

Technical University of Denmark



## Chemical Contaminants

Food monitoring 2012-2013

**Petersen, Annette; Fromberg, Arvid; Andersen, Jens Hinge; Sloth, Jens Jørgen; Granby, Kit; Duedahl-Olesen, Lene; Rasmussen, Peter Have; Cederberg, Tommy Licht**

*Publication date:*  
2016

*Document Version*  
Publisher's PDF, also known as Version of record

[Link back to DTU Orbit](#)

*Citation (APA):*  
Petersen, A., Fromberg, A., Andersen, J. H., Sloth, J. J., Granby, K., Duedahl-Olesen, L., ... Cederberg, T. L. (2016). Chemical Contaminants: Food monitoring 2012-2013. Søborg: National Food Institute, Technical University of Denmark.

## DTU Library

Technical Information Center of Denmark

---

### General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

# Chemical contaminants 2012-2013

---



# Chemical contaminants

Food monitoring 2012-2013

**This report is prepared by:**

Annette Petersen  
Arvid Fromberg  
Jens Hinge Andersen  
Jens J. Sloth  
Kit Granby  
Lene Duedahl-Olesen  
Peter Have Rasmussen  
Tommy Licht Cederberg

National Food Institute  
Division of Analytical Food Chemistry

# Chemical contaminants

## Food monitoring 2012-2013

1. edition, October 2015

Copyright: National Food Institute, Technical University of Denmark

Photo: colourbox.com

ISBN: 978-87-93109-61-2

This report is available at

[www.food.dtu.dk](http://www.food.dtu.dk)

National Food Institute

Technical University of Denmark

Mørkhøj Bygade 19

DK-2860 Søborg

Tel: +45 35 88 70 00

Fax: +45 35 88 70 01

# Table of content

1	Forord	6
2	Preface	7
3	Trace elements	8
3.1	Introduction	8
3.2	Methods of sampling, analysis and quality assurance	8
3.2.1	Sampling	8
3.2.2	Chemical analyses and quality assurance	8
3.3	Mercury	9
3.3.1	Introduction	9
3.3.2	Results and discussion	9
3.4	Lead	9
3.4.1	Introduction	9
3.4.2	Results and discussion	9
3.5	Cadmium	10
3.5.1	Introduction	10
3.5.2	Results and discussion	10
3.6	Arsenic	10
3.6.1	Introduction	10
3.6.2	Results and discussion for inorganic arsenic	10
3.6.3	Results and discussion for total arsenic	10
3.7	Aluminum Aluminium, copper, selenium, zinc and tin	11
4	Nitrate in vegetables	12
4.1	Introduction	12
4.2	Methods of sampling, analysis and quality assurance	12
4.3	Results and discussion	12
5	Mycotoxins	14
5.1	Introduction	14
5.2	Methods of sampling and analytical methods	14
5.3	Results and discussion of mycotoxins	14
5.3.1	Trichothecenes (Deoxynivalenol, HT-2 toxin and T-2 toxin)	14
5.3.2	Ochratoxin A (OTA)	16
6	Chlorinated organic environmental contaminants	17
6.1	Dioxins and PCB	17
6.1.1	Introduction	17
6.1.2	Methods of sampling, analysis and quality assurance	19
6.1.3	Results and discussion	19
6.2	Organochlorine pesticides and level of indicator PCB	23

6.2.1	Methods of sampling, analysis and quality assurance	23
6.2.2	Results and discussion	24
<b>7</b>	<b>Polycyclic Aromatic hydrocarbons (PAH)</b>	<b>26</b>
7.1	Introduction	26
7.2	Methods of sampling, analysis and quality assurance	26
7.3	Results and discussion	27
<b>8</b>	<b>Acrylamide</b>	<b>29</b>
8.1	Introduction	29
8.2	Methods of sampling, analysis and quality assurance	29
8.3	Results and discussion	29
<b>9</b>	<b>Furan</b>	<b>31</b>
9.1	Introduction	31
9.2	Methods of sampling, analysis and quality assurance	31
9.3	Results and discussion	31
<b>10</b>	<b>References</b>	<b>33</b>
<b>11</b>	<b>Appendices</b>	<b>37</b>
11.1	Appendices to trace elements	37
11.1.1	Mercury (mg/kg)	37
11.1.2	Lead (mg/kg, except for water, µg/L)	39
11.1.3	Cadmium (mg/kg except for water, µg/L)	41
11.1.4	Inorganic arsenic (mg/kg)	43
11.1.5	Total arsenic (mg/kg, except for water, µg/L)	45
11.1.6	Aluminum, copper, , selenium,tin and zinc (mg/kg, except for water, µg/L)	47
11.2	Nitrate (enhed mangler) (mg/kg)	48
11.3	Mycotoxins	49
11.3.1	Deoxynivalenol (µg/kg)	49
11.3.2	HT-2 (µg/kg)	49
11.3.3	T-2 (µg/kg)	49
11.3.4	Ochratoxin A (µg/kg)	50
11.4	Dioxin and PCB	51
11.4.1	WHO-TEQ <sup>2005</sup> PCDD/F+PCB	51
11.4.2	WHO-TEQ <sup>2005</sup> PCDD/F	53
11.4.3	WHO-TEQ <sup>2005</sup> PCB	55
11.4.4	PCB-6 (sum of PCB 28, 52, 101, 138, 153 and 180)	57
11.5	PCB and organochlorine pesticides	59
11.5.1	Alpha-HCH	59
11.5.2	Beta-HCH	60
11.5.3	Lindane	61
11.5.4	HCB	62

11.5.5	Dieldrin	63
11.5.6	Chlordane, sum	64
11.5.7	Heptachlor, sum	65
11.5.8	DDT, sum	66
11.5.9	PCB (sum of PCB 28, 52, 101, 105, 118, 138, 153, 156, 170 and 180)	67
11.6	PAH	68
11.6.1	Benzo[ <i>a</i> ]pyrene	68
11.6.2	PAH 4 (sum of benz[ <i>a</i> ]anthracene, chrysene, benzo[ <i>b</i> ]fluoranthene and benzo[ <i>a</i> ]pyrene)	70
11.7	Acrylamide	72
11.8	Furan	73

# 1 Forord

Denne rapport giver en oversigt over indholdet af udvalgte kemiske forureninger i fødevarer, der er analyseret i 2012 og 2013. Resultaterne for en del af disse forureninger kan man finde på Fødevarestyrelsens hjemmeside. Rapporten er en opfølgning af resultaterne, der er vist i rapporten Chemical Contaminants, Food Monitoring 2004-2011 (Petersen et al., 2013).

I rapporten er vist resultater for cadmium, bly, kviksølv, total arsen, uorganisk arsen, aluminium, zink, kobber, nikkel, tin, mangan, selen, nitrat, dioxin, PCB, polycykliske aromatiske hydrocarboner (PAH), akrylamid, deoxynivalenol (DON), HT-2 toksin og T-2 toksin samt ochratoksin A. Analyserne er udført på Fødevarestyrelsens laboratorier i Ringsted og Aarhus.



## **2 Preface**

This report presents the results of analysis for various chemical contaminants in foods on the Danish market. The time period covers the years 2012-2013. Included in this report are results from mercury, total and inorganic arsenic, cadmium, lead, selenium, manganese, copper, aluminium, zinc, tin, nitrate, dioxin, PCB, ochratoxin A, deoxynivalenole, HT-2 toxin, T-2 toxin, polycyclic aromatic hydrocarbons, acrylamide and furan. The analyses were carried out at the Danish Veterinary and Food Administration laboratories in Ringsted and Aarhus (Denmark).

## **3 Trace elements**

### **3.1 Introduction**

The following elements have been analysed in 2012 and/or 2013:

- Mercury (Hg)
- Lead (Pb)
- Cadmium (Cd)
- Arsenic, total (As) and inorganic (iAs)
- Copper (Cu)
- Selenium (Se)
- Aluminium (Al)
- Zinc
- Nickel (Ni)

### **3.2 Methods of sampling, analysis and quality assurance**

#### **3.2.1 Sampling**

The samples were taken in the period 2012-2013. The sampling and analysis was organised in various projects, each covering a certain food-group or –subgroup. In contrast to the previous monitoring periods, no stratified sampling, with the same type of samples being analysed consecutively, was conducted. The projects were defined with respect to the types of foods and trace elements that were to be included on a project-by-project basis by the Danish Food Administration in collaboration with DTU Food. The sampling was conducted by local food inspectors from the Danish Food Administration in various parts of Denmark. The types and numbers of various foods included in the projects and the results of the analysis are given in Appendices 11.1.1 to 11.1.6.

#### **3.2.2 Chemical analyses and quality assurance**

The levels of trace elements were analysed by the regional laboratory of the Danish Food Administration in Aarhus, Denmark. The samples were prepared in accordance with common household practices, but none of the foods were cooked prior to analysis. Only the edible parts of the foods were used and adhered soil was removed by brushing under clean water. The sample preparation involved isolation of the relevant tissue or part of the sample by utensils, which would not contaminate the samples. To determine the total level of trace elements, representative subsamples of the homogenised food samples were digested by microwave-assisted wet-ashing in quartz vessels with concentrated nitric acid. Following this process the trace element level was determined using inductively coupled plasma mass spectrometry (ICP-MS). External calibration with internal standardisation was used for the quantification of trace elements. For the selective determination of inorganic arsenic the samples were extracted with dilute acid at 90°C and the level of inorganic arsenic was determined using anion-exchange HPLC-ICP-MS. The analytical work was generally organised and run in batches comprising up to 15-20 unknown samples, minimum one blank, minimum one double determination for approximately each 10 unknown samples and one or more certified reference material(s). In the event of deviations from a set of criteria for tolerable variations of blanks, for values obtained for CRMs (x-charts) and for double determinations (R-charts), all the analyses in that batch were repeated. The LODs and LOQs, which were calculated in accordance with the three-sigma criterion, were estimated from the variance of the analytical blank values. Results indi-

cated by "<" in Appendices 11.1.1 to 11.1.6 were below the LOD value for the analytical survey in which the result was produced.

The results are shown in appendix 11.1.1 to 11.1.6 and it should be noted that some results are quantified even if the results are below the LOD and LOQ. These results are also included in the in the calculation of the mean and median.

For some commodities both organic and conventional products are analysed. Results for both kinds of products are shown except in a few cases, where the data have been compiled. For example for infant food only one or two samples are not organic and hence it make no sense to show the results for both types as it is not possible to make comparison based on such limited number of data. If more samples of both types are analysed in the future a comparison may become possible.

Maximum levels for mercury, cadmium and lead in selected foodstuffs are regulated in the EU directive 1881/2006 and later amendments (EC, 2006). For drinking water maximum levels for a wide range of trace elements have been established in the Danish drinking water directive (DEPA, 2014)

### **3.3 Mercury**

#### **3.3.1 Introduction**

Mercury (Hg) is naturally present in the Earth's crust usually at levels around 0.02 mg/kg. The element can be found in various chemical forms, both inorganic and organic (e.g. methylmercury), and the organic form that is considered most toxic. It is used in various industrial applications and the main anthropogenic source of mercury is the incineration of waste.

#### **3.3.2 Results and discussion**

In the present study only data for the total amount of mercury (the sum of inorganic an organic bound mercury) has been determined.

As can be seen from appendix 11.1.1 most of the samples analysed for mercury are seafood. Except for pangasius, all samples of fish contained amounts of mercury above LOD. However, none of the samples exceed the maximum levels for mercury in fish at 0.5 mg/kg for most fish species and 1.0 mg/kg for certain predatory fish types (EC, 2006). Also some samples of animal products are analysed. For this kind of food most of the samples are below the LOD (<0.0007 mg/kg). Only for wild ducks and pig kidney levels above the LOD are found. .

### **3.4 Lead**

#### **3.4.1 Introduction**

Lead is a ubiquitous element, found naturally in the Earth's crust at an average level of 10 mg/kg. It is widespread in the environment due to its use in various industrial applications.

#### **3.4.2 Results and discussion**

The results are shown in appendix 11.1.2. As can be seen except for water all samples belong to the groups of fish, shellfish and animal products. For a majority of the samples only low levels below

the LOD have been found. Exceptions are some of the samples belonging to the group of bivalves, a few fish, duck and pigeon meat and honey.

None of the samples exceeded the current EU maximum levels for lead in food (EC, 2006) and drinking water (DEPA, 20149).

## **3.5 Cadmium**

### **3.5.1 Introduction**

Cadmium is a toxic trace element found as an environmental contaminant, both through natural occurrence and from industrial and agricultural sources. Cadmium has no known biological function in humans. Foods are the main source of cadmium exposure for the non-smoking population. Tobacco smoking and work place air have also been identified as major contributors to cadmium exposure.

### **3.5.2 Results and discussion**

The results are shown in appendix 11.1.3. The samples analysed belong to the groups of seafood, animal products and drinking water. For many of the commodities within these food groups there are none or few positive results except for crabs, mussels, shrimps, horse meat and pig kidney and liver. In water a few positive samples are found and only in tap water. None of the samples exceeded the current maximum levels for cadmium in food (EC, 2006) and drinking water (DEPA, 2014).

## **3.6 Arsenic**

### **3.6.1 Introduction**

Arsenic is a ubiquitous element, which is introduced to the environment from both natural and anthropogenic sources. The crust of the Earth contains arsenic, which is released through weathering of rocks and volcanic activity. The toxicity of arsenic compounds strongly depends on their chemical forms (speciation). Inorganic arsenic is considered the most toxic of the arsenic species present in food. In the present period both results for total and inorganic arsenic have been obtained in a range of foodstuffs.

### **3.6.2 Results and discussion for inorganic arsenic**

The results for inorganic arsenic are shown in appendix 11.1.4. It is primary fish and rice products that have been analysed. Compared to total arsenic few of the fish contain levels of inorganic arsenic above the LOQ.

As can be seen for the rice products there is no differences in levels for conventional and organic products. However, it can also be seen that brown rice has higher levels than white rice, which is in accordance with previous results (Chemical contaminants, 2004-2011).

### **3.6.3 Results and discussion for total arsenic**

The results for total arsenic are shown in appendix 11.1.5 . It is primary fish and rice products that have been analysed. The majority of samples have total arsenic levels above the LOQ level.

### **3.7 Aluminium, copper, selenium, zinc and tin**

Aluminium is the most abundant element in the Earth's crust (8%) and it is used in numerous industrial applications. In the present period the total level of Al has been analysed in imported Chinese noodles of wheat in order to comply with EU regulation 878/2010.

Selenium has been determined in ten samples of trout while tin has been determined in some samples of canned tuna. Copper and zinc have been determined in different kind of waters. Copper, tin and zinc have not been included in the analytical programme before.

The results for these five elements are shown together in appendix 11.1.6

## 4 Nitrate in vegetables

### 4.1 Introduction

Nitrate is a naturally occurring compound present in plants which may accumulate in different tissues of the plant. The level of nitrate varies between plant species, the extent of fertilisers use, humidity, temperature and amount of sunlight, e.g. the nitrate level in lettuce tends to be higher in samples from Northern Europe than from Mediterranean countries. The acute toxicity of nitrate is low, but in food and in the gastrointestinal tract nitrate can be reduced to nitrite, which has a higher acute toxicity.

### 4.2 Methods of sampling, analysis and quality assurance

The sampling was carried out on a nationwide basis by authorized personnel from local food control units. Samples were analysed for nitrate at the regional laboratory in Ringsted (Denmark). Samples were taken at vegetable markets all over Denmark. The analyses were performed in accordance with to the method for the determination of nitrate in fruits and vegetables of the Danish Veterinary and Food Administration (FIA-method, ANA-07.1481). The limit of quantification (LOQ) was 5 mg/kg for nitrate. The regional laboratories in Ringsted participate in intercalibrations and performance tests through the Food Analysis Performance Assessment Scheme (FAPAS).

### 4.3 Results and discussion

For nitrate EU has set maximum limits for lettuce, rucola, spinach and baby food (EC, 2011d).

The results of nitrate are shown in the appendix. As it can be seen only four samples of lettuce were taken and none of these samples exceeded the maximum limits for lettuce. Most of the samples taken were rucola and beside a few samples of spring onions (2) and beet root (3) were taken. As it can be seen from table 4.2 the nitrate level in rucola was higher in the foreign samples than in the Danish samples. The minimum is about the same but the maximum, mean and median values were higher for the foreign samples. Among the samples of rucola of foreign origin six of them exceeded the maximum limits set for nitrate in rucola (see table 4.1) while none of the Danish samples exceeded the maximum limits.

All the samples are also analysed for nitrite but no levels above the LOQ of 3 mg/kg were found.

**Table 4.1.** EU maximum limits for nitrate in analysed samples (mg/kg)

Foodstuff	Remarks	Maximum limit (mg nitrate/kg)
Fresh lettuce (not mentioned otherwise)	Harvested 1 October to 31 March	
	Grown under cover	5000
	Grown in open air	4000
	Harvested 1 April to 30 September	
	Grown under cover	4000
	Grown in open air	3000
“Iceberg” type lettuce	Grown under cover	2500

---

	Grown in open air	2000
Rucola	Grown under cover	7000
	Grown in open air	6000

---

## 5 Mycotoxins

### 5.1 Introduction

Mycotoxins are secondary fungal metabolites with diverse structures and toxicological properties that induce a variety of toxic effects in humans and animals. In particular, fungi of the genera *Aspergillus*, *Penicillium* and *Fusarium* are significant in foods and feed all over the world. In Denmark fungi of the genus *Fusarium* are the most important toxigenic fungi just as in other northern temperate regions. *Fusarium* produce various trichothecenes including deoxynivalenole (DON, vomitoxin), HT-2 toxin (HT-2) and T-2 toxin (T-2) which might be present in cereal grain intended for human consumption. The Tolerable Daily Intake (TDI) set by the European Food Safety Authority (EFSA, 2011b) for the sum of HT-2 and T-2 is 0.06 µg/kg body weight which is lower than for DON (1 µg/kg bw/day). Increased levels of DON in cereal grains are often observed in harvest years with frequent rainfall and high humidity during the flowering period and timing, rather than the amount of rain is the most critical factor. How the weather conditions affect the level of HT-2 and T-2 toxins in cereals are less known, but we can also here see great variations from year to year.

