Chemical contaminants

Food monitoring, 1993-1997. Part 2.

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Food monitoring, 1993-1997,
consists of five sub-reports:

Part 1: Nutrients
Part 2: Chemical contaminants
Part 3: Production aids (pesticides and veterinary drugs)
Part 4: Food additives
Part 5: Microbial contaminants

Ministry of Food, Agriculture and Fisheries

Danish Veterinary and Food Administration

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The Danish Veterinary and Food Administration is part of the Danish Ministry of Agriculture, Food and Fisheries. The Danish Veterinary and Food Administration is responsible for the administration, research and control within food and veterinary areas "from farm to fork", as well as practical matters relating to animal protection (otherwise under the Ministry of Justice).

Making of regulations, co-ordination, research and development, take place in the Administrations center in Moerkhoej. The 11 Regional Authorities handle the practical inspection of food and veterinary matters, including import/export etc.

The central administration of The Danish Veterinary and Food Administration employ a staff of approx. 550 full-time employees, whilst the 11 regional authorities employ a further approx.1 400 full-time employees.

PREFACE

A programme for monitoring nutrients and chemical contaminants in foods was established in 1983, and the Danish Veterinary and Food Administration is now carrying this programme further within an expanded field. Results are being reported for periods of five years; thus, the present report covers the third period, 1993-1997.

The reporting of the third period of the monitoring programme consists of the following sub-reports:

Part 1: Nutrients
Part 2: Chemical contaminants
Part 3: Production aids (pesticides and veterinary drugs)
Part 4: Food additives
Part 5: Microbial contaminants

The studies are co-ordinated by the Danish Veterinary and Food Administration. The major part of the chemical analyses was carried out by the regional laboratories in Copenhagen, Odense, Aalborg, and Århus; however, analyses for veterinary drugs were mainly carried out by the Danish Veterinary and Food Administration. Microbiological analyses were carried out by the Danish Veterinary and Food Administration and the municipal environmental and food control units. The reporting was co-ordinated by Gudrun Hilbert, Institute of Food Research and Nutrition.

The Danish Veterinary and Food Administration's monitoring programme for foods does not include analyses of radionucleides; these analyses, as well as the publication of their results, are being undertaken by Risø National Laboratory.

The text of the report does not take into account the fact that certain activities had a different organizational placement prior to the re-organization of the Ministry of Food, Agriculture and Fisheries in 1997, when the Danish Veterinary Service and the National Food Agency of Denmark were united into the Danish Veterinary and Food Administration. All results from these two institutions are being referred to as results of work carried out by the Danish Veterinary and Food Administration.

December, 1999

Danish Veterinary and Food Administration

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1. MONITORING PROGRAMME FOR FOODS

The object of the monitoring programme is, by means of systematic studies of foods and the dietary habits of the Danish population,

- to ascertain whether our foods are subject to any long-term changes in terms of contents of desirable and undesirable substances and/or microorganisms,
- to assess the health significance of any such changes in relation to major changes of dietary habits,
- to disclose potential problems within the area and to provide background material and a basis for decisions to remedy any problems which might have arisen.

The material provided may also serve as a documentation of the health quality of Danish foods, and be used for updating the food composition data base of the Danish Veterinary and Food Administration. Monitoring results are used also in other connections; e.g., microbiological results are reported to the Danish Zoonosis Centre, and results concerning residues of pesticides and veterinary drugs are reported to the EU.

The work with the monitoring programme consists of the following:

- to monitor, by means of analyses, the contents of desirable and undesirable substances/microorganisms in specific foods,
- to investigate the dietary habits of the Danish population,
- to carry out intake estimates (wherever relevant) by combining contents in foods and data on the population's diet.

Subsequently, a nutritional and/or toxicological assessment can be made. Such an assessment will be particularly important whenever changes are found.

Since changes in the contents of foods and changes in our dietary habits usually develop slowly, the studies cover a considerable number of years. Every five years, the results are reviewed, and the analytical results for the foods are compared with the dietary habits over the period. This permits an assessment of whether the intake of desirable substances is adequate, and whether the intake of undesirable substances or microorganisms is acceptably low.

Content findings and intake estimates are compared with earlier results, thus permitting an assessment of the development of contents and intakes over time.

Results are evaluated continuously during the monitoring period, enabling reactions to violations of existing limits, deviations from contents declarations, or other noteworthy observations.

The monitoring programme consists of five sub-fields:

- **Nutrients**, including vitamins, minerals, proximates, and dietary fibres.
- **Chemical contaminants**, including trace elements, nitrate, organic environmental contaminants, and mycotoxins.
- **Production aids**, including residues of pesticides and veterinary drugs.
- **Food additives**.
- **Microbial contaminants**.

Initially, the monitoring programme covered only nutrients and chemical contaminants. The remaining three subjects are new inclusions under the monitoring concept; these are production aids (pesticides and veterinary drugs), which have been reported continuously during several decades and during recent years have attracted increasing attention within the international co-operation and in the public; food additives which, according to three EU directives, shall be followed with a view to application and intake; and finally, microbial contaminants, with an increasing number of reported disease cases which can be attributed to pathogenic bacteria in foods.

With the merger in 1997 of the National Food Agency of Denmark and the Danish Veterinary Service into the new Danish Veterinary and Food Administration it has become possible to compile the data material, especially within the fields concerning microbial contaminants and veterinary drug residues.

Unlike the first two monitoring periods (1983-1987 and 1988-1992), each of which was reported as a whole [1, 2], the reporting of the third period has been divided into five sub-reports according to subject. Each sub-report comprises a number of analyses which, depending on the subject matter, are carried out once or several times during a five-year period. Thus, e.g. vitamins in meat are analysed once, while pesticide residues in fruits and vegetables are analysed yearly. The difference reflects the fact that empirically, vitamin contents in meat will not change within a short time, whereas the monitoring of pesticide residues contains an appreciable element of control, and the use pattern for pesticides is subject to greater fluctuations.

In 1996, the monitoring programme (nutrients and chemical contaminants) was subjected to an international evaluation [3]. The main conclusion was that the monitoring programme was good, but might be improved in some respects. The collection of diet data should be expanded to include a larger number of methods and be effected continuously, and the use of statistical expertise should be optimized, particularly for sampling and processing of results. Further, a

number of more specific suggestions was mentioned. The experience gathered from the evaluation has been included in the reporting of the third period as well as in the planning of the fourth period.

The Ministry of Food, Agriculture and Fisheries has to be informed on the immediate situation concerning Danish foods, the health significance for Danish consumers, and the direction in which matters are likely to develop. In this respect, the monitoring programme can provide background material and a basis for decisions on actions in the form of national or international regulations.

2. INTRODUCTION

As mentioned in Chapter 1, the subject of contaminants has formed part of the monitoring programme since the very beginning, and consequently it is now possible, also in other areas, to assess contents and intakes of contaminants during three monitoring periods, corresponding to 15 years. Table 1 shows the total number of analyses carried out within the field of contaminants during the 3rd monitoring period. Individual chapters describe in further detail how samplings were carried out, and detailed lists of food categories and samples are found in the Appendices to each chapter.

Table 1. *Number of food categories and number of analyses during the 3rd period of the monitoring (1993-1997).*

Substance	Number of food categories	Number of analyses
Lead	83	2256
Cadmium	76	1947
Nickel	77	2035
Mercury	25	1151
Arsenic	9	225
Nitrate	6	1117
Organochlorine pesticides	17	2613
Total PCB	17	2348
PCB congeners	17	2088
Ochratoxin A	4	906

These ten substances/groups of substances were selected for inclusion in the monitoring programme i.a. because of their potentially health hazardous properties. Also other contaminants might have been included, but the scope of a monitoring programme will always be a matter of priorities within the given financial framework. Subjects might be relevant which, however, do not fall under the Danish Veterinary and Food Administration's field of responsibility. This applies to, e.g., the monitoring of radioactivity in foods, belonging under Risø National Laboratory, and the monitoring of contaminants in drinking water, being the responsibility of the Danish Ministry of Environment and Energy.

2.1 Data on contents

Results below the limit of detection

In the calculation of average contents of various contaminants in different foods, it may be problematic if relatively many results fall below the limit of detections of the analytical method. Since the extent and significance of this problem varies for individual contaminants, such problems have been solved in different ways, which will be discussed in the respective chapters.

Quality of analyses

All analyses were carried out at the regional laboratories which have been accredited according to EN45000 during the monitoring period. Various procedures for quality assurance are undertaken in connection with analyses of the various contaminants. Generally, recovery tests are often carried out within each series of analyses, reference materials are continuously being analysed, and laboratories participate regularly in proficiency tests.

2.2 Intake calculations

The intake calculations were based on consumption data from the dietary survey of the National Food Agency of Denmark, 1995 [4]. The survey comprised 3,098 representatively selected individuals: 1,261 children (1-14 years of age) and 1,837 adults (15-80 years of age). The participants (or their parents) recorded their diet continuously for seven days. Data were collected for three periods distributed over the year in order to take into account seasonal variations in the dietary habits. For recording purposes a form with predetermined response categories was used, combined with the possibility of noting foods which were not included in these response options. The form was subdivided into daily meals, and quantities were given in domestic units, such as glasses, slices, plates, pieces. Recorded quantities were converted into grams by means of standard portion sizes for the individual domestic units. Dishes were converted to ingredient level by means of standard recipes. The results of these conversions were expressed for each participant as a daily average of the seven-days diet recordings. With individual-level data it was possible to describe the consumption distribution within the population or within groups such as children and adults or women and men.

Due to the simplified design of the diet recording forms, the total diet was described in terms of 207 raw products/semi-products with a Food Identification number (FoodId) [5]. The Food Identification numbers were used in the dietary survey [4] and are therefore used also in the present report; cf. Appendix 9.1.1. In calculations of the intake of contaminants in this report, the individual-level consumption of each of the 207 foods was multiplied by a qualified estimate of the contaminant content in that particular foodstuff. The result of this is a distribution of the contaminant intake among the 1,837 adults. The intake distribution within the population has been described by means of average, median, and quantiles for high intakes. The calculations in the present report are based exclusively on the diet of adults. The average bodyweight of 70 kg is used for an adult Dane in those cases where the result of the intake calculation is stated as intake per kg bodyweight. The dietary survey's data for children are not sufficiently comprehensive for corresponding calculations with respect to the children's group to be carried out directly with any technical reasonability.

For some of the contaminants it has been attempted in the respective chapters to compare the calculated intakes from the 3rd monitoring period (1993-1997) with calculated intakes from the 1st and 2nd periods. Here it should be noted that the dietary data used for the different monitoring periods [1, 2] are not identical. Moreover, in the earlier monitoring reports [1, 2]

individual-level intakes were calculated only for trace elements, whereas in the present report this has been done for all chemical contaminants.

Accordingly, in comparison with earlier data, the main emphasis has been on the contents of contaminants in characteristic foods and not on calculated intakes. The calculated intakes in the present report shall be seen as the best intake estimate which can be given today by use of the available methods.

2.3 Safety assessments

Assessments of chemical substances in foods are usually based on the concept ADI/TDI (Acceptable/Tolerable Daily Intake for humans), which indicates the quantity which humans may ingest daily for an entire lifetime with no recognizable health risk. ADI is used for substances that are approved for use in the production of foods, such as food additives and pesticides, while TDI is used for substances that occur as unintentional contaminants.

On the basis of existing toxicological, epidemiological, and other studies, the NOAEL (No Observed Adverse Effect Level) is established, which is the daily dose, expressed in mg/kg bodyweight, which has shown no adverse effects in the most sensitive, relevant study. Usually, results from animal studies are used, since relevant and sufficiently sensitive studies in humans are rarely available. When establishing the ADI/TDI, this dose is reduced by an uncertainty factor that shall allow for the extrapolation of results from animals to humans and the variations in the sensitivity and habits of humans, as well as the uncertainty inherent in the evaluation of the study itself. It must be pointed out that the ADI/TDI is no danger line. Intakes above the ADI/TDI over shorter periods of time (weeks, months) will constitute no risk, as long as the average long-term intake does not exceed the ADI/TDI.

3. TRACE ELEMENTS

3.1 Introduction

This chapter covers the monitoring programme's results for the trace elements lead, cadmium, nickel, mercury, and arsenic. These substances were selected for the monitoring programme due to their potential toxic effects on humans.

The total number of analyses for each trace element, and the number of foodstuffs analysed, are given in Table 1. Listing the approx. 7,000 individual results lies outside the scope of the present report; but the contents of the five trace elements in individual foods are given in Appendix 9.2.

As will appear from the Appendices, a wide range of foods has been studied. In the majority of food groups, contents of the five substances were analysed only once during the five-year period 1993-1997, because the results from the two previous 5-year monitoring periods 1983-1987 [1] and 1988-1992 [2] in many cases showed unchanged or decreasing contents of trace elements over time. However, meat and offal from cattle, calves, and poultry were analysed twice during the 5-year period. This is due partly to the fact that the contents of trace elements in these foods can be expected to change somewhat during the period, partly to the fact that at the same time, the more frequent sampling of these foods was used as a control for heavy metals in Danish meat for export.

In the following sections, the five trace elements will be discussed, substance by substance, with particular emphasis on changes in the contents of the trace elements in foods analysed in relation to the 2nd monitoring period, 1988-1992. With a view to an assessment of the safety consequences of trace element findings in foodstuffs, a calculation of the dietary total intake of each trace element has been made, as well as a safety assessment of this.

3.2 Analytical methods

Chemical analyses

The chemical analyses were carried out at the regional laboratories in Aalborg, Odense, and Copenhagen, using the same analytical methods. Determinations of lead, cadmium, nickel, and arsenic were carried out using graphite furnace atomic absorption spectrometry following nitric acid ashing of the homogenized food samples [6]. Determination of mercury was carried out using cold vapour atomic absorption spectrometry [7].

Analyses for trace elements were carried out in series also including control samples. These comprise control of the blank value and control of the accuracy. The variation of the blank value sets a limit to how low concentrations of a trace element can be measured, which is indicated by the limit of detection. In Appendix 9.2, results below the limit of detection are

indicated by the symbol '<' (less than). Control of the accuracy is carried out so that each series of analyses also includes the determination of trace element contents in one or more certified reference materials having a certified, i.e. known, content of the trace elements concerned. If the result of these control analyses did not comply with the certificate, the other results in the analyses series were discarded, and the analyses were repeated.

Data processing

A t-test was carried out to elucidate whether the average content of trace elements in certain selected foods from the 3rd period 1993-1997 had changed in relation to the 2nd period 1988-1992. Prior to the test, all individual values in the populations tested were log-transformed in an attempt to obtain a normal distribution of the data sets. The selection of foods for the test was based on an apparent change in results from the 3rd period in relation to the corresponding results from the 2nd period, and on the fact that the concentration level of the trace element under study was found to be above the limit of detections of the analytical methods used.

3.3 Results

The results found for each of the five trace elements analysed are given in Appendices 9.2.1-9.2.5. For each foodstuff, the results obtained are indicated with average and median values (0.50 quantile), and the average contents found in the 2nd period are given for purposes of comparison. The median value, being the middle value on an ascending scale of individual values, may be a better expression than the average for a central value in the distribution of figures. Thus, if the results set contains very high or very low individual values, these may influence the average, but not the median to any appreciable degree. Moreover, in order to elucidate the distribution of results, minimum and maximum values are given, as well as a 0.90 quantile. This indicates the concentration of a trace element below which 90% of all results in the results set are found. In this way one avoids the character of randomity which may be associated with using the maximum value to express the high values of the obtained distribution of figures.

The results of the tests for changes in contents of trace elements from the 2nd to the 3rd period are shown in Table 2. A more detailed discussion of the test results will be given in relation to the individual trace elements.

Table 2. *Test results (t-test, significance level 0.95) for differences in contents of trace elements in selected foods between the 2nd and 3rd monitoring period. Symbols used: 0: No difference; D: Decrease; I: Increase.*

	2nd period		3rd period		Difference in contents of trace elements between periods				
Food	Year	Samples	Year	Samples	Lead	Cadmium	Mercury	Nickel	Arsenic
Meat and offal									
Beef	1991	43	1995	48	D	0		0	
Chicken	1991	36	1995	28	D	0	0	0	
Eggs	1992	33	1995	30			D		
Kidney, ox	1992	53	1997	49	0	0	I		
Kidney, pig	1990	125	1996	60	D	0	0	0	
Lamb	1989	7	1997	12	0	D		0	
Liver, calf	1992	45	1997	51	D	0		0	
Liver, calf	1992	50	1997	51	0	0			
Liver, chicken	1992	35	1997	25		I		0	
Liver, ox	1992	45	1997	24	0	0	0	D	
Liver, pig	1990	125	1996	65	D	0	0	0	
Mutton	1989	10	1997	22	0	D		0	
Pork	1989	125	1997	120		D		I	
Veal	1991	50	1995	52	D	0	0	0	
Beverages									
Red wine	1992	41	1997	15	D				
Bread									
Rye bread, dark	1992	14	1994	27	0	0		0	
Rye bread, wholemeal	1992	6	1994	19	0	0		0	
White bread	1992	20	1994	44	0	0		I	
White bread, wholemeal	1992	16	1994	24	0	0		0	
Vegetables									
Carrots	1991	20	1996	26	0	0		0	
Celeriac	1991	10	1996	14	I	0		0	
Curly kale	1991	10	1996	13	0	0		0	
Potatoes	1991	41	1993	60	0	0		0	
Spinach	1991	10	1996	12	0	0		0	
Fish									
Cod	1988	50	1995	50			D		0
Mackerel	1988	19	1995	30			0		0
Plaice	1988	33	1995	34			0		D

3.4 Intake calculations

The calculation of the total dietary intake of trace elements was carried out by use of the dietary survey from 1995 [4] as mentioned in Section 2.2, from which it is seen that the diet model used contains 207 foodstuffs. However, since the monitoring programme does not comprise contents analyses for trace elements in all these foods, it has been necessary to

supplement with other Danish data for contents of trace elements in foods. For composite and finished products, contents of trace elements were calculated by combining data on contents in raw produce inputs in relation to weight quantities of raw produce inputs.

The toxicological assessment is based on the calculated dietary intake. Other sources of the trace elements concerned are not included in the assessment.

In relation to the calculation of average contents of a trace element, data sets containing many individual values below the analytical limit of detection constitute a special problem. This is due to the fact that these are subject to a large random error and may vary from zero up to the limit of detection of the analytical method. Nonetheless, these values are used in the calculations of average contents of trace elements, since they constitute the best estimate of the 'true concentration'.

3.5 Lead

A total of 82 foods was analysed for contents of lead, and the results are shown in Appendix 9.2.1. For each foodstuff, the Appendix furthermore shows the average lead contents found during the 2nd period. Generally, the contents of lead in Danish foods from the 3rd period have decreased or remain unchanged in relation to the previous monitoring period, 1988-1992 [2]. The statistically significant decreases in lead contents shown in Table 2 comprise particularly meat and offal, while bread and vegetables show unchanged lead contents in most cases.

Among the sources of lead contents in foods shall be mentioned especially atmospheric precipitation of lead-containing dust from a number of industrial processes and incineration, whereas the assimilation by agricultural crops of lead contents from contaminated agricultural soil is considered of minor significance. Due to this distribution between lead contributions from air and soil, vegetables having a long growth period and a large surface area in relation to their weight are used as markers for atmospheric lead contamination of foods. Examples are curly kale and spinach, and the results in Figure 1 show a 3-4-fold reduction of lead contents in curly kale and spinach from 1984 to 1991, which is ascribed to the reduction of lead addition to petrol. After this, the lead contents remain largely unchanged onwards until 1995. The 0.90 quantile content has decreased even more, which indicates a significant reduction, especially of the highest lead contents in these greens.

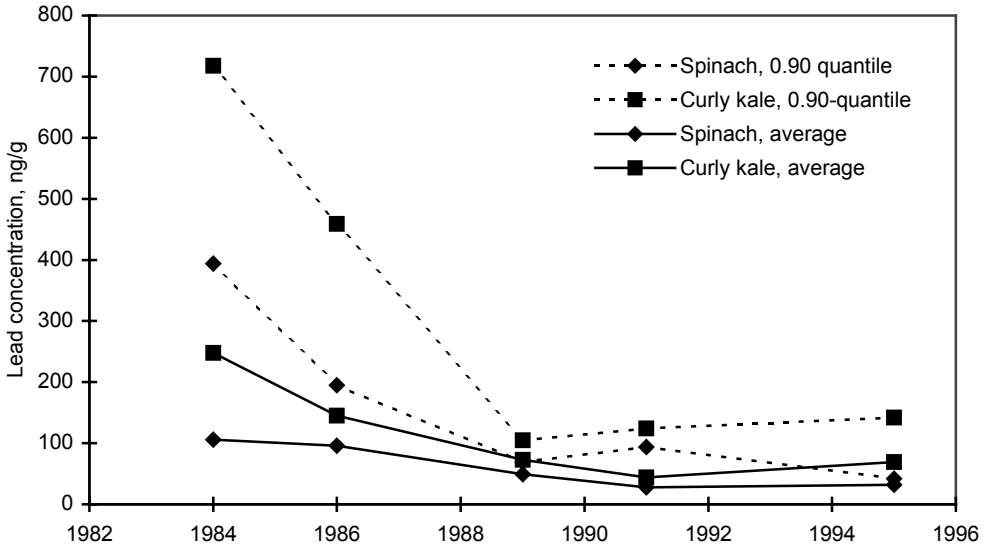

Figure 1. *Development of lead contents in spinach and curly kale during the period from 1984 to 1995.*

Following the atmospheric deposition on plant surfaces, the lead contents in animals' feeds will accumulate in kidneys of, e.g., calves and oxen. This is due to the fact that after being ingested by animals, the heavy metals may be bound to particular proteins in the the animals' kidneys. Thus, also kidneys from slaughter animals may be used as markers for the lead contamination of the animals via feedstuffs. Figure 2 shows a decrease during the period from 1983 to 1997 of the lead contents in kidneys of oxen, calves, and pigs, a decrease which has also been observed in pig's liver.

