Consumption of eggs and meat poses no risk to human health as indicated by the latest dioxin concentrations measured

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In December 2010, a contamination of vegetable oils for animal feed was found in the federal German state of Schleswig-Holstein. Industrial fatty acids with high dioxin concentrations were mixed in with vegetable oils for animal feed and then used for feed production. Contaminated feed was distributed to various poultry and pig fattening farms as well as laying hen and milk production farms and fed to animals.

The control authorities of the Federal States have analysed the dioxin concentrations of meat, egg and milk samples from the farms in question. Only few samples of pork, meat of laying hens and eggs contained dioxin concentrations that exceed the maximum levels permitted by the European Union. In milk and meat of fattening poultry maximum levels were not exceeded. Based on its risk assessment, BfR concludes that neither acute nor long-term adverse health effects are expected for consumers even if eggs or pork with the highest measured concentrations are consumed over an extended period of time.

In regard to dioxin, it is not the daily intake of dioxin that is critical for its effects on human health, but rather the amount present in the human body – the body burden. Dioxins accumulate in the human body over time. As a result of background exposure, every human being takes in traces of dioxins through foods on a daily basis. Due to the fact that in recent decades the primary sources of dioxins in the environment were eliminated, the dioxin contamination of food has decreased considerably.

Official controls in food and feed in regard to compliance with maximum levels are carried out on a regular basis. Information gained by the results of the official controls provides options and strategies for a reduction of the human dioxin body burden by identification and elimination of the source of contamination.

1 Subject of the assessment

Vegetable oils for animal feed contaminated with dioxins were found in Schleswig-Holstein. Industrial fatty acids with high dioxin concentrations were mixed in with vegetable oils for animal feed and subsequently used in the production for compound feed. Contaminated feed was distributed to various poultry and pig fattening farms as well as laying hen and milk production farms and fed to animals. The control authorities of the German Federal States have analysed the dioxin concentrations of meat, egg and milk samples from the farms in question. Some of the samples of pork, meat of laying hens and eggs in the current analysis contained dioxin concentrations that exceed the maximum levels permitted by the European Union. All other analysed food samples have dioxin concentrations below the maximum levels. The Federal States are currently in the process of carrying out further controls. Due to these recent events, the Federal Institute for Risk Assessment (BfR) has conducted an assessment of the risk posed by the consumption of eggs and meat based on current data (data from 24 January 2011; 2 p.m.). The data were provided by the Federal States as well as members of food and agricultural industry associations.

2 Results

The dioxin concentrations found in eggs, meat of laying hens and fattening pigs only exceeded the maximum levels in few cases. All other analysed food samples have dioxin con-

centrations below the maximum levels. None of the analysed samples of compound feeds exceeded the maximum levels for dioxins.

The maximum level for dioxins in meat and meat products laid down in Regulation (EC) No 1881/2006 of 1 pg WHO-PCDD/F-TEQ/g fat was exceeded in 4 of 124 available samples (without measurement uncertainty). 33 out of 175 available egg analyses exceeded the maximum residue level laid down in Regulation (EC) No 1881/2006 for hen egg and egg products of 3 pg WHO-PCDD/F-TEQ/g fat. One picogram corresponds to one trillionth of a gram.

Findings up to 1.51 pg WHO-PCDD/F-TEQ/g fat exceed the maximum level of dioxins in meat by a factor of 1.5. Findings up to 12.14 pg WHO-PCDD/F-TEQ/g fat exceed the maximum level of dioxins for hen eggs by a factor of 4.

BfR concludes that neither acute nor long-term adverse health effects are expected for consumers even if eggs or pork with the highest measured concentrations are consumed over an extended period of time.

Taking into account the mean dioxin concentration in suspect food samples, the dietary exposure of dioxin will be 4% for eggs and 1% for pork as compared to the TDI. The mean consumption is based on data of the National Nutrition Survey II. For high consumption figures, expressed as the 95th percentile, the values will increase to 10% for eggs and 2 % for pork.

For substances like dioxins, it is not the daily dose taken in, but rather the amount already in the human body – the body burden – that is decisive for its effects on human health. Dioxins accumulate within the body, and as a result of existing background exposure, every human being takes in traces of dioxins through food on a daily basis.

Official controls in food and feed in regard to compliance with maximum levels are carried out on a regular basis. Information gained by the results of the official controls provides options and strategies for a reduction of the human dioxin body burden by identification and elimination of the source of contamination.