Ochratoxin A (OTA) is produced by various *Penicillium* and *Aspergillus* species and represents a well-known hazard to human and animal health. The occurrence of OTA in cereals has been followed in several Danish monitoring programs since the mid -1980s. For this reason only a limited number of samples have been analysed during this monitoring period from 2012 to 2013 as the previous monitoring programmes (DFVA, 2005 and Petersen et al, 2013) have shown low levels of OTA in cereal grains.

### 5.2 Methods of sampling and analytical methods

Sampling was carried out on a nationwide basis by authorised personnel from local food control units. Samples were analysed for DON, HT-2, T-2 and OTA by the Danish Veterinary and Food Administration at the regional laboratory in Ringsted. Samples were taken at mills all over Denmark and could have either Danish or foreign origin. In Denmark most of the flour for human consumption is mainly produced from domestic grain and grain from the southern part of Sweden and the northern part of Germany, where the climate and growing conditions for fungi are similar to Denmark. The analyses of DON, HT-2 and T-2 in cereal and cereal products were carried out simultaneously by the regional laboratory in Ringsted using an accredited LC-MS/MS method. OTA was also analysed at the regional laboratory in Ringsted by HPLC/FLD. The laboratory participates regularly in performance tests through FAPAS. The limit of quantification (LOQ) for DON, HT-2, T-2 and OTA was 20, 2, 1.6 and 0.1 µg/kg, respectively. Samples with levels lower than LOQ were assumed to have a level of half the value of LOQ for determinations of the average value.

### 5.3 Results and discussion of mycotoxins

#### 5.3.1 Trichothecenes (Deoxynivalenol, HT-2 toxin and T-2 toxin)

Different kind of cereals and cereal products of wheat, rye, oats and barley were analysed for DON, HT-2 and T-2 during the present monitoring period. In total 186 samples have been analysed and the results are shown in appendix 11.3-1 to 11.3-3. As for the foregoing monitoring period 2004 – 2011 (Petersen et al., 2013) the highest levels of DON were found in oat products with mean and maximum values of 113 and 2400 µg/kg, respectively. DON was found in less than half of the 40



analysed oat samples resulting in a median value below LOQ. Only two samples exceeded the EU maximum limit of 750 µg/kg for DON- both obtained in oatmeal. In accordance with the results from last monitoring period DON was more common found in kernels from wheat than for the barley and rye. The highest mean and median values were obtained for wheat bran except for maize goats, but here only one single sample was analysed. It was remarkable that the levels of DON in rye and wheat bread were similar or even higher than in the flour, because the levels will generally be reduced during the manufacturing process. The number of analysed bread samples and especially for rye was low and for this reason the obtained results should be taken with reservations

The levels of HT-2 toxin and T-2 toxin in samples of wheat and rye were generally low, and even for the positive samples the levels were close to the detection limit corresponding to 2 and 1.6 µg/kg, respectively. The level of HT-2 toxin was generally higher than for T-2 toxin in the analysed samples and HT-2 was also detected more frequently than T-2 (appendix 11.3.2 and 11.3.3). As for DON, the occurrence and contamination levels were higher for rolled oat than for flour of rye and wheat.

There are at present no European maximum levels of HT-2 and T-2 in cereals but only guideline levels for the sum of the two toxins. In oats for human consumption the value is 100 µg/kg and for other cereals 50 µg/kg (EC, 2013a). In cereal based foods for infants and young children the guideline level is 15 µg/kg. As shown in Appendix 11.3.2 and 11.3.3 none of the samples exceed 100 µg/kg (the sum of HT-2 and T-2), but several samples showed levels higher than 15 µg/kg.

In this monitoring period cereal samples of organic and conventional origin were collected and analysed for DON, HT-2 and T-2. The results for DON are shown in table 5.1. Both the average and median levels in products of oat and wheat were significant higher in the conventional samples of both Danish and foreign origin compared to the organic samples. The same distribution was found for the maximum values in oat and wheat, respectively. In products of rye the values for the mean and median levels were more similar between the organic and conventional samples, which were also true for the maximum values. The general frequency (number of positive) also appeared to be higher for DON in the conventional compared to the organic samples. The level of HT-2 and T-2 were low in most of the analysed samples and for many of the samples below LOQ, and it was therefore difficult to compare the level in the organic and conventional cereal samples. However, the data strongly indicate that the number of positive samples for the two mycotoxins were higher in conventional than in the organic samples (results not shown).

**Table 5.1.** Comparison of deoxynivalenol in organic and conventional samples of flour and kernels of oat, wheat and rye.

Cereal		Number of samples	Positive	Average (µg/kg)	Median (µg/kg)	Maximum (µg/kg)
Oat	Organic (Danish)	10	3	37	<LOQ	200
	Conventional (Danish)	9	5	344	94	2400
	Organic (foreign)	9	1	22	<LOQ	210
	Conventional (foreign)	12	8	72	69	120
Wheat	Organic (Danish)	18	11	32	24	87
	Conventional (Danish)	13	9	80	45	230
	Organic (foreign)	9	3	17	49	49
	Conventional (foreign)	32	24	52	200	250

Rye	Organic (Danish)	9	6	20	21	36
	Conventional (Danish)	9	6	30	19	83
	Organic (foreign)	5	5	24	45	60
	Conventional (foreign)	10	7	44	18	58

### 5.3.2 Ochratoxin A (OTA)

During this monitoring period only 18 samples were analysed for OTA in kernels from oat, rye, wheat and in two samples of wheat bran. As shown in Appendix 11.3.4 the level of OTA were below LOQ in most of the samples, and OTA was only found in three rye samples with mean and maximum values of 0.079 and 0.21 µg/kg, respectively, which is far below the maximum EU limit corresponding to 3 µg/kg for these type of products. As in the previous monitoring period 2004-2011, the level of OTA in cereal and cereal products collected on the Danish market are all low and below the EU maximum limit.

## 6 Chlorinated organic environmental contaminants

Dioxins, PCB and chlorinated pesticides have been included in the monitoring in 2012 og 2013. Dioxins and PCB (including indicator PCB) have been analysed by one analytical method and chlorinated pesticides have been analysed together with indicator PCB by another analytical method. Results of indicator PCB are therefore presented in both chapter 6.1 and 6.2.

### 6.1 Dioxins and PCB

#### 6.1.1 Introduction

Dioxins are the short expression for a group of 210 compounds including 75 polychlorinated dibenzo-*p*-dioxins (PCDD) and 135 polychlorinated dibenzofuranes (PCDF). Dioxins have no technological use, but are generated in a number of thermal and industrial processes as unwanted, and often unavoidable, impurities or by-products. Important emission sources are metal production and processing, waste incineration and domestic furnaces. Dioxins are poorly soluble in water but highly soluble in lipids. Due to their lipophilic properties they accumulate in the food chain and are stored in the fatty tissues of animals and humans.

PCB is a group of 209 organochlorine compounds that are synthesised by catalysed chlorination of biphenyl. Due to their physicochemical properties, such as non-flammability, chemical stability, high boiling point, low heat conductivity and high dielectric constants, technical PCB mixtures were widely used in a number of industrial and commercial closed and open applications. As a result of their widespread use, leakages and inappropriate disposal practices, PCB has, like dioxins, a global distribution in the environment. Restrictions on production and use of PCB have decreased the environmental pollution with PCB since a peak level in the 1970s. Many PCB congeners are persistent because they are degraded poorly and therefore can bio-accumulate in the food chain.

Dioxins and dioxin-like PCBs can cause reproductive and developmental problems, damage the immune system, interfere with hormones and also cause cancer. Long-term exposure to dioxins and dioxin-like PCBs in food increases the risk of adverse effects on fetal development.

Based on their structural characteristics and toxicological effects, PCBs can be divided into two groups. One group consists of 12 congeners that can easily adopt a coplanar structure and show toxicological properties similar to the dioxins of concern. These are therefore called “dioxin-like PCBs” (DL-PCBs). The other PCBs do not show dioxin-like toxicity and have a different toxicological profile. These are called “non-dioxin like PCBs” (NDL-PCBs).

In general, environmental and biological samples contain complex mixtures of various dioxin congeners, so the concept of Toxic Equivalency Factors (TEFs) has been developed to facilitate risk assessment. TEFs have been established to express concentrations of mixtures of 2,3,7,8-substituted PCDDs and PCDFs, and some planar non-ortho and mono-ortho chlorine substituted DL-PCB in toxic equivalents (TEQs) of 2,3,7,8-TCDD. TEQ is calculated by multiplying the concentration of each congener with the assigned TEF. The weighted concentrations are summed to produce TEQ for dioxins, TEQ for DL-PCB and Total TEQ, which is the sum of TEQ for dioxins and DL-PCB.

A number of regulatory measures since the 1980s have considerably decreased the emission of dioxins and PCB into the environment. Consequently, human exposure to dioxins has decreased significantly over the last decades. For the general population the major pathway of exposure to dioxins and PCBs is food.

The current maximum and actions levels for dioxins and PCB in food are shown in table 6.1 for fish and fish products and in table 6.2 for other food items (EC, 2011c; 2013b; 2014a).

**Table 6.1.** Maximum levels and actions levels for dioxins and PCB in fish and fish products as established in 2012 to 2014 (EC, 2011c, and 2014a)

Food	Action levels pg WHO-TEQ <sup>2005</sup> /g wet weight		Maximum levels pg WHO-TEQ <sup>2005</sup> /g wet weight		Maximum level ng/g wet weight
	Dioxins	DL-PCB	Dioxins	Dioxins + DL-PCB	PCB-6
Muscle meat of fish	1.5*	2.5*	3.5	6.5	75
Muscle meat of wild fresh water fish	-	-	3.5	6.5	125
Muscle meat of wild caught ell	-	-	3.5	10	300
Marine oils	-	-	1.75	6.0	200
Fish liver	-	-	-	20	200

\*: Actions levels only applies for farmed fish.

**Table 6.2.** Maximum levels and actions levels for dioxins and PCB in food other than fish and fish products as established in 2012 to 2014 (EC, 2011; 2013b and 2014a)

Food	Action levels pg WHO-TEQ <sup>2005</sup> /g fat		Maximum levels pg WHO-TEQ <sup>2005</sup> /g fat		Maximum level ng/g fat
	Dioxins	DL-PCB	Dioxins	Dioxins + DL-PCB	PCB-6
Meat and fat of bovine animal and sheep	1.75	1.75	2.5	4.0	40
Meat and fat of pigs	0.75	0.5	1.0	1.25	40
Meat and fat of poultry	1.25	0.75	1.75	3.0	40
Mixed animal fat	1.0	0.75	1.5	2.5	40
Liver of terrestrial ani- mals	-	-	4.5	10.0	40
Liver of terrestrial ani- mals (not sheep) <sup>1</sup>	-	-	0.3*	0.5*	3.0*
Liver of sheep <sup>1</sup>	-	-	1.25*	2.00*	3.0*
Raw milk and dairy products	1.75	2.0	2.5	5.5	40

Hen eggs and egg products	1.75	1.75	2.5	5.0	40
Vegetable oils and fats	-	-	0.75	1.25	40
Foods for infants and young children	-	-	0.1*	0.2*	1.0*
Fruits, vegetables and cereals	0.3*	0.1*	-	-	-

\*: on the basis of wet weight.

<sup>1</sup>: In force from January 2014

### 6.1.2 Methods of sampling, analysis and quality assurance

The Danish monitoring of dioxins and PCB in food from 2012 to 2013 was a combination of official control analyses and a survey of the general background contamination with dioxins and PCB. Sampling was targeted at relevant matrices but samples were randomly selected. Follow up samples in case maximum levels were exceeded are not included in the monitoring results.

For the analyses of animal fat, eggs, milk and farmed fish, sampling was performed in accordance with EU directive 96/23/EC (EC, 1996) on measures for monitoring certain substances in live animals and animal products. Samples of meat and farmed fish were taken at the slaughterhouses, eggs were taken at egg packing stations, and milk was taken at the farm. Other types of samples were sampled at border control and retail shops.

Wild herring from the Baltic Sea were collected during fishing surveillance by DTU Aqua. Eggs from small free range farms were collected at the farms.

Chemical analyses were carried out at the Danish Veterinary and Food Administration laboratory in Ringsted with the use of an accredited method. The requirements for the analysis of dioxins and PCB as stated in the EU legislation were followed (EC, 2014b). Congener specific determination was achieved for the seven 2,3,7,8-chloro substituted PCDDs, the ten 2,3,7,8-chloro substituted PCDFs, the four non-ortho PCB (PCB77, 81, 126 and 169), eight mono-ortho PCB (PCB105, 114, 118, 123, 156, 157, 167 and 189) and six marker PCB (PCB6: PCB28, 52, 101, 138, 153 and 180). After fat extraction, the fat was cleaned up on an automated PowerPrep system from FMS, USA. Interfering compounds are removed by columns containing sulphuric acid coated silica, alumina and activated carbon and the extract is separated into two fractions (a) PCDD/F and non-ortho PCB and (b) di- and mono-ortho PCB. The instrumental detection and quantification was carried out by GC-HRMS using 60 m DB5 and HT8-columns and at a mass resolution of 10,000.

### 6.1.3 Results and discussion

A total number of 749 samples were analysed for dioxins and PCB in 2012 and 2013. Of these were 187 fish or seafood and 562 other food items with high fat content.

The fish and seafood samples included 105 wild caught fish, 30 aquaculture trout and 52 samples from retail store or imported. Of the wild caught fish 76 were from the Baltic Sea and of these, 23 were salmon and 35 herrings.

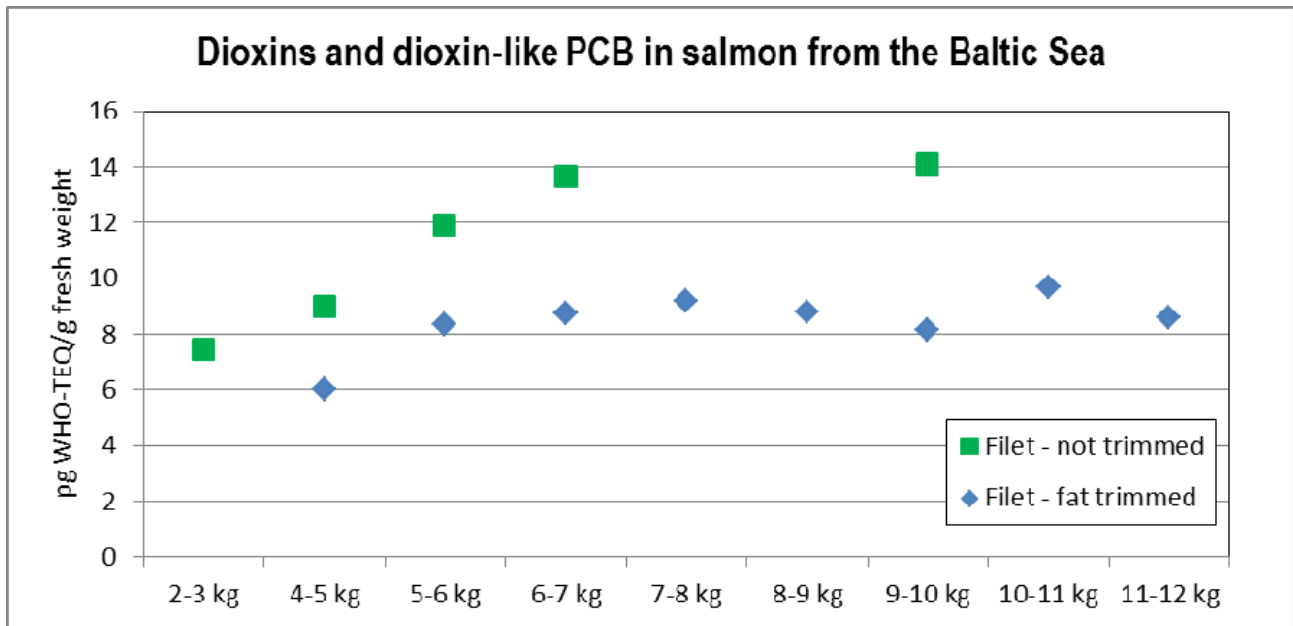
The samples from animal food production included fat from individual animals: 272 bovines, 274 pigs, 19 sheep, 4 horses, 5 buffalos and 15 chickens. 39 cow milks samples were analysed and 116 hens eggs samples. In additions to these commodities a number of processed food items were analysed. This included 8 samples of chicken meat, 1 duck meat, 2 beef meat, 1 goat cheese, 2 meal for infants and 3 infant formulae powder.

The results are shown in the appendices 11.4.1 Levels of WHO-TEQ<sup>2005</sup> PCDD/F+PCB, 11.4.2 Levels of WHO-TEQ<sup>2005</sup> PCDD/F, 11.4.3 Levels of WHO-TEQ<sup>2005</sup> PCB and 11.4.4 Levels of PCB-6 (sum of PCB 28, 52, 101, 138, 153 and 180).