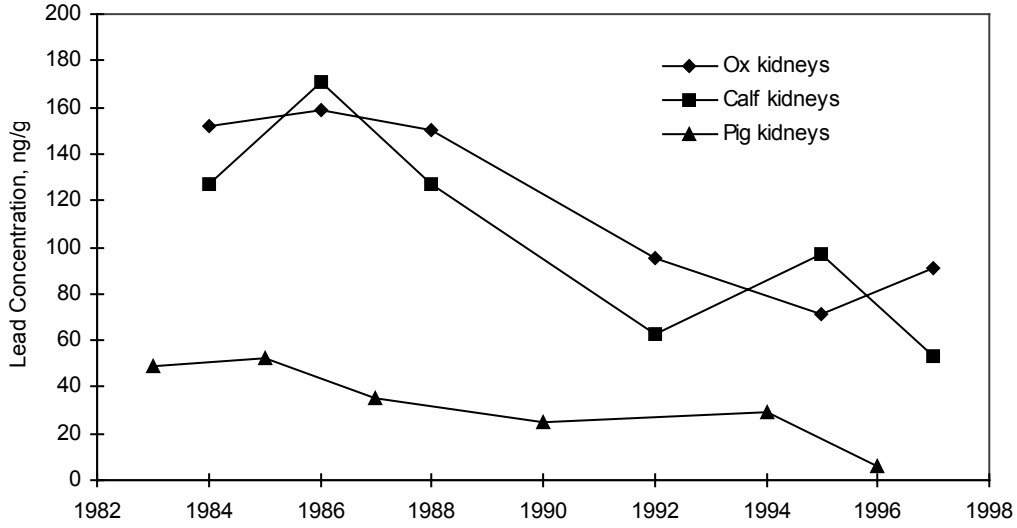

Figure 2. *Development of average lead contents in kidneys of calves, oxen, and pigs during the period from 1983 to 1997.*

The above-mentioned decreases in lead contents in marker foods during the last three monitoring periods may be attributed to the strongly reduced atmospheric lead contamination following the introduction of unleaded or lead-reduced petrol since 1981. The reason why

lead may still be demonstrated in a number of foods, may be that the lead has accumulated over a number of years in the topsoil from where it may be stirred up by the wind and deposited on leaf surfaces or, to a limited extent, be assimilated via the roots. This is believed to be the case especially in fields near roads carrying heavy traffic and in urban areas.

Dietary intake of lead

As mentioned in the previous section, there have been decreases in the lead contents of a number of foods over the last three 5-year periods of the monitoring programme. In order to illustrate this, a calculation of the total dietary intake of lead during the period 1993-1997 has been made.

Table 3. *Total dietary intake of lead during the 1st, 2nd, and 3rd monitoring periods.*

	Dietary lead intake (µg/day)		
	Average	0.90 quantile	0.95 quantile
1st period (1983-1987)	42	66	76
2nd period (1988-1992)	27	40	46
3rd period (1993-1997)	18	25	28

The lead intake from all foods during the third period of the monitoring programme constitutes an average of 18 µg/day (Table 3), which is less than one-half of the intake in the 1st period and two-thirds of the intake in the 2nd period. The decrease in the lead intake among the most exposed population groups, here illustrated by the 0.90 and 0.95 quantiles, is even larger.

The individual food groups contribute to varying extents to the total dietary intake of lead. These contributions occur as the product of the lead concentration in the individual foods within the group and the consumption of these. In spite of a generally low concentration of lead in beverages, this group's contribution to the lead intake is the largest because of a high consumption, followed by vegetables and cereals. The observed decrease in the total lead intake in relation to the 1st and the 2nd periods has taken place for all food groups. This may be due partly to changes in dietary patterns among the Danish population in 1995 [4] in relation to 1985 [2], partly to changes in the lead contents in foods.

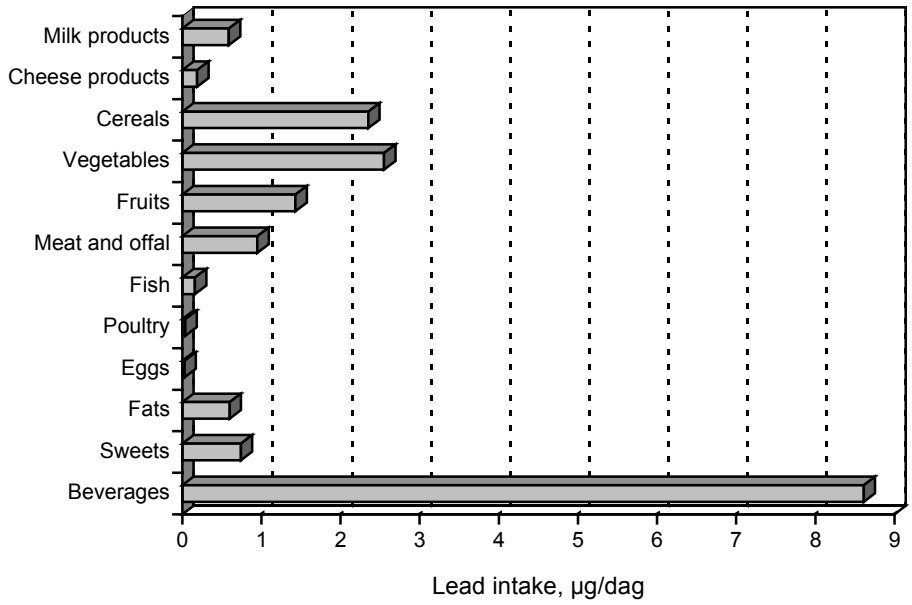

Figure 3. *Contribution of food groups to the total lead intake during the 3rd monitoring period.*

Safety assessment

Lead is accumulated in the body and is toxic to the peripheral as well as the central nervous system. Most critical (sensitive) is the effect on the development of the central nervous system in the foetus and neonates. Thus, a connection has been demonstrated between increased lead content in the blood and inferior intelligence quotient.

In 1972 [8], JECFA established a provisional tolerable weekly intake (PTWI) of 50 µg/kg bodyweight. Due to the higher sensitivity of children, this value applied only to adults, and consequently a value of 25 µg/kg especially for children [9] was established in 1986. In 1993 it was decided to cancel the adults' value and make the children's value applicable to all age groups. Lead was most recently discussed at JECFA's meeting in June 1999, on which occasion the PTWI remained unchanged.

For an adult person of 70 kg, the PTWI would correspond to a daily tolerable intake of 250 µg/day. When this is compared with the calculated intakes as given in Table 3, the average intake constitutes 7% of the tolerable value, while the 0.90 and 0.95 quantile values constitute 10% and 11%, respectively.

With the existing knowledge of the harmful effects of lead, it is therefore estimated that the adult Danish population's dietary intake of lead does not give rise to any health concerns.

Children will eat larger quantities of food in relation to their bodyweight, and may thus ingest relatively larger quantities of lead. The monitoring programme cannot provide any immediate answer to children's dietary lead exposure; but based on experience from other countries it

must be assumed that the dietary intake of lead per kg bodyweight is 2-3 times higher for children than for adults. Accordingly, it is estimated that the effect on the development of the central nervous system will be insignificant and non-measurable.

3.6 Cadmium

A total of 76 different foodstuffs was analysed for contents of cadmium, and the results are shown in Appendix 9.2.2. It appears from the tests for changed cadmium contents in Table 2 that the cadmium contents of the greater majority of foods during the 3rd monitoring period were unchanged in relation to the previous monitoring period, 1988-1992 [2]. Thus, results indicate that the cadmium contents of Danish foods are neither on the decrease nor the increase.

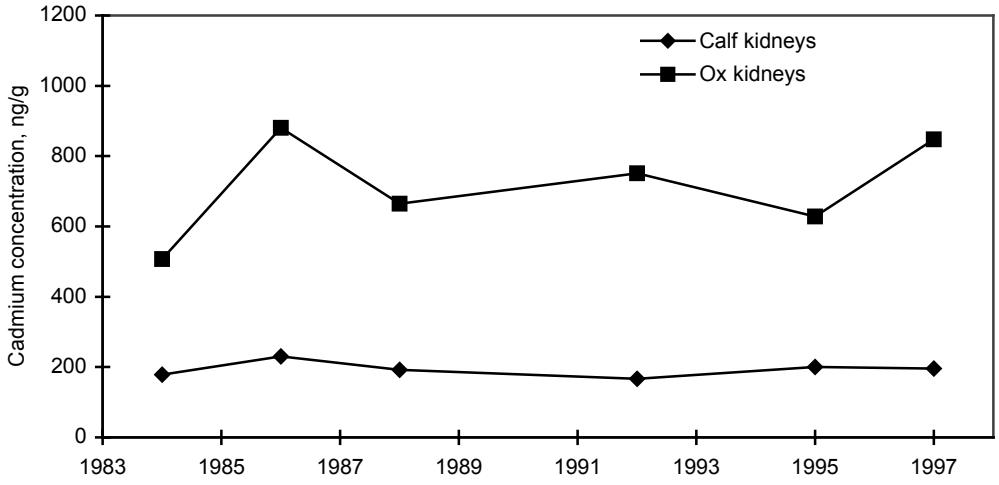

Figure 4. *Development in the average contents of cadmium in kidneys of calves and oxen during the period from 1984 to 1997.*

Like lead, cadmium is bound especially in kidneys and liver from slaughter animals. The results in Figure 4 show that cadmium contents in older animals (oxen) is 3-4 times higher than that in younger animals (calves). While the cadmium contents in calf kidneys are stable over the years, the cadmium contents in ox kidneys vary somewhat more. This may be attributed to the wider age distribution of the adult animals at the time of slaughter. Since the cadmium contents in kidneys cannot be said to increase nor decrease, it must be assumed that the animals' exposure to cadmium via feedstuffs remains unchanged.

In comparison, the cadmium contents in root crops such as potatoes and carrots from the 3rd monitoring period were reduced to approximately one-half of the 1983 levels, as shown in Figure 5.

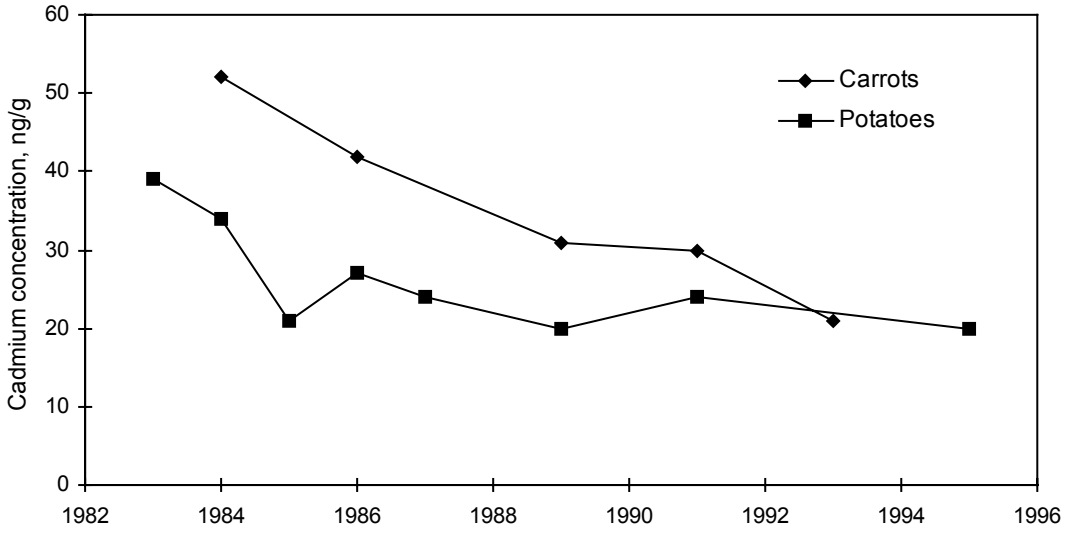

Figure 5. *Development in average contents of cadmium in the root crops potatoes and carrots during the period from 1983 to 1995.*

The sources of cadmium in foods are atmospheric deposition of cadmium-containing dust directly onto crops etc., as well as assimilation via soil. Apart from a natural content, the cadmium contents of the soil originate from atmospheric deposition and from application of cadmium-containing fertilizers. Concurrently with the increasingly more efficient flue gas cleaning at enterprises in Denmark as well as in our neighbouring countries, a gradual reduction of the atmospheric precipitation may be expected. The admission of cadmium to agricultural soil via the use of fertilizers depends on the cadmium contents of the fertilizer used. However, it is estimated that changes in the total cadmium content of the soil take place gradually over several years, as the existing cadmium content of the soil is high in relation to the admission via fertilizers.

Dietary intake of cadmium

In order to illustrate the health significance of cadmium contents in foods, a calculation of the total dietary cadmium intake has been made. The food groups that are the main contributors to our total cadmium intake are cereals, vegetables and beverages, as shown in Figure 6. For cereals, an increase in the cadmium intake from 6.5 to 8.3 µg per day in relation to the 2nd period is observed. This increase may be explained by an increasing average content of cadmium in rye bread, since much rye bread today is manufactured using a large proportion of ingredients with relatively high contents of cadmium, such as kernels and seeds, i.a. sunflower seeds. On the other hand, the contribution to the total cadmium intake from beverages as well as from meat and offal has decreased markedly in relation to the 2nd period. The contribution from the other food groups is unchanged between the two periods.

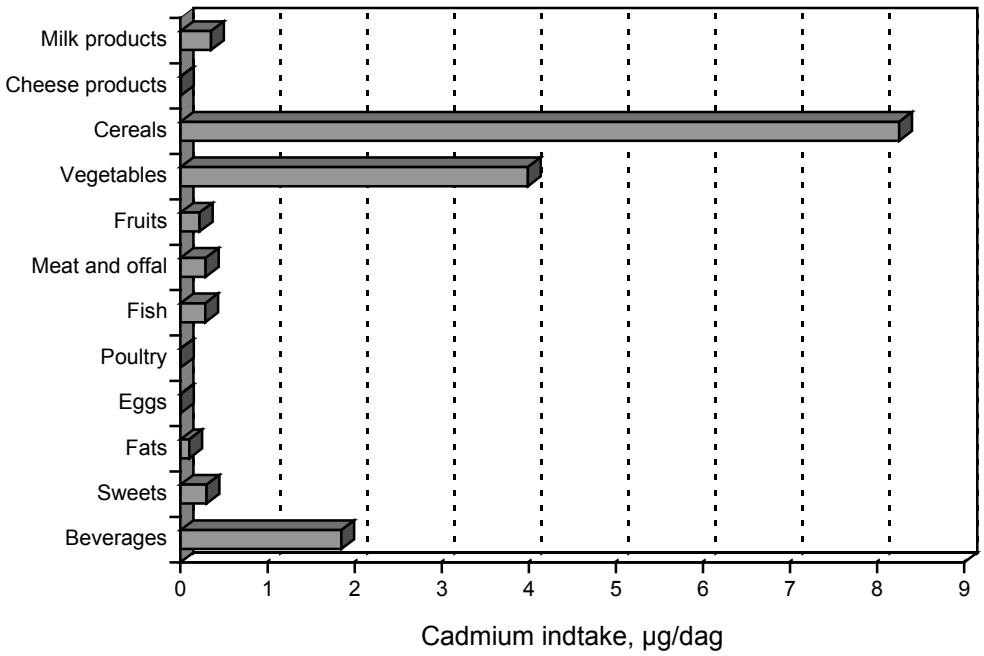

Figure 6. *Contributions of the food groups to the cadmium intake during the 3rd monitoring period.*

The total dietary intake of cadmium is shown in Table 4. The table shows a minor decrease in the average cadmium intake from the 1st to the 2nd monitoring period, from 20 mg per day to 17 mg per day, whereas the dietary intake of cadmium is unchanged in the 3rd period of the monitoring programme, 1993-1997. This is seen as an unexpected result in view of the implementation of a number of public measures to reduce the use of cadmium in materials and products as well as emissions of cadmium to the environment. On the long run, these initiatives should lead to lower contents of cadmium in the environment and in foods, and hence to a lower dietary intake; but this expected development has not yet been observed.

Table 4. *Total dietary cadmium intake in the 1st, 2nd, and 3rd monitoring periods.*

	Dietary intake of cadmium (µg/day)		
	Average	0.90 quantile	0.95 quantile
1st period (1983-1987)	20	28	32
2nd period (1988-1992)	17	25	28
3rd period (1993-1997)	17	25	28

Safety assessment

Cadmium is accumulated in the body, primarily in the liver and the kidneys, where it has a very long half-life and exerts a toxic effect especially on the kidneys. In 1972, JECFA established a provisional tolerable weekly intake (PTWI) of 400-500 µg/person. This value was confirmed in 1988 [10] and again in 1993 [11], but then it was expressed in µg/kg

bodyweight and was thus given the value of 7 μg/kg bodyweight/week, corresponding to 70 μg/person/day. However, in 1993 a number of supplementary studies was requested, and it was pointed out that the PTWI was established without any appreciable safety factor and that the margin between actual exposure through a normal diet and harmful doses is relatively narrow.

I 1993 [11], IARC classified cadmium to be carcinogenic in humans by inhalation, while no such effect by oral intake has been proven. SCF assessed the new situation in 1995 [12], and although JECFA's PTWI of 7 μg/kg bodyweight concerning the effect on kidneys was agreed upon, a dose which was certain to exclude any carcinogenic effect could not be identified; therefore, the importance of reducing the daily exposure as much as possible was emphasized.

From Table 4 it appears that the average dietary intake of cadmium is 17 μg/day; i.e. 24% of the tolerable value of 70 μg/day, the 0.90 and 0.95 quantiles being 25 and 28 μg/day, respectively, constituting 36% and 40% of the tolerable value. In consideration of the low safety factor in the PTWI establishment and the unresolved question about a potential carcinogenic effect, this margin between actual intake and tolerable intake must be considered unsatisfactory; therefore it is important to continue the monitoring of cadmium contents in Danish foods and also to continue the efforts to indentify the main sources of cadmium contamination in order to reduce these.

In the establishment of the PTWI for cadmium it has been presumed that only a certain percentage of the dietary cadmium intake will be assimilated. This value is, however, an average value, and there may be significant variations, depending on the chemical form and in which foods cadmium occurs. Thus, cadmium bound to metal-binding proteins (metallothioneines) will reduce the bioavailability and thereby the toxicity, whereas other forms might be assimilated and accumulated to a greater extent. Therefore, in order to obtain a more balanced risk assessment it must be considered whether future studies on the forms in which cadmium is found in foods should be included concurrently with the increasing knowledge of the bioavailability of the various forms.

3.7 Nickel

Nickel contents were analysed in 76 foodstuffs, and the results are shown in Appendix 9.2.3. In comparison with the corresponding results from the period 1988-1992 [2], the contents are generally unchanged, which also appears from the tests shown in Table 2.

The results in Appendix 9.2.3 show nickel to be found in relatively high concentrations in certain categories of foods, such as the coarse cereals, bread, and beans. Also fruits such as avocadoes, peaches, and raspberries contain high levels of nickel. The occurrence of nickel at a high concentration level in these foods can hardly be interpreted as a condition of contamination, but is probably due to a genetically conditioned assimilation of nickel from the soil. Like e.g. cadmium, nickel is furthermore regarded as an element having a considerable availability for plants from the soil which therefore may constitute a significant source of nickel in foods of vegetable origin.

Another variable source of nickel in foods may be contaminants in the external environment. Atmospheric contamination by nickel may originate from, e.g., combustion of fossil fuels and may, like lead, be deposited on the surfaces of green crops. However, the nickel contents in greens such as curly kale, lettuce, and spinach in the 3rd period were not lower than in the 2nd period. On the other hand, nickel contents in calf liver and kidneys show a decreasing tendency from 1984 to 1997, as shown in Figure 7. Like lead and cadmium, nickel accumulates in the kidneys, and the observed decrease may be due to decreasing contents of nickel in the animals' feedstuff.