3 Rationale

3.1 Risk assessment

3.1.1 Agent

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 occur and can be released as by-products of certain industrial processes, especially during combustion processes (e.g. combustion of domestic and toxic waste). They can also

occur during forest fires and volcano eruptions. They are thus not produced for certain purposes (except for scientific purposes).

Section 5 of the annex of Regulation (EC) No 1881/2006 lists maximum levels for WHO-PCDD/F-TEQ as well as for WHO-PCDD/F-PCB-TEQ in foodstuff.

3.1.2 Hazard assessment

Acute short-term effects of high doses of dioxin have been described in humans following occupational, accidental or intentional exposure only. The most characteristic effect is a persistent skin dermatitis referred to as “chloracne”. Changes of parameters of blood chemistry (especially elevated levels of triglycerides, cholesterol and transaminases) indicate involvement of the liver and changes in lipid metabolism.

In long-term experiments with laboratory animals, disorders of the reproductive function, of the immune and nervous system as well as the hormone balance were observed. A very high susceptibility to dioxin was observed in male rats showing developmental effects on the immune and genital system after prenatal exposure (e.g. WHO 2002). Furthermore, effects on liver and thyroid gland were identified as susceptible endpoints. Currently, the importance of these observations for human is unresolved. Dioxins are classified as tumour promoters.

Little is known on the toxicity of dioxins in non-laboratory and farm animals. In laying hens, reduction of the laying performance of 10 to 30 % as well as occurrence of neurological symptoms have been reported (Federal Ministry of Agriculture - Belgium 2000); however, the feed was highly contaminated (781 ng WHO-PCDD/F-TEQ/kg). In Austria, no toxic effects were observed in pigs and poultry after use of dioxin-containing clay minerals as binding agent; however, dioxin levels in feed were much lower (4.8 to 6.2 ng WHO-PCDD/F-TEQ/kg) than those in Belgium.

Therefore, no adverse impact on animal health has to be expected in case of moderately elevated levels of dioxins in feed (SCAN 2000). Regarding possible long-term effects of dioxin (e.g. cancer) in farm animals, no information is available, attributable to their limited life and utilisation span. According to the high lipophilicity of dioxins, the storage in fat and adipose tissue is the most important issue of contamination of feed.

3.1.3 Exposure assessment

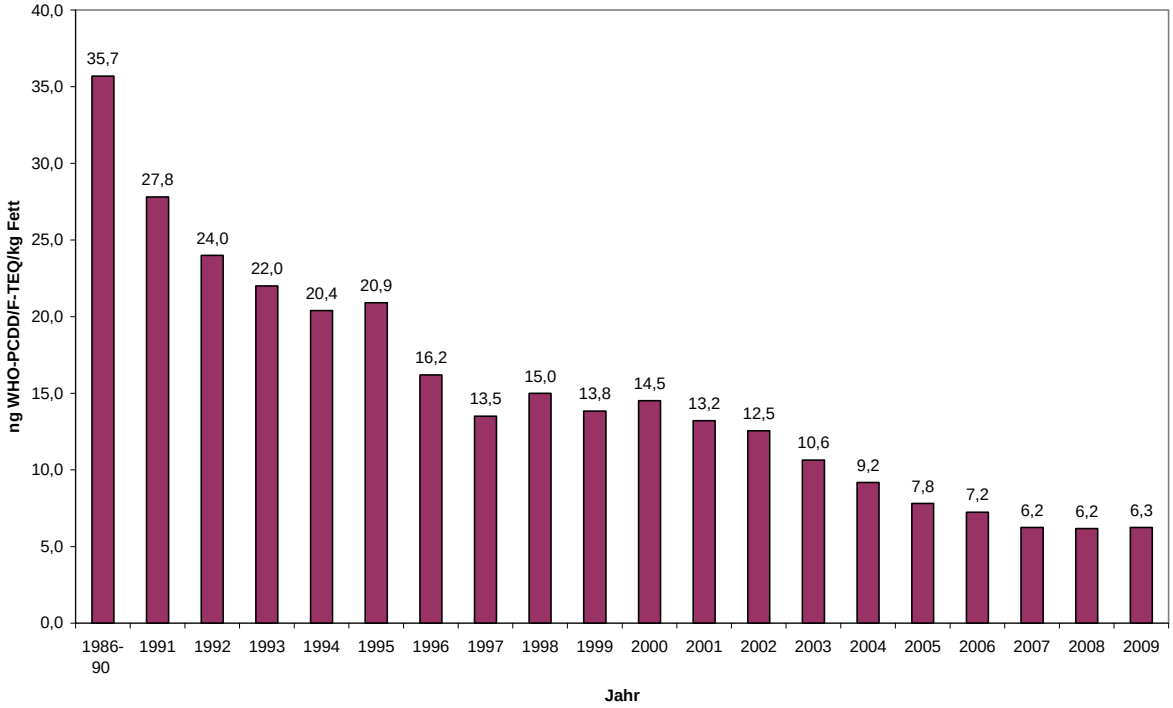
Breast milk as example of body burden through background exposure

