

LEVELS OF POPS AND METALS IN HOME PRODUCED FREE RANGE EGGS IN BELGIUM

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Abstract

Free range eggs obtained from private hen holders in Belgium were examined for contamination with different chemical substances. It was observed that dioxins, DDT forms and Pb were often detected at high levels as compared to maximal authorized levels in eggs. The results mainly confirmed results obtained in 2004 when we investigated a smaller group of samples. The consumption of these eggs holds some health risks, especially as regards to dioxins since a daily consumption of one egg with the median concentration of the found results for PCDD/Fs leads to a TEQ contribution of 29 % of the tolerable weekly intake.

Introduction

Food products produced by private owners are not subjected to any authority control, which sometimes calls into question their safety and marketability. For many people in Belgium it is common to keep hens in the backyard and to consume their eggs. A previous study already highlighted the chemical contamination in eggs from free range hens.^{1,2} The current paper summarizes preliminary results obtained within the framework of a more elaborate project which aims to determine the chemical contamination in eggs from free range hens as well as the possible contamination sources and pathways.

Materials and methods

40 eggs samples were collected at private homes spread over the 10 Belgian provinces during the month of November 2006. A minimum of 3 and a maximum of 5 sampling sites per province were visited, collecting each time 15 eggs as well as a sample of the soil, the excreta of the hens and the feed (mainly kitchen left-overs). The eggs were pooled and metals (Mn, Co, Ni, Cu, Zn, As, Se, Mo, Cd, Sb, Tl, Pb and Hg), PCBs (IUPAC n°s 28, 52, 101, 118, 138, 153 and 180), pesticides (α -HCH, β -HCH, γ -HCH, HCB, heptachlor, heptachlorepoxyde, trans-nonochlor, aldrin, dieldrin, α - and β -endosulfan, α - and γ -chlordane, oxychlordane, endrin, methoxychlor, nitrofen, o,p'-DDT, p,p'-DDT, o,p'-DDE, p,p'-DDE, o,p'-DDD and p,p'-DDD as well as dioxins (PCDD/Fs by CALUX) were analysed as described previously.²

Results and discussion

a) Comparison with norm levels

The results show a considerable number of samples with contaminant levels above their tolerated level in eggs. Out of the 40 samples respectively 37, 7, 2 and 1 exceed the norm level for dioxins (3 pg WHO TEQ/g fat)³, for the sum of DDT, DDE, DDD (500 ng/g fat)⁴, for the sum of α - , γ - and oxychlordane (50 ng/g fat)⁴ and for the sum of 7 marker PCBs (200 ng/g fat).⁵ 16 samples have a Pb level above the former maximal level of 100 ng/g. This demonstrates that in addition to the earlier observed problem of dioxin contamination^{2,6}, Pb and DDT are sometimes present at unacceptably high levels in free range eggs.

b) Ranges and geographical distribution

Simple descriptive statistics indicate that the results range from 1.52 to 12.77 pg TEQ / g fat for dioxins, from 10.60 to 340.60 ng / g fat for the sum of the marker PCBs, from non-detectable to 21390.40 ng/g fat for the sum of the DDTs and from 3.13 to 471 µg/kg egg for Pb. Geographically seen, elevated dioxin contamination is a generally observed phenomenon for all areas in Belgium. Some trends for the other 'problem' contaminants (values above the norm) can also be observed. The province Eastern Flanders (area 2 on the map in Figure 1) with 4 samples out of 5 exceeding the norm level for Pb and 3 samples above the norm for the sum of the DDTs is highly contaminated. In Western Flanders (area 1 on the map) as well as in Walloon Brabant (area 4 on the map) two out of 3 samples exceed the norm value for Pb. In the province of Antwerp (area 3 on the map) 2 out of 4 samples contain unacceptably high Pb values.