The levels of dioxins and PCB determined in 2012 and 2013 are comparable to the levels found in the Danish food monitoring 2000 – 2011 (Cederberg et al, 2010a; Petersen et al., 2013) with a tendency to a decrease compared to the first part of the monitoring periods. In 2012 and 2013 only samples of eggs from free range hens from small farms as well as salmon and herring from the Baltic Sea exceeded the maximum and actions levels for dioxins and PCB (table 6.1 and table 6.2).

In 2013 a follow up project on wild salmon from the Baltic Sea was conducted. The levels of dioxins and PCB in Baltic salmon do not comply with the maximum levels but Danish studies in 2005 and 2006 showed that intensively trimming of fat from the salmon filet reduced the levels of dioxins and PCB (Cederberg et al 2010b; Cederberg and Heinrich 2007; Cederberg et al 2005). A Danish order originally from 2006 made it possible to sell filet of Baltic salmon provided that the filet is fat trimmed and originate from a salmon weighing up to a maximum of 5.5 kg (BEK 2011). The aim of the follow up project was to verify if the content of dioxins and PCB in the Baltic salmon has decreased since 2006 so the limit of 5.5 kg could be changed or removed.

In Figure 6.1 the results for the different weight classes of salmon are shown. The data points represent the level of the sum of dioxins and dioxin-like PCB in filet of Baltic salmon, without fat trimming and fat trimmed, respectively. It can be seen that fat trimming reduce the levels of dioxins and PCB significantly, but trimmed filets from salmon with the weight of approximately 5.5 kg still exceed the maximum level of 6.5 pg WHO-TEQ PCDD/F+PCB/g fresh weight (taking into account the analytical uncertainty).

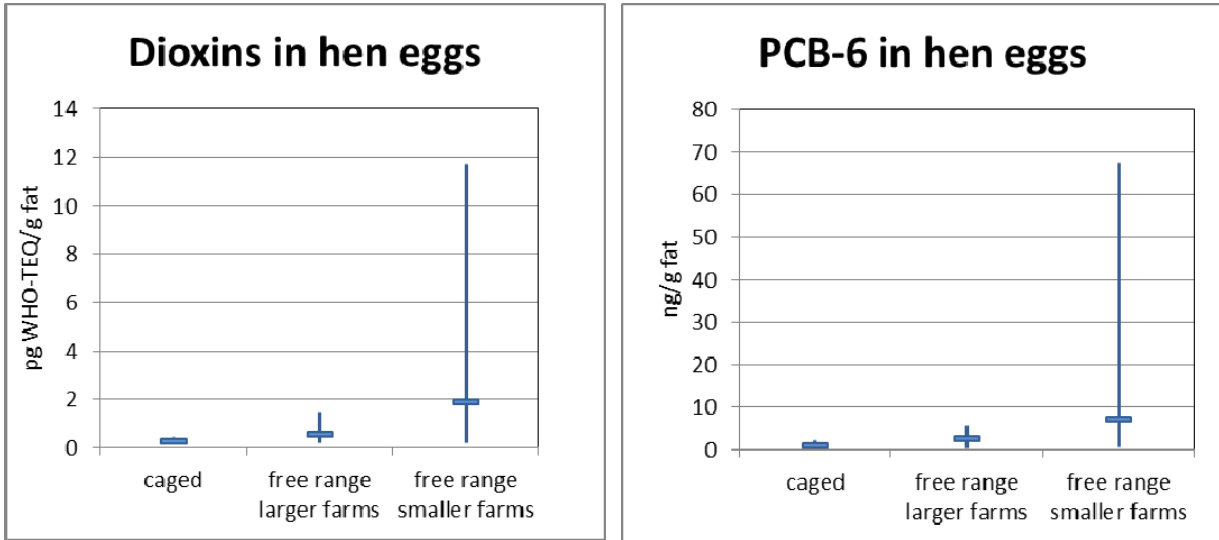


**Figure 6.1.** Levels of dioxins and dioxin-like PCB (WHO-TEQ PCDD/F+PCB) in salmon from the Baltic Sea in 2013.. The samples are from filets without skin and from filets without skin and trimmed for visible fat.

In 2012 and 2013 special effort was directed against official control of dioxin and PCB in eggs from free range hens especially from small farms (Sørensen et al 2014). Studies from other countries in Europe have shown that dioxins and PCB levels in eggs from free range hens can be elevated and exceed maximum levels. The source of the dioxins and PCB is probably from the soil, in which the hens have access to.

In Figure 6.2 the levels of dioxin (WHO-TEQ PCDD/F) and indicator PCB-6 in hen eggs are shown for three different egg production types: hens in cages, free range hens from large farms and free range hens from small farms. Large farms have typical thousands of hens whereas small farms have few hundreds or less. The results show that eggs from hens in cages and free range hens from large farms complied with the maximum and actions levels. The levels of dioxin and PCB in eggs from free range hens from small farms display large variations ranging from content at the same levels as the other two production types and to levels exceeding the maximum levels. Out of 57 samples 6 samples did not comply with the maximum level for dioxins and 16 samples did not comply with the action level for dioxins. Only two samples did not comply with maximum or actions level for PCB.

The Danish Veterinary and Food Administration has together with the Danish egg producers issued a guidance document describing the situation and possible measures to be taken in order to reduce the level of dioxins and PCB in hen eggs (Fødevarestyrelsen 2013).



**Figure 6.2.** Levels of dioxins (WHO-TEQ PCDD/F) and indicator PCB-6 in hen eggs sampled from different productions types: hens in cages, free range hens from large farm and free range hens from small farms. Horizontal bar represent the average and the vertical line marks the minimum and maximum analytical results.



## 6.2 Organochlorine pesticides and level of indicator PCB

Contamination by organochlorine compounds may derive from pollution of the environment where the compounds, being fat-soluble and having apolar properties, accumulate through the food chain. In meat, eggs, and dairy products they may also derive from residual levels of the organochlorine pesticides in feedstuffs or from applications in the environment of the animals.

### 6.2.1 Methods of sampling, analysis and quality assurance

The environmental contaminants are unevenly distributed in the various foods. For example levels in fish depend on the type of fish, the area where the fish live and the age of the fish etc. Lean fish have appreciably lower levels of organochlorine pesticides and indicator PCB than fat fish such as herring. Samples of herring and liver from cod for monitoring the contamination levels of the various Danish waters were collected by the Danish Directorate of Fisheries from the Kattegat and the Belts.

For the analyses of meat, eggs, milk and farmed fish, sampling was performed in accordance with EU directive 96/23/EC (EC, 1996) on measures for monitoring certain substances in live animals and animal products.

Samples of meat and farmed fish were taken at the slaughterhouses, eggs were taken at egg packing stations, and milk was taken either at the dairy works or directly from the livestock. When possible, samples of organically produced products were included, however due to the very limited number of samples, results are not presented separately. The substances monitored for are mainly fat-soluble, and so they will be found in the lipid phase, i.e. the fat. For dairy products milk were analysed and samples of eggs. Kidney fat or meat from cattle, pigs, horse, sheep and farmed deer and subcutaneous fat or meat from poultry were also analysed. Studies (Fries et al., 1978; Fries and Marrow, 1977; Lorber et al., 1997; Rumsey et al., 1967) have shown that the levels of organochlorine pesticides and indicator PCB in such fatty tissues are representative of the levels in the market meat when measured on the basis of fat. Fillets of fish were analysed after removing the skin, because it is assumed that very few people eat the fish skin and that the migration of the substances from the skin to the rest of the fish during preparation is minimal.

The chemical analyses of organochlorine pesticides and indicator PCB were carried out at the Danish Veterinary and Food Administration laboratories in Aarhus (2012) and Ringsted (2013) in accordance with the quality assurance manual, including participation in international ring tests. The analytical procedure includes extraction using an organic solvent, after which the organochlorine contaminants are isolated and detected by gas chromatography with either EC or MS detection.

Included in the program are a number of organochlorine pesticides, these are for the method used in Århus: p,p'-DDT with its metabolites p,p'-DDE, p,p'-DDD and o,p'-DDT (the values for these four substances are reported here as the sum of the four, referred to as the DDT), aldrin, isodrin, endrin, dieldrin, HCB (hexachlorobenzene),  $\alpha$ - and  $\beta$ -HCH (hexachlorocyclohexane), lindane ( $\gamma$ -HCH), heptachlor and heptachlor epoxide, which is a metabolite of heptachlor,  $\alpha$ -chlordane,  $\gamma$ -chlordane, oxychlordane, trans-nonachlor,  $\alpha$ -endosulfan. Furthermore ten indicator PCB congeners are PCB28, PCB52, PCB101, PCB105, PCB118, PCB138, PCB153, PCB156, PCB170, and PCB180. Indicator PCB sum is calculated as the sum of the 10 congeners. For the method used in Ringsted the follow-

ing compounds are reported; Azinphos-ethyl, Bifenthrin, Chlorobenzilate, Chlorpyrifos, Chlorpyrifos-methyl, Cyfluthrin (sum), Cypermethrin (sum), DDT (sum), Deltamethrin, Diazinon, Dieldrin, Endosulfan (sum), Endrin, RR- and SS-Fenvalerat esfenvalerat, RS- and SR- Fenvalerat, esfenvalerat, alpha-HCH, beta-HCH, Heptachlor (sum), Lindane, Methidathion, Methoxychlor, Parathion, Parathion-methyl (sum), Permethrin (sum), Pirimiphos-methyl, Profenofos, Quintozene (sum), Tecnazene. The results are calculated as ng/g fish/cod liver/meat (fresh weight), or as ng/g fat for fat from pigs, cattle, sheep, deer, horse, poultry and eggs and dairy products.

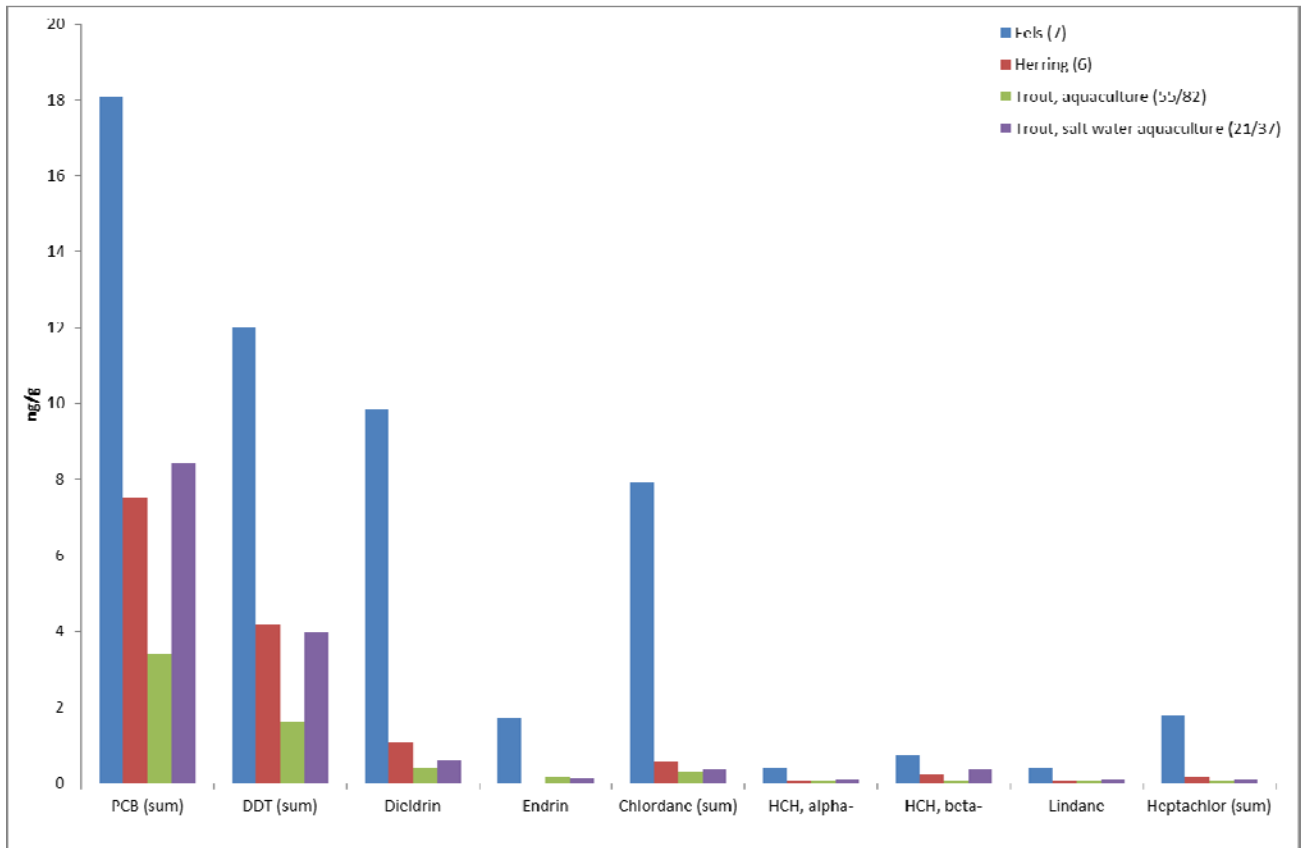
## 6.2.2 Results and discussion

The average levels of the substances analysed in various foods are presented in appendixes 11.5.1 – 11.5.9. The tables show the total number of samples for each of the foodstuffs under study, the number of samples with levels above the detection limits; the average levels of the individual organochlorine compounds, minimum, maximum and median values. The indicator PCB-sum has been calculated as the sum of the averages for the 10 indicator congeners. Calculations of the average levels of the various environmental contaminants in foods are briefly described below.

For the environmental contaminants PCB and organochlorine pesticides, it may be assumed that they are present in varying quantities everywhere in the environment. In order to follow the lower levels and to better estimate the dietary intake of the population, all findings have been reported. When calculating the average levels of the various substances, level in samples without positive findings has to be estimated as the level may be zero or it may be just below the limit of detection. For the two previous monitoring periods all values below the limit of detection were set to one-third of the limit of detection in order to use the historical data as well as make it possible to compare the calculations. This calculation method has therefore been used for the data from 2012 as well, however as there in 2013 has been a change of laboratory and analytical method, including other pesticides and with other limits of detection, results below the limit of detection were set to zero for 2013, assumed to be the best estimate for the majority of pesticides analysed.

Fish samples are the food matrix where the organochlorine contaminants are commonly found. The levels of organochlorine pesticides and indicator PCB in fish depend among other things on the fish species as well as on the water where the fish was caught. The levels of these substances vary according to the fish species due to the fact that the fatty level of different fish species varies. Differences in the organochlorine levels between the bodies of water may be explained by differences in the environmental pollution of the waters with organochlorine pesticides and indicator PCB. The present monitoring period does not include additional information on factors concerning the fish, such as their food basis, age and sex.

In figure 6.3 below the average levels of the organochlorine contaminants in fish samples are shown. The numbers of samples are for eels and herring 7 and 6, respectively. For aquaculture trout and salt water aquaculture trout the number of samples are 82 and 37, respectively, except for HCB and PCB were the number of samples are 55 and 21, respectively. The number of samples for eel and herring are low, however the highest levels are found in eel and the highest levels are found for PCB and DDT. Levels for all the compounds are comparable with the results found and reported in the previously monitoring report covering the period 2004-2011 (Petersen et al., 2013).



**Figure 6.3.** Levels of organochlorine contaminants in fish samples

For the group of products of animal origin there are some general trends; only a very limited number of compounds are observed and at only low level. Comparing the levels of organochlorine pesticide in the different foods of animal origin, the levels are more or less the same, however for some of the sample types, but only based on few samples, levels seems to have a tendency to be higher. For animal fat, DDT and PCB are detected at low levels in a majority of samples, and HCB is also detected at low levels in some samples, except for poultry, and in pork samples HCB is only detected in few samples. The highest level seems to be found in fat from sheep, however only based on three samples. A number of milk samples contain low levels of HCB, dieldrin, DDT and PCB and for eggs a few samples contain DDT. These findings are all consistent with the findings in the previous monitoring period 2004-2011 (Petersen et al, 2013)

## 7 Polycyclic Aromatic hydrocarbons (PAH)

### 7.1 Introduction

Polycyclic aromatic hydrocarbons (PAH) constitute a large class of organic chemicals that normally occur in complex mixtures of several hundred compounds. They are composed of two or more aromatic rings, formed by incomplete combustion of e.g. organic material in industrial processes, waste incineration, and in motor vehicle exhaust. Food can be contaminated from environmental sources and during the processing of foods e.g. drying, smoking and barbecuing. During smoking, drying and barbecuing PAH are found bound to particles in the smoke, formed either from the heating source itself (e.g. wood or charcoal burning) or from lipids dripping on the heating source. For non-smokers, food is the main source of human exposure to PAH.

### 7.2 Methods of sampling, analysis and quality assurance

PAHs have been included in the national control programme since 2005. All sampling in 2012 and 2013 was performed by authorised personnel from the Danish Veterinary and Food Administration. PAH method development started at the National Food Institute, DTU in 2005 on vegetable oils and included sampling on the Danish market as published by Fromberg and coworkers in 2007. Following vegetable oils, sampling and analysis of mussels (Duedahl-Olesen and Ghorbani, 2008), smoked meat and fish including barbecued meat, baby foods, dried products and finally cocoa products in 2012 were incorporated in analysis methods. The collection of smoked samples included, from the very start, process information. This information combined with level data on samples from 2005 to 2008 included recommendations on processing for mitigation of PAH in smoked products (Duedahl-Olesen et al, 2010).