Dioxins taken in by humans through food are persistent and accumulate in body fat. As an easily obtained body fluid rich in fat, breast milk is a good bioindicator for the human body burden through background exposure in regard to lipophillic and persistent dioxins stored in body fat. Dioxin concentrations in breast milk, blood and fat tissue with respect to the fat content are similar in all three matrices (Beck 1992). Over the past 25 years, regulations and technical measures to minimise environmental emissions have reduced the entry into the food chain and thus the daily dioxin intake of humans (see figure 1).

Data on dioxins in breast milk for the years from 1985 to 2009 were provided by the Federal States to the Federal Institute for Risk Assessment (dioxin database of the Federal Republic of Germany and the Federal States 2010). Recent calculations on the basis of those data show a continuous decrease of mean dioxin concentrations in breast milk from 35.7 ng WHO-PCDD/F-TEQ/kg milk fat (1985-1990) to 6.3 ng WHO-PCDD/F-TEQ/kg milk fat in 2009, which corresponds to a decline of more than 80% compared with 17% of the dioxin content measured 25 years ago. Similar trends were observed in other industrial countries.

Also, the 95th percentile and reported maximum values of dioxins in breast milk follow this trend, with 10 and 11.5 ng WHO-PCDD/F-TEQ/kg milk fat in 2009 (equal to 10 and 11.5 pg WHO-PCDD/F-TEQ/g milk fat or 0.35 and 0.4 ng WHO-PCDD/F-TEQ/L milk), which represents only 30% of the average burden of 1990.

Figure 1: Time trend of dioxins (ng WHO-PCDD/F-TEQ/kg fat) in breast milk in Germany (1986-2009); only contents of PCDD/PCDF are shown, dioxin-like PCBs are not included here.



Exposure from food consumption

The assessment of long-term exposure is based on food consumption data from the “Dietary History” interviews of the National Nutrition Survey II (MRI, 2008). This survey was conducted in 2005/2006 and represents about 20,000 German speaking people aged 14 to 80 years. The computer supported dietary history (DISHES programme) provides data of 15,371 respondents and their usual consumption of the last four weeks. Data recorded by dietary history method provide sound estimates of long-term intake of substances when foods are summarised in broad categories or are consumed regularly.

The exposure has been estimated in the frame of the research project „LExUKon“ (Lebensmittelbedingte Aufnahme von Umweltkontaminanten; Blume et al. 2010) which was performed on behalf of the Ministry of Environment, Nature Conservation and Nuclear Safety.

The estimates of dietary exposure are based on the individual body weights of the interviewed persons. In 14,468 of them, the body weight was measured. In 846 subjects the self reported values were used. In a number of 57 persons body weight was estimated according to the “Hot-Deck” method (Little und Rubin 2002).

In children, the estimates of dietary exposure are based on data from the VELS-study[1] (Heseker et al. 2003). This study was performed in 2001 and 2002 in 816 children aged 6 months to 5 years in Germany. Two three-day dietary protocols were recorded by the parents for every child regarding all eaten foods. An extrapolation to raw food was made for all foods and dishes with consideration of the preparation factors. The BfR model refers to children between 2 and 5 years with an average body weight of 16.5 kg [2].

Dioxin concentrations in eggs and pork in the current dioxin case

Table 1 displays all data that are available to BfR, expressed as WHO-PCDD/F-TEQ (24.01.2011) that have been measured in eggs and pork, as well as the permitted maximum levels and the percentage exceeding these levels. They have been provided by the Federal States and by members of the food and agricultural associations. These measurements are not representative for the contamination of food on the German market, but are exclusively risk oriented samples. They therefore do not represent the current situation of overall food contamination. Some data could not be considered as they were not provided as numerical values. Uncertainties have to be taken into account due to different accuracy of analytical measurements.

