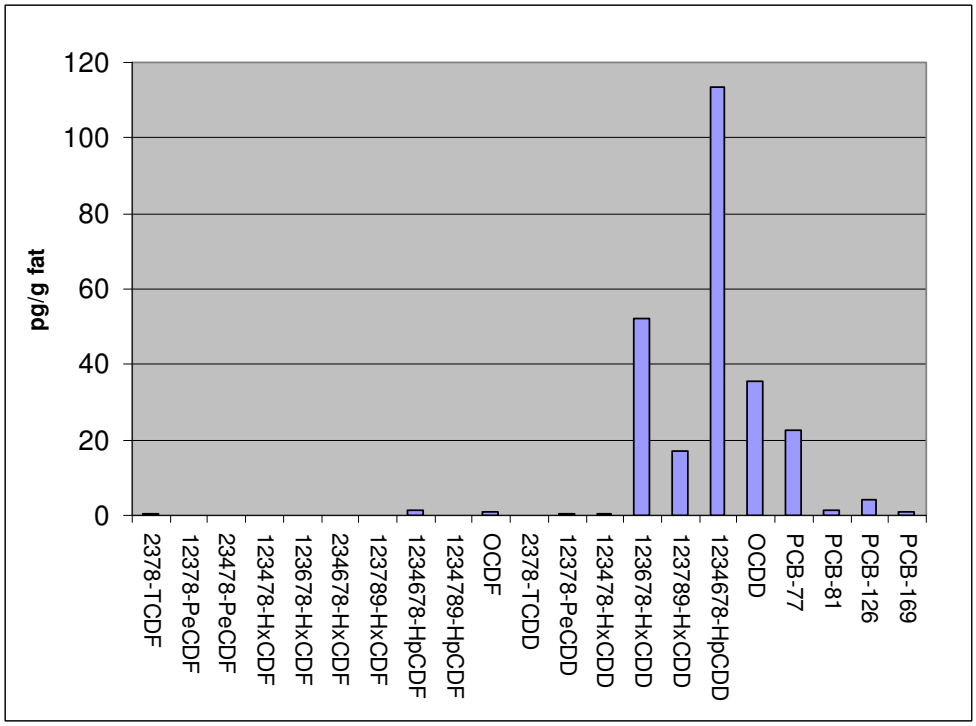

Figure 1. The congener pattern in a Danish egg sample collected the 7th of December 2010 after the hens were fed with the contaminated German feed.

Results and discussion:
The quite special congener pattern found in the contaminated eggs is shown in Figure 1. The distribution is dominated by 123678-HxCDD, 1234678-HpCDD and OCDD. Indicator PCB were also measured, but all concentrations were below 1,2 ng/g fat. Figure 2 show that 123678-HxCDD is totally dominating the contribution to the TEQ-value. Often it is possible to identify the source of a contamination from the congener pattern in the sample. But in this case, it has not been possible conclusively to identify a source, because the pattern is unknown.