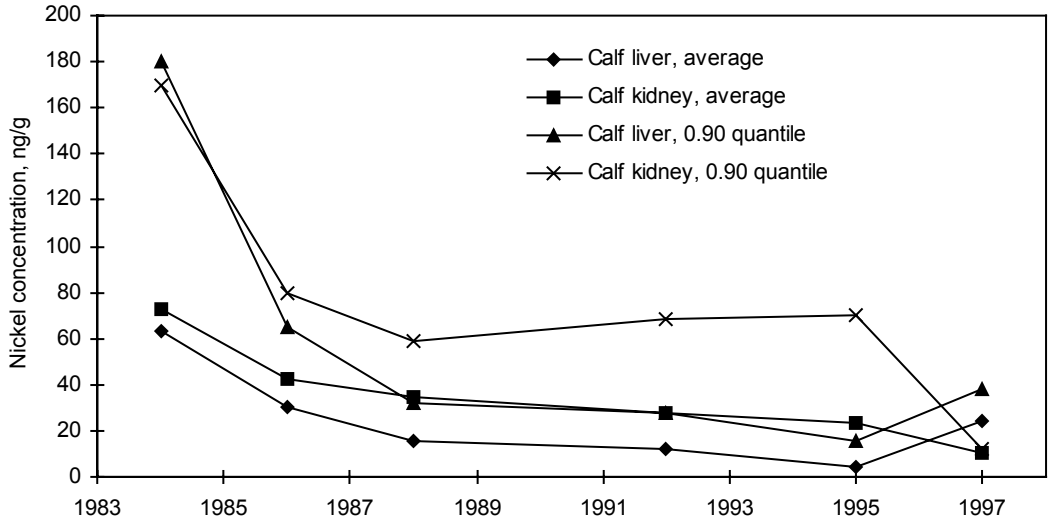

Figure 7. *Development of nickel contents in calf liver and kidneys during the period from 1984 to 1997.*

Further it should be mentioned that the nickel contents in certain foods show great variations between years during the three monitoring periods 1983-1997. An example of this is the nickel content in wholemeal rye bread and dark rye bread, as shown in Figure 8. The causes of the variation are not known.

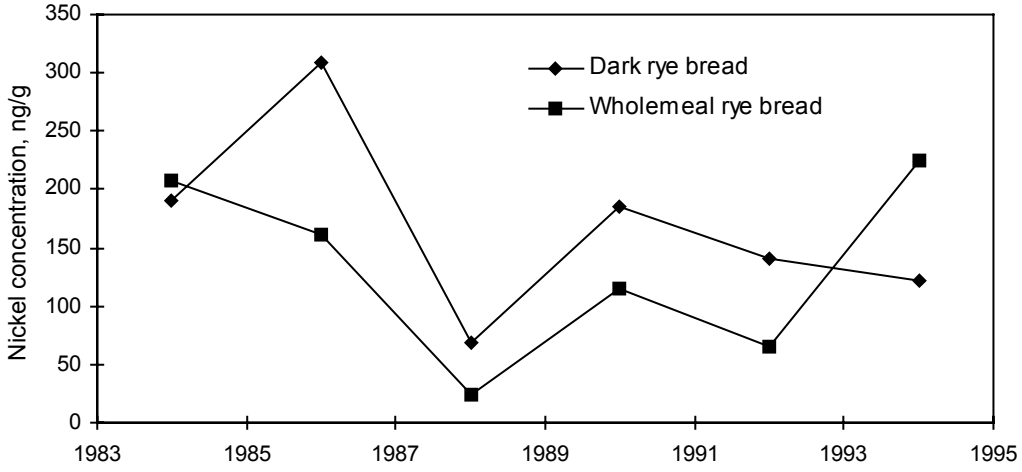

Figure 8. *Development in the average nickel contents in wholemeal rye bread and dark rye bred during the period from 1984 to 1997.*

The last source of nickel contents in food and water is set-off from household utensils and packing materials with which the foods come into contact. Generally, stainless steel is an acceptable material for direct contact with foods, the set-off of i.a. nickel being negligible. However, nickel-plated surfaces, such as nickel-plated heating elements in electric kettles, may release nickel in quantities [13] that may give rise to health concerns. For this reason, such nickel-plated heating elements have been withdrawn from the market and replaced by stainless steel.

Dietary intake of nickel

The above-mentioned variations in the nickel contents of certain foods imply that the calculated nickel intake may be expected to vary somewhat between the three monitoring periods. However, the calculated intake of nickel in Table 5 shows the dietary nickel intake to be unchanged from the 2nd to 3rd period, but decreased in relation to the 1st period.

Table 5. *Total dietary intake of nickel in the 1st, 2nd, and 3rd monitoring periods.*

	Dietary intake of nickel (µg/day)		
	Average	0.90 quantile	0.95 quantile
1st period (1983-1987)	199	302	353
2nd period (1988-1992)	157	241	281
3rd period (1993-1997)	160	232	270

The contributions of the individual food groups to the total nickel intake are shown in Figure 9. There has been an increased intake of nickel via milk products from the 2nd to 3rd period [2]. But the increased contribution from milk products is primarily due to the fact that cocoa

milk, containing nickel via its cocoa ingredients, now has been included in the dietary model used. For vegetables, fats, eggs, and offal, there has been a decreased contribution to the nickel contents as compared with earlier results. The high nickel intake from beverages is due to tea and coffee which may have high contents of nickel.

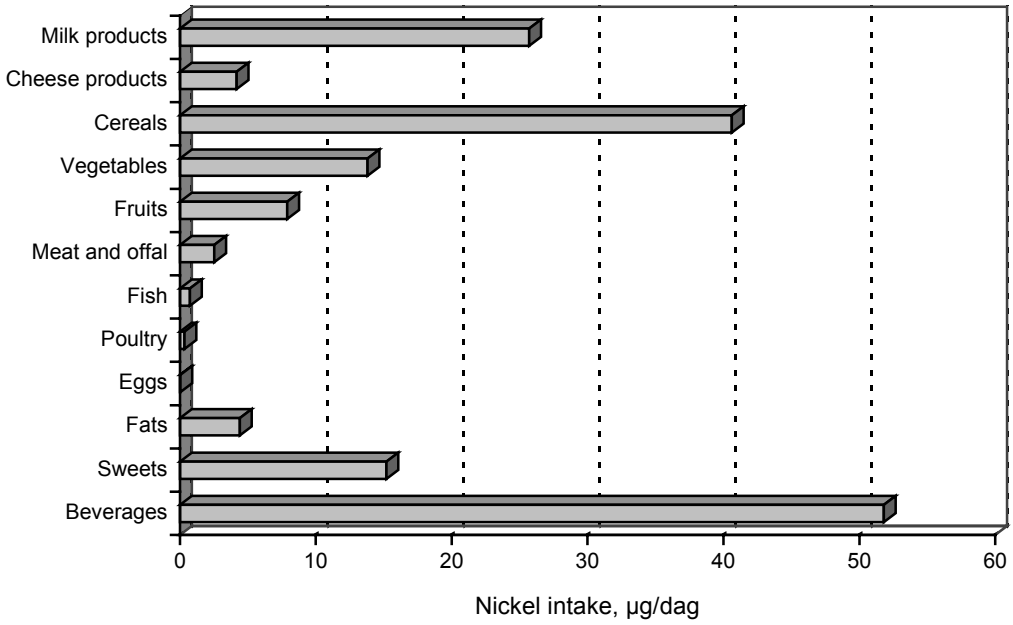

Figure 9. *Contributions of food groups to the nickel intake in the 3rd monitoring period.*

Safety assessment

The nickel contents in foods constitute no health hazard for the greater majority of the population. On the other hand, some of the persons who have developed contact allergy towards nickel, may experience allergic reactions with eczema also after ingestion of nickel-containing foodstuffs. In order to avoid provoking allergic attacks caused by nickel in foods, it is recommended that the intake of nickel is kept below 250 µg/day [14]. Table 5 shows that while the average diet, containing 160 µg/day, lies below this limit, 10% of the population will ingest quantities close to or above this value (the 0.90 quantile being 232 µg/day and the 0.95 quantile 270 µg/day). Thus, for nickel allergic persons in this group, the nickel contents may be a problem; and therefore the Danish Veterinary and Food Administration has published a booklet providing nickel allergy sufferers with good advice on which foods to choose and which to avoid to prevent triggering off allergic reactions caused by the diet [14].

3.8 Mercury

A total of 25 foodstuffs were analysed for contents of mercury during the 3rd period of the monitoring programme, and the results are given in Appendix 9.2.4. The food groups studied were meat and offal, fish, poultry, and eggs. The results for mercury in foods from the 3rd monitoring period are generally on a level with the corresponding results from the 2nd period;

accordingly, the tests for changes in mercury contents in Table 2 show only few changes in average contents between the two periods.

Mercury contents are much higher in fish than in other foods. This is mainly due to natural circumstances, i.e. the concentration of mercury through the food chain of fish. Predatory fish at the top of the food chain may therefore contain considerable quantities of mercury. A significant proportion of this mercury derives from volcanic eruptions. Furthernmore, in isolated bodies of water, also pollution caused by human activities may affect the mercury contents of fish. The most important of such known pollution sources have now been stopped; as a result, the mercury contents in fish from the areas concerned have now dropped to an acceptable level from a safety point of view.

Mercury contents in meat are still at a very low level, near the limit of detection of the analytical method used, i.e. approx. 7 ng/g, and do not present any health problem.

Also liver and kidneys from calves and pigs have low and stable mercury contents, as shown in Figure 10. The lower mercury contents in these organs compared with corresponding results from the mid-1980s reflect the fact that the mercury contamination of the animals' feed and environment is now at a low and stable level. The earlier, sporadically occurring illegal uses of mercury-treated seed grain as pig feed, which could give rise to greatly increased mercury contents in the animals' kidneys, are thus no longer observed.

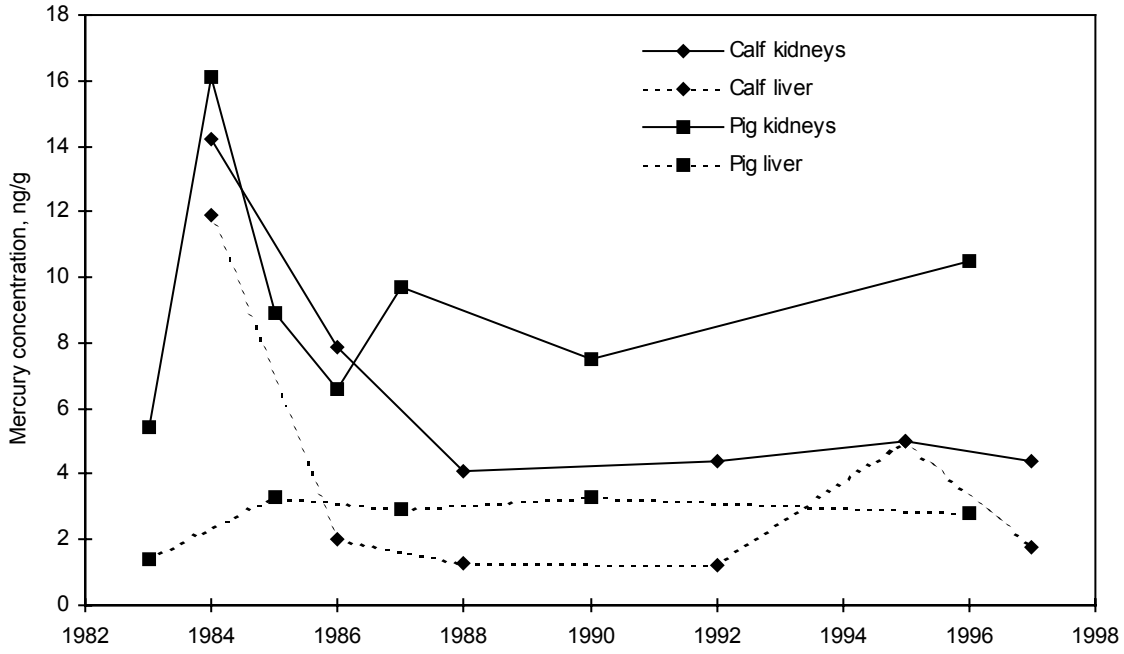

Figure 10. *Development in the contents of mercury in liver and kidneys from pigs and calves during the period from 1984 to 1997.*

The results for mercury in herring, plaice, cod, and flounder for the years 1983, 1988, and 1995 in Figure 11 show the mercury contents (average and median) for the same fish species to be largely unchanged. Only the highest mercury contents in cod (0.90 quantile values) are

decreasing from 1983 to 1995. Analyses of the same four fish species, caught in the North Sea, the Kattegat, and the Baltic Sea, respectively, after the 2nd monitoring period [2] revealed that mercury contents in flounder from the Baltic Sea and in cod from the North Sea were higher than in the same fish species caught in the other waters. However, it is not possible to give an unambiguous explanation of this difference nor of the development over time in the mercury contents of the samples, since both the intensity of the mercury pollution of the waters and biological factors such as food selection and growth conditions may influence the resulting contents of mercury.

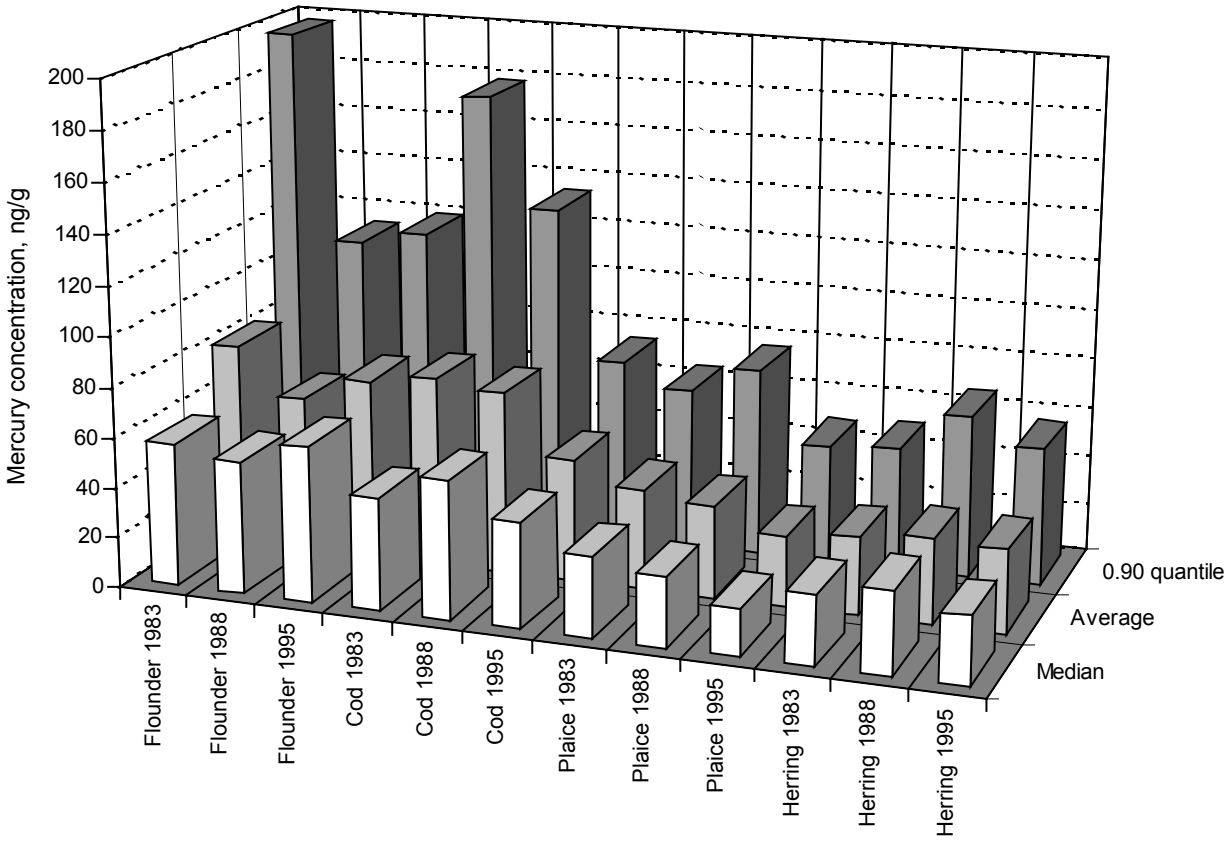

Figure 11. *Development of contents of mercury in flounder, cod, plaice, and herring during the years 1983, 1988, and 1995.*

Dietary intake of mercury

Only 25 foodstuffs were included in the 3rd period of the monitoring programme with results for mercury. Therefore, the calculation of the intake was to a considerable extent based on results from the 2nd monitoring period and from other Danish sources. The estimated total dietary intake of mercury is shown in Figure 12.

Table 6. *Total dietary intake of mercury in the 1st, 2nd, and 3rd monitoring periods.*

	Dietary intake of mercury (µg/day)		
	Average	0.90 quantile	0.95 quantile
1st period (1983-1987)	7	12	15
2nd period (1988-1992)	5	7	9
3rd period (1993-1997)	4	5	7

The distribution of the mercury intake via the food groups is shown in Figure 12. In the 3rd period, the food groups meat/offal and fish contribute somewhat less to the mercury intake than in the 2nd period [2]. The observed decrease in the calculated intake of mercury may be due to changed dietary habits in the latest dietary survey from 1995 [4].

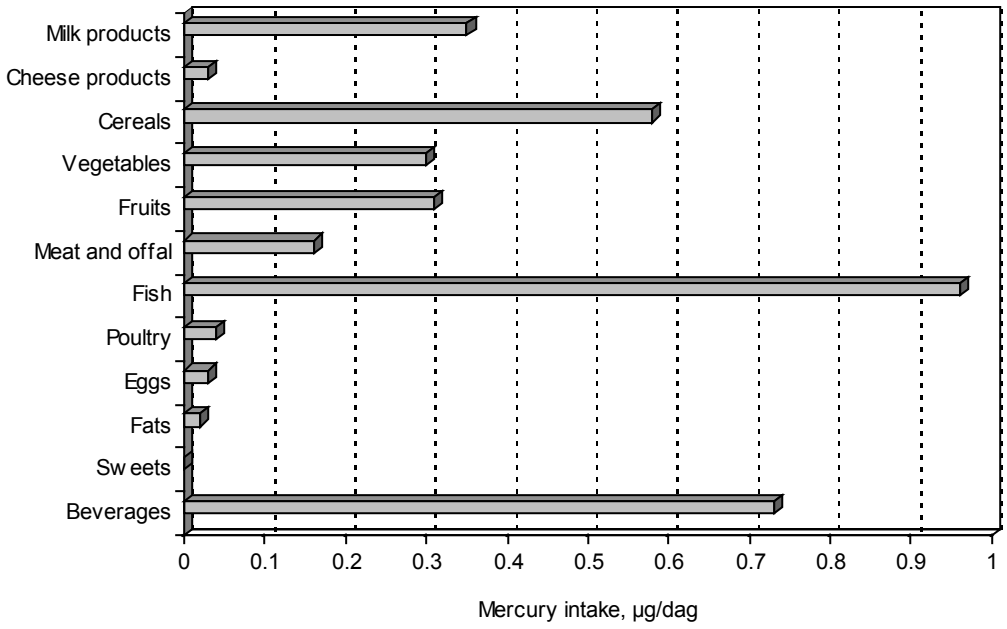

Figure 12. *Distribution of mercury intake via the 12 food groups.*

Since the mercury intake of individuals is highly dependent on the individual's consumption of fish, the 0.95 quantile will thus illustrate the mercury intake of a fish-eating person according to the dietary survey of 1995 [4]. Occasionally the public food control has demonstrated that mercury contents in certain food fish may approximate the established maximum limit for contents of this substance. Frequent consumption of such fish may therefore lead to an appreciably increased intake of mercury.

Safety assessment

Mercury is accumulated in the body and has a long half-life. With inorganic mercury, harmful effects will be manifest in the kidneys first, whereas organic mercury (methylmercury) primarily affects the central nervous system.

In 1972, JECFA established a provisional tolerable weekly intake (PWTI) of 5 μg/kg bodyweight for mercury, of which no more than 3.3 μg may be present as methylmercury [8]. These values were confirmed in 1978 [15]. In 1988 [10], methyl mercury was subjected to a closer examination, and although no occasion for changing the PTWI was found, it was pointed out that the risk was probably greater for pregnant and nursing women, but that data were not available to establish another, lower PTWI for this group.