In 2012-2013 all PAH analysis were carried out by accredited analysis at the Danish Veterinary and Food Administration, Region West, Aarhus. All sampling and analysis was carried out in compliance with, the method performance criteria for benzo[*a*]pyrene in EC Regulation No. 333/2007 (EC, 2007a) with amendments on benzo[*a*]pyrene and sum of PAH 4 namely benz[*a*]anthracene, chrysene, benzo[*b*]fluoranthene and benzo[*a*]pyrene in EC Regulation No. 836/ 2011 (EC, 2011b). Between the selected focus areas, e.g. smoked products the sampling was random.

In table 7.1 the maximum limits for both benzo[*a*]pyrene and the sum of PAH 4 are given. In comparison to the report with data from 2004 to 2011 cocoa and cocoa products as well as smoked mussels has been included. At the same time some maximum limits have been adjusted.

**Table 7.1.** Maximum limits for benzo[*a*]pyrene and PAH 4 in selected foods (EC 2006 and 2011a)

Food	Benzo[ <i>a</i> ]pyrene (µg/kg)	PAH 4 (µg/kg)
Processed cereal-based foods and baby foods for infants and young children.	1	1
Infant formulae and follow-on formulae, including infant milk and follow-on milk	1	1
Oils and fats (excl. cocoa butter and coconut oil) intended for direct human consumption or use as an ingredient in foods	2	10
Cocoa beans and derived products	5.0 µg/kg fat <sup>a)</sup>	35.0 µg/kg fat <sup>a)</sup>
Muscle meat of fish other than smoked	2 <sup>b)</sup>	
Smoked meat and smoked meat products	5 <sup>c)</sup>	30 <sup>d)</sup>
Muscle meat of smoked fish and smoked fish products	5 <sup>c)</sup>	30 <sup>d)</sup>

Bivalve molluscs	5 <sup>e)</sup>	30
Bivalve molluscs, smoked	6.0	35.0

<sup>a)</sup> From 1. April 2013. No specific method for fat determination given.

<sup>b)</sup> Valid until Sept. 2012 then no limit.

<sup>c)</sup> From Sept. 2014 reduced to 2 µg/kg

<sup>d)</sup> Valid from Sept. 2012 until Sept. 2014 reduced to 12 µg/kg

<sup>e)</sup> Until Sept. 2012 10 µg/kg

### 7.3 Results and discussion

A total of 169 samples were analysed in 2012-2013. A summation of PAH data for different sample types are given with average, minimum, maximum and median values in Appendix 11.6 for benzo[*a*]pyrene (Appendix 11.6.1) and the sum of PAH 4 (Appendix 11.6.2). For calculation of average values and median, all samples are included. Samples with no detected values are included as 0. The limit of detection, LOD is between 0.1 and 0.3 µg/kg depending on the matrix.

In 2012 -2013 a seafood project included analysis of 19 mussels (*Mytilus edulis*) and 3 oysters all complying the maximum limits with benzo[*a*]pyrene levels below 0.5 µg/kg fresh weight. However, one smoked mussel sample with a benzo[*a*]pyrene level of 6.9 µg/kg and PAH 4 level of 30 µg/kg did not comply with EC maximum limits for benzo[*a*]pyrene of 6.0 µg/kg (see table 7.1). Analysis of PAH included 38 other fish samples with 33 smoked, 1 raw and 3 grilled fish products. One cod roe sample with benzo[*a*]pyrene levels of 6.6 µg/kg and PAH 4 sum of 42 µg/kg did not comply with the two maximum limits set in EC of 5 µg/kg and 30 µg/kg (EC 2011a).

Over the same period of time, 23 dried samples with 12 baby food samples all complying the EC maximum limits. Also 11 dried fruit samples were analysed with levels ranging from less than the detection limit to 2.6 µg/kg for benzo[*a*]pyrene. These products are not included in EU legislation for PAH.

In 2012 and 2013 a total number of 31 vegetable oils (Appendix 11.6.1 and 11.6.2) were collected and analysed with one noncompliant sesame oil sample with a benzo[*a*]pyrene level of 11 µg/kg and a sum of PAH 4 of 32 µg/kg. All other vegetable oils comply to the maximum limits given in table 7.1.

Ten tea samples with benzo[*a*]pyrene levels ranging from 0.3 to 42 µg/kg were similar to levels found in the previous report (Petersen et al., 2013). These samples were included in a publication on tea and coffee levels with estimations of 2 to 14% carry over to the final drinkable infusion (Duedahl-Olesen et al., 2015a). No EU limits for PAH levels apply to these products.

For the products of cocoa highest levels of PAH were found in milk chocolate with all 14 samples complying to the EC legislation. In contradiction to maximum limits for other food items, cocoa products have maximum limits based on the products fat level. Evaluation of methods for fat analysis is in progress in the European Union.

All together 53 meat products included beef, pork, chicken and lamb samples with 28 grilled and 18 smoked products and 7 samples either broiled, deep fried or heat treatment not given. For heat treated beef meat one sample with a benzo[*a*]pyrene level of 17.5 µg/kg and a smoked beef meat with a benzo[*a*]pyrene level of 7.5 µg/kg do not comply the EC legislation with a maximum limit of 5.0 µg/kg for benzo[*a*]pyrene. Also the two PAH 4 sums of 48 µg/kg and 35 µg/kg, respectively does not comply with the maximum limit of 30 µg/kg. For a grilled pork tenderloin the benzo[*a*]pyrene

level of 63 µg/kg and PAH 4 sum of 195 µg/kg is far above the EC maximum limits of 5.0 µg/kg and 30 µg/kg for heat treated meat products sold to the consumer (EC 2011a). A statistical difference in PAH level between gas and electric barbecuing compared to flame and coal barbecuing has been reported including these results and results reported in the previous monitoring period 2004-2011 (Duedahl-Olesen et al., 2015b).

All together 163 samples according to PAH level were compliant samples corresponding to more than 96 % of all samples.

## 8 Acrylamide

### 8.1 Introduction

Acrylamide is a genotoxic process contaminant which is formed as part of the Maillard reactions when carbohydrate rich food is heat treated. In 2002, its occurrence in food was identified by Swedish researchers who found acrylamide in a range of heat treated foods (Tareke et al., 2002). The original suspicion had arisen when measurements using blood of unexposed control persons contained acrylamide haemoglobin adducts; a biomarker for acrylamide exposure (Tareke et al. 2002). The main precursors of the acrylamide formation is the amino acid asparagine and reducing sugars which form Maillard reaction intermediates resulting in acrylamide formation during food heating processes such as frying, roasting, toasting, grilling, etc.. Even autoclaving of e.g. baby food cereals in glass generates acrylamide.

### 8.2 Methods of sampling, analysis and quality assurance

Since the identification of acrylamide as a food process contaminant it has been monitored and investigated in Danish food products. In 2002 an analytical method based on LC-MS/MS was validated and accredited at DTU Food. In 2009, the method was implemented at the Danish Veterinary and Food Administration in Århus . The method is used to survey and monitor acrylamide occurrence in relevant food products. In 2012-2013 mainly coffee, breakfast cereals and potato products were surveyed.

In 2012 and 2013 different foods (see below) were investigated to monitor the levels in relevant food and to investigate if mitigation measures have lowered the levels. Since 2007 the monitoring has included the food categories recommended by EC (EC 2007b, 2010, 2011f). For the surveys, the foods were sampled from manufacturing, wholesale and catering companies by food inspectors of the Danish Veterinary and Food Administration.

### 8.3 Results and discussion

No maximum limits have been set for acrylamide but according to Commission Recommendation 2013/67/EU (EC, 2013c) indicative values have been set for some foods and these are shown in table 8.1.

**Table 8.1.** Indicative values for AA in foods according to Commission Recommendation 2013/647/EU

Foodstuff	Indicative value (µg/kg)
French fries ready-to-eat	600
Potato crisps from fresh potatoes and from potato dough	1 000
Potato based crackers	
Soft bread	
Wheat based bread	80
Soft bread other than wheat based bread	150
Breakfast cereals (excl. porridge)	
- Bran; bran products and whole grain cereals, gun puffed grain (gun puffed only relevant if labelled)	400
- wheat and rye based products <sup>(1)</sup>	300
- maize, oat, spelt, barley and rice based products <sup>(1)</sup>	200

Biscuits and wafers	500
- Crackers with the exception of potato based crackers	500
- Crispbread	450
- Gingerbread	1 000
- Products similar to the other products in this category	500
Roast coffee	450
Instant (soluble coffee)	900
Coffee substitutes	
(a) coffee substitutes mainly based on cereals	2 000
(b) other coffee substitutes	4 000
Baby food, other than processed cereal based foods <sup>(2)</sup>	
(a) not containing prunes	50
(b) containing prunes	80
Biscuits and rusks for infants and young children	200

In appendix 11.7 are shown which samples that were taken in 2012 and 2013 as well as mean, median, minimum and maximum levels in µg/kg. It appears that French fries, coffee, cocoa and chocolate are the samples taken most frequently. The samples are categorised according to the food category codes given in the EFSA technical report concerning requirements for data submission (EFSA, 2014).

Overall, the highest amounts of acrylamide were found in potato products, followed by coffee products and crackers. The lowest levels of acrylamide were found in baby food, bread products and savoury snacks. The highest amount at all of 7900 µg/kg was found in “deep fried fries”.

If the levels shown in appendix 11.7 are compared with the indicative values shown in table 8.1 it can be seen that some of the samples e.g. within the potato and coffee categories exceed the indicative values.

In the report “Food Contaminants” from 2013 (Petersen et al., 2013) the results for the period 2004 to 2011 are shown. In this period recommendations and mitigation procedures have been introduced to lower the levels for acrylamide in food, especially for potato products. According to the results from the Danish monitoring in 2012 and 2013 there is however no evidence for that the levels of acrylamide in food are lowered compared to the previous studies.



## **9 Furan**

### **9.1 Introduction**

Furan is a process contaminant and, like other process contaminants, such as acrylamide and PAHs, it is formed during the processing of food, either during manufacture or during the final preparation of the meal, including home-cooked meals. Furan is a volatile contaminant found in cooked or thermally processed foods and is formed during Maillard reactions (Maga, 1979). Furan contributes to the flavour properties of the food, but has been shown to be carcinogenic and possibly toxic to reproduction in animal experiments.

High levels of furan have been found, especially in canned and jarred ready-to-eat food items, but also in coffee and fried foods (Fromberg et al., 2009). The results presented in this report are from the two food surveys in 2012 and 2013, respectively, which were planned in order to collect samples as described in the EU recommendation on the monitoring of the presence of furan in foodstuffs (EC 2007c, EFSA 2011a, EC, 2011c).

The number of results and the number of food items covered are limited, and furthermore it is difficult to obtain appropriate consumption data for processed foods, therefore there is no basis for intake calculations based on these results. Evaluations made by the Joint FAO/WHO Expert Committee on Food Additives (JECFA) on furan led to estimates for MOEs of 960 for average and 480 for high dietary exposures (JECFA, 2011).

### **9.2 Methods of sampling, analysis and quality assurance**

Samples for the projects are collected from wholesalers, and have been focused on samples of canned and heat treated products, ready-to-eat products, sauces, soups and coffee.

### **9.3 Results and discussion**

Results for furan in food samples are presented in appendix 11.8 showing the number of samples, number of positive samples with detectable level of furan, the calculated average (ng/g), minimum (ng/g) and maximum (ng/g) values and the median (ng/g).

Results found in the two surveys are similar to results presented in the previously monitoring report, only ground coffee beans seems to have slightly lower average levels that found in the previously surveys, however still samples with high furan level are found. Furan is a known volatile flavour compound in coffee. The highest level of furan were found in ground coffee beans, probably due to the high temperatures used during the roasting of coffee beans to achieve the desired aroma profile. The levels of furan found in instant coffee were lower. Experiments have shown a transfer of around half (20-100%) of the theoretical furan amount from the coffee to the brewed coffee regardless of the source (coffee beans or instant coffee). However, lower levels were found in the brewed instant coffee, where only few nano-gram furan per gram brewed instant coffee was observed compared to the about 50 ng/g found in brewed coffee when using coffee beans. So even though furan is volatile, a relatively high amount of furan is found in coffee brewed from coffee beans. About 20 ng/g of furan was found in crisps, canned and jarred foods, including infant meals, ready-to-eat meals and sauces.

## 10 References

BEK nr. 1256 af 15/12/2011. Bekendtgørelse om forbud mod salg til humant konsum af visse laks og sild, der er fisket eller fanget i Østersøen.

Cederberg TL, Sørensen S, Lund KH, Friis-Wandall S. 2010a. Danish monitoring of dioxins and PCB in food and feed during the years 2000 to 2009 - levels, time trend and human exposure. In *Organohalogen Compounds*. pp. 952-955.

Cederberg TL, Timm-Heinrich M, Sørensen S, Lund KH. 2010b. Dioxins and PCB in salmon from the southern baltic sea and reduction in levels during processing. In *Organohalogen Compounds*. pp. 1430-1433.

Cederberg TL, Timm Heinrich M 2007. Trimningseffekt på dioxinindhold i laks II. Lyngby: Danmarks Tekniske Universitet, Fødevarerinstitutionen. 28 p.

Cederberg TL, Timm Heinrich M, Willadsen P 2005. Trimningseffekt på dioxinindhold i laks. Søborg: Danmarks Fødevarerforsknig. 29 p.

DVFA, Danish Veterinary and Food Administration, 2005. Food Monitoring 1998-2003, Part 1, Chemical contaminants. Publication No. 2005:01.

DEPA, Danish Environmental Agency 2014. No. 26/63/2014.

Duedahl-Olesen, L., Christensen, J.H., Højgård, A., Granby, K., and Timm-Heinrich, M. (2010). The influence of smoking parameters on the level of PAHs in Danish smoked fish. *Food Additives and Contaminants*. 27:1294-1305.

Duedahl-Olesen, L., Ghorbani, F (2008). Optimisation of large volume injection for improved detection of Polycyclic Aromatic Hydrocarbons (PAH) in mussels. *Polycyclic Aromatic Compounds* vol. 28 (4) 282-301.

Duedahl-Olesen, L., Navaratnam, M., Jewula, J., Jensen, A.H. (2015a). PAH in some brands of tea and coffee. *Polycyclic Aromatic Compounds*. 35: 74-90.

Duedahl-Olesen, L., Aaslyng, M., Meinert, L., Jensen, A.H., Binderup, M-L. (2015b). Polycyclic Aromatic Hydrocarbons (PAH) in Danish barbecued meat" *Food Control* 57: 169-176.

EC, 1996, Council directive 96/23/EC on measures to monitor certain substances and residues thereof in live animals and animal products repealing Directives 85/358/EEC and 86/469/EEC and Decisions 89/187/EEC and 91/664/EEC. *Official Journal of the European Communities* L125/10S.

EC, 2006. Commission Regulation No. 1881/2006/EC of 19 December 2006 setting maximum levels for certain contaminants in foodstuffs. *Official Journal of the European Union* L 364:5 – 24.

EC, 2007a. Commission Regulation No. 333/2007/EC of 28 March 2007 laying down the methods of sampling and analysis for the official control of the levels of lead, cadmium, mercury, inorganic tin, 3-MCPD and benzo(a)pyrene in foods. *Official Journal of the European Union* L 88: 29-38.

EC, 2007b. Commission recommendations of 3 May 2007 on the monitoring of Acrylamide levels in food. Official Journal of the European Union, L 123, 12.5.2007, pp.33-39.

EC, 2007c, Commission Regulation (EC) No 199/2006 of 3 February 2006 amending Regulation (EC) No 466/2001 setting maximum levels for certain contaminants in foods as regards dioxins and dioxin-like PCBs.

EC, 2010. Commission recommendations of 2 June 2010 on the monitoring of acrylamide levels in food. Official Journal of the European Union, L 137, 3.6.2010, pp.4-10.

EC, 2011a. Commission Regulation No. 835/2011 of 19 August 2011a amending Regulation (EC) No. 1881/2006 as regards maximum levels for polycyclic aromatic hydrocarbons in foods. Official Journal of the European Union L 215: 4 – 8.

EC, 2011b. Commission Regulation (EU) No.836/2011 of 19 August 2011b amending Regulation (EC) No. 333/2007 laying down the methods of sampling and analysis for the official control of the levels of lead, cadmium, mercury, inorganic tin, 3-MCPD, and benzo(*a*)pyrene in foods. Official Journal of the European Union L 215:9-16.

EC, 2011c, Commission Regulation (EU) No 1259/2011 of 2 December 2011 amending Regulation (EC) No 1881/2006 as regards maximum levels dioxins, dioxin-like PCBs and non dioxin-like PCBs in foodstuffs.

EC, 2011d, Commission Regulation (EU) No 1258/2011 of 2 December 2011 amending Regulation (EC) No 1881/2006 as regards maximum levels for nitrates in foods.

EFSA 2011e. Update on furan levels in food from monitoring years 2004-2010 and exposure assessment. EFSA Journal EFSA Journal 2011; 9(9):2347. [33 pp.]. Available online: <http://www.efsa.europa.eu/en/efsajournal/pub/2347.htm>

EC, 2011f. Commission Recommendation of 11 January 2011 on investigations into the levels of acrylamide in food, C (2010) 9681 final.

EC, 2013a. Commission Recommendation of 27 March 2013 on the presence of T-2 and HT-2 in cereals and cereal products.

EC, 2013b. Council Regulation (EU) No. 1067/2013 of 30 October 2013 amending Regulation (EC) No 1881/2006 as regards maximum levels of the contaminants dioxins, dioxin-like PCBs and non dioxin-like PCBs in liver of terrestrial animals.