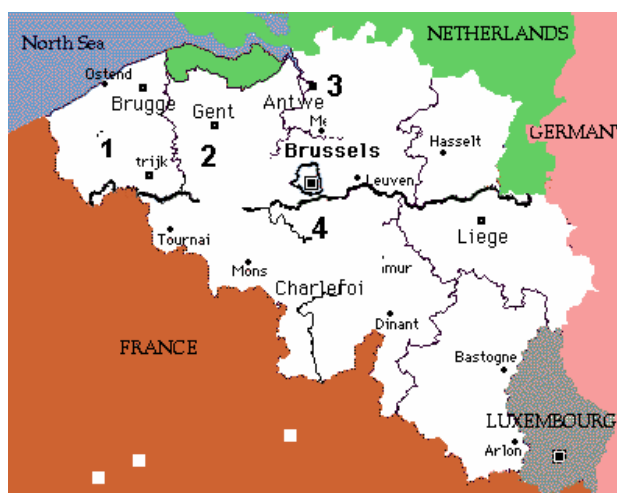


Figure 1: map of Belgium and its 10 provinces

c) Characterization of the contamination

The predominant PCB congeners detected in the egg samples are PCB 153, PCB 138 and PCB 180. They contribute respectively for 54 %, 43 % and 24 %, to the sum of the 7 marker PCBs.

On the other hand, p,p'-DDE, p,p'-DDD and p,p'-DDT constitute the largest contribution to the sum of the DDTs. Their contributions amount to 89 %, 23 % and 23 % of Σ DDTs, respectively.

d) Comparison with previous results

The present results can be compared with the results obtained during our previous study from 2004.²

The median for the dioxin results is now lower: 5.86 versus 8.53 pg TEQ/g fat in 2004 (Figure 2). It must be noted that the eggs from 2004 and 2006 were sampled during different periods in the year. However, conclusions about seasonal variations of results can not yet be made but will be possible when the results of a second sampling effected during the spring of 2007 will be available. Moreover, the bioanalytical method used for the determination of the dioxin TEQ (CALUX method) implies an uncertainty of 15- 20 %. Despite this it is confirmed that eggs from hens of private owners are contaminated with dioxins at levels above the norm of 3 pg TEQ/g fat.

The ranges (min-mean-max) for dioxins, PCBs, Σ DDTs and for Pb for the two years are shown in Figures 2 to 5.

Figure 2

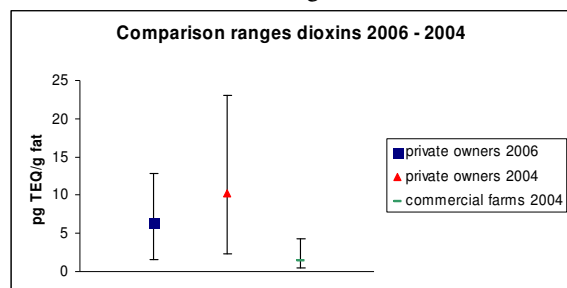


Figure 3

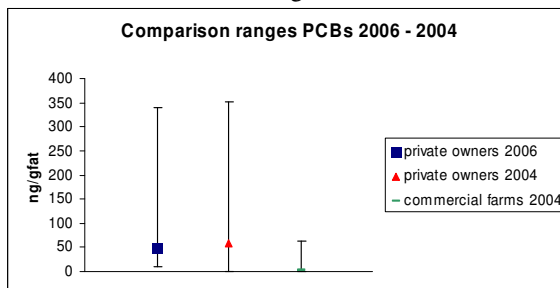


Figure 4

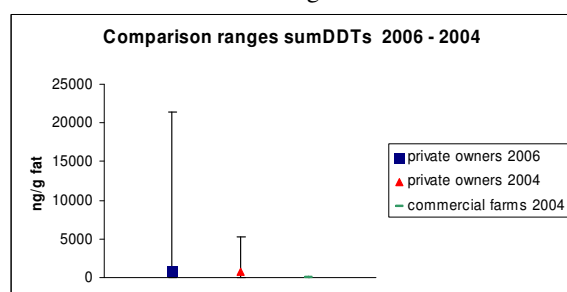


Figure 5

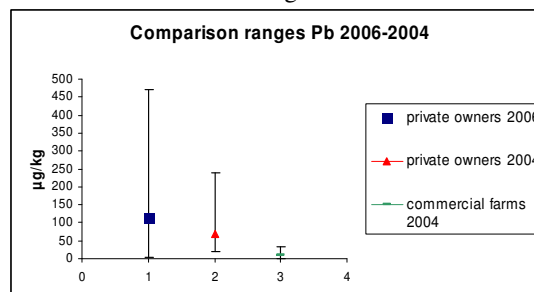


Fig 2-5: ranges (min-mean-max of the values obtained) for contaminants determined in eggs in 2004 and in 2006.