In June 1999, JECFA assessed the latest epidemiological data for the intake of organic mercury in relation to the neurological effects on children. Two comprehensive studies, one from the Faroe islands and one from the Seychelles, did not show unambiguous results. The study from the Faroe islands reported a connection between exposure to methylmercury in the embryonic/foetal stages and low scores by seven-year-old children in a series of neurological tests directed to skills such as motoric function, language, and memory. The study from the Seychelles did not report neurological effects in children up to the age of $5^1/_2$ years. The two studies are not immediately comparable with respect to the age of the children nor the methods used. Due to ongoing studies of seven-year-old children from the Seychelles, using methods comparable to those used on the Faroe islands, JECFA decided to postpone a final assessment. The existing PTWI was not changed.

From Table 6 it can be seen that the estimated total intake of mercury constitutes an average of 4 μg/day, the 0.90 and 0.95 quantiles being 5 and 7 μg/day, corresponding to 28 and 35 and 49 μg/week per person, respectively; i.e. 8-14% and 12-21% of the PTWI for total mercury, assuming all intakes to be methylmercury. This does not give rise to health concerns.

With the levels which can be found in some fish, one may occasionally consume quantities which, converted to daily doses, would approximate the tolerable value. However, the toxic effect of mercury depends on total intakes over a period rather than day-to-day variations, so occasional intakes of somewhat larger quantities are of no significance to the overall assessment.

3.9 Arsenic

In the 3rd period of the monitoring programme, fish was the only food group that was analysed for contents of arsenic. This is due to the fact that the results from the 1st and 2nd periods showed the arsenic contents in fish to be much higher than those in other food groups, and that the arsenic intake via fish constituted 73% of the total dietary intake of arsenic [1]. The results for arsenic in fish are given in Appendix 9.2.5.

The results for arsenic contents in plaice, cod, flounder, and herring are shown in Figure 13 and cover the years 1983, 1988, and 1995, corresponding to the three periods of the monitoring programme. The results demonstrate differences in the arsenic contents between fish species and variations in the average and high contents between years. However, these variations are difficult to explain, since the contents of arsenic are caused by natural circumstances and may hardly be due to pollution to any particular extent.

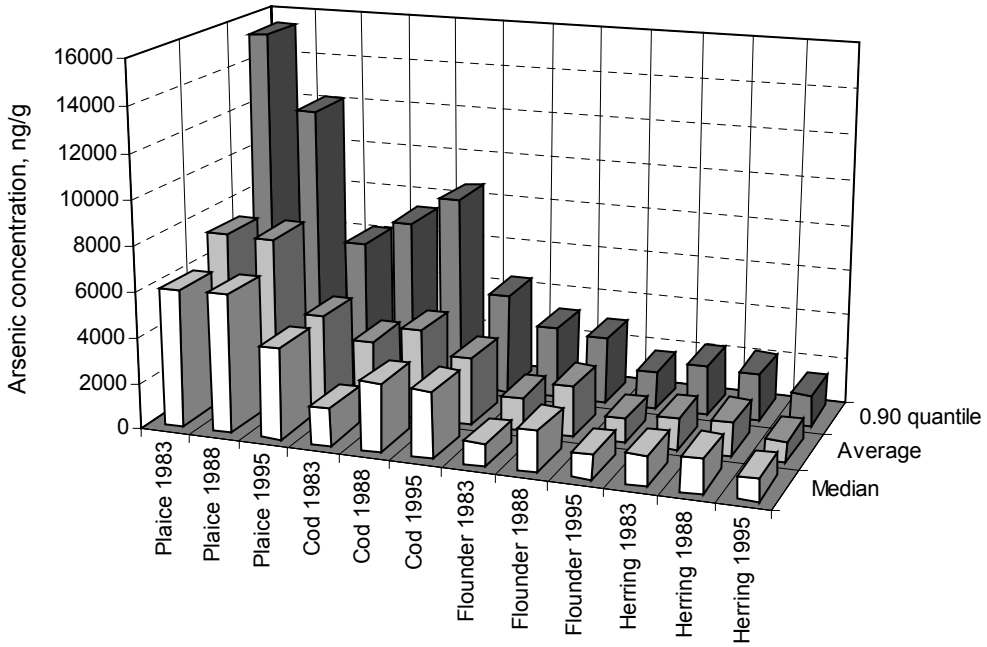

Figure 13. *Development of arsenic contents in plaice, cod, flounder, and herring during the years 1983, 1988, and 1995.*

After the 2nd period of the monitoring programme [2], results for arsenic contents in the same four fish species, caught in the North Sea, the Kattegat, and the Baltic Sea, respectively, showed that arsenic contents were also determined by the fishing ground. The arsenic contents in plaice and cod from the North Sea and the Kattegat (high and medium salinity) were thus 4-8 times higher than in the same fish species from the Baltic Sea (low salinity). The observed differences in these arsenic contents are probably due to biological factors such as growth rate and food choice in the compared waters. It is not likely that such differences are due to arsenic pollution of the seas.

Dietary intake of arsenic

In connection with the implementation of the 1st period of the monitoring programme, 1983-1987 [1], a calculation of the total dietary arsenic intake was made. This showed that the arsenic intake from fish constituted 86 µg per day in relation to a total daily intake of 118 µg, corresponding to 73%. The comparable contribution from fish in the 3rd period makes up 65 µg of arsenic per day.

Safety assessment

Arsenic occurs mainly as the non-toxic compound arsenobetaine [16] in fish. The content of the far more toxic inorganic arsenic constitutes only 1-5% of the total arsenic content of fish [17]. In 1988, JECFA established a provisional tolerable weekly intake (PTWI) of 15 µg per kg bodyweight [10]. The committee observed that fish may contain considerable quantities of arsenic, but in the organic form which does not have the same toxic effects as inorganic arsenic. Since the part of inorganic arsenic makes up 1-5% of the total arsenic content in fish, it is estimated that the findings in fish, and the earlier findings from the 1st period concerning arsenic in foods, do not give rise to health problems. Therefore it may be considered whether arsenic needs to be included in the monitoring programme in future.

4. NITRATE

4.1 Introduction

Nitrate is the main nitrogen source of plants, and nitrate may therefore be accumulated in plant parts and thereby in fruits and vegetables. In the plants, nitrate is reduced to nitrite as the first step in the amino acid and protein synthesis. Several factors are decisive for a plant's content of nitrate. These are circumstances such as the plant species, the quantity of nitrogen available to the plant, and, i.a., light and heat, which act on the nitrogen metabolism.

The acute toxicity of nitrate as such is low; but in foods or in the gastro-intestinal tract, nitrate may be transformed into nitrite, having a much higher acute toxicity. However, the health problem in relation to nitrite is primarily its contribution to the formation of nitrosamines. Many nitrosamines have been found to have a potent carcinogenic effect in animal experiments, and it is considered likely that they may also be carcinogenic in humans [18].

In 1979 and 1980 [19], a comprehensive study of the contents of nitrate in fruits and vegetables in Denmark was carried out. This study formed the basis of the selection of crops for the monitoring programme, as it was calculated that the contribution of the crops selected, i.e. leeks, potatoes, cabbage, lettuce, and beetroots, was more than one-half of the total nitrate intake from fruits and vegetables.

4.2 Sampling, analytical method, and quality assurance

The sampling was carried out on a nation-wide basis by the municipal food control units, after which the samples were sent to the regional laboratory in Odense. The analyses were performed according to the Danish Veterinary and Food Administration's method for the determination of nitrate in fruits and vegetables [20,21,22]. In addition to individual determinations, each sample series included one blank determination, one duplicate determination, and one sample with an addition of a known quantity of nitrate for recovery calculation. The regional laboratory in Odense participates in intercalibrations/performance tests through FAPAS.

4.3 Data on contents

As in the previous monitoring periods, lettuce, potatoes, cabbage, leek, and beetroot were analysed in the 3rd period. Since Chinese cabbage is in many cases used in the same way as lettuce, it was decided from 1994 to add Chinese cabbage to the selection of crops.

Analyses for nitrate took place in the years 1993 [20], 1994 [21], May-December 1995, and January-April 1996. The latter results have been pooled and are presented as 1995/96 [22]. The results have also been presented in a periodical article [23].

The results for each of the years under study are shown in Appendix 9.3.1. As it appears from the Appendix, there is a considerable year-to-year agreement between the average contents in individual products, with the exception of leek, in which the contents found in 1993 were substantially lower than the results from the other years. The standard deviation, however, is large. The results for nitrate vary widely according to crop, but there is also considerable variation within the same crop. Even between crops that have been grown within a short distance of one another, great differences have been found.

In the two previous monitoring periods, contents of nitrate were analysed in the years 1984-1998 [1,2]; i.e. four years in the 1st and one year in the 2nd monitoring period. In Table 7, average contents in lettuce, leek, potatoes, cabbage, and beetroot are shown for the years 1984-1988 and 1993-1996, and scatter for individual measurings is also indicated.

Table 7. *Comparison of nitrate contents (mg/kg fresh weight) in the various vegetables during the years 1984-1988 and 1993-1996.*

	1984-1988	1993-1996
	average ± standard deviation	average ± standard deviation
Lettuce, Danish	1900±950	2600±1300
Lettuce, foreign	1900±950	1300±840
Lettuce, all samples	1900±950	2200±1300
Potatoes, Danish	80±70	140±95
Potatoes, foreign	120±95	260±130
Potatoes, all samples	90±80	180±120
Beetroots	2000±1300	1500±990
Leeks	290±230	280±360
Cabbage	230±240	330±230

Leeks, cabbage, and beetroots

As seen in Table 7, the content of nitrate in leeks from this monitoring period is on a level with the findings from the two previous monitoring periods. Nitrate content in beetroots has decreased from the previous monitoring periods, whereas the content in cabbage has increased.

Potatoes

Table 7 shows that in the present monitoring period as well as in the years 1984-1988, higher contents of nitrate were found in foreign than in Danish potatoes. At the same time, considerably more nitrate was found in both Danish and foreign potatoes in the present monitoring period as compared with earlier periods. In the previous two periods, averages from 50 to 171 mg nitrate/kg were found in potatoes, compared with now from 110 to 319 mg

nitrate/kg. The differences may have several causes, such as different cultivars, places of origin, fertilization, and dry matter contents.

Lettuce

The category 'lettuce' comprises both head lettuce and iceberg lettuce. As can be seen in Appendix 9.3.1, less nitrate was found in foreign lettuce than in Danish lettuce. There are several explanation to this. It is known that lettuce with open heads, such as head lettuce, contains more nitrate than lettuce with closed heads, such as iceberg lettuce; and many of the foreign samples are iceberg lettuce, whereas the Danish samples are mainly head lettuce. Light and heat are factors influencing the nitrate content. Nearly all Danish lettuce is grown in greenhouses, and during winter hardly any artificial light is used in these greenhouses, even though there is not much natural light in Denmark. Consequently, the nitrate content varies throughout the year, which is shown for Danish lettuce in Figure 14. As shown in the figure, the content is lower in summer than in winter.

Considerably more nitrate has been found in Danish lettuce during the present monitoring period than in the previous periods; see Table 7. On the other hand, foreign lettuce contains appreciably less nitrate in the present period than earlier. This is due to two circumstances. In the first monitoring periods, most of the foreign lettuce was head lettuce originating from The Netherlands, whereas the by far greater part of the foreign lettuce in the present period was iceberg lettuce from Spain. In total, the average content of nitrate in all samples of lettuce has increased slightly from the previous periods to the present period.

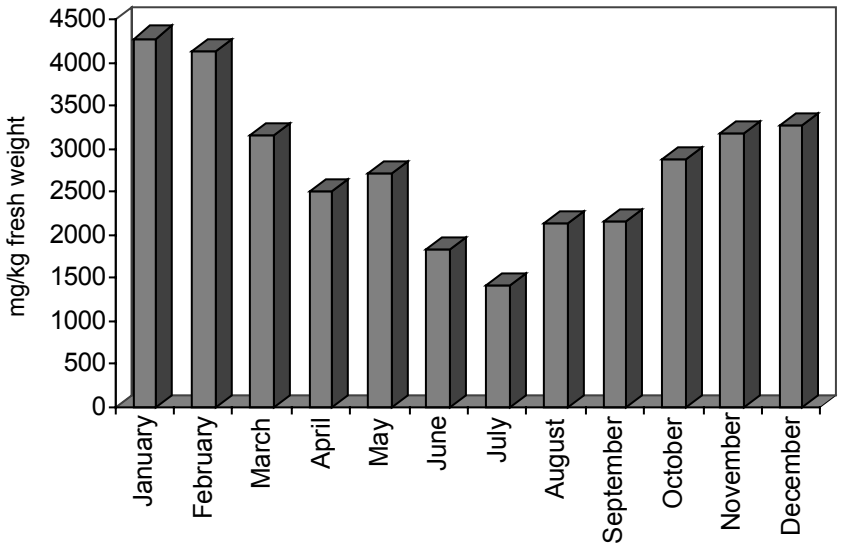

Figure 14*. Content of nitrate in Danish lettuce month by month. Average for the years 1993-1996.*

Maximum limits

In the EU [24, 25], common maximum limits, in force from 1997, have been adopted for the contents of nitrate in lettuce as well as fresh and frozen spinach. Table 8 shows the maximum limits and the number of Danish samples which would have exceeded the 1997 limits if these had been in force during 1993-1996. All samples in May are assumed to have been grown in greenhouses, and in June, July, and August only samples explicitly specified as indoor or outdoor culture, are included. The figures in Table 8 show that a certain proportion of Danish-grown lettuce exceeds the maximum limits.

Table 8. *Maximum limits for contents of nitrate in lettuce, and the number of Danish samples from 1993-1996 which would have exceeded the maximum limits introduced in 1997.*

Time interval	Maximum limit (mg/kg fresh weight)	Number of samples/Number of violations
1st October – 31st March	4,500	156/17
1st April – 30th September	3,500	94/11
1st May – 31st August (outdoor culture)	2,500	5/2

4.4 Intake calculations

Figure 15 shows the differences in average intakes of nitrate from various products in the present period as compared with the previous two periods. For each product, the mean value of contents for all years was used in the calculations. In the period 1984-1988, figures from Danmarks Statistik [26,27] were used, whereas now the dietary survey of the National Food Agency of Denmark from 1995 [4] is being used. This has made it possible to group the nitrate intake into head lettuce, iceberg lettuce, and Chinese cabbage, whereas earlier these three crops were included in one collective group. Therefore, Figure 15 does not have separate columns for iceberg lettuce and Chinese cabbage for the period 1984-1988. The consumption of potatoes, cabbage, and beetroots has decreased when the figures from Statistics Denmark and the National Food Agency of Denmark are compared, i.e. from 166, 18, and 2 g/day, respectively, to 124, 8, and 0.9 g/day. For lettuce and leeks, the intake is the same as earlier, i.e. approx. 4 and 2 g/day.

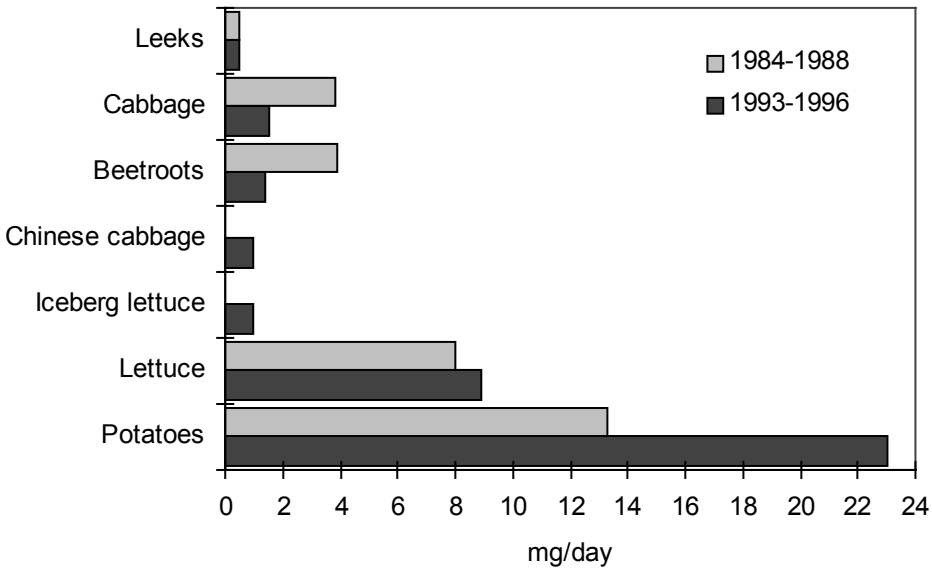

Figure 15. *Comparison of the nitrate intake from vegetables included in the monitoring programme.*

As seen in Figure 15, potatoes are the major individual contributor to the Danish population's nitrate intake from fruits and vegetables, followed by head lettuce, cabbage, beetroots, iceberg lettuce, Chinese cabbage, and leeks. In the vegetables under study, potatoes were found to have the lowest nitrate content; but then the consumption of potatoes is much higher than that of the other vegetables. Furthermore, the considerably higher contents found in potatoes during the present period as compared with the earlier periods indicate a marked increase of the intake of nitrate from potatoes. Also for lettuce, the intake of nitrate has increased, likewise due to higher contents. The intake of nitrate from cabbage and beetroots, on the other hand, has decreased. This is due to a lower consumption of these two products. The increased intake of nitrate from potatoes and lettuce exceed by far the decrease for cabbage and beetroots, so the total average intake of nitrate from the products included in the Danish monitoring programme is now approx. 37 mg/day, compared with approx. 30 mg/day earlier.

In Table 9 the intake of nitrate from vegetables, as well as a total intake, has been calculated. The first column shows the intake of nitrate from vegetables, partly with data from the monitoring programme, partly with data from other studies of vegetables [28, 29]. The second column shows the total intake of nitrate from all foods calculated on the basis of information in other studies on the nitrate contents of various other foodstuffs such as bread and dairy products [28,29,30]. Meat and fish were not included in the calculations, since it was estimated that no reliable data on contents were available, and because of the insignificant contributions of meat and fish to the total intake of nitrate.

The total intake includes the contribution from drinking water. Drinking water is not comprised by the monitoring programme, and nitrate contents in drinking water vary considerably in Denmark. The greater part of Danish water contains less than 5 mg/l, which means in practice that the drinking water is based on nitrate-free ground water [31]. According to the dietary survey [4], the Danish population drinks on an average 1.95 litre of

liquid in the form of water, apple juice, soda water, coffee, and tea. In the calculations in Table 9, an average nitrate content in water of 2.5 mg nitrate/l has been used, which gives an intake of 4.9 mg/day. Thus, water contributes to a lesser extent to the average intake of nitrate.

Table 9. *Intake of nitrate.*

	Via vegetables (mg/day)	Total intake (mg/day)
Average	50	61
Median	45	56
Standard deviation	29	30
0.90 quantile	84	96
0.95 quantile	100	113

A few percent of the waterworks and water companies exceed the recommended limit of 25 mg/l or the maximum permitted limit of 50 mg/l. If the drinking water does not contain 2.5 mg/l, which was used in the calculations in Table 9, but 25 mg nitrate/l, it gives an intake from water of 49 mg nitrate/day, which is comparable with that from fruits and vegetables.

As it appears from Table 9, the contribution from other foods such as, e.g., bread and dairy products is not very high compared with the intake from fruits and vegetables. The average intake increases from 50 mg nitrate/day to 61 mg/day when the contribution from other foods is added to that from vegetables and water.

4.5 Safety assessment

For nitrate, an acceptable daily intake (ADI) of 5 mg/kg bodyweight has been established [32]. The value is expressed as sodium nitrate, in conversion giving a value of 3.7 mg nitrate/kg bodyweight, which corresponds to a value of 257 mg/day for a person weighing 70 kg. As seen in Table 9, the average as well as the 0.95 quantile intake are thus somewhat lower than the established ADI value.

5. ORGANIC ENVIRONMENTAL CONTAMINANTS

5.1 Introduction

The increasing industrialization is accompanied with the pollution of the surrounding environment with a number of substances which have been found to be slowly degradable in the environment and which are found as contaminants in our foods today. Traditionally, the attention has been directed towards the persistent organochlorine contaminants such as dioxin, PCB (polychlorinated biphenyls) and compounds which have earlier been widely used as pesticides (for example DDT). However, recent years have brought about an increased realization of the fact that also other environmental pollutants can lead to the contamination of foods. This applies to, i.a., certain disinfectants, substances used in cosmetics, and fire-retarding substances.

In the monitoring programme, analyses for organochlorine compounds are carried out because of their potential health hazardous effect on humans; see Section 5.6. The r[E1][E2]esults of the studies under the monitoring programme are presented in a series of reports that are published successively by the Danish Veterinary and Food Administration. The data base of the monitoring of persistent organochlorine compounds, reported in its entirety in this chapter, has previously been reported in part [33,34,35,36]. The data for 1997 have not been published before; and also some minor projects [37,38,39] are presented here for the first time.