Table 1: Content of WHO-PCDD/F-TEQ in pg/g fat (24.01.2011)

	eggs from hens	pork
n (measurements)	175	124
mean	1.9	0.3
minimum	0.1	0.1
maximum	12.1	1.5
maximum level (ML)	3.0	1.0
% of samples exceeding ML	19	3

The mean value which can be calculated from the available data (which should not be compared with the mean contamination in the entire eggs or meat on the market) is about 2 pg/g of fat in eggs and 0.3 pg/g of fat in pork. Both values are below the current maximum EU level according to Regulation (EC) No 1881/2006 (eggs: 3 pg/g of fat WHO-PCDD/F-TEQ; pork 1 pg/g fat WHO-PCDD/F-TEQ).

Exposure in animal feed

In a German national survey of PCDD/F levels in animal feed, about 200 samples were analysed for their dioxin concentrations. Compound feed as well as roughage were analysed to obtain a representative survey of PCDD/F concentrations in feed for livestock production in Germany. The calculated median level was 0.033 ng WHO-PCDD/F-TEQ/kg (88 % dry mat-

[1] **V**erzehrsstudie zur **E**rmittlung der **L**ebensmittelaufnahme von **S**äuglingen und Kleinkindern für die Abschätzung eines akuten Toxizitätsrisikos durch Rückstände von Pflanzenschutzmitteln

[2] http://www.bfr.bund.de/cm/218/bfr_entwickelt_neues_verzehrsmodell_fuer_kinder.pdf

ter), which was below the maximum EU level of 0.75 ng WHO-PCDD/F-TEQ/kg. None of the analysed feed samples exceeded the maximum EU level (Schwind et al. 2009).

Dioxin levels in animal feed in the current dioxin case in Germany

The German Federal Institute for Risk Assessment obtained results of PCDD/F analysis of 238 feed samples for livestock production. Fifty samples were of compound feed, 184 samples were classified as feed materials (fat and fatty acids). Four samples were not clearly characterised, and excluded from further calculations and reporting. These measurements are not representative for the contamination of feed on the German market, but are exclusively risk oriented samples. The data were provided by the Federal States as well as members of food and agricultural industry associations (data from 24 January 2011). None of the PCDD/F-levels in compound feed exceeded the maximum EU level of 0.75 ng WHO-PCDD/F-TEQ/kg. The maximum level of 0.468 ng WHO- PCDD/F TEQ/kg was found in feed for lactating sows. The range of all analysed compound feed was 0.039-0.468 ng WHO-PCDD/F TEQ/kg with an arithmetic mean of 0.104 ±0.096 ng WHO-PCDD/F-TEQ/kg, including feed for pigs, poultry and cattle.

Dioxin levels from fat and fatty acids as feed materials differ notably. There is a remarkable decline of dioxin levels from the fatty acids as feed material to the fat used for compound feed. About 21 % of 85 analysed fat samples exceeded the maximum EU level of 0.75 ng WHO- CDD/F-TEQ/kg, and one sample had about tenfold of the maximum level. WHO-PCDD/F-TEQ levels ranged from 0.11 – 7.56 ng/kg with an arithmetic mean of 0.710 ± 0.852 ng WHO-PCDD/F-TEQ/kg.

Significantly higher WHO-PCDD/F TEQ levels were analysed in fatty acids (n = 86), ranging from 0.31 – 62.07 ng WHO-PCDD/F-TEQ/kg. In total 71 % of all fatty acid samples exceeded the maximum EU level for WHO-PCDD/F-TEQ in vegetable oils (0.75 ng/kg). About 30 % of these samples had even more than tenfold levels of the maximum level; the arithmetic mean was 5.55 ± 12.80 ng WHO-PCDD/F TEQ/kg. Mixed fatty acid samples (“Mischfettsäuren”) (n = 10) had the highest WHO-PCDD/F TEQ levels with 2.01 – 150 ng/kg, all levels were higher than the maximum EU level (0.75 ng WHO-PCDD/F-TEQ/kg).

3.1.3.1 Dioxin dietary exposure due to the consumption of eggs and pork in the current dioxin case

Assessment of dioxin intake in adults

To estimate the consumed amounts of food, all dishes and recipes as well as nearly all prepared foods have been broken down to their raw ingredients with consideration of preparation factors. Mostly standard recipes have been used which do not take into account variation of manufacturing and preparation and the respective consumed amounts of the food.