EC, 2013c. Commission Recommendation of 8 November 2013 on investigations into the levels of acrylamide in food.

EC, 2014a. Commission Recommendation of 11 September 2014 amending the Annex to Recommendation 2013/711/EU on the reduction of the presence of dioxins, furans and PCBs in food and feed.

EC, 2014b. Commission Regulation (EU) No 589/2014 of 2 June 2014 laying down methods of sampling and analysis for the control of levels of dioxins, dioxin-like PCBs and non dioxin-like PCBs in certain foodstuffs and repealing Regulation (EC) No 252/2012.

EFSA 2011a,. Update on furan levels in food from monitoring years 2004-2010 and exposure assessment. EFSA Journal 2011; 9(9):2347. [33 pp.]. Available online: <http://www.efsa.europa.eu/en/efsajournal/pub/2347.htm>

EFSA, 2011b. Scientific Opinion on the risks for animal and public health related to the presence of T-2 and HT-2 in food and feed, EFSA Journal 2011; 9(12):2481.

EFSA, 2014, Technical Report, Specific requirements for chemical of contaminants' data submission, EFSA supporting publication 2014:EN-601

Fries, G.F., Cook, R.M., and Prewitt, L.R., 1978, Distribution of polybrominated biphenyl residues in the tissues of environmentally contaminated dairy cows, J. Dairy Sci. 61, 420-425.

Fries, G.F. and Marrow, G.S., 1977. Distribution of hexachlorobenzene residues in beef steers, J. Animal Sci. 45, 1160.

Fromberg, A., Højgård, A., Duedahl-Olesen, L. (2007). Analysis of polycyclic aromatic hydrocarbons (PAH) in vegetable oils combining gel permeation chromatography (GPC) with solid phase extraction (SPE) cleanup. Food Additives and Contaminants 24: 758-767. Fromberg, A., Fagt, S. and Granby, K., 2009, SCIENTIFIC REPORT submitted to EFSA. Furan in heat processed food products including home cooked food products and ready-to-eat products. <http://www.efsa.europa.eu/fr/scdocs/doc/1e.pdf> visited 06-03-2013.

Fødevarestyrelsen 2013. Vejledning til producenter om forebyggelse og håndtering af dioxin/PCB i æg.

JECFA, 2011a. Evaluation of certain food additives and contaminants. Seventy-second report of the joint FAO/WHO expert committee on food additives. WHO technical report series 959.

Lorber, M., Feil, V., Winters, D., and Ferrario, J., 1997. Distribution of dioxins, furans, and coplanar PCBs in different fat matrices in cattle, Organohalogen compounds, 32, 327

Maga, J.A. (1979). Furans in Foods. Critical Reviews in Food Science and Nutrition 4, 355-400. 11:355-400.

Petersen et al. 2013. Chemical Contaminants 2004-2011, DTU Food, National Food Institute, 3<sup>rd</sup> edition June 2015

Rumsey, T.S., Putnam, P.A., Davis, R.E., and Corley, C., 1967, Distribution of p,p'-DDT residues in adipose and muscle tissues of beef cattle, J. Agr. Food Chem., 15, 898.

Sørensen, S; Krüger, L.; Bossi, R.; Cederberg, T.L.; Lund, K.H. 2014. Dioxins and PCBs in hen eggs from conventional and free range farms from the Danish control program in 2012-13. 34th International Symposium on Halogenated Persistent Organic Pollutants, Madrid, August 31 to September 5, 2014. Organohalogen Compounds vol 76.

Tareke, E., Rydberg, P., Karlsson, P., Eriksson, S. and Tornqvist, M., 2002. Analysis of Acrylamide, a carcinogen formed in heated foods. Journal of Agricultural and Food Chemistry 50, 4998-

5006.

# 11 Appendices

## 11.1 Appendices to trace elements

### 11.1.1 Mercury (mg/kg)

Commodity	No of samples	Positive	Min	Max	Median	Mean
<b>FISH AND SHELL</b>						
<b>FISH</b>						
Cockle ( <i>Cardium edule</i> )	2	2	0.011	0.0138	0.013	0.013
Cod ( <i>Gadus morhua</i> )	8	8	0.014	0.101	0.040	0.052
Crab ( <i>Cancer</i> spp.)	10	10	0.028	0.105	0.041	0.048
Greenland Halibut ( <i>Reinhardtius hippoglossoides</i> )	12	12	0.021	0.103	0.042	0.034
Herring ( <i>Clupea harengus</i> )	4	4	0.036	0.075	0.055	0.046
Lobster	2	2	0.061	0.085	0.073	0.073
Lumpsucker ( <i>Cyclopterus lumpus</i> ),	4	0	<0.001	<0.001		
Mackerel ( <i>Scomber scombrus</i> )	1	1	0.074	0.074		
Mussel ( <i>Mytilus edulis</i> )	29	29	0.0044	0.041	0.011	0.019
Norway lobster ( <i>Nephrops norvegicus</i> )	2	2	0.053	0.10	0.079	0.079
Oyster	1	1	0.012	0.012		
Pangasius	5	4	<0.001	0.0055	0.003	0.003
Plaice ( <i>Pleuronectes platessa</i> )	4	4	0.029	0.048	0.033	0.052
Redfish ( <i>Sebastes marinus</i> )	2	2	0.062	0.064	0.063	0.063
Saithe ( <i>Pollachius virens</i> )	1	1	0.14	0.14		
Salmon ( <i>Salmo salar</i> )	2	2	0.0105	0.036	0.023	0.023
Scallop	19	19	0.0034	0.023	0.016	0.016
Shrimps, cold water	44	44	0.0076	0.18	0.029	0.033
Shrimps, warm water	34	33	<0.001	0.021	0.008	0.009
Shrimps, warm water shrimps, breaded	1	1	0.0029	0.029		
Sole ( <i>Solea solea</i> )	1	1	0.072	0.072		
Tilapia	10	10	0.0078	0.012	0.010	0.010
Trout ( <i>Oncorhynchus mykiss</i> ), aquaculture	10	10	0.0114	0.023	0.017	0.017
Tuna ( <i>Thunnus</i> )	1	1	0.33	0.33		
Tuna in oil, canned	5	5	0.043	0.9	0.16	0.41
Tuna in tomato, canned	1	1	0.018	0.018		
Tuna in water, canned	6	6	0.044	0.80	0.20	0.46

Commodity	No of samples	Positive	Min	Max	Median	Mean
<b>MEAT AND MEAT PRODUCTS</b>						
Chicken meat	90	0	<0.0007	<0.0007		
Deer meat, farmed	5	0	<0.0007	<0.0007		
Deer meat, wild	2	0	<0.0007	<0.0007		
Duck meat (wild duck)	12	10	<0.0007	0.042	0.0065	
Horse meat	6	0	<0.0007	<0.0007		
Ostrich meat ( <i>Struthio camelus</i> )	4	0	<0.0007	<0.0007		
Pheasant meat ( <i>Phasianus colchius</i> )	1	0	<0.0007	<0.0007		
Pig kidney	10	2	<0.0007	0.0028	<0.0007	
Pig liver	13	0	<0.0007	<0.0007		
Pig meat	94	0	<0.0007	<0.0007		
Pigeon meat ( <i>Columba spp.</i> )	5	0	<0.0007	<0.0007		
Sheep meat	6	0	<0.0007	<0.0007		
Veal liver	12	1	<0.0007	0.0059		
Honey	39	0	<0.017	<0.017		
Buttermilk	4	0	<0.0007	<0.0007		
Cow milk, 1 - 2.9% fat (semi-skimmed milk)	2	0	<0.0007	<0.0007		
Cow milk, < 1% fat (skimmed milk)	4	0	<0.0007	<0.0007		
Cow milk, >3% fat (whole milk)	2	0	<0.0007	<0.0007		



### 11.1.2 Lead (mg/kg, except for water, µg/L)

Commodity	No of samples	Positive	Min	Max	Median	Mean
<b>FISH AND SHELL</b>						
<b>FISH</b>						
Cockle ( <i>Cardium edule</i> )	2	2	0.134	0.176	0.155	0.155
Cod ( <i>Gadus morhua</i> )	8	0	0	<0.003		
Crab ( <i>Cancer spp.</i> )	10	4	<0.003	0.0226	<0.003	<0.003
Greenland Halibut ( <i>Reinhardtius hippoglossoides</i> )	12	0	<0.003	<0.003		
Halibut ( <i>Hippoglossus hippoglossus</i> )	1	0	<0.002	<0.002		
Herring ( <i>Clupea harengus</i> )	4	0	<0.002	<0.002		
Lobster	2	2	0.014	0.063	0.039	0.28
Lumpsucker ( <i>Cyclopterus lumpus</i> ), roe	4	0	<0.003	<0.003	<0.003	<0.003
Mackerel ( <i>Scomber scombrus</i> )	1	1	0.048	0.048		
Mussel ( <i>Mytilus edulis</i> )	29	29	0.048	0.23	0.152	0.143
Norway lobster ( <i>Nephrops norvegicus</i> )	2	2	0.0103	0.0181	0.0142	0.0142
Oyster	1	1	0.061	0.061		
Pangasius	5	0	<0.006	<0.006		
Plaice ( <i>Pleuronectes platessa</i> )	4	0	<0.002	<0.002		
Redfish ( <i>Sebastes marinus</i> )	2	0	<0.003	<0.003		
Saithe ( <i>Pollachius virens</i> )	1	0	<0.002	<0.002		
Salmon ( <i>Salmo salar</i> )	2	0	<0.003	<0.003		
Scallop	19	14	<0.003	0.016	<0.003	0.010
Shrimps, cold water sh	44	1	<0.003	<0.003		
Shrimps, warm water	34	8	<0.006	0.051	<0.006	<0.006
Shrimps, breaded	1	0	<0.0056	<0.0056		
Sole ( <i>Solea solea</i> )	1	1	0.0060	0.0060		
Tilapia	10	0	<0.006	<0.006		
Trout ( <i>Oncorhynchus mykiss</i> ), aquaculture	10	0	<0.003	<0.003		
Tuna ( <i>Thunnus</i> )	1	0	<0.003	<0.003		
Tuna in oil, canned	5	0	<0.003	<0.003		
Tuna in tomato, canned	1	0	<0.003	<0.003		
Tuna in water, canned	6	0	<0.003	<0.003		
<b>MEAT AND MEAT PRODUCTS</b>						
Chicken meat	90	0	<0.003	<0.003		
Deer meat, farmed	5	0	<0.003	<0.003		

Commodity	No of samples	Positive	Min	Max	Median	Mean
Deer meat, wild	3	0	<0.003	<0.003		
Duck meat (wild duck)	15	7	<0.003	0.26	<0.003	
Horse meat	6	0	<0.003	<0.003		
Ostrich meat ( <i>Struthio camelus</i> )	4	0	<0.003	<0.003		
Pheasant meat ( <i>Phasianus colchius</i> )	7	0	<0.003	<0.003		
Pig kidney	10	0	<0.003	<0.003		
Pig liver	13	0	<0.003	<0.003		
Pork meat	94	5	<0.003	0.021	<0.003	
Pigeon meat ( <i>Columba spp.</i> )	8	3	<0.003	0.181	<0.003	
Sheep meat	6	0	<0.003	<0.003		
Veal liver	12	4	<0.003	0.037	0.0071	
Honey	39	9	<0.001	1.1	<0.0004	
Buttermilk	4	0	<0.003	<0.003		
Cow milk, 1 - 2.9% fat (semi-skimmed milk)	2	0	<0.003	<0.003		
Cow milk, < 1% fat (skimmed milk)	4	0	<0.003	<0.003		
Cow milk, >3% fat (whole milk)	2	0	<0.003	<0.003		
WATER ( $\mu\text{g/L}$ )						
Tap water	43	31	<0.02	2.4	0.18	
Tap water, iced	3	3	0.37	0.97	0.76	
Water, production	6	5	<0.02	2.0	0.37	

### 11.1.3 Cadmium (mg/kg except for water, µg/L)

Commodity	No of samples	Positive	Min	Max	Median	Mean
<b>FISH AND SHELL FISH</b>						
Cockle ( <i>Cardium edule</i> )	2	2	0.032	0.0351	0.034	0.034
Cod ( <i>Gadus morhua</i> )	8	0	<0.001	<0.001		
Crab ( <i>Cancer</i> spp.)	10	10	0.0068	0.03	0.010	0.013
Greenland Halibut ( <i>Reinhardtius hippoglossoides</i> )	12	0	<0.001	<0.001		
Halibut ( <i>Hippoglossus hippoglossus</i> )	1	0	<0.0007	<0.0007		
Herring ( <i>Clupea harengus</i> )	4	2	<0.0007	0.068	0.002	0.003
Lobster	2	2	0.017	0.023	0.020	0.020
Lumpsucker ( <i>Cyclopterus lumpus</i> ), roe	4	0	<0.001	<0.001		
Mackerel ( <i>Scomber scombrus</i> )	1	0	<0.001	<0.001		
Mussel ( <i>Mytilus edulis</i> )	28	28	0.072	0.15	0.09	0.11
Norway lobster ( <i>Nephrops norvegicus</i> )	2	2	0.0099	0.073	0.041	0.041
Oyster	1	1	0.42	0.42		
Pangasius	5	0	<0.002	<0.002		
Plaice ( <i>Pleuronectes platessa</i> )	4	0	<0.0007	<0.0007		
Redfish ( <i>Sebastes marinus</i> )	2	2	<0.001	<0.001	<0.001	<0.001
Saithe ( <i>Pollachius virens</i> )	1	0	<0.0007	<0.0007		
Salmon ( <i>Salmo salar</i> )	2	0	<0.002	<0.002		
Scallop	19	19	0.12	0.47	0.32	0.30
Shrimps, cold water	44	44	0.004	0.128	0.016	0.028
Shrimps, warm water	34	0	<0.004	<0.004		
Shrimps, breaded	1	0	<0.024	<0.024		
Sole ( <i>Solea solea</i> )	1	0	<0.0007	<0.0007		
Tilapia	10	0	<0.004	<0.004		
Trout ( <i>Oncorhynchus mykiss</i> ), aquaculture	10	0	<0.001	<0.001		
Tuna ( <i>Thunnus</i> )	1	1	0.016	0.016		
Tuna in oil, canned	5	5	0.011	0.031	0.021	0.020
Tuna in tomato, canned	1	1	0.017	0.017		
Tuna in water, canned	6	5	<0.001	0.048	0.024	0.024
<b>MEAT AND MEAT PRODUCTS</b>						
Chicken meat	90	0	<0.003	<0.003		
Deer meat, farmed	5	0	<0.003	<0.003		
Deer meat, wild	3	0	<0.003	<0.003		
Duck meat (wild duck)	15	1	<0.003	0.014	<0.003	<0.003
Horse meat	6	6	<0.002	0.092	0.0188	0.031
Ostrich meat ( <i>Struthio camelus</i> )	4	0	<0.003	<0.003		

Commodity	No of samples	Positive	Min	Max	Median	Mean
lus)						
Pheasant meat (Phasianus colchius)	7	0	<0.003	<0.003		
Pig kidney	10	9	0.093	0.19	0.16	0.152
Pig liver	13	13	0.020	0.058	0.03	0.032
Pig meat	94	0	<0.003	<0.09		0.034
Pigeon meat (Columba spp.)	8	3	<0.09	0.24	0.0016	0.032
Sheep meat	6	0	<0.003	<0.003		
Veal liver	12	12	0.010	0.057	0.015	0.019
Honey	39	0	<0.003	<0.003		
Buttermilk	4	0	<0.003	<0.003		
Cow milk, 1 - 2.9% fat (semi-skimmed milk)	2	0	<0.003	<0.003		
Cow milk, < 1% fat (skimmed milk)	4	0	<0.003	<0.003		
Cow milk, >3% fat (whole milk)	2	0	<0.003	<0.003		
WATER ( $\mu\text{g/L}$ )						
Tap water	43	4	<0.01	0.063	<0.01	<0.01
Tap water, iced	3	0	<0.01	<0.01		
Water, production	6	0	<0.01	<0.01		

#### 11.1.4 Inorganic arsenic (mg/kg)

Commodity	No of samples	Positive	Min	Max	Median	Mean
<b>BREAKFAST CEREALS</b>						
Puffed, organic	3	2	<0.01	0.097	0.084	0.061
Puffed	6	5	<0.01	0.14	0.091	0.080
<b>FISH AND SHELL FISH</b>						
Cockle ( <i>Cardium edule</i> )	2	0	<0.03	<0.03		
Cod ( <i>Gadus morhua</i> )	3	0	<0.03	<0.03		
Halibut ( <i>Hippoglossus hippoglossus</i> )	1	0	<0.03	<0.03		
Herring ( <i>Clupea harengus</i> )	4	0	<0.03	<0.03		
Lobster	2	0	<0.03	<0.03		
Mussel ( <i>Mytilus edulis</i> )	19	9	0.0012	0.058	0.022	0.023
Norway lobster ( <i>Nephrops norvegicus</i> )	2	2	0.015	0.021	0.018	0.018
Oyster	3	1	0.021	<0.03	0.021	0.021
Plaice ( <i>Pleuronectes platessa</i> )	4	0	<0.02	<0.02		
Saithe ( <i>Pollachius virens</i> )	1	0	<0.03	<0.03		
Shrimps, cold water	2	0	<0.03	<0.03		
Sole ( <i>Solea solea</i> )	1	0	<0.02	<0.02		
<b>INFANT FOOD</b>						
Infant food, cereal-based, powder	9	6	<0.01	0.22	0.034	0.063
Infant food, ready-to-eat, canned	9	0	<0.01	<0.01		
<b>RICE AND RICE PRODUCTS</b>						
Rice cake (puffed), organic	12	12	0.18	0.35	0.23	0.24
Rice cake (puffed)	12	11	<0.01	0.27	0.21	0.19
Rice cake (puffed), with quinoa, organic	3	3	0.18	0.34	0.31	0.28
Rice drink	5	1	<0.01	0.032	<0.01	<0.01
Rice flour	5	5	0.041	0.074	0.07	0.06
Rice flour, whole-meal, organic	2	2	0.17	0.30	0.24	0.24
Rice, brown, organic	11	10	<0.01	0.55	0.14	0.17
Rice, brown	10	9	<0.01	0.3	0.12	0.13
Rice, short grained, organic	4	4	0.083	0.093	0.090	0.090
Rice, short grained	6	6	0.085	0.11	0.10	0.10

