Risiken erkennen – Gesundheit schützen

Assessment of dioxin concentration in eggs in response to warning of EU Rapid Alert System for Food and Feed

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Elevated dioxin levels in eggs have been reported in Germany and the Netherlands. The maximum level laid down in Regulation (EC) No. 1881/2006 for dioxins of 3 picograms WHO-PCDD/F-TEQ per gram of fat and for dioxins and dioxin-like PCBs of 6 picograms WHO-PCDD/F-PCB-TEQ per gram of fat was exceeded in some of the samples analysed by official controls. From the perspective of food legislation, these products are therefore not marketable.

Dioxins and polychlorinated biphenyls (PCBs) are environmental contaminants that humans mainly take in through foods of animal origin. Because dioxins and PCBs are stored in the fatty tissue of humans where they also accumulate, the daily intake amount should be minimised as much as possible.

The dioxin concentrations that were found do not constitute an acute health hazard for consumers. The consumption of such contaminated eggs over a short period of time is not expected to have adverse effects on health. For reasons of preventive consumer protection, however, PCB and dioxin contamination should be minimised as much as possible. In this respect, unnecessary and avoidable additional exposure is not acceptable.

1 Subject of the assessment

The Federal Ministry of Food, Agriculture and Consumer Protection (BMELV) has asked the Federal Institute for Risk Assessment (BfR) to conduct an immediate assessment of the dioxin findings in eggs.

2 Results

The maximum level for chicken eggs laid down in Regulation (EC) No. 1881/2006 of 3 pg WHO-PCDD/F-TEQ/g fat and 6 pg WHO-PCDD/F-PCB-TEQ/g fat was exceeded in the provided samples as they were communicated to the Federal Institute for Risk Assessment (BfR). According to food legislation, these products are therefore not marketable.

The findings of up to 14.89 pg WHO-PCDD/F-PCB-TEQ/g fat exceed the maximum level of dioxins and PCBs for chicken eggs and egg products by a factor of 2.5. A one-time acute consumption of 142 g of egg (ca. 2-3 eggs) would constitute an intake of 3.95 pg WHO-PCDD/F-PCB-TEQ/kg body weight (bw). This consumption of eggs alone would cause the tolerable daily intake (TDI) of 2 pg WHO-PCDD/F-PCB-TEQ/kg bw for dioxin-like PCBs to be exceeded by a factor of 2.

The short-term consumption of these contaminated eggs is not expected to have any adverse health effects. However, for reasons of preventive consumer protection, PCB and dioxin contamination should be minimised as much as possible. In this respect, unnecessary and avoidable additional exposure is not acceptable.

3 Reasons

3.1 Agent

3.1.1 Dioxins

The term “dioxins” refers to two classes of chlorinated compounds that consist of 75 polychlorinated dibenzo-p-dioxins (PCDD) and 135 polychlorinated dibenzofurans (PCDF). Dioxins (PCDD/F) have similar chemical, physical and toxicological properties and are lipophillic compounds that accumulate in the fatty tissue of humans and animals. 17 congeners which are chlorinated in the 2,3,7,8-position, are considered highly toxic as well as persistent. Persistent chemicals are chemical substances that remain stable in the environment over a prolonged period of time.

The congener 2,3,7,8-TCDD, the so-called Seveso dioxin, is the most toxic dioxin congener. The other dioxins with a 2,3,7,8-chlorine substitution are assigned toxic equivalency factors (TEF) in relation to this congener. The concentration of each of these congeners that was determined in a sample is multiplied by the TEF defined by the World Health Organization (WHO). These products are then added up to provide the dioxin toxic equivalency concentration (WHO-PCDD/F-TEQ).

Dioxins are adverse by-products which inevitably occur and can be released as a result of certain industrial processes such as combustion, e.g. combustion of household or special waste. Except for research purposes, they are thus not produced intentionally.

3.1.2 Dioxin-like polychlorinated biphenyls

Polychlorinated biphenyls (PCBs) are a class of 209 congeners of chlorinated substances that differ in regard to the number and position of chlorine atoms attached to biphenyl. 130 of these congeners are found in commercially produced mixtures. In contrast to dioxins, PCBs are intentionally produced for various applications, mainly as incombustible viscous liquids with no electric conductivity used in transformers and in hydraulics (mining). Like dioxins, PCBs are lipophillic, partially persistent and accumulate in the fatty tissue of humans and animals.

Some PCBs have a molecular structure similar to dioxins and comparable biological effects. They are thus referred to as dioxin-like PCBs (dl-PCBs). Like dioxins, dl-PCBs are assigned TEFs that classify these PCB congeners according to their toxicity in comparison to 2,3,7,8-TCDD. Similar to the PCDD/F, dl-PCBs can thus be summed as toxic equivalency concentration (WHO-PCB-TEQ). Yet dl-PCBs only make up a small portion of PCBs, while the so-called non-dioxin-like PCBs (ndl-PCBs) are greater in number and concentration.