Sources of intake of organochlorine compounds

The occurrence of persistent organochlorine compounds in the environment is changing relatively slowly over a span of years; similar time trends are characteristic of contents in fish, meat, eggs, and dairy products, which are the foods with the greatest contributions to the intake of organochlorine compounds. Contents of organochlorine compounds may derive from pollution of the environment where the compounds, being fat-soluble and because of their apolar properties, accumulate up through the food chain. In meat, eggs, and dairy products, contents of the organochlorine pesticides may also derive from residual contents in feedstuffs or from applications in the environment of the animals.

Analysed compounds

The studies comprised a number of organochlorine compounds which earlier were used mostly as insect-controlling pesticides. These are: p,p'-DDT with its metabolites p,p'-DDE and p,p'-DDD (the values for these three substances are reported here as the sum of the three, referred to as the ΣDDT), aldrin, dieldrin, HCB (hexachlorobenzene), α- and β-HCH (hexachlorocyclohexane), lindane (γ-HCH), and heptachlor epoxide, which is a metabolite of heptachlor.

Among the substances under study, only lindane has been permitted for use in Denmark in the period 1993-1997. From 1st December 1994, import and sale of lindane were prohibited, and

all use was prohibited from 1st July 1995 [40]. Dieldrin was discontinued in 1988, whereas aldrin was withdrawn already in 1963. The use of DDT was prohibited in 1984, and heptachlor has not been used since 1972 [41]. HCB and α- and β-HCH have never been permitted for use in Denmark. However, organochlorine pesticides have been used world-wide since the time of the Second World War and are still being used in some developing countries. A substance such as DDT has been used widely, i.a. for controlling malaria-carrying mosquitoes, but also for the control of insect pests in Denmark. Formerly, the stability of the substance was considered an advantage in relation to its insect-controlling purposes; and it was not realized till later that DDT and other organochlorine pesticides break down slowly in animals and humans. Being also highly fat-soluble, the substances concentrate in fatty tissues from which they are not readily eliminated.

Also PCB (polychlorinated biphenyls) has been included in the analyses. PCB is a group of 209 compounds which, due to their physical and chemical properties, were utilized for industrial purposes since the 1930s. PCB has been widely used as isolating material in capacitors and transformers. Furthermore, i.a. because of its chemical stability and fire-retarding properties, PCB has been used in hydraulic systems and as an additive to paints, printing inks, coolants, and cutting oils, and PCB has been used as a plasticizer in plastics.

In Denmark, regulations that have led to significant restrictions in the use of PCB, were introduced in the 1980s. Thus, import and sale of PCB and PCB-containing products were prohibited in 1986 [42]. The use of larger, existing transformers and capacitors containing PCB was, however, permitted until January 1995, while smaller transformers and capacitors containing PCB may be used for as long as they last [42]. Even though the use of PCB has been regulated over a number of years in most western countries, the substances will, due to their stability, remain in the environment for many years to come.

PCB contents in individual samples have been determined as total PCB using Aroclor 1260 as reference. Aroclor 1260 is a technical mixture of different PCB compounds, usually referred to as PCB congeners. Each PCB congener is specified by a number. The analysis for total PCB is highly method-dependent, and a comparison of results between laboratories is subject to considerable uncertainty. As an alternative to this method, a new, improved analytical method has been used since 1994, involving a specific determination of 12 individual PCB congeners: PCB28, PCB52, PCB101, PCB105, PCB114, PCB118, PCB138, PCB153, PCB156, PCB167, PCB170, and PCB180. Because PCB114 and PCB167 are practically never detected, these congeners were not included in the present report. The text differentiates between total PCB, calculated with Aroclor 1260 as reference, and ΣPCB, calculated as the sum of the 10 congeners.

Report and limit of detections

In earlier monitoring periods, a so-called report limit was used, and likewise in the 3rd period through 1993 for fish and through 1995 for products of animal origin. During these years, analysis results were reported only if contents were at least 0.1 mg/kg for total PCB and 0.01 mg/kg for organochlorine pesticides, with the exception of the ΣDDT for which the report

limit was set to 0.02 mg/kg in 1993 and 1994 and 0.01 mg/kg in 1995. In analyses of individual PCB-congeners from 1994, findings above the analytical limit of detection were reported, also for products of animal origin. The higher report limits were used because analyses near the limit of detection are very cost-expensive. Accordingly, a report limit was used, which for organochlorine pesticides was higher than the limit of detection but at the same time lower than any existing limit value. For total PCB, the report limit and the limit of detection were usually the same. As expected, contents of persistent organochlorine pesticides and PCB in foods have decreased, since these substances are no longer in use. In order better to follow the lower contents and better to estimate the population's dietary intake, it has been the practice since 1995 to report all findings above the limit of detection. This limit varies according to the different substances and may vary from year to year. Appendix 9.4.3 presents tables of the report and limit of detections used.

5.2 Sampling, analytical methods, and quality assurance

The results from the 1st monitoring period, 1983-1987, showed that contents in lean fish such as cod, plaice, and flounder are appreciably lower than contents in fat fish, represented by herring. As the studies on this background were planned with a view to closely following the food group with the highest contents, the samplings of fish in the 2nd and 3rd periods comprise exclusively fat fish and cod liver. In the 3rd period, the following were involved: salmon, mackerel, herring, and eel from Danish main waters. The exception is a project from 1992/1993, where one of each of 41 fish species was sampled, including 9 species of fat fish, 10 of medium-fat fish, and 22 of lean fish [39]. For reasons of resource priorities, fish, dairy products, and eggs were not sampled under the monitoring programme in 1997.

For the analyses of meat, samplings of nation-wide coverage were aimed at. The dairy products butter and cheese were sampled such that the analyses would cover the Danish milk production as well as a selection of imported products. Since the analysed substances are fat-soluble, they will be found in the milk fat; therefore, primarily dairy products having relatively high fatty contents, such as butter, composite products of vegetable fat and milk fat, and cheese were sampled. Samples of eggs were taken at the egg packing stations, so that both Danish and foreign eggs were included in the analyses.

Kidney fat from cattle and pigs, and subcutaneous fat from poultry, was analysed. Studies [43,44,45,46] have shown the contents of organochlorine pesticides and PCB in such fatty tissues to be representative of the contents in market meat, measured on the basis of fat. Fillets of fish were analysed after removal of the skin, as it is presumed that only a few will eat fish skin, and that the migration of the substances from the skin to the rest of the fish during preparation will be minimal.

In Appendix 9.4.1, the number of samples of the various foods within the monitoring period is presented.

The chemical analyses are carried out at the regional laboratories in Aalborg and Århus. The fatty content of the sample is extracted using an organic solvent, after which the

organochlorine pesticides and PCB are isolated from the fatty phase and detected by gas chromatography with EC detection. For further information on the analytical methods, see reference [47]. The results are calculated as mg/kg fish/cod liver/eggs (fresh weight), or as mg/kg fat for pigs, cattle, poultry, and dairy products.

The analyses are carried out in accordance with the quality assurance manual *Forskrifter og retningslinier for bestemmelse af pesticid- og lægemiddelrester i fødevarer* (Instructions and guidelines for the determination of pesticide and drug residues in foods) [48] supplemented by *Vejledning om pesticidrester i fødevarer samt regler og retningslinier for kontrol hermed* (Instructions concerning pesticide residues in foods, and regulations and guidelines for the control of these) [49], and other general quality assurance procedures; see Section 2.1.

5.3 Data on contents

The average contents of the substances analysed in various foods are presented in Appendix 9.4.2. The tables show the total number of samples for each of the foodstuffs under study, the number of samples with contents above the detection/report limits; the average contents of the individual organochlorine compounds; a 95% confidence interval (given only in some cases; see below); and the maximum value. The ΣPCB has been calculated as the sum of the averages in Appendix 9.4.2 for 10 congeners; see Section 5.1.

Calculation of average contents

Two different calculation methods were used for the calculation of average contents of the various organochlorine environmental contaminants in foods. The calculated values are given in Appendix 9.4.2, and the calculation methods are briefly described below.

It must be assumed that environmental contaminants are present in varying quantities everywhere in the environment. In the calculation of average values in the types of samples analysed, data sets with many values below the detection/report limit constitute a particular problem, as such values may vary from zero (or near zero) and up to the detection/report limit concerned.

For the calculation of average contents in the present monitoring period (1993-1997) a programme, *Mean-BDL* [50], which allows for the fact that the distribution of results from random samplings of environmental contaminants can be described by a logarithmic normal distribution, was used. Thus, it is likely that when several measurings are above the limit of detection for a given substance and foodstuff, then the few measurings below the limit of detection will be higher than if only a few measurings were above the limit of detection.

The programme *Mean-BDL* cannot calculate an average when all measurings are below the limit of detection or only a few are above it. In such cases, values below the limit of detection are set to one-third of the limit of detection in the calculation of average contents. One-third of the limit of detection was chosen on the basis of what will correspond to the value which *Mean-BDL* has been using for figures below the limit of detection when only a few data are

above the limit of detection. This approach will probably lead to an overestimation of contents in those cases where no contents were found in any samples. In the cases where the programme *Mean-BDL* was used, a 95% confidence interval for average contents is given in Appendix 9.4.2.

In the period 1983-1987 [1], values below the report limit were set to zero if the average was above the report limit, which leads to an underestimation of the contents. When the average was below the report limit, the contents were set to the report limit, which leads to an overestimation of the contents. In order to obtain a more realistic picture of the intake, a calculation method was chosen for the period 1988-1992 [2] where values below the report limit were set to one-half of the report limit.

The use of different calculation methods makes it more difficult to compare the intakes calculated for the three monitoring periods. However, the diet data on which the calculations were based also differ, which complicates any comparison in advance; see Section 2.2.

Contents in fish

It appears from Appendix 9.4.2 that contents of organochlorine pesticides and PCB in fish depend on the fish species as well as the water where the fish was caught. One of the reasons why the contents of these substances vary according to fish species is the fact that the fatty content varies according to fish species; and the difference between waters can be explained by the difference in the environmental pollution of the waters with organochlorine pesticides and PCB. No information was available on other factors concerning the fish included in the studies, such as their food basis, age and sex, as well as the season. It is, however, likely that a relation exists between these parameters and the variation in the contents of organochlorine pesticides and PCB in the fish. Therefore, even when the samples are grouped according to fish species and waters, there are great variations within the same species and the same water.

Results for eel caught at different locations are taken collectively, since only few eels in each location were sampled, and since, judging from findings of organochlorine compounds, all eels can be said to originate from areas with low pollution [51].

Figures 16 and 17 show the average contents of organochlorine compounds in herring and cod liver, respectively; the fish are divided into two groups according to fishing grounds. Thus, the main Danish waters are divided into 1) the Baltic Sea, the Belts, the Sound; and 2) the North Sea, the Skagerrak, the Kattegat. The reason for this subdivision is the likelihood that one individual person's intake of fish may consist of fish originating mainly from one water or one body of waters. The division into two bodies of water is not statistically supported in all cases, but is still the best approach based on the statistical studies discused in Section 5.4. The distribution on waters for fish consumed by the Danish population is not known.

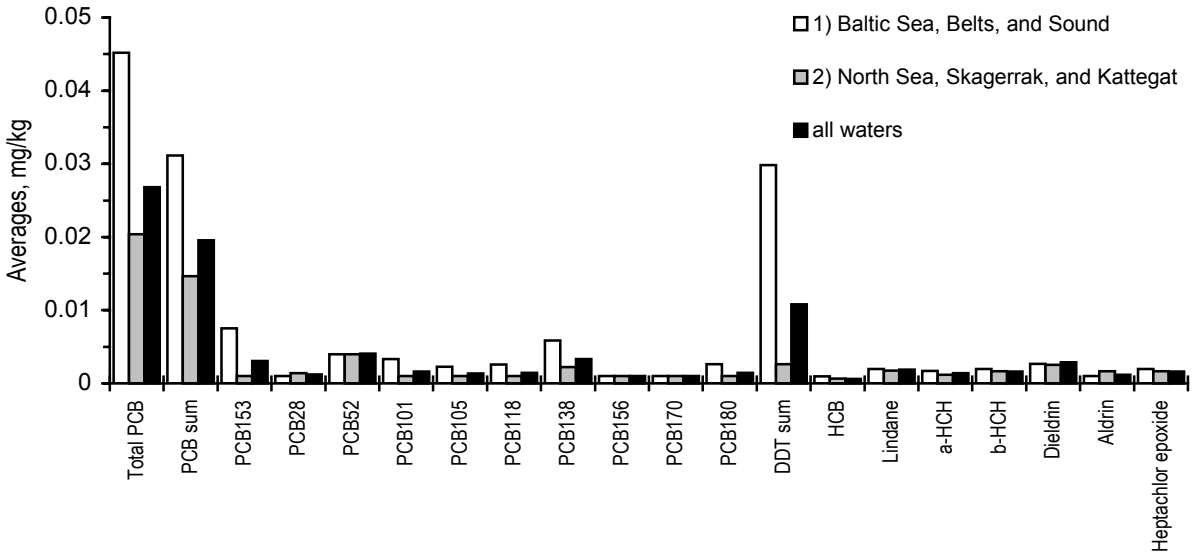

Figure 16. *Average contents (mg/kg) of the various substances in herring. In the figure, average contents from 1993-1996 for organochlorine pesticides and total PCB were used, and from 1994-1996 for PCB congeners and ΣPCB.*

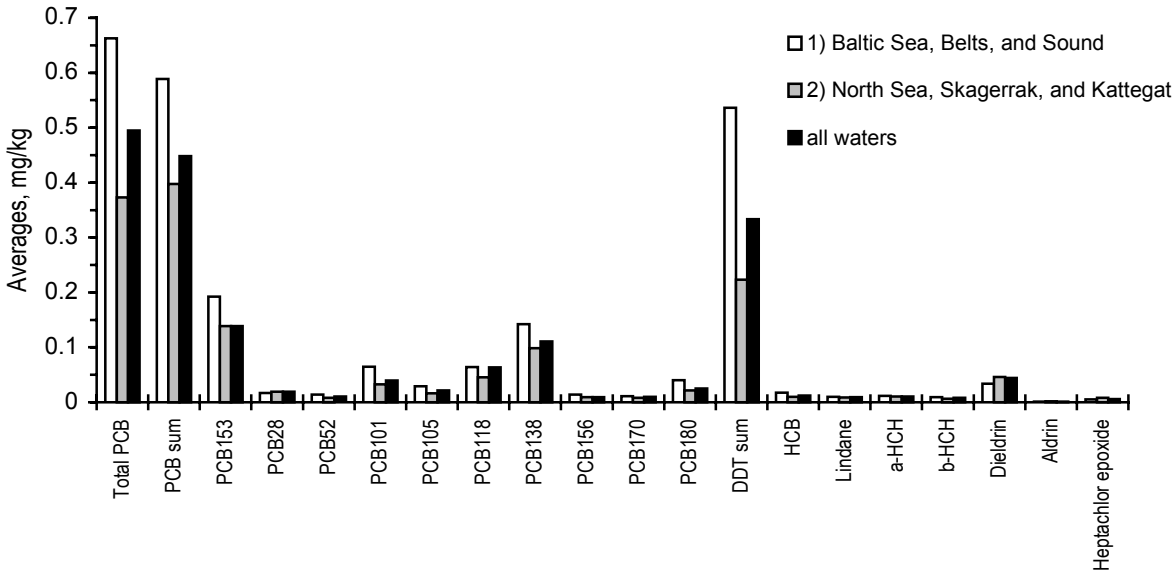

Figure 17. *Average contents (mg/kg) of the various substances in cod liver. In the figure, average contents from 1993-1996 for organochlorine pesticides and total PCB were used, and from 1994-1996 for PCB congeners and ΣPCB.*

In Figures 16 and 17 it is seen that the contents in group 1) are typically higher than in group 2). Thus, the measured contents reflect the higher level of pollution in the inner waters. As it appears from the figures, mainly ΣDDT, PCB153, and PCB138 are found in fish.

It should be noticed that the results presented in Figure 16 indicate that the contents of PCB52 are equal for the two groups of waters. This is a good example of the fact that for substances

where only few samples have contents above the limit of detection, the limit of detection will have a great significance for the calculated average contents. The limit of detection for PCB52 is relatively high, as seen in Appendix 9.4.3. Only one of a total of 79 samples of herring contains PCB52 above the limit of detection.

For the determination of the PCB contents, the present monitoring period (1993-1997) employs two different methods, as mentioned in Section 5.1. Figures 16 and 17 illustrate that the contents of PCB in herring and cod liver are roughly equal, irrespective of whether PCB was based on total PCB or ΣPCB. Appendix 9.4.5 shows the correlation between the two methods for the determination of PCB contents.

The black columns in Figures 16 and 17 include results from measurings on fish for which the water of origin was not reported, referred to as ”unknown water” in Appendix 9.4.2. If many of the fish that were caught in unknown waters have low contents, it may in some cases, as seen in the figures, lead to lower average contents when all waters are pooled, than for each of the two groups of waters.

Cod liver has a fatty content of 30-80 per cent, whereas herring contains 1-15 per cent of fat [52,53], depending on, i.a., the time of the year. This difference in fatty content is reflected by a content of organochlorine environmental contaminants which is 10 times higher in cod liver than in herring, as shown in Figures 16 and 17.

Contents in products of animal origin

The highest average contents of the individual substances ΣDDT and lindane were found in animal fat. For ΣDDT, contents above the limit of detection were found in approx. 21% of meat samples (beef, pork, and poultry), in 19% of butter samples, and in 13% of cheese samples. However, the contents are generally relatively low, average contents being merely between 0.002 and 0.007 mg/kg animal fat; for details, see Appendix 9.4.2.

Lindane was found especially in foreign butter and cheese, and also in poultry fat. Lindane was demonstrated in 32% of the foreign cheese samples during the present period, with an average content calculated to 0.01 mg/kg fat. In foreign butter, lindane was demonstrated in 4 of 11 samples with an average content calculated to 0.007 mg/kg. In comparison, contents of lindane have not been demonstrated in 410 analysed samples of Danish butter. In poultry fat, contents of lindane were demonstrated in 15% of samples, and an average content has been calculated to 0.004 mg/kg.

HCB was found in many samples, but in relatively low concentrations. The highest number of HCB demonstrations (27%) was in samples of beef fat and foreign butter. The average contents in animal fats were calculated to between 0.001 and 0.004 mg/kg; for details, see Appendix 9.4.2.

Dieldrin was demonstrated in 4% of foreign cheese and in 3% of poultry fat, the calculated average contents being fjerkræfedt 0.003 mg/kg and 0.004 mg/kg, respectively.

As seen in Appendix 9.4.2, PCB was on the whole not found above the limit of detection in products of animal origin.

Contents in fruits and vegetables

The contents of organochlorine pesticides in fruits and vegetables are reported in the sub-report on production aids [54]. The monitoring programme does not comprise analyses for PCB in fruits and vegetables.

Assessment of contents in relation to recommended values for acceptable contents

Table 10 shows the maximum limits for organochlorine pesticides in fat from meat, dairy products, and eggs [55]. There were no violations during the period. When comparing with Appendix 9.4.2 it can be seen that average contents of all substances are lower by a factor of at least 10 in relation to the maximum levels, and in most cases lower by a factor of at least 100.

Table 10. *Maximum levels for organochlorine pesticides[55].*

Substance	Maximum limit (mg/kg*)		
	Fat from meat	Butter, cheese, etc.	Eggs
Aldrin	0.2	0.15	0.02
ΣDDT	1.0	1.0	0.1
Dieldrin	0.2	0.15	0.02
Heptachlor epoxide	0.2	0.1	0.02
HCB	0.2	0.1	0.02
α-HCH	0.1	0.075	0.01
β-HCH	0.1	0.075	0.01
Lindane	1.0	0.2	0.1

* mg/kg fat for meat and dairy products, and mg/kg fresh weight for eggs.

In fish and fish products, a maximum level of 2 mg/kg for ΣDDT has been established, and in fish liver of 5 mg/kg for ΣDDT [55]. No corresponding maximum limits exist for the other substances.

The Danish Veterinary and Food Administration has published a list of *Vejledende værdier for acceptabelt indhold af PCB og chlorholdige pesticider i fiskeolie* (Recommended values for acceptable contents of PCB and organochlorine pesticides in fish oil) [56]. Fish oil is not included in the monitoring programme, but the values may serve as an indication of the quantities that are tolerable in other foods.

Table 11. *Recommended values for acceptable contents of PCB and organochlorine pesticides in fish oil [56].*

Substance	mg/kg fish oil
ΣDDT	0.4
Dieldrin	0.1
Heptachlor epoxide	0.02
HCB	0.05
α-HCH	0.02
β-HCH	0.02
Lindane	0.02
PCB-153	0.1
ΣPCB /PCB total	0.4

It should be noticed that the recommended value for ΣDDT in fish oil is somewhat lower than the maximum limits. The figures in Table 11 are comparable to those in Appendix 9.4.2 for average contents in the different foodstuffs. Some of the average contents in cod liver are higher than the stated 0.4 mg/kg for total PCB and ΣPCB and 0.1 mg/kg for PCB-153.