Table 2 shows the intake estimate based on data from the National Nutrition Survey II (LExUKon project) and the values of dioxins.

Table 2: Model based long term estimate (adults) of WHO-PCDD/F-TEQ using currently submitted measurements

food	Mean content (pg/g fat)	Dietary exposure pg/d/kg bw based on average values		Percentage of TDI (%)	
		Mean consumption	High consumption	Mean consumption	High consumption
Eggs, including dried eggs	1.9	0.081	0.199	4.1	9.9
Pork	0.3	0.012	0.030	0.6	1.5

Taking into account a mean consumption of food, the dietary exposure of dioxin and PCB (2 pg/ kg bw per day; SCF 2001) will be 4 % for eggs (WHO-PCDD/F-TEQ) and about 1 % for pork as compared to the TDI. For high consumption figures, expressed as the 95th percentile the values will increase to 10 % for eggs and 2 % for pork.

It must be clearly stated that this estimate is based on the data related to the current dioxin event. Extrapolations or conclusions for life long exposure are not possible on which comparisons with TDI should be based. Therefore, the available data of dioxin contents are due to a limited time of occurrence with respective time limited dietary exposure.

Assessment of dietary exposure in children

The estimation of dietary exposure in children has been performed by taking the available dioxin data analysed in eggs and pork and combining that data with consumption figures from the above mentioned VELS study.

Table 3 shows the intake estimate made for children aged 2 to 5 years for WHO-PCDD/F-TEQ on the basis of the VELS-data and the current available mean contaminant results. The consumption of pork is regarded to pure meat and does not include intake of meat products.

Table 3: Model based estimate of long term exposure (children 2 to < 5) of WHO-PCDD/F-TEQ based on current measurements

Food	Dietary exposure pg/d/ kg bw* on the basis of mean contents	Percentage of TDI (%)
	Mean consumption considered	
Eggs	0.252	12.6
Pork	0.009	0.4

*Standard body weight in VELS: 16.15 kg

The use of the data from the VELS study is based on a low number of individual values from single days. Therefore, uncertainties must be taken into account when using these data for lifelong extrapolation. This is of particular importance when more detailed information of food groups is needed or if there is a considerable portion of non-consumers.

The VELS data are results from extrapolations of prepared to raw foods on the basis of preparation factors. An overestimation of exposure may result because eggs and meat are mostly eaten as prepared food.

3.1.3.2. Exposure assessment through the intake of feed for laying hens and fattening pigs

Dioxin intake by livestock is primarily (PCDD/F) related to ingestion of soil or soil-contaminated feed (Rychen et al. 2008). PCDD/F from the atmosphere and soil can be on the plants. The intake of PCDD/F by the roots is negligible for most plants. The maximum level for feed materials of plant origin with exception of vegetable oils and by-products permitted by the EU (Directive 2002/32/EC) is 0.75 ng WHO-PCDD/F-TEQ/kg (88% dry matter). An overview of average dioxin levels for feed is shown in Table 4.

A calculated daily intake of 1-3 kg feed dry matter (fattening pig) or 0.1-0.2 kg feed dry matter (laying hen) of a compound feed with dioxin levels from 0.043 to 0.382 ng WHO-PCDD/F-TEQ/kg (feed for fattening pigs) and from 0.048 to 0.11 ng WHO-PCDD/F-TEQ/kg (feed for laying hens) result in a dioxin intake for fattening pigs from 0.049 to 1.302 ng WHO-PCDD/F-TEQ or 0.005 to 0.025 ng WHO-PCDD / F -TEQ for laying hens, respectively.

Table 4: Dioxins in feed (in ng WHO- PCDD/F-TEQ/kg; EFSA 2010)

feed	PCDD/F
Feed of vegetable origin (except oils)	0.11
Vegetable oils incl. by-products	0.17
Mineral feedingstuff	0.08
Animal fat, including milk fat and egg fat	0.28
Fish oil	0.80
Additives compounds of trace elements	0.13
Pre-mixtures	0.07
Compound feed excl. fur animals, pets, fish	0.11
Feed for fur animals, pets and fish	0.18

3.2 Risk characterisation

Tolerable intake levels

The WHO has laid down the tolerable daily intake (TDI) as between 1 and 4 pg WHO-PCDD/F-PCB-TEQ per kg body weight and day (WHO 2000). This definition regards the upper limit (4 pg WHO-PCDD/F-PCB-TEQ/kg body weight) as a provisional basis of the maximum tolerable intake. The lower level documents the WHO target to reduce the intake of WHO-PCDD/F-PCB-TEQ in humans to below 1 pg/kg body weight. The WHO derived the TDI range from the Lowest Observed Adverse Effect Levels (LOAEL) described by various authors for different species and for different end points.

