Organochlorinated contaminants in Belgian eggs from free range hens

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Introduction

In 2002 the Scientific Committee of the Belgian Federal Agency for the Safety of the Food Chain (FASFC) was asked for a health risk assessment following the discovery of elevated dioxin levels in free range chicken's eggs from private owners, living north of Antwerp.[1] Observed levels were considerably higher than those found in free range chicken's eggs from commercial farms. In its advice (2002/35, www.favv.be) the committee emphasized the risks associated with regular consumption of those eggs as well as the need for more elaborate studies to gauge the problem's magnitude and possible health effects. In 2004 the Scientific Institute of Public Health and the Veterinary and Agrochemical Research Centre initiated a study focusing on contaminations by organohalogenated compounds, including dioxin-like chemicals, PCBs, organochlorine pesticides, as well as by trace elements such as heavy metals, in eggs from free range chickens sampled in all regions of Belgium. The aim was to compare the levels of contaminants in eggs from private owners with those in eggs from commercial farms, both from free range chickens.

The present paper presents the results for persistent organic pollutents (POPs) only, results for trace element levels will be presented elsewhere.

Materials & methods

Eggs were obtained from 22 private owners (PO), residing in different parts of Belgium.Additionally, samples from 19 commercial farms (CF) were collected by the FASFC. Of each sample 10 egg yolks were pooled for the analyses of organohalogenated contaminants and 2 eggs were used for duplicate analyses of trace elements.

Investigated POP analytes comprised of the sum of 7 marker polychlorinated biphenyls (PCBs; IUPAC Nrs 28, 52, 101, 118, 138, 153, 180), polychlorinated dioxins and furans, dioxin-like PCBs and the organochlorine pesticides (OCPs) alfa-HCH, beta-HCH, gamma-HCH, HCB, heptachlor, heptachlor epoxide, aldrine, dieldrin, a- and b-endosulfan, p,p'-DDD, p,p'-DDE, o,p'-DDT, p,p'-DDT, methoxychlor and endrine.

PCBs and OCPs were determined by GC-ECD and by GC-ECD and GC-MS/MS, respectively according to accreditated methods.

Dioxin-like compounds were analysed with the CALUX bioassay. Egg fat was hexane-extracted by ASE from lyophilised yolks and cleaned on acidified silicagel and activated carbon, yielding a dioxin and a PCB fraction as described.[2]

Results and discussion

Table 1 shows descriptive statistics of the most abundant POPs' concentrations. For the private owners the norm levels for PCBs[3] (200 ng/g fat) and for the sum of DDT/DDD/DDE[4] (500 ng/g fat) were respectively 2 and 6 times exceeded. The determined dioxin TEQ values (CALUX TEQs) were above 3 pgTEQ/g fat in 90 % of the cases. As a general approach, ratios of median concentrations in PO eggs over median concentrations in CF eggs are investigated as a tool for comparison. This ratio exceeds 3 for the sum of the 7 marker PCBs and 8 for the dioxin TEQ values and for the sum of DDT/DDD/DDE (Figure1). Since the most abundant contaminants in the eggs obtained from private owners are dioxin-likes, PCBs and DDT and its metabolites, this indicates the probability of environmental contamination with these POPs.The mean dioxin level found in eggs from private owners is 10.18 pg TEQ/g fat, the median value equals 8.53 pg TEQ/g fat, whereas the corresponding levels in eggs from commercial farms are 1.44 pg TEQ/g fat (mean) and 1.04 pg TEQ/g fat (median), respectively.

The large difference between private owners and commercial farms might be linked to the fact that a vast majority of the chickens of commercial farms stay indoors and do not make use of outdoor foraging facilities. It has also been shown by Schuler et al. that the level of dioxin contamination of free range eggs was linked to the size of the yard.[5] Thus, in large yards occupied by a small number of chickens, the level of egg contamination by dioxins was higher. Hence, the more extensive contact of hens from private owners with the environment might explain the difference observed in this study between the eggs from private owners and those from commercial farms.

The EU maximal level for dioxins in eggs is 3 pg PCDD/F WHO-TEQ/g fat.[6] The WHO has defined a tolerable daily intake (TDI) of dioxins and dioxin-like PCBs of 1-4 pg TEQ/kg body weight. The Scientific Committee on Food (SCF) of the EU has set the tolerable weekly intake (TWI) for dioxins and dioxin-like PCBs to 14 pg WHO TEQ/kg bw.[7] We calculated that a daily consumption of 1 egg with a TEQ concentration equal to the median value for the PO eggs corresponds with an intake of 0.85 pg TEQ/kg bw (for a person of 60 kg). In case of the mean concentration the intake amounts to 1.02 pg TEQ/kg bw. It is generally known that dioxin intake occurs predominantly via consumption of fatty food from animal origin, with meat, dairy products and fish being the major contributors. Consequently, in addition to eggs, there is already significant dioxin TEQ intake. The total TEQ intake of private owners with pronounced egg consumption is likely to exceed the TWI. Therefore, a restriction of the PO eggs' consumption to a maximum of 2 eggs/week is suggested.