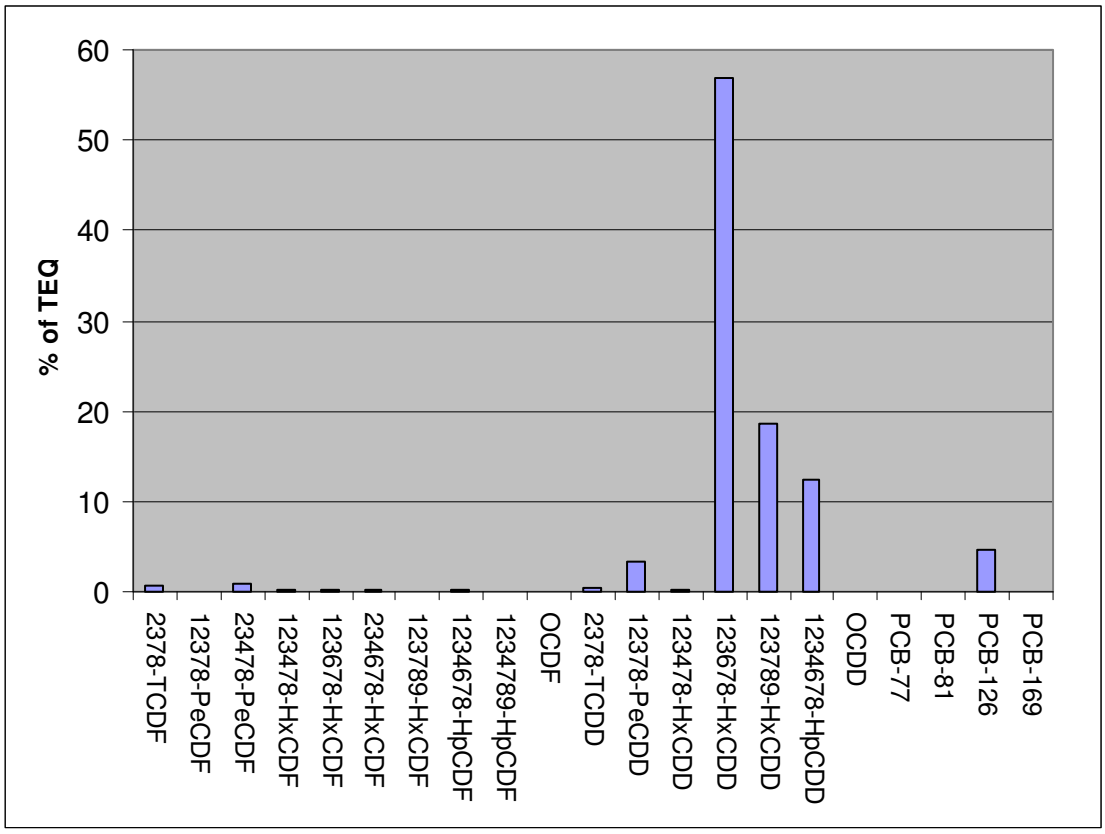

Figure 2. Congener pattern in percent of the total TEQ in contaminated egg (same sample as in Figure 1).

Table 1. TEQ values in all egg samples collected over the 3 month period.

Sample date	TEQ values	Confidence interval
	pg PCDD/F-TEQ/g fat (WHO-1998-TEF-values)	pg PCDD/F-TEQ/g fat (WHO-1998-TEF-values)
7-December-2010	8.6	6.1 – 11
30-December-2010	3.6	2.5 – 4.7
11-January-2011	4.1	2.9 – 5.3
24-January-2011	3.1	2.1 – 4.0
24-January-2011	3.3	2.3 – 4.3
16-February-2011	1.6	1.1 – 2.1
2-March-2011	0.9	0.7-1.2
3-March-2011	0.41	0.28-0.53

In total, 8 samples from 7 different dates were analyzed. In the first samples both dioxins and PCB were analyzed, but as the mono- and di-ortho-PCB content was negligible, only the dioxins and non-ortho-PCB were analyzed in the next samples. The TEQ-values found in the samples are given in Table 1.

All eggs are coming from the same hens house on a conventional farm without access to soil at outdoor areas. We have no control of the origin of each sample but we assume that the hens have a fairly uniform level of dioxins, as their only source of dioxins is from the feed, which is identical for all hens. To level out the variability between the individual hens, 12 eggs from the same day are pooled to one sample. We have no information on which day the farmer stopped using the contaminated feed and therefore we don't know the exact day 0. We use the first data point (12/7/2010) as day 0 although the production period for these eggs might have been in the same period as the contaminated feed was used.

In Figure 3, the decay of the 4 most important congeners in the eggs can be seen during the 3 month period. Most of the congeners show a sharp decrease from the first to the second measurement point followed by a more gradual decrease at the end. In Figure 3, the data has been fit with an exponential function and the equation and regression coefficient has been calculated. But as seen on the figure, the match is not that good, especially at longer time periods. This kind of bimodal time curves with a rapid drop in dioxin concentration during the first days followed by a more gradual decrease have previously been shown in other studies [4-8]. Our data derived from random samples from a hen house with thousands of laying hens, gives a good agreement with the much more controlled studies from the literature, where each hen and each egg is followed closely during the feeding experiment.