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).

Risk assessment for adults and children

Taking into account a mean consumption of food, the dietary exposure will be 4 % for eggs and about 1 % for pork as compared to the TDI. For high consumption figures, expressed as the 95th percentile the values will increase to 10 % for eggs and 2 % for pork.

Therefore, no adverse health effects for the consumer are to be expected. For children no adverse health effects are to be expected by a dietary exposure to dioxins of 12.6 and 0.4 % of the TDI for eggs and pork, respectively.

Risk assessment for infants

The WHO has laid down the tolerable daily intake (TDI) as between 1 and 4 pg WHO-PCDD/F-PCB-TEQ per kg body weight and day (WHO 2000). This level applies to the total of dioxins and dioxin-like PCBs. The TDI characterises the dose which represents no expected health risk in the case of a lifelong daily intake. Considering the current data situation, a three-month-old breastfed infant takes in 35 pg WHO-PCDD/F-TEQ/kg body weight per day on average. The WHO has dealt intensively with the intake levels of infants which are significantly higher in respect of the TDI (on average 84 pg WHO-PCDD/F-TEQ/kg body weight and day). According to the WHO assessment, breastfeeding has proven health benefits for the infant, and since this higher dioxin intake only occurs during a very short life span, the WHO has recommended breastfeeding unconditionally.

The German National Breastfeeding Committee recommends breastfeeding unconditionally (Nationale Stillkommission 1995), too. Even in former times of elevated concentrations of pollutants in breast milk, the Committee did not see any reason to restrict the recommendation to breastfeeding. The National Breastfeeding Committee recommends that infants be breastfed until solid foods are introduced, which should be no earlier than at the beginning of the 5th month, and it does not consider that continuing breastfeeding after introducing solid foods represents a health risk, as long as mother and child feel comfortable. As a precaution, however, it demands that appropriate measures should continue to be taken to minimise the residues of all foreign substances in breast milk.

In the current case of increased dioxin levels in eggs and meat, dioxin intake in adults is distinctly below the TDI. Therefore it cannot be assumed that there is a significant increase in the dioxin level of breast milk. Breastfeeding can therefore be recommended unconditionally in the current case as well.

Risk assessment for farm animals

Depending on animal species, dioxin intakes of 0.005 to 1.302 ng WHO-PCDD/F-TEQ per day may result from the above-mentioned ration calculations. It can be assumed that pigs in the final fattening period and sows have a higher dioxin intake due to high feed intake. Since, however, the currently available data of compound feed (complete feed for pigs and poultry)

are below the maximum EU Level for dioxins, no adverse health effects for the animals are to be expected

4 Model calculation to determine the dioxin body burden (body burden concept)

The following presents worst-case scenarios for adults regarding the consumption of eggs and pork which are contaminated with dioxins at a level above the EU maximum level. The calculations assume a maximum measured level of 12 pg/g egg fat or 1.5 pg/g pig fat. In case of a high consumption (2 eggs or 2 slices of pork per day) the total daily exposure calculated is 3.5 pg/kg body weight in case of eggs and 1.2 pg/kg body weight in case of pork (including all other foodstuffs with average dioxin contaminations and an average consumption of these foods). If the eggs (maximum level = 3 pg/g fat) or the pork (maximum level = 1 pg/g fat) were only contaminated with concentrations at the maximum EU levels, the daily exposure computed would be 1.4 and 1.0 pg/kg body weight, respectively. The background exposure already included in these calculations amounts to 0.7 pg/kg body weight. Therefore, in the case of a high consumption of 2 eggs per day with a dioxin level of 12 pg/g of egg fat, the TDI value of the SCF (2 pg/kg body weight) is exceeded according to the calculation. To assess potential health risks, in the case of extremely persistent compounds such as dioxins, however, the total amount of dioxins accumulated in the body (body burden) and the corresponding concentration in the body fat is much more relevant.