Overall, the results indicate a distinct enhancement of the environmental contaminants in the free range eggs from private owners as compared to eggs from commercial farms. The data gathered until now represent different regions in Belgium and it can be concluded that the enhanced contamination of eggs from private owners is not restricted to one location. Similar enhanced contamination of free range eggs from private owners has been observed by the laboratory of the FASFC (Huig Vanderperren, unpublished results) and Traag et al. previously published high total TEQ levels observed in eggs of free range chickens in the Netherlands.[8]

Previous studies always pointed towards the intake of contaminated soil and soil organisms (annelids, insects) as the cause of the contamination of free range eggs although other factors can not be excluded .[1,5,8]

Further studies are ongoing to confirm the cause of contamination of the eggs analysed in the present study.

Figure 1: Ratios of the median concentrations of POPs in eggs from private owners to those in eggs from commercial farms.

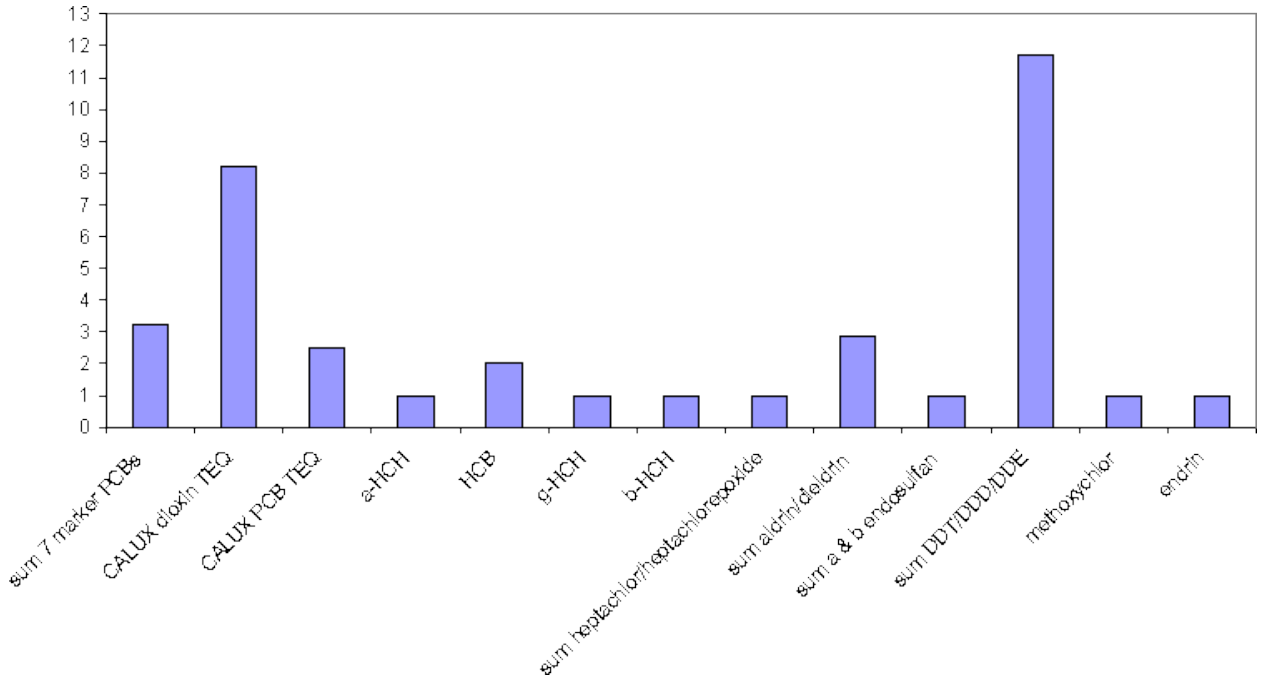

Table 1: Descriptive statistics of POP contaminations in free range eggs.

Contaminants	Private owners (n = 22)						Commercial farms (n = 19)				
	quartile1	median	quartile3	mean	range	norm	quartile1	median	quartile3	mean	range
sum 7 marker PCBs (ng/g fat)	10.00	32.30	73.80	62.36	10-351	200	10	10	10	12.80	10-63.20
dioxin TEQ (CALUX)(pg/g fat)	5.57	8.53	12.01	10.18	2.28-23	3	0.62	1.04	1.94	1.44	0.5-4.21
PCB TEQ (CALUX)(pg/g fat)	0.50	1.73	2.68	2.05	0.06-11.84		0.53	0.69	0.91	0.77	0.31-1.69
sumDDT,DDD,DDE (ng/g fat)	50	125	520	771	30-5250	500	10	10	10	19	10-170

Acknowledgements

The FASFC is gratefully acknowledged for help with the farm sample collections and Huig Vanderperren for sharing data for free range hen's eggs from private owners**.**

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