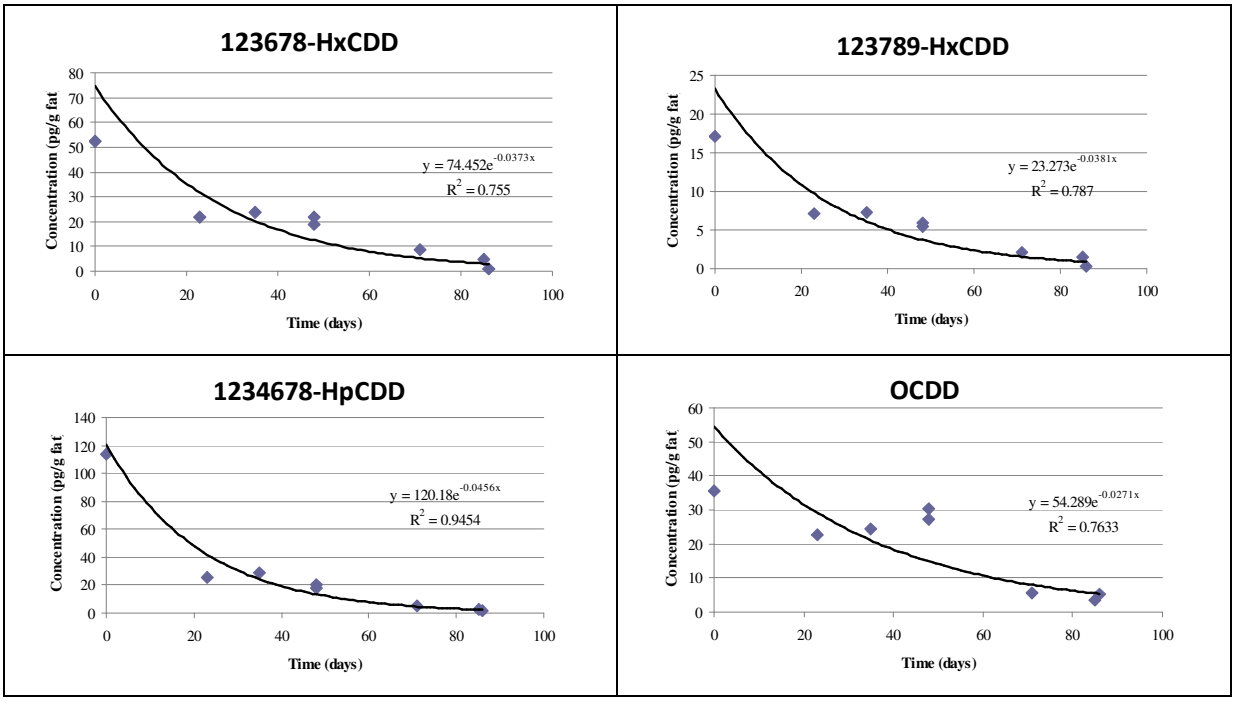

Figure 3. The excretion of the 4 dominant congeners from the contaminated hens to the eggs.

From the equations in Figure 3, estimates of the excretion halftime can be calculated. It is only a rough estimate because of the relatively few data points and the regression coefficient (R^2) is not especially good for some of the congeners. The results are shown in table 2.

Table 2. The halftime calculated from the exponential equation in Figure 3.

	Exponential equation	
	R^2	t½ (days)
123678-HxCDD	0.75	19
123789-HxCDD	0.78	18
1234678-HpCDD	0.94	15
OCDD	0.76	26

This study shows that it might not be necessary to cull all animals contaminated during an incident. The initial excretion rate is rather high and this could reduce the dioxin concentration below the action limit in a rather short time. Further, the bimodal dioxin decrease indicates 2 types of available dioxin: The first type, which are the readily excreted dioxin could be blood bound, depending only on the equilibrium between the hen blood and the yolk in the egg. The second type, which are from a more unavailable source like the adipose tissue, are depending on the equilibrium between the adipose tissue and the blood phase, which are shifted towards the more lipophilic adipose tissue.

Acknowledgements:
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References:

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