The sum total of WHO-PCDD/F-TEQ and WHO-PCB-TEQ is referred to as total dioxin toxic equivalency concentration (WHO-PCDD/F-PCB-TEQ). Section 5 of the annex of Regulation (EC) No. 1881/2006, passed by the European Commission on 19 December 2006, lists maximum levels for WHO-PCDD/F-TEQ as well as for WHO-PCDD/F-PCB-TEQ in foodstuff.

3.2 Hazard potential

Acute short-term effects of high doses of dioxins and dl-PCBs in humans have only been described as a result of accident or at the workplace. The most common effects are long-term skin dermatitis referred to as “chloracne”. Changes in clinical chemical parameters (es-

pecially elevated concentrations of triglycerides, cholesterol and transaminase in blood) indicate liver damage and changes in lipid metabolism.

Animal studies have revealed chronic long-term effects of dioxins and PCBs such as adverse effects on reproductive functions, the immune system, the nervous system and hormone balance. The studies have identified liver and thyroid glands as the organs most susceptible to dioxin and PCB exposure. Various dioxins and PCBs are thought to promote the development of tumours. Especially the results of epidemiological studies on the probably reversible impairment of neuropsychological development in children through prenatal (placental) and postnatal (breast milk) PCB exposure have been subject of recent debate.

WHO has laid down levels for the tolerable daily intake (TDI) in the range of 1 to 4 pg WHO-PCDD/F-PCB-TEQ/kg body weight and day (WHO 2000). The latter value (the TDI of 4 pg WHO-PCDD/F-PCB-TEQ/kg body weight) is considered as provisional basis of the maximum tolerable intake. The first value depicts the WHO goal to reduce human intake levels of WHO-PCDD/F-PCB-TEQ below 1 pg /kg body weight. WHO derived the TDI range from the lowest observed adverse effect levels (LOAEL) described by various authors for different species and different endpoints.

The Scientific Committee on Food (SCF) in the European Union (EU) laid down the tolerable weekly intake (TWI) of 14 pg WHO-PCDD/F-PCB-TEQ/kg body weight in 2001. SCI derived the TWI based on the LOAEL for reduced sperm production and altered sexual behaviour of male Wistar rats described by Faqi et al. (1998).

3.2 Exposure

3.2.1 Results from egg samples

Table: data available on the dioxin contamination of eggs

Source of data	WHO-PCDD/F-TEQ pg/g fat	WHO-PCB-TEQ pg/g fat	WHO-PCDD/F-PCB-TEQ pg/g fat
LUFA-ITL 1	8.22		
LUFA-ITL 2	6.57		
Muva Kempten	13.64		14.89
Rikilt 1	5.9	0.96	6.9
Rikilt 2	10.9	1.29	12.2

Table 1 provides an overview of the research results communicated by the Ministry for Food, Agriculture, Consumer Protection and Regional Development of Lower Saxony (German federal state) through BMELV and via the Rapid Alert System for Food and Feed (RASFF) of the European Commission. The Lower Saxony Ministry communicated three results on the concentration of dioxins in eggs. Furthermore, two additional findings in egg samples were reported via the RASFF, which are presumably linked with the samples from Lower Saxony.

According to these investigations, the dioxin concentrations are between 5.9 and 13.6 pg WHO-PCDD/F-TEQ/g fat. 6.9 - 14.9 pg WHO-PCDD/F-PCB-TEQ/g fat were determined for the sum of dioxins and dl-PCBs. The German national residue monitoring plan also reported upper values of similar levels (BfR 2010).

Interestingly, the recent findings indicate a low contribution of dl-PCBs of only 8 to 14% of WHO-PCDD/F-PCB-TEQ. This is unusual for the European background presence of dioxins

and PCBs in eggs. According to a recently published Scientific Report by the European Food Safety Authority (EFSA 2010), dl-PCBs make up an average of 42% of WHO-PCDD/F-PCB-TEQ. This indicates that these elevated findings of dioxins in eggs are not the result of contamination from background presence.

3.2.2 Consumption of eggs

In order to estimate the intake of dioxins and PCBs through eggs, data from the second German National Nutrition Survey (NVS II; Max Rubner Institute (MRI) 2008) were analysed. The analysis for chronic exposure is based on data of dietary history interviews which were used to record regular eating habits over the last four weeks (calculated in respect to date of interview). The evaluation of maximum consumption (acute exposure) is based on data of two independent 24h recalls of the NVS II.

The data evaluation was carried out as part of the “LExUKon” (dietary intake of environmental contaminants - *Lebensmittelbedingte Aufnahme von Umweltkontaminanten*) project funded by the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU). In addition to BfR, the Research Advisory Institute for Hazardous Substances FoBiG and the University of Bremen are all involved in the project.