Commodity	No of samples	Positive	Min	Max	Median	Mean
Rice, white, organic	11	9	<0.01	0.14	0.08	0.07
Rice, white	57	45	<0.01	0.22	0.06	0.06
Noodles	7	5	<0.01	0.15	0.047	0.060
OTHER CEREALS						
Crispbread, rye	4	1	<0.01	0.045	<0.01	0.029
Müsli	2	2	0.17	0.25	0.21	0.21
MISCELLANEOUS FOOD						
Dietary supplement	5	4	<0.01	0.093	0.068	0.058
Snacks	10	5	<0.01	0.063	<0.01	0.033

### 11.1.5 Total arsenic (mg/kg, except for water, µg/L)

Commodity	No of samples	Positive	Min	Max	Median	Mean
<b>BREAKFAST CEREALS</b>						
Puffed, organic	3	3	<0.008	0.13	0.12	0.089
Puffed	6	6	0.069	0.18	0.11	0.11
<b>FISH AND SHELL FISH</b>						
Cockle ( <i>Cardium edule</i> )	2	2	0.83	0.96	0.90	0.90
Cod ( <i>Gadus morhua</i> )	3	3	3.8	18	5.8	9.2
Halibut ( <i>Hippoglossus hippoglossus</i> )	1	1	27	27		
Herring ( <i>Clupea harengus</i> )	4	4	1.2	1.8	1.5	1.5
Lobster	2	2	11	14	12	12
Mussel ( <i>Mytilus edulis</i> )	19	19	0.72	1.5	1.1	1.1
Norway lobster ( <i>Nephrops norvegicus</i> )	2	2	12	13.5	13	13
Oyster	1	1	0.87	0.87		
Plaice ( <i>Pleuronectes platessa</i> )	4	4	1.2	1.8	9.6	9.6
Saithe ( <i>Pollachius virens</i> )	1	1	1.7	1.7		
Shrimps, cold water	2	2	16	18	17	17
Sole ( <i>Solea solea</i> )	1	1	6.5	6.5		
<b>INFANT FOOD</b>						
Infant food, cereal-based, powder	9	8	<0.008	0.25	0.06	0.090
Infant food, ready-to-eat, canned	9	2	<0.008	0.064	<0.008	<0.008
<b>RICE AND RICE PRODUCTS</b>						
Rice cake (puffed), organic	12	12	0.25	0.39	0.28	0.29
Rice cake (puffed)	12	12	0.030	0.33	0.26	0.24
Rice cake (puffed), with quinoa, organic	3	3	0.20	0.42	0.41	0.34
Rice drink	5	1	<0.008	0.037	<0.008	<0.008
Rice flour	5	5	0.072	0.20	0.087	0.11
Rice flour, whole-meal, organic	2	2	0.19	0.34	0.26	0.26
Rice, brown, organic	11	10	<0.008	0.7	0.18	0.24
Rice, brown	10	9	<0.008	0.32	0.18	0.18
Rice, short grained, organic	4	4	0.097	0.12	0.12	0.11

Commodity	No of samples	Positive	Min	Max	Median	Mean
Rice, short grained	6	6	0.13	0.24	0.15	0.17
Rice, white, organic	11	11	<0.008	0.19	0.11	0.10
Rice, white	57	56	<0.008	0.27	0.095	0.10
Noodles, rice	7	7	0.035	0.37	0.090	0.12
<b>OTHER CEREALS</b>						
Crispbread, rye	4	4	0.045	0.12	0.069	0.075
Müsli	2	2	0.19	0.32	0.26	0.26
<b>MISCELLANOUS FOOD</b>						
Dietary supplement	5	5	0.049	0.23	0.16	0.15
Snacks	10	9	<0.008	0.12	<0.008	0.068
<b>WATER (µg/L)</b>						
Tap water	43	34	<0.04	2.0	0.36	0.60
Tap water, iced	3	0	<0.04	<0.04	<0.04	<0.04
Water, production	6	6	0.31	1.2	0.37	0.62



### 11.1.6 Aluminium, copper, selenium, tin and zinc (mg/kg, except for water, µg/L)

Commodity	No of samples	Positive	Min	Max	Median	Mean
<b>Aluminium</b>						
Noodles	21	21	3.0	8.0	5.1	5.2
<b>Selenium</b>						
Trout (Oncorhynchus mykiss), aquaculture	10	10	0.11	0.16	0.13	0.13
<b>Tin</b>						
Tuna in oil, canned	1	0	<4	<4		
Tuna in water, canned	7	0	<4	<4		
<b>Copper (µg/L)</b>						
Tap water	43	33	<0.3	150	9.4	2.4
Tap, water, iced	3	3	12	28	21	22
Water, production	6	5	<0.3	6.9	3.8	1.8
<b>Zinc (µg/L)</b>						
Tap water	43	41	<0.4	750	21	142
Tap water, iced	3	3	24	126	80	234
Water, production	6	6	3.4	341	22	81

## 11.2 Nitrate (mg/kg)

Foods	No. of samples	Min	Max	Mean	Median
Spring onions	2	220	600	410	410
Beet root	3	2900	3800	3267	3100
Head lettuce	4	800	1300	1100	1200
Rucola, Danish	10	2100	6000	4210	4250
Rucola, foreign origin	26	2800	9600	6400	6300

## 11.3 Mycotoxins

### 11.3.1 Deoxynivalenol (µg/kg)

Commodity	No. of samples	Positive	Mean	Median	Max
Barley (kernels, grit)	6	2	25	<LOQ	73
Bread, rye	3	3	59	54	100
Bread, wheat	10	8	47	41	100
Breakfast cereals	8	5	65	36	270
Maize groats	1	1	80	80	80
Oat (kernels, rolled)	40	17	113	<LOQ	2400
Oat bran	1	0	<LOQ	<LOQ	<LOQ
Rye (kernels, flour)	33	24	28	21	83
Wheat (kernels, flour)	72	47	48	30	250
Wheat bran	12	10	70	64	150

LOQ for DON is 20 µg/kg

### 11.3.2 HT-2 (µg/kg)

Commodity	No. of samples	Positive	Mean	Median	Max
Barley (kernels, grit)	6	3	6	3.5	17
Bread, rye	3	0	<LOQ	<LOQ	0
Bread, wheat	10	1	1.1	<LOQ	2.2
Breakfast cereals	8	3	2.7	<LOQ	10
Maize groats	1	0	<LOQ	<LOQ	<LOQ
Oat (kernels, rolled)	40	18	4.1	<LOQ	25
Oat bran	1	1	3.7	3.7	3.7
Rye (kernels, flour)	33	6	1.4	<LOQ	5
Wheat (kernels, flour)	72	9	1.3	<LOQ	6
Wheat bran	12	6	2.5	1	8

LOQ for HT-2 toxin is 2.0 µg/kg

### 11.3.3 T-2 (µg/kg)

Commodity	No. of samples	Positive	Mean	Median	Max
Barley (kernels, grit)	6	2	2.1	0	7.1
Bread, rye	3	0	<LOQ	<LOQ	<LOQ
Bread, wheat	10	0	<LOQ	<LOQ	<LOQ
Breakfast cereals	8	1	1.1	<LOQ	2.9
Maize groats	1	1	3	3	3
Oat (kernels, rolled)	40	10	1.5	<LOQ	12
Oat bran	1	0	0.8	<LOQ	<LOQ
Rye (kernels, flour)	33	1	0.82	<LOQ	1.6
Wheat (kernels, flour)	72	0	<LOQ	<LOQ	<LOQ
Wheat bran	12	1	0.83	<LOQ	1.1

LOQ for T-2 toxin is 1.6 µg/kg

#### 11.3.4 Ochratoxin A (µg/kg)

Commodity	No. of samples	Positive	Mean	Median	Max
Oat (kernels, rolled)	1	0	<LOQ	<LOQ	<LOQ
Rye (kernels, flour)	10	3	0.079	<LOQ	0.21
Wheat (kernels, flour)	5	0	<LOQ	<LOQ	<LOQ
Wheat bran	2	0	<LOQ	<LOQ	<LOQ

LOQ for OTA is 0.1 µg/kg

## 11.4 Dioxin and PCB

### 11.4.1 WHO-TEQ<sup>2005</sup> PCDD/F+PCB

Commodity	Remarks	No of samples	Mean	Min	Max	Median
<b>Fish and seafood</b>						
<b>pg WHO-TEQ2005/g fresh weight</b>						
Angler ( <i>Lophius piscatorius</i> )		2	0.08	0.07	0.08	0.08
Brill		1	0.20	0.20	0.20	0.20
Cod		3	0.13	0.11	0.14	0.14
Cod	Baltic Sea	2	0.26	0.24	0.29	0.26
Cod liver		5	36.23	28.01	44.21	34.93
Cod liver	Non DK	3	5.29	0.48	7.82	7.59
Common dab ( <i>Limanda limanda</i> )		2	0.79	0.54	1.04	0.79
Dogfish, piked ( <i>Squalus acanthias</i> )		1	0.25	0.25	0.25	0.25
Eels		1	1.62	1.62	1.62	1.62
Eels, smoked		4	3.87	1.71	6.30	3.74
Fish oil		1	3.75	3.75	3.75	3.75
Fish oil		7	1.84	0.38	4.90	0.85
Fish sauce		1	0.03	0.03	0.03	0.03
Flounder	Baltic Sea	2	2.78	1.10	4.47	2.78
Garfish ( <i>Belone belone</i> )		3	0.81	0.51	0.97	0.97
Greater weever, <i>Trachinus draco</i>		1	1.33	1.33	1.33	1.33
Greenland Halibut		10	0.61	0.33	1.78	0.50
Herring		6	1.27	0.57	1.64	1.38
Herring	Baltic Sea	35	4.87	1.33	10.71	4.55
Herring	North Sea	2	0.81	0.76	0.87	0.81
Ling ( <i>Molva molva</i> )		2	0.37	0.05	0.69	0.37
Mackerel		5	1.42	0.51	3.04	1.24
Mackerel	Baltic Sea	2	16.06	3.21	28.91	16.06
Oyster Sauce		2	0.04	0.04	0.04	0.04
Plaice		3	0.31	0.17	0.47	0.29
Plaice	Baltic Sea	2	0.82	0.68	0.95	0.82
Pollack ( <i>Pollachius pollachius</i> )		1	0.08	0.08	0.08	0.08
Porbeagle		1	0.09	0.09	0.09	0.09
Ready-to-eat, fish based		1	0.03	0.03	0.03	0.03
Salmon		1	0.16	0.16	0.16	0.16
Salmon, aquaculture		1	0.52	0.52	0.52	0.52
Salmon - 2-3 kg not trimmed	Baltic Sea	3	7.46	6.02	9.06	7.32
Salmon - 4-5 kg	Baltic Sea	3	5.99	5.11	6.86	6.02
Salmon - 4-5 kg not trimmed	Baltic Sea	1	8.99	8.99	8.99	8.99
Salmon - 5-6 kg	Baltic Sea	3	8.34	7.97	8.66	8.38
Salmon - 5-6 kg not trimmed	Baltic Sea	2	11.93	11.61	12.25	11.93
Salmon - 6-7 kg	Baltic Sea	1	8.73	8.73	8.73	8.73

Commodity	Remarks	No of samples	Mean	Min	Max	Median
Salmon - 6-7 kg not trimmed	Baltic Sea	1	13.65	13.65	13.65	13.65
Salmon - 7-8 kg	Baltic Sea	2	9.20	9.04	9.36	9.20
Salmon - 8-9 kg	Baltic Sea	2	8.80	8.67	8.93	8.80
Salmon - 9-10 kg	Baltic Sea	2	8.16	7.96	8.36	8.16
Salmon - 9-10 kg not trimmed	Baltic Sea	1	14.13	14.13	14.13	14.13
Salmon - 10-11 kg	Baltic Sea	1	9.71	9.71	9.71	9.71
Salmon - 11-12 kg	Baltic Sea	1	8.61	8.61	8.61	8.61
Sea catfish and wolf-fish (Anarhichas)		3	0.53	0.21	0.99	0.39
Sprat		4	1.67	1.37	2.15	1.59
Sprat	Baltic Sea	8	4.94	2.30	7.19	4.70
Trout, aquaculture		30	0.31	0.15	0.67	0.29
Tuna, canned in oil		1	0.04	0.04	0.04	0.04
Tuna, canned in water		1	0.05	0.05	0.05	0.05
Turbot		4	0.99	0.08	3.13	0.37
<b>Food other than fish</b>						
<b>pg WHO-TEQ2005/g fat</b>						
Beef meat		2	0.57	0.55	0.60	0.57
Cheese, goat, 45-55% fat in dry matter		1	0.66	0.66	0.66	0.66
Chicken meat		8	0.58	0.23	1.39	0.38
Cow milk, raw		5	0.59	0.41	0.95	0.51
Cow milk, raw	on grass	16	0.50	0.33	0.70	0.50
Cow milk, raw	kept inside	19	0.53	0.26	1.20	0.46
Duck meat, steak (air or oil)		1	0.29	0.29	0.29	0.29
Egg, whole, chicken		12	0.29	0.18	0.61	0.27
Egg, whole, chicken	not caged	47	0.87	0.26	2.19	0.74
Egg, whole, chicken	free range	57	2.65	0.24	12.09	1.86
Fat, beef (leaf fat)		104	0.63	0.14	3.74	0.40
Fat, beef (leaf fat)	free range	68	0.84	0.23	4.17	0.66
Fat, buffalo (leaf fat)		5	1.46	0.97	1.93	1.43
Fat, chicken (belly fat)		10	0.28	0.10	0.70	0.26
Fat, chicken (belly fat)	free range	5	0.52	0.22	1.21	0.38
Fat, horse (leaf fat)		4	5.18	1.69	9.81	4.61
Fat, lamb (leaf fat)		8	0.83	0.33	1.39	0.82
Fat, pork (leaf fat)		117	0.20	0.05	0.81	0.17
Fat, pork (leaf fat)	free range	57	0.24	0.11	0.60	0.21
Fat, sheep (leaf fat)		11	0.85	0.39	1.29	0.86
Infant formulae, powder		3	0.08	0.06	0.09	0.09
Ready-to-eat meal for infants and young children, canned		2	0.02	0.02	0.03	0.02

#### 11.4.2 WHO-TEQ<sup>2005</sup> PCDD/F

Commodity	Remarks	No of samples	Mean	Min	Max	Median
<b>Fish and seafood</b>						
<b>pg WHO-TEQ2005/g fresh weight</b>						
Angler ( <i>Lophius piscatorius</i> )		2	0.04	0.03	0.04	0.04
Brill		1	0.06	0.06	0.06	0.06
Cod		3	0.04	0.03	0.05	0.05
Cod	Baltic Sea	2	0.17	0.14	0.20	0.17
Cod liver		5	6.15	5.24	7.10	6.41
Cod liver	Non DK	3	1.47	0.25	2.11	2.04
Common dab ( <i>Limanda limanda</i> )		2	0.38	0.27	0.50	0.38
Dogfish, piked ( <i>Squalus acanthias</i> )		1	0.08	0.08	0.08	0.08
Eels		1	0.43	0.43	0.43	0.43
Eels, smoked		4	1.06	0.42	2.12	0.85
Fish oil		1	0.57	0.57	0.57	0.57
Fish oil		7	0.35	0.06	0.99	0.21
Fish sauce		1	0.03	0.03	0.03	0.03
Flounder	Baltic Sea	2	1.46	0.49	2.44	1.46
Garfish ( <i>Belone belone</i> )		3	0.18	0.07	0.23	0.22
Greater weever, <i>Trachinus draco</i>		1	0.37	0.37	0.37	0.37
Greenland Halibut		10	0.23	0.12	0.78	0.16
Herring		6	0.62	0.30	0.88	0.66
Herring	Baltic Sea	35	2.64	0.56	5.93	2.52
Herring	North Sea	2	0.47	0.43	0.51	0.47
Ling ( <i>Molva molva</i> )		2	0.11	0.01	0.21	0.11
Mackeral		5	0.40	0.18	0.80	0.30
Mackeral	Baltic Sea	2	4.26	1.04	7.49	4.26
Oyster Sauce		2	0.04	0.03	0.04	0.04
Plaice		3	0.15	0.08	0.25	0.14
Plaice	Baltic Sea	2	0.47	0.42	0.52	0.47
Pollack ( <i>Pollachius pollachius</i> )		1	0.02	0.02	0.02	0.02
Porbeagle		1	0.04	0.04	0.04	0.04
Ready-to-eat, fish based		1	0.03	0.03	0.03	0.03
Salmon		1	0.08	0.08	0.08	0.08
Salmon, aquaculture		1	0.19	0.19	0.19	0.19
Salmon - 2-3 kg not trimmed	Baltic Sea	3	2.80	2.20	3.37	2.83
Salmon - 4-5 kg	Baltic Sea	3	2.30	1.95	2.70	2.24
Salmon - 4-5 kg not trimmed	Baltic Sea	1	3.59	3.59	3.59	3.59
Salmon - 5-6 kg	Baltic Sea	3	3.39	3.21	3.52	3.44
Salmon - 5-6 kg not trimmed	Baltic Sea	2	4.94	4.61	5.28	4.94
Salmon - 6-7 kg	Baltic Sea	1	3.49	3.49	3.49	3.49