PCB and DDT results from both sampling periods are mainly comparable (Figures 3 and 4). Undetected results for marker PCB congeners and DDT forms were set equal to zero to make a comparison with results from 2004 possible. In contrast with the mentioned POP levels, the median Pb values obtained in the present study as well as their ranges exceed the ones from 2004 (Figure 5).

e) Intake scenarios and percentage of the tolerated intakes

To estimate the impact on human health of the elevated contaminant values in eggs we compared intake values from 3 scenarios to the tolerated or acceptable intake for dioxins, Σ DDTs and Pb. The daily consumption of 1 egg with a concentration equal to the median value is considered as *normal use*; whereas *extreme use* is defined as the daily consumption of 3 eggs with a concentration equal to the median value. The daily consumption of 1 egg with a concentration equal to the maximal obtained value is *extreme contamination*. Estimated ingestions of PCDD/Fs were compared to the tolerable weekly intake (TWI) of 14 pg TEQ / kg bw for the sum of PCB TEQ and PCDD/F TEQ.⁷ PCB TEQ values are not yet taken into consideration. For the normal use scenario 29 % of the TEQ TWI is reached while the extreme contamination scenario leads to 64 % of the TEQ TWI. An extreme use is the worst with 88 % of the TWI (Figure 6).

Figure 6

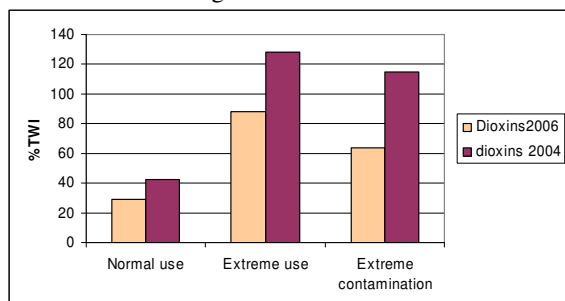


Figure 7

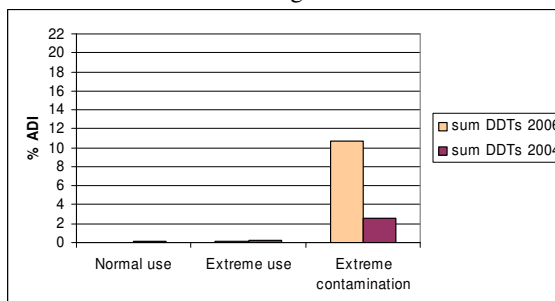
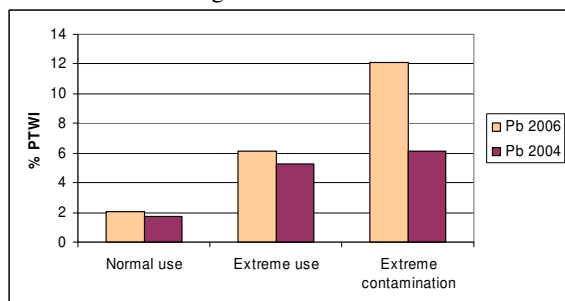


Figure 8



The Σ DDTs ingestion results are compared to the acceptable daily intake (ADI) of 20 $\mu\text{g}/\text{kg}$ bw/day from WHO/FAO.⁸ In this case none of the 3 scenarios leads to an important percentage of the ADI (Figure 7).

For Pb we compared the values to the provisional tolerable weekly intake (PTWI) of 25 μg kg^{-1} bw (JECFA, 2000) (Figure 8).

Except for cases of extreme contamination the DDTs and Pb levels lead to smaller than 10 % of the acceptable daily and provisional tolerable weekly intakes, respectively (Figure 7 and Figure 8).

Acknowledgments

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