The latter is, for example, equivalent to the fat concentration in breast milk, which has decreased considerably in the past 20 years (see Fig. 1). For the following considerations a body burden with a dioxin concentration of 10 pg/g fat for an adult is assumed. Also it is assumed that the adults' body weight is 60 kg with a fat content of 25 % which is equivalent to a fat weight of 15 kg. This corresponds to a dioxin body burden of 150,000 pg which increases by about 42 pg per day due to background contamination of foods. Due to the half-life of 7 years, only about 40 pg are eliminated daily. Hence, this model adult is nearly in a steady state. With a constant background exposure, the concentrations of dioxin increase only insignificantly for the rest of his life.

If another worst-case scenario is assumed in that the high consumption of 2 eggs (each with 12 pg/g fat) will take place daily for **one month**, this will yield an additional intake of 5,040 pg (background contamination deducted) which will lead to an increase of the body burden of 3.4 % (from 10.0 to 10.3 pg/g body fat). The daily consumption of contaminated eggs beyond the period of one month is highly unlikely, based on the currently known facts. Theoretically the high consumption of 2 eggs (each with 12 pg/g) per day **for one year** would result in an additional intake of 61,320 pg (background contamination deducted) and would thus results in an increase of the body burden by 40.9 % (from 10.0 to 14.1 pg/g body fat).

Even based on the extreme assumptions which, in reality, can be excluded with high probability, the calculated body burdens are significantly lower than the average body burden measured in the German population 20 years ago (see Fig. 1). At that time this amounted to about 30 pg/g body fat. With regard to these concentrations it can be assumed with a high certainty that they do not pose a health risk. Thus the consumption of contaminated eggs with those levels of dioxins that have been ascertained is not associated with any health risks, even if the eggs are consumed over a longer period of time.

5 Minimisation measures

In the past the main input sources were via the air (metal industry and waste incineration plants) and dioxin contaminated chemicals e.g. pentachlorophenol, PCB, certain herbicides (e.g. chlorinated phenoxy carboxylic acids).

The contamination of the environment and food with dioxins has significantly decreased in Germany since the end of the 1980's. As a consequence the dioxin content in breast milk was reduced as already explained. This is due to a whole range of technical and legal measures, especially emission limits for incineration processes and the prohibition decree in chemical production. The following are some national and European regulations by way of illustration: Emission limitation rules, rules prohibiting the production, distribution and use of certain chemicals and products, rules and recommendations for soil and sewage sludge, rules for maximum levels in feed and food.

At the international level, the Stockholm Convention on Persistent Organic Pollutants (POPs = persistant organic pollutants) was signed in May 2001 and became effective on 17 May 2004. It is a global agreement to stop or limit the production, use and release of POPs (Richter et al. 2001).

Future measures and minimisation strategies

According to a notification of 15 October 2010 from the EU Commission to the Council, the European Parliament and the European Economic and Social Committee, small combustion plants account for 22 % of total emissions and are thus one of the main emission sources whereas the rest of emissions result from a wide range of industrial and non-industrial sources. For a further reduction, the local sources must be examined in more detail. Measures at the regional and/or national level will probably be more successful.

The sources that remain at present are thus relatively widely distributed between industrial and non-industrial sources. It seems more reasonable to eliminate them through national, regional and local measures (EU 2010).

6 Conclusion

BfR used the data on dioxin content in food and feed provided by the Federal States and members of the agricultural sector to assess a possible health risk for consumers.

The dioxin concentrations found in eggs, meat of laying hens and fattening pigs only exceeded the maximum levels in few cases. All other analysed food samples have dioxin concentrations below the maximum levels. None of the analysed samples of compound feeds exceeded the maximum levels for dioxins.

BfR concludes that neither acute nor long-term adverse health effects are expected for consumers even if eggs or pork with the highest measured concentrations are consumed over an extended period of time.

Taking into account the mean dioxin concentration in suspect food samples, the dietary exposure of dioxin will be 4 % for eggs and 1 % for pork as compared to the TDI. The mean consumption is based on data of the National Nutrition Survey II. For high consumption figures, expressed as the 95^{th} percentile the values will increase to 10 % for eggs and 2 % for pork.

For substances like dioxins, it is not the daily dose taken in, but rather the amount already in the human body – the body burden – that is decisive for its effects on human health. Dioxins accumulate within the body, and as a result of existing background exposure, every human being takes in traces of dioxins through food on a daily basis.

Official controls in food and feed in regard to compliance with maximum levels are carried out on a regular basis. Information gained by the results of the official controls provides options and strategies for a reduction of the human dioxin body burden by identification and elimination of the source of contamination.

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