Short-term exposure (acute)

According to NVS II data, the 95th percentile of consumers for acute (max.) consumption of eggs was 142 g (ca. 2-3 eggs) per day.

It should be noted that in this evaluation the ingredients of composite foods, e.g. pasta or cake, were not itemised individually. Quantities of egg consumed through these foods are therefore not taken into account, in contrast to the long-term exposure assessment.

Long-term exposure (chronic)

According to NVS II data, the 95th percentile of all interviewees for the chronic consumption of eggs was 0.058 g fat/kg body weight/day.

In this calculation the recipes/ dishes and nearly all individual ingredients were itemised and relevant processing factors were taken into account. Therefore all relevant amounts consumed were included. The recipes are largely provided with standard recipes and thus do not take into account any variation in preparation/production and the resulting amounts consumed.

It should be noted that differences may result from different methodological approaches of data preparation (itemisation, as described above) in contrast to consumed amounts published in the MRI report (MRI, 2008).

3.2.3 Assessment of exposure through the consumption of eggs

Short-term exposure

On average, eggs contain ca. 11.3% fat (Souci et al. 2000). Calculations based on this value indicate that an individual who consumes 142 g egg takes in ca. 15.9 g fat from eggs. The calculation of a worst-case scenario is based on the most highly contaminated sample of 14.89 pg WHO-PCDD/F-PCB-TEQ/g fat. High consumers (95th percentile of the maximum

consumption in one day) would thus take in 237 pg WHO-PCDD/F-PCB-TEQ/person. At an assumed average body weight of 60 kg, the individual intake is 4 pg WHO-PCDD/F-PCB-TEQ /kg body weight.

Long-term exposure

This calculation is also based on the most contaminated sample with 14.89 pg WHO-PCDD/F-PCB-TEQ/g fat. A high consumer (95th percentile of the total population) would thus take in 1 pg WHO-PCDD/F-PCB-TEQ /kg bw.

3.3 Health assessment

According to analytical results of the years 2000 to 2003, the daily intake of dioxins and PCBs (as WHO-PCDD/F-PCB-TEQ) through foods in Germany averaged ca. 2 pg WHO-PCDD/F-PCB-TEQ/kg body weight and day (*Government/Länder* working group on dioxins 2003). Due to the fact that contamination has continually decreased since then, the current daily oral intake can be assumed to be in the range of 1 - 2 WHO-PCDD/F-PCB-TEQ/kg body weight and day, which corresponds to a weekly intake of 7-14 pg WHO-PCDD/F-PCB-TEQ/kg body weight.

The health assessment should be based on the tolerable weekly intake determined by SCF (TWI: 14 pg WHO-PCDD/F-PCB-TEQ /kg bw and week) for PCDD/F and dl-PCB, which corresponds to an intake of 2 pg WHO-PCDD/F-PCB-TEQ/kg body weight and day. It is thus comparable with the range for daily tolerable intake of 1 - 4 pg WHO-PCDD/F-PCB-TEQ/kg bw and day laid down by WHO.

The *acute intake* through the consumption of contaminated eggs of 4 pg WHO-PCDD/F-PCB-TEQ/kg body weight exceeds the TWI of SCI, yet remains slightly below the upper limit of the range laid down by WHO. The sole consumption of the most contaminated eggs thus leads to exceedances of the common intake of 1-2 pg WHO-PCDD/F-PCB-TEQ/kg body weight and day through all foods by a factor of 2. If the common daily intake amount of 1-2 pg WHO-PCDD/F-PCB-TEQ/kg bw and day derived by various sources is incorporated in the calculation, the sum of 5 to 6 pg WHO-PCDD/F-PCB-TEQ/kg body weight and day also exceeds the upper limit of the range determined by WHO for the TDI.

The calculated *chronic intake* of dioxins and PCBs through the contaminated eggs is below the TDI, if only these eggs are taken into account. Yet eggs usually only constitute a portion of 8% of the daily intake of dioxins and dl-PCBs through food (Mathar and Solbach 2005). If calculations are based on this, then at a total daily intake of 2 pg WHO-PCDD/F-PCB-TEQ/kg body weight and day only ca. 0.16 pg WHO-PCDD/F-PCB-TEQ/kg are normally taken in through eggs. This illustrates that the contaminated eggs which are subject of this assessment at an intake of 1 pg WHO-PCDD/F-PCB-TEQ /kg bw lead to an elevated exposure of consumers to dioxins through eggs.

4 Conclusion

The short-term intake of eggs which are subject of this assessment does not constitute an immediate health risk. However for reasons of preventive consumer protection PCB and dioxin contamination should be minimised as much as possible. In this respect, unnecessary and avoidable additional exposure is not acceptable.

5 References

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