5.4 Development in contents of organic environmental contaminants over time

Fish

While the contents of organochlorine environmental contaminants in fish decreased significantly during the 1970s and the beginning of the 1980s [2,34,35,57], recent years' development over time is not so unambiguous. This section gives a description of the development through the two latest monitoring periods (1988-1997).

There is a number of factors which may be of significance to the contents of contaminants in fish, but which it has not been possible to take into consideration, such as the food basis of the fish, their age, weight and sex, and the season. In particular, it may cause a decline in concentration over time if the fish that are caught today are younger and thus, other things being equal, have not had the opportunity to accumulate so large quantities of contaminants. Such an effect will be hardly distinguishable from the effect of lower concentrations in the water over time.

PCB in cod liver was initially selected as a model for the development over time, since practically all results here are above the limit of detection. By a closer analysis of these data it can be seen that the distribution of concentrations is best described by a logarithmic normal distribution, and that the development over time can be described by a linear regression based on logarithmized data [58].

In order to estimate a regression line for data sets containing observations below the limit of detection, a programme, *Regres-BDL*, which allows for a description of results by means of a logarithmic normal distribution, and where values below the limit of detection are estimated on the basis of values above the limit of detection [59], has been developed. By means of an analysis of variance, the programme can at the same time be used to assess whether the regression lines for different waters may be pooled. This programme has been used on the results for cod liver and herring. Waters that have been pooled because their regression lines

do not differ significantly, and because the waters are at the same time physically joined, are indicated by the same symbol in Figures 18 to 22.

Figure 18 shows the development over time for PCB (total PCB) in cod liver. A significant decline is seen in the PCB concentration from 1988 to 1996. The PCB concentration in cod liver from the Baltic Sea, the Belts, and the Sound are typically highest, while the concentration in cod liver from the Skagerrak is typically lowest.

In Figure 19 the corresponding development over time for DDT (ΣDDT) in cod liver is seen. Also here a significant decline is seen in the concentration of DDT from 1988 to 1996, with the highest concentrations in cod liver from the Baltic Sea and the lowest in cod liver from the Skagerrak.

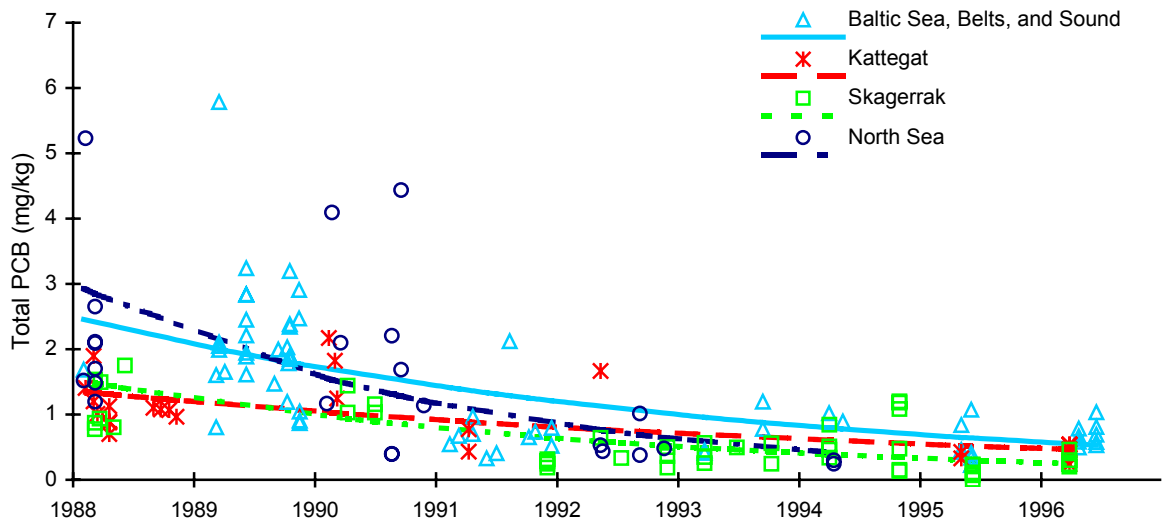

Figure 18. *PCB in cod liver from Danish waters, 1988 - 1996. Each point represents one sample, and the lines show the regression lines from a linear regression based on the logarithmized data.*

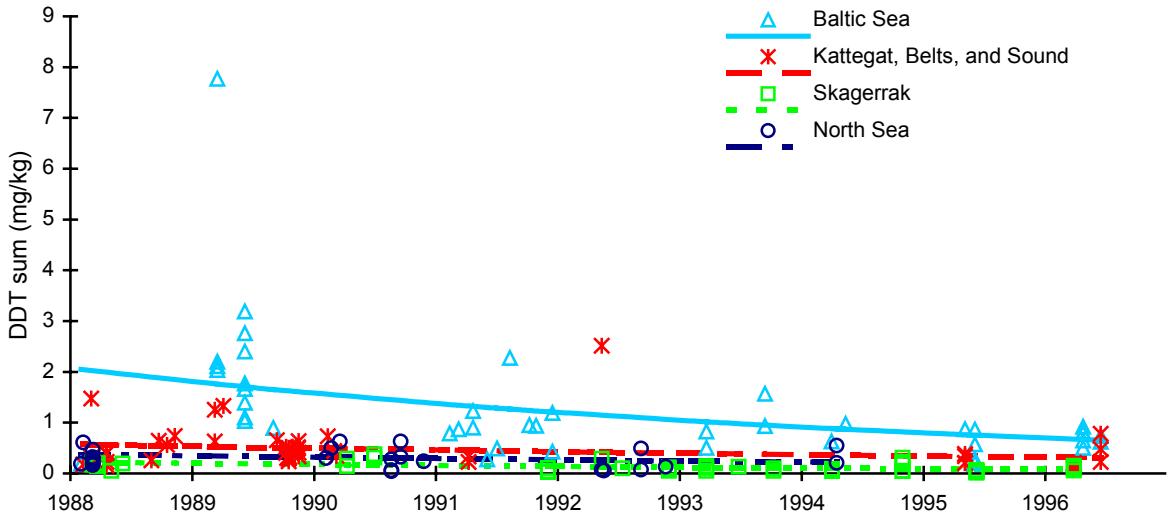

Figure 19. *DDT in cod liver from Danish waters, 1988 - 1996. Each point represents one measuring, and the lines show the regression lines from a linear regression based on the logarithmized data.*

Figures 20 and 21 show the development over time for HCB and dieldrin, respectively. The development for these substances is not so unambiguous as that for PCB og DDT. Only in cod liver from the Baltic Sea, a clear decline is observed.

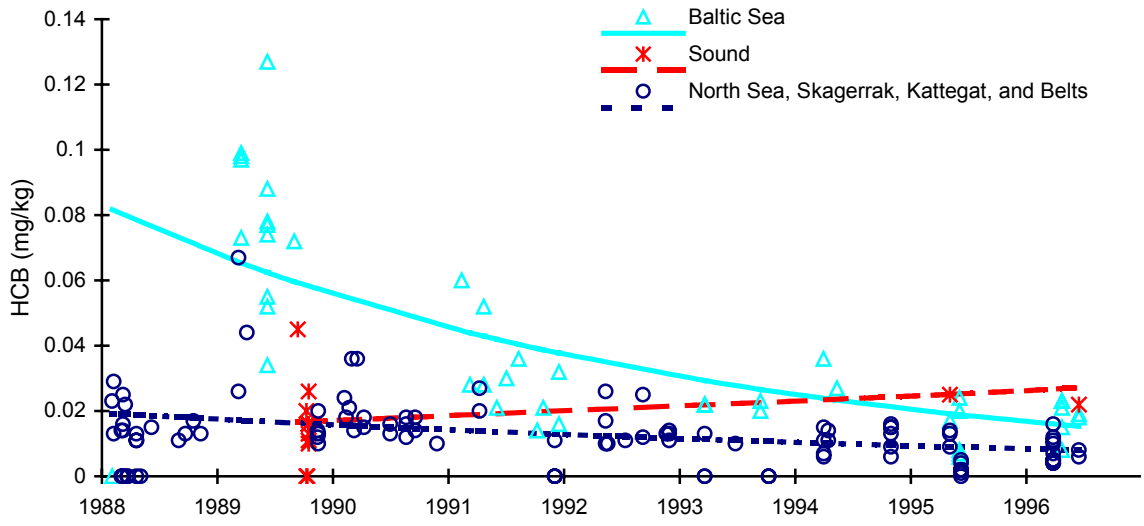

Figure 20. *HCB in cod liver from Danish waters, 1988 - 1996. Each point represents one sample, and the lines show the regression lines from a linear regression based on the logarithmized data.*

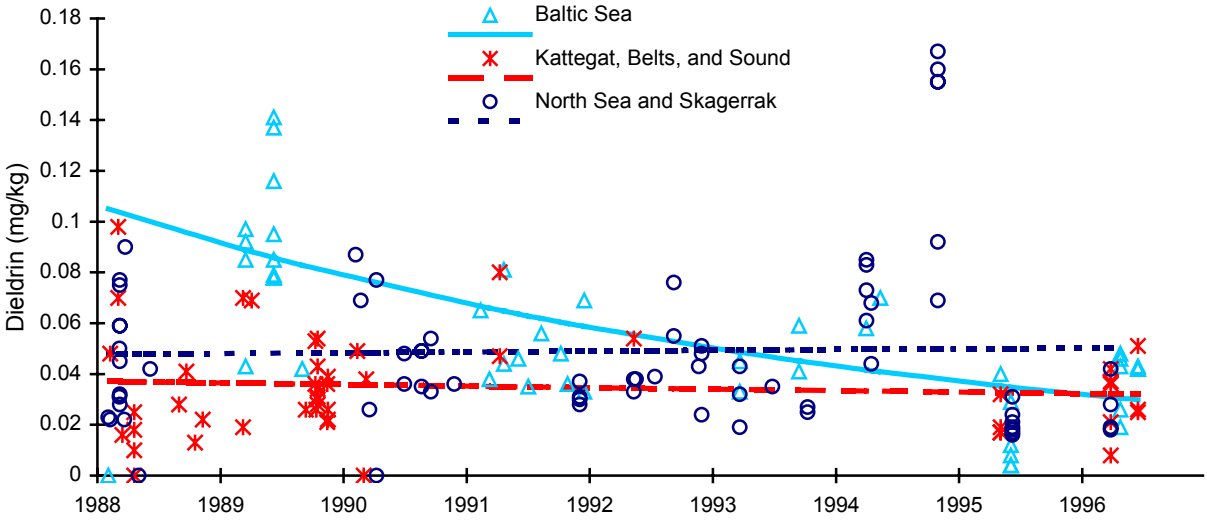

Figure 21. *Dieldrin in cod liver from Danish waters, 1988 - 1996. Each point represents one sample, and the lines show the regression lines from a linear regression based on the logarithmized data.*

For herring also, a number of samples contain DDT above the limit of detection. The development in DDT contents of herring appears from Figure 22 which shows that contents in herring from the Baltic Sea are typically higher than contents in herring from other waters. The contents of other substances measured are typically below the limit of detection (see Appendix 9.4.2).

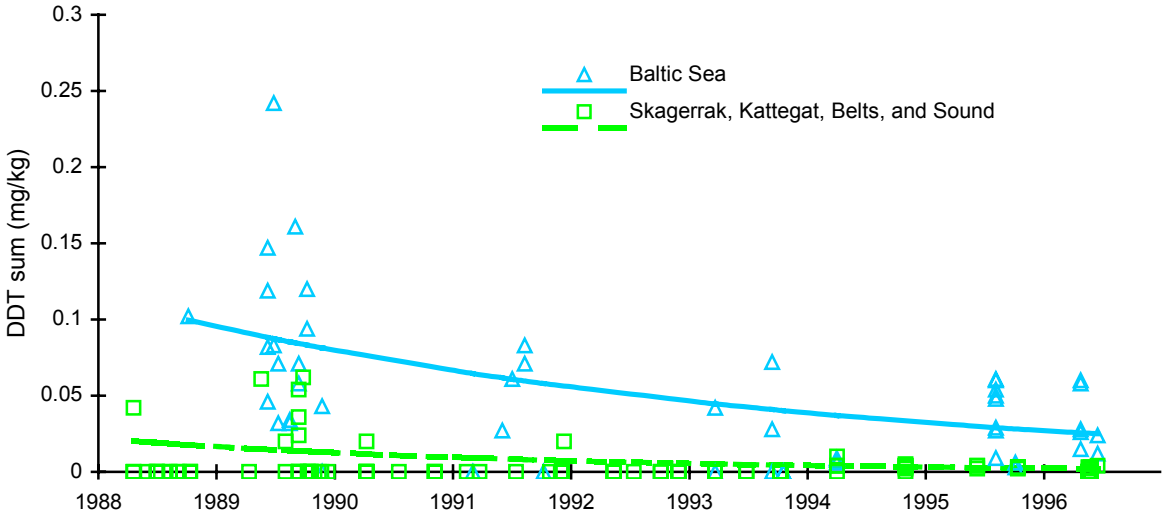

Figure 22*. DDT in herring from Danish waters, 1988 - 1996. Each point represents one sample, and the lines show the regression lines from a linear regression based on the logarithmized data.*

An overall tendency towards a decline in concentrations over time is observed; but this does not apply to all fish species and all substances. By comparison of different waters, no two or more waters have been found which, according to statistical analyses, may be pooled for all substances.

In general, when considering the 3rd monitoring period (1993-1997) alone, no unambiguous development for organochlorine environmental contaminants in fish is found. Accordingly, the year of catch has been disregarded in the calculation of average contents; see Section 5.3 concerning calculation of averages.

Products of animal origin

For products of animal origin, so few results are above the report limit that it is difficult to observe any development in concentrations. Instead, the result is perceived as a logic variable (either/or) in relation to whether the result is above or below the report limit. In order to observe the development over time from 1988 to 1996/97, more recent results that are above the limit of detection but below the report limit used earlier, were set to 0 (see Section 5.1 concerning report and limit of detections).

For PCB (total PCB) in products of animal origin, only three findings were above the report limit [2]. Therefore, only the development for organochlorine pesticides is described in this section.

The development over time of findings of organochlorine pesticides in animal fat has been analysed by means of a logistic regression where also regions and seasons were included as variables [60].

No correlation between the number of findings of contaminants and the regions from where the samples originate, nor any seasonal variation, has been found in the data material [60, 61].

For animal fat, Figures 23 to 24 show the number of results above the report limit from 1988 to 1997. A great difference is seen as to which substances are frequently found in the various sample types.

For poultry fat (Figure 23), dieldrin was frequently demonstrated during the years 1988 – 1993, whereas there were no findings from 1994 and onwards. The decline in the number of detections of dieldrin in poultry fat is found to be significant [60]. The cause of the frequent findings of dieldrin during the years up to 1993 may have been contents in imported feedstuffs. The substance which has been demonstrated in the largest number of samples during recent years, is lindane.

In beef fat (Figure 24), the most frequently occurring substances were HCB og DDT. Apart from the fact that dieldrin was found in some samples earlier, no significant development over time is observed [60].

In pork fat (Figure 25), almost exclusively DDT is found. Results from recent years might indicate a decrease in the number of detections of DDT in pork fat; but analyses through several years are required to observe whether this is a lasting development.

With the exception of dieldrin in poultry, no overall unique development over time is observed for the contents of organochlorine pesticides in animal fat.

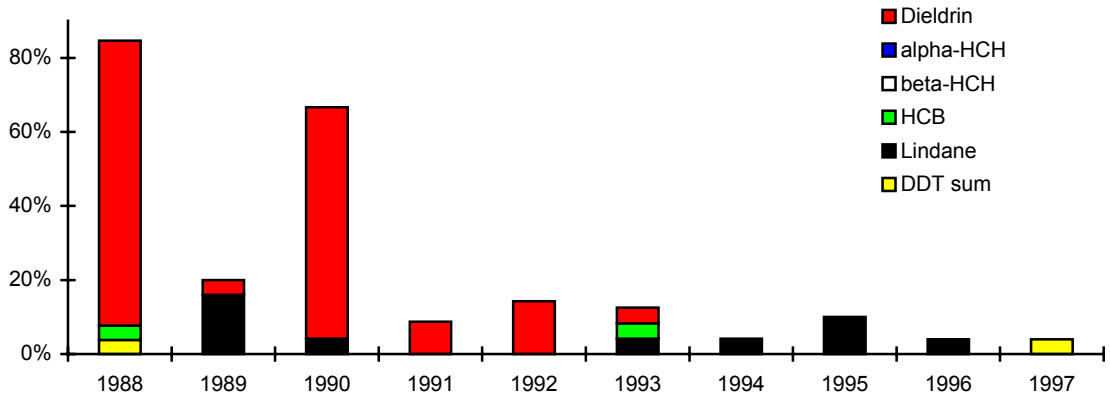

Figure 23. *Poultry fat, 1988-1997. Number of results above the report limit in relation to the number of samples. If several substances are demonstrated in the same sample, the figure may exceed 100%.*

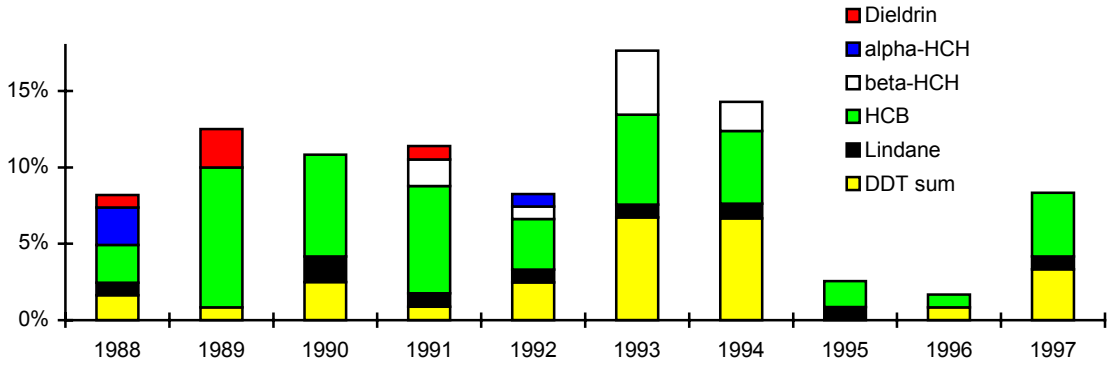

Figure 24. *Beef fat, 1988-1997. Number of results above the report limit in relation to the number of samples. If several substances are demonstrated in the same sample, the figure may exceed 100%.*

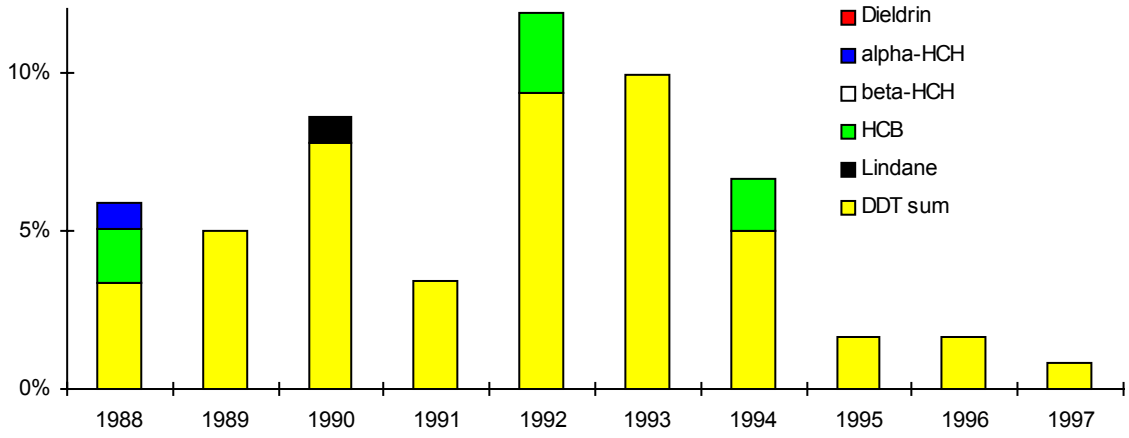

Figure 25. *Pork fat, 1988-1997. Number of results above the report limit in relation to the number of samples. If several substances are demonstrated in the same sample, the figure may exceed 100%.*

For cheese, Figure 26 shows the number of results above the report limit from 1988 to 1996. A distinction is made between cheese of Danish and foreign origin. It is seen that lindane is the most frequently occurring substance, and that there is an appreciably higher number of findings in foreign than in Danish cheese. In the years 1994–1996, organochlorine pesticides above the earlier used report limit have not been found in Danish cheese.