Commodity	Remarks	No of samples	Mean	Min	Max	Median
Salmon - 6-7 kg not trimmed	Baltic Sea	1	5.90	5.90	5.90	5.90
Salmon - 7-8 kg	Baltic Sea	2	3.88	3.79	3.96	3.88
Salmon - 8-9 kg	Baltic Sea	2	3.59	3.32	3.86	3.59
Salmon - 9-10 kg	Baltic Sea	2	3.24	3.03	3.45	3.24
Salmon - 9-10 kg not trimmed	Baltic Sea	1	6.35	6.35	6.35	6.35
Salmon - 10-11 kg	Baltic Sea	1	3.85	3.85	3.85	3.85
Salmon - 11-12 kg	Baltic Sea	1	3.57	3.57	3.57	3.57
Sea catfish and wolf-fish (Anarhichas)		3	0.29	0.11	0.56	0.20
Sprat		4	0.69	0.57	0.89	0.66
Sprat	Baltic Sea	8	2.44	1.00	3.82	2.30
Trout, aquaculture		30	0.12	0.05	0.27	0.11
Tuna, canned in oil		1	0.03	0.03	0.03	0.03
Tuna, canned in water		1	0.03	0.03	0.03	0.03
Turbot		4	0.29	0.03	0.92	0.11
<b>Food other than fish</b>						
<b>pg WHO-TEQ2005/g fat</b>						
Beef meat		2	0.36	0.33	0.38	0.36
Cheese, goat, 45-55% fat in dry matter		1	0.33	0.33	0.33	0.33
Chicken meat		8	0.47	0.20	0.96	0.34
Cow milk, raw		5	0.41	0.22	0.70	0.36
Cow milk, raw		16	0.31	0.20	0.53	0.28
Cow milk, raw		19	0.37	0.14	1.05	0.27
Duck meat, steak (air or oil)		1	0.24	0.24	0.24	0.24
Egg, whole, chicken		12	0.23	0.14	0.41	0.23
Egg, whole, chicken		47	0.54	0.19	1.49	0.52
Egg, whole, chicken		57	1.87	0.19	11.68	1.41
Fat, beef (leaf fat)		104	0.32	0.05	1.82	0.22
Fat, beef (leaf fat)		68	0.38	0.09	2.41	0.30
Fat, buffalo (leaf fat)		5	0.64	0.48	0.91	0.59
Fat, chicken (belly fat)		10	0.22	0.09	0.30	0.24
Fat, chicken (belly fat)		5	0.33	0.14	0.61	0.28
Fat, horse (leaf fat)		4	2.86	0.56	5.53	2.67
Fat, lamb (leaf fat)		8	0.38	0.17	0.67	0.39
Fat, pork (leaf fat)		117	0.18	0.04	0.58	0.16
Fat, pork (leaf fat)		57	0.21	0.09	0.57	0.17
Fat, sheep (leaf fat)		11	0.49	0.19	0.86	0.54
Infant formulae, powder		3	0.07	0.06	0.08	0.08
Ready-to-eat meal for infants and young children, canned		2	0.02	0.01	0.02	0.02



### 11.4.3 WHO-TEQ<sup>2005</sup> PCB

Commodity	Remarks	No of samples	Mean	Min	Max	Median
<b>Fish and seafood</b>						
<b>pg WHO-TEQ2005/g fresh weight</b>						
Angler ( <i>Lophius piscatorius</i> )		2	0.04	0.04	0.04	0.04
Brill		1	0.13	0.13	0.13	0.13
Cod		3	0.09	0.06	0.11	0.09
Cod	Baltic Sea	2	0.10	0.09	0.10	0.10
Cod liver		5	30.08	21.54	38.97	28.53
Cod liver	Non DK	3	3.83	0.23	5.71	5.55
Common dab ( <i>Limanda limanda</i> )		2	0.40	0.27	0.54	0.40
Dogfish, piked ( <i>Squalus acanthias</i> )		1	0.17	0.17	0.17	0.17
Eels		1	1.19	1.19	1.19	1.19
Eels, smoked		4	2.81	1.29	4.18	2.89
Fish oil		1	3.18	3.18	3.18	3.18
Fish oil		7	1.50	0.21	4.28	0.79
Fish sauce		1	0.00	0.00	0.00	0.00
Flounder	Baltic Sea	2	1.32	0.60	2.03	1.32
Garfish ( <i>Belone belone</i> )		3	0.64	0.44	0.74	0.73
Greater weever, <i>Trachinus draco</i>		1	0.96	0.96	0.96	0.96
Greenland Halibut		10	0.39	0.19	1.00	0.32
Herring		6	0.65	0.27	0.85	0.71
Herring	Baltic Sea	35	2.23	0.69	4.77	2.14
Herring	North Sea	2	0.34	0.33	0.36	0.34
Ling ( <i>Molva molva</i> )		2	0.25	0.03	0.48	0.25
Mackerel		5	1.02	0.29	2.24	0.94
Mackerel	Baltic Sea	2	11.80	2.18	21.43	11.80
Oyster Sauce		2	0.00	0.00	0.00	0.00
Plaice		3	0.16	0.09	0.22	0.15
Plaice	Baltic Sea	2	0.34	0.26	0.43	0.34
Pollack ( <i>Pollachius pollachius</i> )		1	0.05	0.05	0.05	0.05
Porbeagle		1	0.05	0.05	0.05	0.05
Ready-to-eat, fish based		1	0.00	0.00	0.00	0.00
Salmon		1	0.08	0.08	0.08	0.08
Salmon, aquaculture		1	0.34	0.34	0.34	0.34
Salmon - 2-3 kg not trimmed	Baltic Sea	3	4.66	3.82	5.68	4.49
Salmon - 4-5 kg	Baltic Sea	3	3.70	3.16	4.16	3.78
Salmon - 4-5 kg not trimmed	Baltic Sea	1	5.41	5.41	5.41	5.41
Salmon - 5-6 kg	Baltic Sea	3	4.94	4.76	5.14	4.94
Salmon - 5-6 kg not trimmed	Baltic Sea	2	6.98	6.97	7.00	6.98
Salmon - 6-7 kg	Baltic Sea	1	5.24	5.24	5.24	5.24
Salmon - 6-7 kg not trimmed	Baltic Sea	1	7.75	7.75	7.75	7.75

Commodity	Remarks	No of samples	Mean	Min	Max	Median
Salmon - 7-8 kg	Baltic Sea	2	5.32	5.25	5.39	5.32
Salmon - 8-9 kg	Baltic Sea	2	5.21	5.06	5.35	5.21
Salmon - 9-10 kg	Baltic Sea	2	4.92	4.91	4.93	4.92
Salmon - 9-10 kg not trimmed	Baltic Sea	1	7.78	7.78	7.78	7.78
Salmon - 10-11 kg	Baltic Sea	1	5.86	5.86	5.86	5.86
Salmon - 11-12 kg	Baltic Sea	1	5.04	5.04	5.04	5.04
Sea catfish and wolf-fish (Anarhichas)		3	0.24	0.10	0.43	0.18
Sprat		4	0.98	0.80	1.26	0.93
Sprat	Baltic Sea	8	2.50	1.30	3.37	2.40
Trout, aquaculture		30	0.19	0.09	0.41	0.19
Tuna, canned in oil		1	0.01	0.01	0.01	0.01
Tuna, canned in water		1	0.02	0.02	0.02	0.02
Turbot		4	0.69	0.04	2.20	0.27
<b>Food other than fish</b>						
<b>pg WHO-TEQ2005/g fat</b>						
Beef meat		2	0.22	0.17	0.27	0.22
Cheese, goat, 45-55% fat in dry matter		1	0.33	0.33	0.33	0.33
Chicken meat		8	0.11	0.02	0.43	0.04
Cow milk, raw		5	0.18	0.11	0.25	0.19
Cow milk, raw	on grass	16	0.19	0.12	0.31	0.18
Cow milk, raw	kept inside	19	0.17	0.11	0.25	0.16
Duck meat, steak (air or oil)		1	0.04	0.04	0.04	0.04
Egg, whole, chicken		12	0.06	0.03	0.19	0.04
Egg, whole, chicken	not caged	47	0.33	0.04	0.89	0.28
Egg, whole, chicken	free range	57	0.79	0.04	4.44	0.62
Fat, beef (leaf fat)		104	0.32	0.01	1.92	0.17
Fat, beef (leaf fat)	free range	68	0.45	0.09	1.78	0.35
Fat, buffalo (leaf fat)		5	0.82	0.49	1.35	0.85
Fat, chicken (belly fat)		10	0.06	0.01	0.39	0.03
Fat, chicken (belly fat)	free range	5	0.19	0.08	0.60	0.08
Fat, horse (leaf fat)		4	2.32	1.13	4.27	1.94
Fat, lamb (leaf fat)		8	0.45	0.13	0.85	0.42
Fat, pork (leaf fat)		117	0.03	0.00	0.32	0.01
Fat, pork (leaf fat)	free range	57	0.02	0.01	0.09	0.02
Fat, sheep (leaf fat)		11	0.37	0.16	0.74	0.31
Infant formulae, powder		3	0.01	0.00	0.01	0.01
Ready-to-eat meal for infants and young children, canned		2	0.00	0.00	0.01	0.00

#### 11.4.4 PCB-6 (sum of PCB 28, 52, 101, 138, 153 and 180)

Commodity	Remarks	No of samples	Mean	Min	Max	Median
<b>Fish and seafood</b>						
<b>pg WHO-TEQ2005/g fresh weight</b>						
Angler ( <i>Lophius piscatorius</i> )		2	0.25	0.24	0.25	0.25
Brill		1	1.77	1.77		
Cod		3	1.00	0.62	1.54	0.85
Cod	Baltic Sea	2	0.50	0.47	0.53	0.50
Cod liver		5	329.05	204.48	500.68	301.65
Cod liver	Non DK	3	44.56	26.56	59.72	47.41
Common dab ( <i>Limanda limanda</i> )		2	2.53	2.39	2.68	2.53
Dogfish, piked ( <i>Squalus acanthias</i> )		1	5.93	5.93		
Eels		1	11.76	11.76	11.76	11.76
Eels, smoked		4	38.97	23.62	68.03	32.11
Fish oil		7	27.14	1.12	136.40	4.07
Fish oil		1	139.85	139.85		
Fish sauce		1	0.05	0.05		
Flounder	Baltic Sea	2	5.78	4.09	7.46	5.78
Garfish ( <i>Belone belone</i> )		3	11.51	9.25	14.73	10.54
Greater weever, <i>Trachinus draco</i>		1	7.32	7.32		
Greenland Halibut		10	3.76	2.13	8.60	3.40
Herring		6	6.92	3.27	9.15	7.21
Herring	Baltic Sea	35	18.75	7.06	37.61	17.10
Herring	North Sea	2	3.48	3.11	3.86	3.48
Ling ( <i>Molva molva</i> )		2	2.51	0.19	4.84	2.51
Mackerel		5	10.15	2.84	19.88	9.90
Mackerel	Baltic Sea	2	125.72	23.29	228.15	125.72
Oyster Sauce		2	0.10	0.10	0.10	0.10
Plaice		3	0.94	0.47	1.49	0.87
Plaice	Baltic Sea	2	2.08	1.29	2.87	2.08
Pollack ( <i>Pollachius pollachius</i> )		1	0.43	0.43		
Porbeagle		1	2.23	2.23		
Ready-to-eat, fish based		1	0.04	0.04		
Salmon		1	0.82	0.82		
Salmon, aquaculture		1	3.42	3.42		
Salmon - 2-3 kg not trimmed	Baltic Sea	3	35.00	29.97	40.63	34.41
Salmon - 4-5 kg	Baltic Sea	3	29.70	27.21	34.62	27.28
Salmon - 4-5 kg not trimmed	Baltic Sea	1	40.34	40.34		
Salmon - 5-6 kg	Baltic Sea	3	33.42	31.37	35.90	32.98
Salmon - 5-6 kg not trimmed	Baltic Sea	2	56.87	55.59	58.14	56.87
Salmon - 6-7 kg	Baltic Sea	1	35.04	35.04		

Commodity	Remarks	No of samples	Mean	Min	Max	Median
Salmon - 6-7 kg not trimmed	Baltic Sea	1	58.03	58.03	58.03	58.03
Salmon - 7-8 kg	Baltic Sea	2	36.67	36.42	36.92	36.67
Salmon - 8-9 kg	Baltic Sea	2	37.35	36.54	38.15	37.35
Salmon - 9-10 kg	Baltic Sea	2	40.22	39.69	40.76	40.22
Salmon - 9-10 kg not trimmed	Baltic Sea	1	65.00	65.00	65.00	65.00
Salmon - 10-11 kg	Baltic Sea	1	52.77	52.77	52.77	52.77
Salmon - 11-12 kg	Baltic Sea	1	43.72	43.72	43.72	43.72
Sea catfish and wolf-fish (Anarhichas)		3	1.25	0.82	1.25	0.82
Sprat		4	5.96	5.10	6.91	5.91
Sprat	Baltic Sea	8	16.72	9.45	22.45	16.38
Trout, aquaculture		30	2.28	1.20	4.66	2.28
Tuna, canned in oil		1	0.06	0.06	0.06	0.06
Tuna, canned in water		1	0.06	0.06	0.06	0.06
Turbot		4	6.80	1.03	6.80	1.03
<b>Food other than fish</b>						
<b>pg WHO-TEQ2005/g fat</b>						
Beef meat		2	0.25	0.19	0.31	0.25
Cheese, goat, 45-55% fat in dry matter		1	1.13	1.13	1.13	1.13
Chicken meat		8	1.41	0.23	4.69	0.44
Cow milk, raw		5	0.92	0.71	1.16	0.98
Cow milk, raw	on grass	16	1.78	0.67	13.58	0.94
Cow milk, raw	kept inside	19	0.86	0.52	1.23	0.80
Duck meat, steak (air or oil)		1	0.47	0.47	0.47	0.47
Egg, whole, chicken		12	0.77	0.41	2.26	0.56
Egg, whole, chicken	not caged	47	2.36	0.33	5.46	2.02
Egg, whole, chicken	free range	57	7.03	0.61	67.29	4.42
Fat, beef (leaf fat)		104	1.41	0.32	8.58	0.79
Fat, beef (leaf fat)	free range	68	2.16	0.47	11.02	1.49
Fat, buffalo (leaf fat)		5	4.82	2.19	7.05	4.82
Fat, chicken (belly fat)		10	0.54	0.13	2.39	0.36
Fat, chicken (belly fat)	free range	5	0.90	0.73	1.18	0.81
Fat, horse (leaf fat)		4	7.98	4.22	15.80	5.96
Fat, lamb (leaf fat)		8	2.35	1.07	4.57	2.01
Fat, pork (leaf fat)		117	0.87	0.03	14.57	0.32
Fat, pork (leaf fat)	free range	57	0.71	0.03	3.31	0.48
Fat, sheep (leaf fat)		11	2.47	1.05	4.23	2.29
Infant formulae, powder		3	0.07	0.06	0.08	0.07
Ready-to-eat meal for infants and young children, canned		2	0.03	0.02	0.05	0.03

## 11.5 PCB and organochlorine pesticides

Positive: Number of samples with levels in ng/g fish, ng/g egg or ng/g fat for other foods

### 11.5.1 Alpha-HCH

Commodity	No. of samples	Positive	Mean	Min	Max	Median
Cod liver, Belts	4	3	0.4	0.0	0.9	0.5
Cod liver, Kattegat	1	1			0.2	
Eels	7	7	0.4	0.4	0.5	0.4
Egg, chicken	57	0				
Fat, beef	7	0				
Fat, chicken	6	0				
Fat, farmed deer	1	0				
Fat, horse	2	0				
Fat, lamb	1	0				
Fat, pork	91	0				
Fat, sheep	3	0				
Herring	6	3	0.1	0.0	0.1	0.1
Meat, beef	13	0				
Meat, chicken	15	0				
Meat, farmed deer	4	0				
Meat, horse	3	0				
Meat, pork	86	0				
Meat, sheep	3	0				
Milk, raw, Danish	70	0				
Trout, aquaculture	82	5	0.0	0.0	0.2	0.0
Trout, salt water aquaculture	37	21	0.1	0.0	0.3	0.1

### 11.5.2 Beta-HCH

Commodity	No. of samples	Positive	Mean	Min	Max	Median
Cod liver, Belts	4	4	3.2	2.2	3.9	3.4
Cod liver, Kattegat	1	1			2.4	
Eels	7	7	0.7	0.7	0.8	0.7
Egg, chicken	57	0				
Fat, beef	7	0				
Fat, chicken	6	0				
Fat, farmed deer	1	0				
Fat, horse	2	0				
Fat, lamb	1	0				
Fat, pork	91	0				
Fat, sheep	3	0				
Herring	6	5	0.2	0.0	0.5	0.1
Meat, beef	13	0				
Meat, chicken	15	0				
Meat, farmed deer	4	0				
Meat, horse	3	0				
Meat, pork	86	0				
Meat, sheep	3	0				
Milk, raw, Danish	70	0				
Trout, aquaculture	82	20	0.0	0.0	0.2	0.0
Trout, salt water aquaculture	37	21	0.4	0.0	1.1	0.4