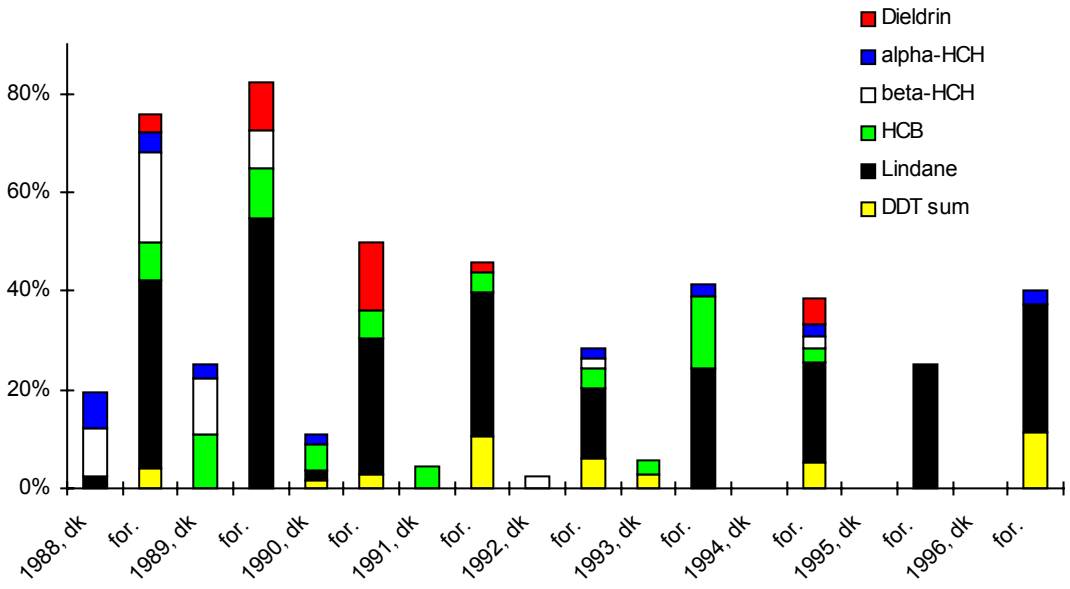

Figure 26. *Cheese, 1988-1997. Number of results above the report limit in relation to the number of samples. If several substances are demonstrated in the same sample, the figure may exceed 100%. A distinction has been made between samples of Danish (dk) and foreign (for.) origin.*

5.5 Intake calculations

Procedure

The intake calculations were carried out as described in Section 2.2. In Appendix 9.4.6 the product types used for the different foods are listed, as well as their Food Identification numbers and percentages of fat.

For analyses of cheese and butter it is noted whether the product is of Danish or foreign origin. For example, the contents of lindane are higher in foreign than in Danish cheeses; 49 of 151 samples of foreign cheese and 1 of 128 samples of Danish cheese have contents above the limit of detection. The distribution between consumption of Danish and foreign cheese and butter is known, and this fact has been taken into consideration in the calculation of average intakes, since the average contents in Danish and foreign cheese have been summed up after being multiplied by 0.7 for Danish cheese and 0.3 for foreign cheese, respectively

[62]. For butter, considerably fewer foreign samples than Danish samples have been analysed; hence, the intake calculations were based on the Danish figures.

In the intake calculations for lamb, the average contents of the various substances in beef and pork were used, since the monitoring programme does not comprise lamb. This will probably lead to a slight overestimation of the intake, as the contents of these substances in other studies [63, 64] were determined to be lower in lamb than in beef. However, an exception will be those cases where chemicals (e.g. lindane) have been used to protect the wool against vermin. This error is estimated to be insignificant in view of the fact that the consumption of beef and pork by far exceeds that of lamb [4].

The fish are grouped according to whether they are fat, medium-fat, or lean [65,66]. In the calculation of daily intakes of each fat fish species, the weighted average of the average contents for the different waters, given in Appendix 9.4.2, is used. Data for medium-fat and lean fish have been taken from a study of 41 different fish species; see Appendix 9.4.4. The study was carried out in 1993 and did not include analyses for individual PCB congeners. The PCB contents in medium-fat and lean fish are lower than in fat fish, because these substances, as mentioned, are usually found in the fatty tissues.

In the calculation of intakes of individual PCB congeners, the ratio between total PCB in medium-fat fish and in fat fish is presumed to apply also to the individual congeners. The ratio was calculated by taking the average for total PCB in medium-fat fish from the study of the 41 different fish species (0.035 mg/kg) and the average of the weighted averages in salmon, mackerel, and herring for total PCB in Appendix 9.4.2 (0.042 mg/kg). The average content of the individual congener in medium-fat fish was calculated by multiplying the ratio by the average content of the individual congener in fat fish (average for salmon, mackerel, and herring from all waters; Appendix 9.4.2). A similar assumption and calculation were done for lean fish. Data on contents for cod liver and eel were not used in the calculation of the average daily intakes.

Contents of organochlorine pesticides and PCB were not found in the 53 analysed samples of vegetable oils. Organochlorine pesticides were also not found in the analyses of grain and cereals in the present monitoring period. For these foods, the contents were set to zero in the calculation of the Danish population's intake of organochlorine pesticides.

Assessment of daily intakes

Table 12 presents the calculated average daily intakes of organochlorine compounds, excluding any contribution from fruits and vegetables. Furthermore, the 0.90 and 0.95 quantiles for the daily intake are given. The median intake is largely the same as the average intake of all substances; however, the median intake tends to be slightly lower.

Table 12. *Calculated intakes (for fish: all waters) as μg per day (excluding fruits and vegetables).*

Substance	Average (μg/day)	0.90 quantile (μg/day)	0.95 quantile (μg/day)
Aldrin	0.2	0.4	0.4
ΣDDT	0.5	0.8	1.0
Dieldrin	0.3	0.4	0.4
HCB	0.2	0.4	0.4
α-HCH	0.2	0.3	0.3
β-HCH	0.3	0.4	0.5
Heptachlor epoxide	0.2	0.4	0.4
Lindane	0.3	0.4	0.4
PCB28	0.2	0.4	0.4
PCB52	0.3	0.5	0.6
PCB101	0.3	0.4	0.5
PCB105	0.2	0.3	0.3
PCB118	0.2	0.3	0.3
PCB138	0.2	0.4	0.4
PCB153	0.2	0.4	0.4
PCB156	0.2	0.3	0.3
PCB170	0.2	0.2	0.3
PCB180	0.1	0.2	0.2
ΣPCB *	2.2	3.2	3.6
Total PCB	4	5	6

*The intake of ΣPCB was calculated on the basis of the sum of average contents of the 10 PCB congeners. Due to rounding off, the ΣPCB is not in accordance with the figures obtained by adding the average contents of the individual PCB congeners in the table.

When comparing the figures for average daily intakes of total PCB and ΣDDT in the three monitoring periods, it is important to bear in mind that diet data as well as calculation methods for average contents (see Section 5.3) have differed.

For ΣDDT and total PCB, intake calculations have been made in all three monitoring periods [1,2], and the intakes have apparently decreased. The following values for average daily intakes were reported for ΣDDT: < 3.4 μg/day (1983-1987), < 2 μg/day (1988-1992), and 0.5 μg/day (1993-1997), and for total PCB: < 12 μg/day (1983-1987), < 7.9 μg/day (1988-1992), and 4 μg/day (1993-1997).

In the monitoring period 1983-1987, only a few foodstuffs were comprised by the calculation; however, some of those that are assumed to contribute with the largest part of the intake of the substances concerned, were selected. The intake of, i.a., cod liver has been estimated, contributing substantially to the total calculated intake. In the monitoring period 1988-1992, the intake calculations are based on the average daily intake of fish and the total average intake of fat. As discussed in Section 5.3, the average contents, and thus the intake of persistent organochlorine environmental contaminants, is believed to be overestimated.

In the monitoring period 1993-1997, two methods for the calculation of average contents were used (see Section 5.3), which should lead to a more real picture of the intake. It is likely, however, that contents and thus intakes were overestimated also in this period.

The greatest uncertainty in the comparison between periods is the '<' symbols in the two first periods. It is not possible, e.g., to say whether <3.4 µg/day is greater or lesser than <2 µg/day for the ΣDDT. As it appears from Section 5.4, there is a generally downward trend for the contents of organochlorine compounds in fish. The development for products of animal origin is, however, as seen in Figures 23 to 26, not so clear.

The contribution from fruits and vegetables to the intake of organochlorine pesticides has been described in the sub-report on production aids [54]. As mentioned earlier, the calculations are more difficult when the majority of measurings are below the limit of detection. The limit of detections for fruits and vegetables are higher than those presented in Appendix 9.4.3, and only few results are above the limit of detection, which is likely to result in an overestimation of the intake. Thus, it does not make any sense to compare the intake from fruits and vegetables with the intake from fish and products of animal origin as reported here. In spite of an occasionally higher estimated intake from fruits and vegetables [54], the largest contribution of organochlorine environmental contaminants is assumed to derive from fish, meat, dairy products, and eggs.

Histograms for the intake distribution for adults of ΣPCB and PCB153, which is often used as an indicator for PCB [67], are shown in Figures 27 and 28, and for ΣDDT and HCB in Figures 29 and 30. The contribution from fruits and vegetables is not included. The HCB histogram is closer to a normal distribution (bell-shaped) than the other three histograms, reflecting the fact that especially fats and meat contribute to the intake. The distribution for the intake of fats and meat is more evenly distributed than for e.g. fish, of which many eat next to nothing and a few eat a lot [4]. Both for PCB and ΣDDT the contribution from fish is greater, which causes the histogram to appear more lopsided.

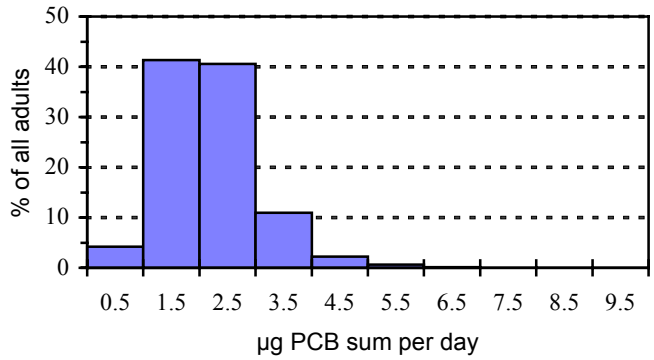

Figure 27. *Daily intake of ΣPCB (µg per day), distribution for adults.*

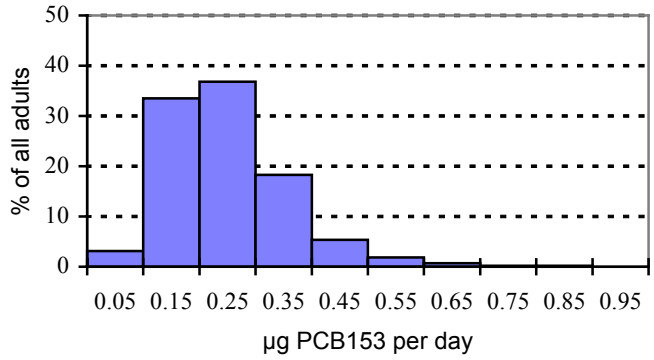

Figure 28. *Daily intake of PCB153 (µg per day), distribution for adults.*

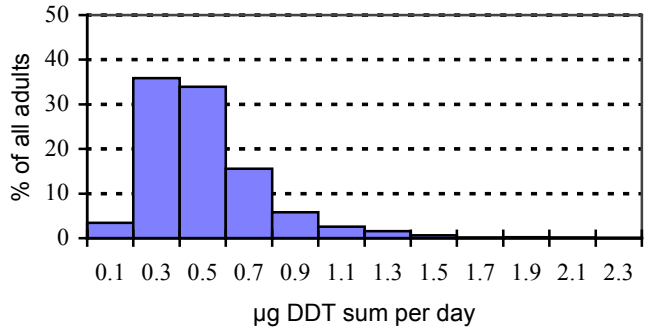

Figure 29. *Daily intake of ΣDDT (µg per day), distribution for adults.*

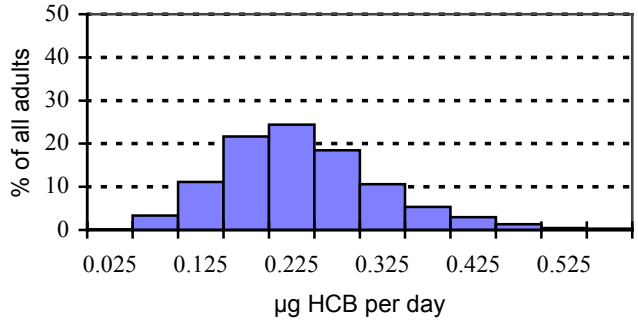

Figure 30. *Daily intake of HCB (µg per day), distribution for adults.*

Contributions of individual foods groups to the daily intake

Figure 31 shows the estimated contributions of individual food groups to the average daily intake of PCB153, ΣDDT, and HCB. No allowances have been made for the contribution from fruits and vegetables. The group of fats comprise the contribution from composite products, butter, and chocolate. Especially fish contributes to the average daily intake of ΣDDT and also, to a certain extent, of PCB153, where there is an apparently more even distribution between the contributions of the food groups. In Appendix 9.4.2 it is seen that contents of PCB153 above the limit of detection are found predominantly in fish. Figure 31

shows that for foods of which many samples have contents below the limit of detection, these foods may nonetheless be of great consequence for the calculated average intake if the limit of detection is relatively high and the consumption is of a certain size. Thus, fats provide the greatest contribution to the intake of PCB153 according to the pie diagram in Figure 31, even though contents of PCB153 were found in only approx. 2% of these samples.

For ΣDDT, approximately one-third of the average daily intake derives from fish. As seen in Appendix 9.4.2, HCB is found only in low quantities in fish, which fact is also reflected in a low contribution to the average daily intake of HCB from fish.

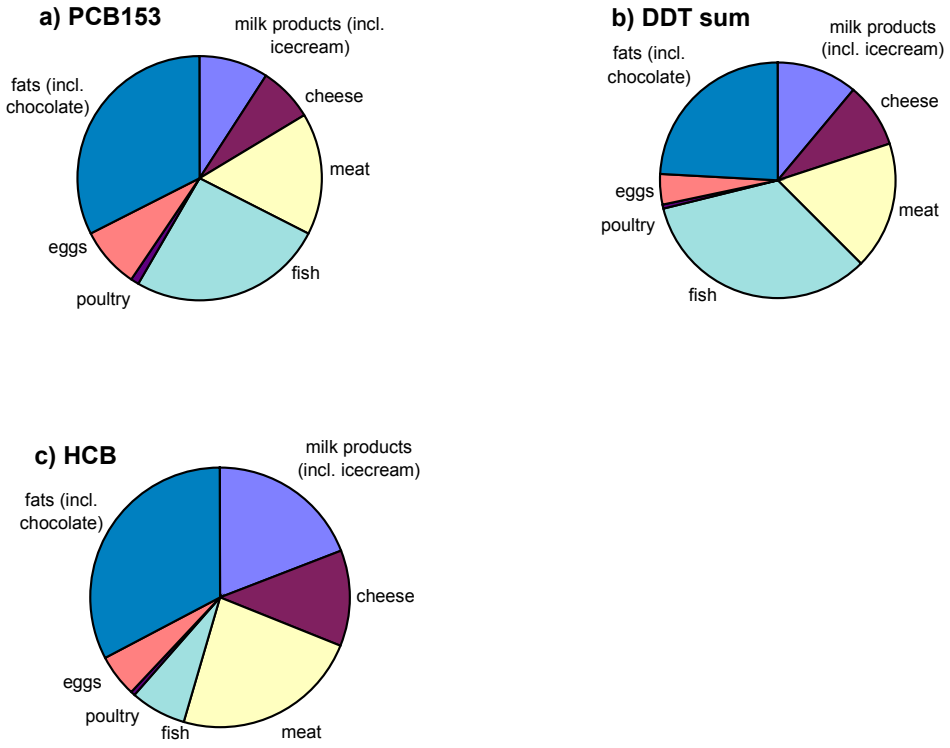

Figure 31. *Estimated contributions of various food groups to intakes of a) PCB153, b) ΣDDT, and c) HCB. Fruits and vegetables are not included.*

Cod liver and fish oils

The dietary survey [4] has not recorded the Danish consumption of cod liver. In order to illustrate the significance which cod liver may have for the intakes of ΣPCB and ΣDDT, Table 13 gives an example of how much cod liver must be consumed to double the fish-derived part of the daily average intakes of these substances. It is seen that an average daily consumption of cod liver of 0.7 g and 0.5 g is required to double the contribution from fish to the average daily intakes of ΣPCB and ΣDDT, respectively. This corresponds to a yearly consumption of approximately two tins of 125 g.

Table 13. *Rough estimate of how much cod liver must be consumed to double the fish-derived part of the average intakes of ΣPCB and ΣDDT, respectively.*

Substance	Content* (mg/kg liver)	Intake from fish ** (μg/day)	Required consumption of cod liver to double the contribution from fish (g/day)
ΣPCB	0.43	0.28	0.7
ΣDDT	0.36	0.17	0.5

* Average of averages for all waters; see Appendix 9.4.2.
** The part of the average daily intake of the substance deriving from fish.

Likewise for fish oils, no real picture of the Danish consumption exists. Table 14 shows the approximate contents [68] of total PCB (calculated as Aroclor 1260) and ΣDDT in fish oils. In order to double the fish-derived part of the average daily intakes of total PCB and ΣDDT, a daily consumption of 2.9 g and 1.3 g, respectively, of an ordinary fish oil is required. The contents of organochlorine environmental contaminants in the individual fish oil samples vary considerably. The use in Table 14 of an average content in fish oil may be somewhat misleading, as the consumer will typically buy one bottle of fish oil and use the entire contents.

Table 14. *Rough estimate of how much fish oil must be consumed to double the fish-derived part of the average daily intakes of ΣPCB and ΣDDT, respectively.*

Substance	Content* (mg/kg fish oil)	Intake from fish ** (μg/day)	Required consumption of fish oil to double the contribution from fish (g/day)
Total PCB	0.15	0.44	2.9
ΣDDT	0.135	0.17	1.3

* Average contents [68].
** The part of the average daily intake of the substance deriving from fish.

5.6 Safety assessment

A common aspect of the organochlorine compounds included in the monitoring programme is the fact that the liver is one of the most sensitive organ systems in experimental animals. Following high daily doses, mice and rats have been observed to develop cancer of the liver. None of the substances cause any damage to the hereditary factors, and it is generally agreed that the carcinogenic effects of these substances have a threshold value. Some of these organochlorine compounds have shown a potential to affect hormone systems *in vitro*; but in general, these effects have been very slight and could not be demonstrated satisfactorily in experimental animals unless extremely high doses were used. Impact on certain enzymatic systems in the liver is a characteristic effect of these substances and is believed to be of significance to some of the effects that can be observed in various hormone systems following administration of high doses to experimental animals.

The TDI/ADI values established for the organochlorine compounds are briefly mentioned below. More detailed descriptions and backgrounds of the established values may be found, i.a., in reference [69].

HCB: In 1998, IPCS under WHO suggested a TDI for the non-carcinogenic effects of HCB of 0.17 μg/kg bodyweight per day, while 0.16 μg/kg bodyweight per day was suggested as a recommended value for the carcinogenic effect of HCB [70].

Lindane: The substance was most recently assessed by FAO/WHO's expert group JMPR in 1997, when a provisional ADI of 1 μg/kg bodyweight was established [71].

α- and β-HCH: No ADI or TDI values have been established for α- and β-HCH. The American ATSDR (Agency for Toxic Substances and Disease Registry) has suggested a 'Minimal Risk Level' of 0.6 μg/kg bodyweight/day for β-HCH [72].

Heptachlor epoxide: WHO assessed this substance in 1991, establishing an ADI of 0.1 μg/kg bodyweight for the sum of heptachlor and heptachlor epoxide [73].

Dieldrin and aldrin: Aldrin is rapidly converted into dieldrin in plants and animals; therefore dieldrin is the subject of the greatest safety interest. Already in 1977, JMPR established an ADI of 0.1 μg/kg bodyweight for the sum of dieldrin and aldrin. For dieldrin, IPCS suggested a TDI of 0.05 μg/kg bodyweight in 1989 [74].

ΣDDT: In 1984, JMPR established an ADI of 20 μg/kg bodyweight for all combinations of DDT, DDD, and DDE, based on studies in humans [75]. Later, the US Environmental Protection Agency has established an RfD (corresponding to tolerable daily intake) of 0.5 μg/kg bodyweight/day [76] for the non-carcinogenic effects of DDT. On the background of recent studies and assessments, a TDI of 0.5 μg/kg bodyweight for the sum of DDT, DDE, and DDD is considered the most relevant.

PCB: The safety assessment of PCB is particularly complicated, involving mixtures of congeners having different toxicological properties and effects. Most toxicological studies were carried out on the original, commercial products that are not representative of the mixtures that are concentrated in the food chains. There is also a number of other uncertainties in the existing toxicological studies concerning PCB [69]. On the basis of various considerations discussed in the reference [69], a TDI for total PCB of 0.1 μg/kg bodyweight/day is considered relevant.