### 11.5.3 Lindane

Commodity	No. of samples	Positive	Mean	Min.	Max.	Median
Cod liver, Belts	4	4	0.6	0.4	0.7	0.6
Cod liver, Kattegat	1	0				
Eels	7	7	0.4	0.3	0.5	0.4
Egg, chicken	57	0				
Fat, beef	7	0				
Fat, chicken	6	0				
Fat, farmed deer	1	0				
Fat, horse	2	0				
Fat, lamb	1	0				
Fat, pork	91	0				
Fat, sheep	3	0				
Herring	6	3	0.1	0.0	0.1	0.0
Meat, beef	13	0				
Meat, chicken	15	0				
Meat, farmed deer	4	0				
Meat, horse	3	0				
Meat, pork	86	0				
Meat, sheep	3	0				
Milk, raw, Danish	70	0				
Trout, aquaculture	82	20	0.0	0.0	0.2	0.0
Trout, salt water aquaculture	37	21	0.1	0.0	0.3	0.1

#### 11.5.4 HCB

Commodity	No. of samples	Positive	Mean	Min.	Max.	Median
Cod liver, Belts	4	4	5.1	2.0	8.9	4.7
Cod liver, Kattegat	1	1			5.2	
Eels	7	7	6.1	5.1	8.3	5.9
Egg, chicken	42	1			2.5	
Fat, beef	7	7	1.4	0.4	2.2	1.5
Fat, chicken	6	0				
Fat, farmed deer	1	1			3.1	
Fat, horse	2	2			4.6	
Fat, lamb	1	1			4.7	
Fat, pork	77	6	0.1	0.0	1.9	0.0
Fat, sheep	3	3	3.6	3.0	4.7	3.2
Herring	6	6	0.7	0.6	1.0	0.7
Milk, raw, Danish	55	55	1.7	0.5	5.6	1.5
Trout, aquaculture	82	55	0.4	0.0	1.4	0.3
Trout, salt water aquaculture	37	21	0.7	0.0	2.0	1.0



### 11.5.5 Dieldrin

Commodity	No. of samples	Positive	Mean	Min.	Max.	Median
Cod liver, Belts	4	4	6.9	2.4	17.0	4.0
Cod liver, Kattegat	1	1			25.0	
Eels	7	7	9.8	6.8	12.0	10.0
Egg, chicken	57	0				
Fat, beef	7	1			0.8	
Fat, chicken	6	0				
Fat, farmed deer	1	0				
Fat, horse	2	2			0.5	
Fat, lamb	1	0				
Fat, pork	91	2			0.6	
Fat, sheep	3	1			0.5	
Herring	6	6	1.1	0.2	1.5	1.2
Meat, beef	13	0				
Meat, chicken	15	0				
Meat, farmed deer	4	0				
Meat, horse	3	0				
Meat, pork	86	0				
Meat, sheep	3	0				
Milk, raw, Danish	70	25	0.8	0.0	3.8	0.0
Trout, aquaculture	82	55	0.4	0.0	1.3	0.4
Trout, salt water aquaculture	37	21	0.6	0.0	1.7	0.5

### 11.5.6 Chlordane, sum

Commodity	No. of samples	Positive	Mean	Min.	Max.	Median
Cod liver, Belts	4	4	5.8	3.1	11.6	4.2
Cod liver, Kattegat	1	1			8.3	
Eels	7	7	7.9	6.3	9.8	7.7
Egg, chicken	42	0				
Fat, beef	7	0				
Fat, chicken	6	0				
Fat, farmed deer	1	0				
Fat, horse	2	0				
Fat, lamb	1	0				
Fat, pork	77	0				
Fat, sheep	3	0				
Herring	6	6	0.6	0.3	0.8	0.6
Milk, raw, Danish	55	0				
Trout, aquaculture	82	55	0.3	0.0	1.0	0.3
Trout, salt water aquaculture	37	21	0.4	0.0	1.5	0.3

### 11.5.7 Heptachlor, sum

Commodity	No. of samples	Positive	Mean	Min.	Max.	Median
Cod liver, Belts	4	4	1.5	0.1	2.6	1.6
Cod liver, Kattegat	1	1			1.5	
Eels	7	7	1.8	1.5	2.1	1.8
Egg, chicken	57	0				
Fat, beef	7	0				
Fat, chicken	6	0				
Fat, farmed deer	1	0				
Fat, horse	2	0				
Fat, lamb	1	0				
Fat, pork	91	0				
Fat, sheep	3	0				
Herring	6	5	0.2	0.0	0.3	0.1
Meat, beef	13	0				
Meat, chicken	15	0				
Meat, farmed deer	4	0				
Meat, horse	3	0				
Meat, pork	86	0				
Meat, sheep	3	0				
Milk, raw, Danish	70	1			1.5	
Trout, aquaculture	82	27	0.0	0.0	0.2	0.0
Trout, salt water aquaculture	37	21	0.1	0.0	0.3	0.1

### 11.5.8 DDT, sum

Commodity	No. of samples	Positive	Mean	Min.	Max.	Median
Cod liver, Belts	4	4	87.5	47.5	165	68.7
Cod liver, Kattegat	1	1			211	
Eels	7	7	12.0	10.8	13.4	11.9
Egg, chicken	57	10	5.0	0.0	29.5	5.0
Fat, beef	7	7	2.5	1.6	4.8	2.1
Fat, chicken	6	3	0.6	0.4	0.8	0.5
Fat, farmed deer	1	1			1.4	
Fat, horse	2	2			2.9	
Fat, lamb	1	1			3.3	
Fat, pork	91	38	0.6	0.0	3.6	0.4
Fat, sheep	3	3	3.4	1.9	4.9	3.5
Herring	6	6	4.2	1.8	6.9	3.6
Meat, beef	13	0				
Meat, chicken	15	0				
Meat, farmed deer	4	0				
Meat, horse	3	0				
Meat, pork	86	0				
Meat, sheep	3	0				
Milk, raw, Danish	70	51	1.7	0.0	5.9	1.7
Trout, aquaculture	82	55	1.6	0.0	6.5	1.7
Trout, salt water aquaculture	37	21	4.0	0.0	9.8	5.0

**11.5.9 PCB (sum of PCB 28, 52, 101, 105, 118, 138, 153, 156, 170 and 180)**

Commodity	No. of samples	Positive	Mean	Min.	Max.	Median
Cod liver, Belts	4	4	299	209	487	251
Cod liver, Kattegat	1	1			454	
Eels	7	7	18.1	16.0	20.4	18.4
Egg, chicken	42	2			109	
Fat, beef	7	7	2.8	1.6	4.6	2.7
Fat, chicken	6	0				
Fat, farmed deer	1	1			8.1	
Fat, horse	2	2			13.7	
Fat, lamb	1	1			5.5	
Fat, pork	77	9	1.0	0.9	1.6	0.9
Fat, sheep	3	3	4.2	1.8	8.9	1.9
Herring	6	6	7.5	5.0	13.5	5.3
Milk, raw, Danish	55	38	4.2	3.7	7.6	4.0
Trout, aquaculture	55	55	3.4	1.5	7.1	3.1
Trout, salt water aquaculture	21	21	8.4	4.5	15.3	8.3

## 11.6 PAH

### 11.6.1 Benzo[a]pyrene

Levels of benzo[a]pyrene in µg/kg fresh weight.

Food	No. of sam- ples	Positive <sup>1</sup>	Mean µg/kg	Min µg/kg	Max µg/kg	Median µg/kg
<b>Baby foods</b>						
Baby food, cereal-based	4	0	0	0	0	0
Infant formula	6	1	0.02	0	0.1	0
Ready-to-eat meals, canned	2	0	0	0	0	0
<b>Fruit and vegetables</b>						
Dried fruit	11	5	0.59	0	2.6	0
<b>Fat and vegetable oils</b>						
Olive oil	15	7	0.13	0	0.90	0
Rapeseed oil	5	3	0.28	0	0.75	0.30
Sunflower oil	2	1	0.05	0	0.1	0.05
Coconut oil	3	1	0.07	0	0.2	0
Vegetable oil	6	2	1.8	0	11	0
<b>Coffee and tea</b>						
Teas	10	10	11	0.3	42	8.5
<b>Miscellaneous</b>						
Chocolate	12	11	1.0 <sup>2</sup>	0	3.3 <sup>2</sup>	0.69 <sup>2</sup>
Cocoa Butter	1	1	0.80 <sup>2</sup>	0.80 <sup>2</sup>	0.80 <sup>2</sup>	0.80 <sup>2</sup>
Cocoa powder	1	1	0.61 <sup>2</sup>	0.61 <sup>2</sup>	0.61 <sup>2</sup>	0.61 <sup>2</sup>
<b>Fish and seafood</b>						
Mussels ( <i>Mytilus edulis</i> )	19	15	0.12	0	0.30	0.10
Mussels ( <i>Mytilus edulis</i> ), smoked	1	1	6.9	6.9	6.9	6.9
Oyster	3	3	0.33	0.10	0.50	0.40
Herring, smoked	8	2	0.09	0	0.5	0
Mackerel, raw	1	0	0	0	0	0
Mackerel, smoked	6	5	0.33	0	0.60	0.35
Salmon, smoked	7	3	0.89	0	5.1	0
Salmon, grilled	2	1	1.4	0	2.7	1.4
Eels, smoked	3	2	0.2	0	0.3	0.3
Fish and other seafood	2	2	0.3	0.2	0.4	0.3
Cod roe, smoked	7	5	1.7	0	6.6	1.2
Atlantic wolffish, grilled	1	1	0.10	0.10	0.10	0.10
<b>Meat</b>						
Beef meat, heat treated	5	2	3.7	0	17.5	0
Beef meat, grilled	13	3	0.06	0	0.6	0
Beef meat, minced grilled	7	2	0.53	0	3.4	0
Beef meat, smoked	3	1	2.5	0	7.5	0
Beef meat, pastrami	3	1	1.1	0	3.4	0
Chicken meat, smoked	1	0	0	0	0	0
Pork meat, roasted	1	0	0	0	0	0
Pork meat, smoked	8	1	0.05	0	0.40	0

<b>Food</b>	<b>No. of sam- ples</b>	<b>Positive<sup>1</sup></b>	<b>Mean µg/kg</b>	<b>Min µg/kg</b>	<b>Max µg/kg</b>	<b>Median µg/kg</b>
Pork meat, grilled	2	1	32	0	63	32
Pork chops, grilled	1	0	0	0	0	0
Pork, sausage grilled	4	2	0.50	0	1.9	0.05
Pork, sausage deep fried	1	1	0.10	0.1	0.1	0.1
Lamb, smoked	3	1	0.03	0	0.10	0
Veal meat, grilled	1	1	0.20	0.20	0.20	0.20

<sup>1</sup>Number of samples with a value above LOD

### 11.6.2 PAH 4 (sum of benz[*a*]anthracene, chrysene, benzo[*b*]fluoranthene and benzo[*a*]pyrene)

Sum of PAH4 in µg/kg fresh weight.

Food	No of samples	Positive <sup>1</sup>	Mean µg/kg	Min µg/kg	Max µg/kg	Median µg/kg
<b>Baby foods</b>						
Baby food, cereal-based	4	1	0.03	0	0.10	0
Infant formula	6	1	0.02	0	0.10	0
Ready-to-eat meals, canned	2	0	0	0	0	0
<b>Fruit and vegetables</b>						
Dried fruit	11	6	9.8	0	37	0.30
<b>Fat and vegetable oils</b>						
Olive oil	15	15	2.2	0.5	6.6	1.8
Rapeseed oil	5	3	1.2	0	4.0	0.8
Sunflower oil	2	1	0.30	0	0.60	0.30
Coconut oil	3	3	0.73	0.4	1.4	0.40
Vegetable oil	6	5	5.9	0	32	0.60
<b>Coffee and tea</b>						
Teas	10	10	56	3.4	173	44
<b>Miscellaneous</b>						
Chocolate	12	12	6.4 <sup>2</sup>	0.77 <sup>2</sup>	19 <sup>2</sup>	5.1 <sup>2</sup>
Cocoa Butter	1	1	5.8 <sup>2</sup>	5.8 <sup>2</sup>	5.8 <sup>2</sup>	5.8 <sup>2</sup>
Cocoa powder	1	1	7.9 <sup>2</sup>	7.9 <sup>2</sup>	7.9 <sup>2</sup>	7.9 <sup>2</sup>
<b>Fish and seafood</b>						
Mussels ( <i>Mytilus edulis</i> )	19	19	1.1	0.60	2.4	1.1
Mussels ( <i>Mytilus edulis</i> ), smoked	1	1	30	30	30	30
Oyster	3	3	4.5	0.7	7.1	5.8
Herring, smoked	8	6	0.90	0	4.1	0.35
Mackerel, raw	1	1	0	0	0	0
Mackerel, smoked	6	6	2.2	0.20	4.3	2.2
Salmon, smoked	7	7	5.7	0.2	32	0.4
Salmon, grilled	2	1	4.0	0	8.0	4.0
Eels, smoked	3	3	1.3	0.60	1.9	1.5
Fish and other seafood	2	2	1.6	1.4	1.8	1.6
Cod roe, smoked	7	6	11	0	42	6.9
Atlantic wolfish, grilled	1	1	0.60	0.60	0.60	0.60
<b>Meat</b>						
Beef meat, heat treated	5	3	10	0	48	0.20
Beef meat, grilled	13	3	0.25	0	2.2	0
Beef meat, minced grilled	7	2	1.5	0	9.6	0
Beef meat, smoked	3	1	12	0	35	0
Beef meat, pastrami	3	1	5.9	0	18	0
Chicken meat, smoked	1	1	0.10	0.10	0.10	0.10
Pork meat, roasted	1	0	0	0	0	0
Pork meat, smoked	8	7	0.59	0	2.6	0.3
Pork meat, grilled	2	2	98	0.20	195	98



<b>Food</b>	<b>No of samples</b>	<b>Positive<sup>1</sup></b>	<b>Mean µg/kg</b>	<b>Min µg/kg</b>	<b>Max µg/kg</b>	<b>Median µg/kg</b>
Pork chops, grilled	1	0	0	0	0	0
Pork, sausage grilled	4	4	0.90	0.20	2.4	0.50
Pork, sausage deep fried	1	1	0.90	0.90	0.90	0.90
Lamb, smoked	3	2	0.63	0	1.6	0.3
Veal meat, grilled	1	1	1.0	1.0	1.0	1.0

<sup>1</sup>Number of samples with a value above LOD

<sup>2</sup>µg/kg fat

## 11.7 Acrylamide

All results are in µg/kg.

“0” means the level was below LOQ.

Food codes are based on EFSA, 2014 that is based on Commission Recommendation 2010/307/EU

2010/307-code	2010/307-categories	No of samples	Positive	Min	Max	Median	Mean
1.1	French fries from fresh potatoes	2	2	170	1190	680	680
1.3	Unspecified French fries	24	24	20	1540	420	505
2.1	Potato crisp	18	18	200	1470	520	594
3.2	Deep fried fries	24	24	56	7900	595	883
3.3	Not specified pre-cooked French fries, potato products for home cooking	19	19	97	4900	590	916
4	Soft bread	18	15	0	68	12	18
4.1	Not specified bread	15	9	0	31	3.6	4.9
5	Breakfast cereals (excluding muesli and porridge)	7	5	0	350	11	64
5.3	Bran products and whole grain cereals, gun puffed grain	2	2	180	250	215	215
6.1	Crackers	7	7	77	800	210	328
6.2	Crisp bread	14	14	49	400	102	128
6.3	Biscuits and wafers	22	22	17	560	102	159
6.5	Not specified biscuits, crackers, crisp bread and similar (excluding pastry and cake)	1	1	13	13		
7.1	Roasted coffee (dry)	20	20	75	510	236	181
7.2	Instant coffee (dry)	9	9	27	1090	760	736
8	Baby foods, other than processed cereal based foods	6	2	0	9.8	0	2.1
9	Processed cereal-based foods for infants and young children	3	2	0	19	11	10
10.1	Muesli and porridge	1	1	58	58		
10.2	Cake and pastry	7	6	0	28	7.7	11
10.3	Savoury snacks	2	2	10	19	15	15
10.4	Other products based on cereals	4	4	69	220	95	120
10.6	Cocoa and cocoa products	12	12	7	350	70	88
10.7	Chocolate	9	9	39	182	133	110
11	Miscellaneous (dried fruit)	5	4	0	140	8.6	46

## 11.8 Furan

Levels of furan in selected processed foods (ng/g =  $\mu$ g/kg)

Foods	No. samples	No. positive	Mean	Min.	Max.	Median
Cereals	1	1	14	14	14	14
Coffee, ground beans	17	17	2475	63	5500	2350
Coffee, instant	19	19	290	28	785	260
Crisps	9	9	16	2.6	29	15
Infant meals	8	8	19	2.2	33	24
Ready-to-eat meals	47	44	21	<lod	90	14
Sauces	25	24	19	<lod	103	9.5
Soups	1	1	42	42	42	42
Vegetables, canned	4	4	10	0.5	32	2.8

<LOD: below limit of determination

National Food Institute  
Technical University of Denmark  
Mørkhøj Bygade 19  
DK - 2860 Søborg

T: 35 88 70 00  
F: 35 88 70 01  
[www.food.dtu.dk](http://www.food.dtu.dk)

ISBN: 978-87-93109-61-2