Table 15 below gives the calculated intakes of the organochlorine substances and the ADI/TDI values discussed above.

Table 15. *Calculated intakes (μg/kg bodyweight/day) of organochlorine substances for an adult person (70 kg) (from Table 12), compared with the indicated ADI/TDI values.*

Substance	Average intake (μg/kg/day)	Intake, 0.90 quantile (μg/kg/day)	Intake, 0.95 quantile (μg/kg/day)	ADI/TDI (μg/kg/day)
Aldrin	0.003	0.006	0.006	0.05
ΣDDT	0.007	0.011	0.014	0.5
Dieldrin	0.004	0.006	0.006	0.05
HCB	0.003	0.006	0.006	0.16
α-HCH	0.003	0.004	0.004	0.6
β-HCH	0.004	0.006	0.007	0.6
Heptachlor epoxide	0.003	0.006	0.006	0.1
Lindane	0.004	0.006	0.006	1
ΣPCB	0.030	0.044	0.051	0.1

This does obviously not give occasion for any immediate safety concerns, even for persons with high intakes of the substances. In this context it may, however, be mentioned that the protection level for PCB is significantly lower than that for the other organochlorine substances measured.

As mentioned in Section 2.3, the ADI/TDI does not indicate any danger line, but the quantity which humans can ingest daily on a life-long basis without any recognizable health hazard. For the above-mentioned organochlorine substances it is the total quantity which is assimilated in the human body, rather than the daily intake, which is important. Thus, short-term or long-term (weeks, months) intakes above the ADI/TDI are of no health significance as long as the average exposure over very long periods of time is kept below this value.

6. MYCOTOXINS

6.1 Introduction

Mycotoxins are toxins produced by fungi. They can cause disease in humans and animals and can give rise to lesions of, e.g., the liver, kidneys, or the nervous system. Some mycotoxins have been found carcinogenic in animal experiments, and a few are believed to have similar effects in humans. Examples of mycotoxins that may be important in connection with foods, are aflatoxins, ochratoxin A, patulin, and trichothecenes.

Ochratoxin A

Ochratoxin A is produced by fungi of the genera *Aspergillus* and *Penicillium*. *P. verrucosum* is assumed to be the only important ochratoxin A producing species under Danish climatic conditions where, given favourable conditions, it is capable of producing considerable quantities of toxin. The occurrence of ochratoxin A in Danish-produced grain is considered the potentially most serious problem in relation to the occurrence of mycotoxins in Danish crops; but also other mycotoxins may be found in Danish crops.

Only the determination of ochratoxin A in grain and flour has been a part of the Danish Veterinary and Food Administration's monitoring programme since 1986. The results from the period 1986-1992 were reported collectedly in the report for the monitoring programme 1988-1992 [2] and in an article [77]. All results since 1986 have also been included in the present report; see Appendix 9.5.

6.2 Sampling, analytical methods, and quality assurance

Ochratoxin A may occur in grain that has been harvested having a high content of water and dried inefficiently or too slowly, or in grain that has been stored under humid conditions. The occurrence may vary greatly from year to year due to climatic differences during harvest, for which reason samples are collected every year to be analysed for ochratoxin A. In order to determine whether the grain storage time has any effect on the occurrence of ochratoxin A, grain samples are collected in spring (2nd quarter) as well as in autumn (4th quarter).

On the background of results and experience from the 2nd monitoring period [2,77], some changes were made in the composition of samples in the beginning of the present period. The changes were made in order to concentrate the efforts on the most important crops, and in order to better elucidate any differences between products of conventional and organic origin. Therefore, since 1994/95 the following sample types were collected per year (totalling approx. 200): Wheat kernels, conventionally-grown, approx. 50 samples; rye kernels, conventionally-grown, approx. 50 samples; rye flour, conventionally-grown, approx. 30 samples; rye flour, organically-grown, approx. 30 samples; wheat flour, conventionally-grown, approx. 20 samples; wheat flour, organically-grown, approx. 20 samples.

Previously, samples of i.a. oat kernels, barley kernels, wheat bran, and imported grain were also collected; but these product types have been omitted from the analyses because they constitute a minor proportion of the total quantity of cereals consumed in Denmark, and the products have not shown higher contents than those now included. Wheat and rye products, making up the most important part of the Danish population's consumption of cereals, are now included the monitoring programme. Whole wheat and rye kernels are sampled in spring (2nd quarter) and in autumn (4th quarter) in order to provide the best opportunity of assessing the significance of the climatic conditions around harvest and the effect of the duration of the storage time on the contents of ochratoxin A. Unlike earlier periods, the monitoring programme now includes sampling of flour in retail packagings, i.a. with a view to finding out whether the content of ochratoxin A in whole kernels differs from that in flour as a result of, e.g., a reduction of contents during the milling process. Organically-grown grain was previously included in the monitoring studies; but it has generally been found difficult in practice to collect a sufficient number of samples of organic grain. Instead, retail-packaged organic wheat and rye flour are now included in the studies, since such samples are easier to collect. The drawback of retail-packaged samples is the fact that these may consist of mixtures of Danish and imported grain, which will make the relation to Danish harvest conditions less relevant.

The analyses during the 3rd monitoring period were carried out at the regional laboratory in Aalborg. In 1997, a new analytical method for ochratoxin A using immunoaffinity columns was introduced. The quality parameters of the new and the old methods are of the same order of magnitude. The quality control comprised regular duplicate determinations, and continuous verifications were carried out by the Danish Veterinary and Food Administration. Further information on samplings, analytical methods, and quality assurance is found in the sub-reports for the monitoring period [78,79,80,81,82,83].

6.3 Data on contents

All results from the monitoring period 1993-1997, as well as all other results since the start of the ochratoxin A monitoring, are presented in the tables of Appendix 9.5. The results have not been grouped according to spring (2nd quarter) and autumn (4th quarter) samplings, because no clear trend has yet been found as to findings of higher contents in grain sampled in spring than in grain sampled in autumn.

The period 1993-1997 has been characterized by mainly dry harvest conditions, which have been generally prevailing in Denmark since 1988, whereas 1987 was a very wet harvest year. The results show a clear dependence on the weather during harvest. The harvest conditions were estimated on the basis of data concerning climatic conditions [77] and are indicated in Appendices 9.5.1-9.5.3 for each harvest year. For conventional wheat kernels (Appendix 9.5.1) and conventional rye kernels (Appendix 9.5.2), the two monitoring periods contain a sufficient number of samples to provide a reasonable comparison, and the contents are clearly lower in the latest period with generally dry harvest conditions. The contents of ochratoxin A will also depend on any changes in agricultural practice, particularly changes in relation to

grain-drying and storage procedures. The agricultural grain-drying capacities were improved after the great problems with wet grain in the mid-1980s; and this may be a contributing factor to the lower contents found during the latest five-year period. Future results from the monitoring of ochratoxin A contents in grain from wet harvest years will reveal whether the agriculture now has adequate grain-drying facilities to cope with wet harvest years.

Organic/conventional products

During the last monitoring period, organically-grown rye and wheat kernels tended to have higher contents of ochratoxin A than the corresponding conventional products (Appendices 9.5.1 and 9.5.2), while there was no difference between contents in wheat bran, oat kernels, and barley kernels from the two production methods (Appendix 9.5.4). One problem, however, which made the comparison uncertain, was that there were substantially fewer samples of organic products than of conventional products. Therefore, the sampling procedure was changed in 1994/95 so that a larger number of organic samples were collected, which improved the feasibility of comparing contents in organic and conventional products. The samples were collected in retail packages, and only organic wheat flour and rye flour were sampled along with the same number of conventional products. With respect to the relation to harvest years it is not certain whether the samples originate from that particular Danish harvest year; and especially for organic flour, a very large part of the products on the Danish market is known to be imported.

The results from the years 1993-1997 (Appendix 9.5.3) for organic and conventional wheat and rye flour show that the organic products still tend to have higher contents than conventional products; in particular, this applies to rye flour. However, the number of samples is still relatively modest, so that a few samples with very high contents will have a considerable effect on the average contents. For rye flour, the tendency to higher contents in organic products is confirmed by the generally high median values.

The difference is presumably to be explained in terms of grain-drying and storage conditions and not the organic method of cultivation. According to the present knowledge of the ecology of the fungus *P. verrucosum* [84], the formation of ochratoxin A will take place after harvest if grain, harvested too wet, is not dried rapidly, or during the subsequent storage if the grain has been insufficiently dried or if the storage conditions are inadequate. One cannot, however, preclude the possibility that there are differences between the organic and the conventional cultivation methods which may render organic grain more susceptible to the growth of *P. verrucosum* and the formation of ochratoxin A; but under all circumstances, the formation of ochratoxin A can apparently be avoided if the grain-drying and storage conditions are good enough [84].

The problem with ochratoxin A contents in cereals has been pointed out to the organic industry, i.a. via the monitoring results; and the industry is attempting to put a stop to the problem, e.g. in the form of improved self-imposed control at mills.

For conventionally-grown wheat (kernels and flour) and rye (kernels and flour), it appears from Appendices 9.5.1-9.5.3 that the average contents in kernels and flour correspond quite well. This indicates that no substantial reduction in ochratoxin A contents takes place during the milling process.

The median value for contents in flour is generally higher than that for contents in kernels. This seems logical, since the content of ochratoxin A must be expected to be more evenly distributed in flour than in whole kernels, because the very non-uniformly distributed, naturally formed ochratoxin A in grain will be blended during the milling process.

On the background of the results from the first monitoring period and intake calculations based on these [77], a maximum limit of 5 μg/kg for contents of ochratoxin A in cereals for human consumption [85] was introduced per 1st July 1995. Every harvest year since harvest 1995, samples exceeding the maximum limit have been found; one sample from the harvest year 1995, five samples from the harvest year 1996, and four samples from the harvest year 1997; i.e. 10 violations in a total of 507 samples (cf. Appendices 9.5.1-9.5.3), or approx. 2% of the samples. Of these, five samples were organic (four of rye flour and one of rye kernels) and five were conventional (four of rye flour and one of wheat kernels).

The monitoring programme was not intended as a control project, so the batches of grain/flour from which the samples were collected, have usually been consumed before the results of the analyses were available. Therefore, the only possible follow-up action on violations has been that the food control units that collected the samples have requested the producer/retailer to improve their production and self-imposed control procedures.

It is yet too early to evaluate whether the introduced maximum limit has contributed to an improved quality of cereals in Denmark due to any improved procedures for production and self-imposed control at farms and mills.

6.4 Intake calculations

The intake calculations were carried out as described in Section 2.2. For cereals, intake calculations were made on six different types of consumption, based partly on whether the consumption consisted of exclusively organic or conventional products, partly on data on contents from three different periods: 1986-1992, 1986-1997, and 1993-1997, corresponding to what may be regarded, in terms of harvest weather, as a relatively wet period, a medium period, and a dry period. During the last monitoring period, calculations were also made on three corresponding types of different data sets related to the weather around harvest [77]. But here, data from individual years were used, for instance 1987 as the ’very wet’ example, which is an extreme value with relatively few data from one very wet year. Calculating intakes from e.g. the above-mentioned periods is more relevant, because now larger bodies of data are available, and because it is the long-term intake which is immediately relevant in relation to the potentially health hazardous effects of ochratoxin A.

As mentioned earlier, the content of ochratoxin A in grain depends on several factors among which harvest weather and drying and storage conditions are some of the most important. Therefore, it may be difficult to clarify whether results from the intake calculations will be adequate for the ochratoxin A intake during coming years, for example whether the average harvest weather during 1986-1997 is reasonably representative of the average harvest weather over a longer period of time, or whether changes in agricultural practice will lead to greater or lesser problems with the occurrence of ochratoxin A in grain.

The average contents of ochratoxin A in the products (Appendices 9.5.1-9.5.4) were calculated by setting results below the limit of detection to zero, the use of another value, e.g. one-half of the limit of detection, being of minor significance, since it will be samples with high contents that are of overall importance for the calculated average contents. The averages were used in the intake calculations on the grounds that based on a given random sample, this will be the best expression of the average exposure of the individual consumer; partly because cereals are foods that most people consume every day, partly because it is the exposure during a long period of time which is relevant from a safety point of view. From studies [86] it is known that the majority of the Danish population have contents of ochratoxin A in their blood, which fact indicates a general and continuous intake of ochratoxin A through the diet.

Ochratoxin A is a highly stable substance, and in the intake calculations it has been assumed that all ochratoxin A is present in the finished foods.

Appendix 9.5.6 presents those estimates of contents in the various foods that are included and used in the intake calculations. Data on contents for other foods than cereals were estimated on the basis of Danish and foreign studies [87,88,89], cf. comments in the Appendix. Those other foods were included because they have been mentioned as possible significant sources of the intake of ochratoxin A.

The calculated intakes of ochratoxin A are given as ng/kg bodyweight/day, which is the traditional indication for mycotoxins in the literature. As mentioned in Section 2.2, the average weight of 70 kg is used for an adult Danish person. The fact that the precise weights of individual persons have not been used, is of no essential importance for the ochratoxin A intake distribution (results not shown).

Table 16 gives the calculated total intakes for the six different types of cereal consumption, together with the total contributions from the six other foods included in the intake calculations (see Appendix 9.5.6).

The intake via each of these six foods is shown in Table 17. It appears from the tables that rye bread is the most important intake source of ochratoxin A, and especially rye bread is of great importance where consumption of organic products is concerned.

Table 16 and Figure 32 show that by consumption of exclusively organic cereals, nearly one-half of the population would exceed the TDI value of 5 ng/kg bodyweight/day (see Section 6.5). This calculation was based on all data on contents since 1986 and is, as mentioned earlier, presumably the best estimate of the average contents of ochratoxin A in cereals over

long periods of time. On the other hand, persons who eat conventional cereals, even persons with a high consumption of cereals, remain below the TDI value.

Table 16. *Calculated intakes (ng/kg bodyweight/day) by an adult Danish person (70 kg) for six different types of consumption of cereals, together with contributions from all other foods included in the calculations. For further details, see Appendix 9.5.6.*

Intake:	Average (ng/kg/day)		Median (ng/kg/day)		0.95 quantile (ng/kg/day)	
Cultivation method:	Conventional	Organic	Conventional	Organic	Conventional	Organic
Wet harvest (1986-92)						
Totally via all foods	2.8	6.5	2.7	6.1	4.7	11.4
Via rye bread	0.9	3.9	0.8	3.6	1.8	8.1
Via other cereals	1.0	1.6	0.9	1.5	1.8	3.0
Medium harvest (1986-97)						
Totally via all foods	2.4	4.8	2.3	4.6	4.0	8.2
Via rye bread	0.7	2.6	0.7	2.4	1.5	5.4
Via other cereals	0.7	1.2	0.7	1.1	1.3	2.2
Dry harvest (1993-97)						
Totally via alle foods	2.0	3.1	1.9	3.0	3.4	5.2
Via rye bread	0.6	1.3	0.5	1.2	1.2	2.7
Via other cereals	0.4	0.8	0.4	0.8	0.8	1.5

However, on the background of data on contents from the 3rd monitoring period (1993-1997), persons having a high consumption of exclusively organic cereals (the 0.95 quantile) have only had intakes close to the TDI value; see Table 16. This may be due partly to the generally dry summers of these five years, partly to improved production conditions in the organic industry. The monitoring during coming years will possibly clarify this, and reveal whether the contents of ochratoxin A in conventional and organic products are actually approaching each other.

Table 17. *Calculated intakes (ng/kg bodyweight/day) by an adult Danish person (70 kg) via each of the six other foods included in the intake calculations; see Appendix 9.5.6.*

Intake:	Average (ng/kg/day)	Median (ng/kg/day)	0.95 quantile (ng/kg/day)
Intake via pork products	0.16	0.15	0.3
Intake via poultry products	0.01	0.00	0.03
Intake via raisins	0.02	0.00	0.11
Intake via coffee	0.4	0.3	0.9
Intake via red wine	0.3	0.15	1.1
Intake via beer	0.15	0.07	0.6

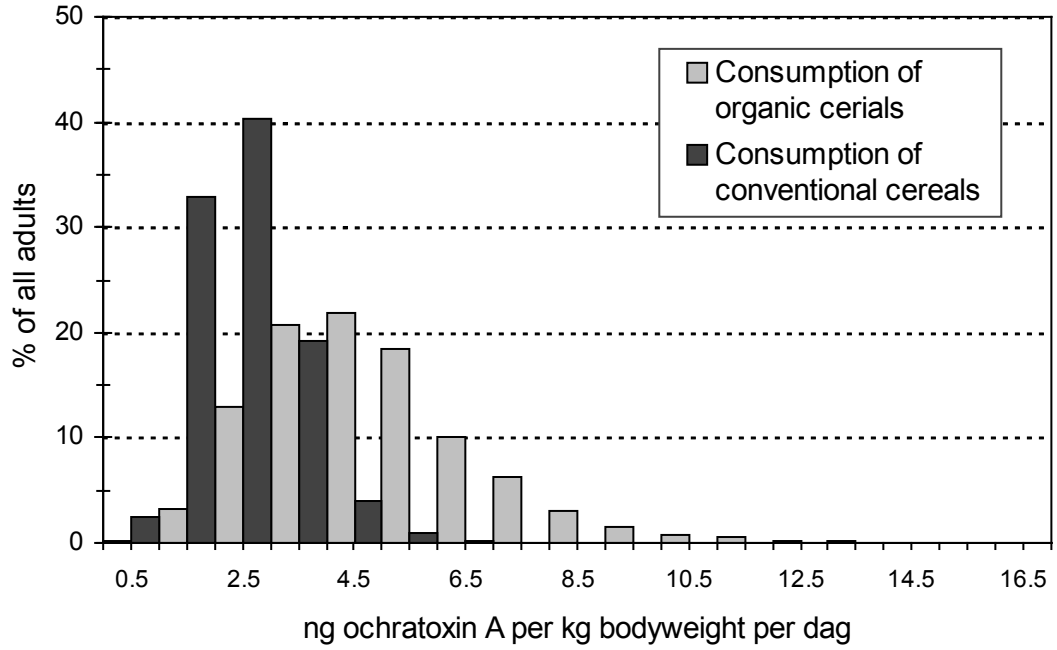

Figure 32. *Distribution of intakes of ochratoxin A by the 1,837 persons participating in the 1995 dietary survey [4], calculated using all data for the period 1986-1997 (medium harvest climate) and consumption of either exclusively conventional cereals or exclusively organic cereals, and consumption of the six other foods included in the calculations.*

As it appears from the results in Tables 16 and 17, there is no indication that products from pork, poultry, and raisins have any substantial importance for the intake of ochratoxin A, even for persons having a large consumption of these products. The beverages coffee, red wine, and beer may all have a certain significance for the total intake, especially in persons with a large consumption of the products concerned; see 0.95 quantiles in Table 17.

On the background of the intake calculations it can be concluded that cereals are the main sources of the Danish population's intake of ochratoxin A, and that the intake of ochratoxin A

for persons who eat organic cereals has so far been found higher than for persons who eat conventional cereals.

6.5 Safety assessment

Several risk assessments of ochratoxin A have been carried out internationally, and it has been proposed to establish the tolerable daily intake in the interval between 'as low as possible and no higher than 5 ng/ kg' or up to 14 ng/kg bodyweight/day, depending on the toxic effect and calculation method on which the establishment is based. SCF reassessed ochratoxin A in 1998 [90] and recommended a TDI value as low as possible and no higher than 5 ng/kg bodyweight/day, corresponding to the limit arrived at by a Nordic toxicology group in 1991 [91], and which has been in use in Denmark since then.

By consumption of conventionally grown cereals, the Danish population's total intake of ochratoxin A does not exceed the existing TDI value.

As seen in section 6.4, approximately one-half of the population might exceed the TDI value by consuming exclusively organic cereals. This calculation was based on all data on contents since 1986 and, as mentioned, considered the best estimate for average long-term contents of ochratoxin A in cereals. If, however, the calculations were based on the 3rd monitoring period alone, the intake would not exceed the TDI value of 5 ng/kg bodyweight, even for persons with a large consumption of organic cereals.

As discussed in section 6.3, a maximum limit of 5 µg/kg for contents of ochratoxin A in cereals for human consumption was introduced per 1st July 1995. Calculations based on the existing data material show that this limit will generally safeguard the population against intakes above the TDI value. As mentioned, it is yet too early to assess whether the establishment of the maximum limit and/or the alertness toward the problem have brought about any general reduction of the contents of ochratoxin A in cereals in Denmark.

6.6 Other analyses for mycotoxins in Danish foods

The Danish Veterinary and Food Administration is continuously carrying out analyses for mycotoxins in foods on the Danish market. The publication *Mycotoxins in Danish foods* [92] contains a recent overall survey of a number of these analyses. In many cases such analyses are carried out in order to identify any problems concerning the contents of myxotoxins in foods and, in this context, to consider the possible necessity of new regulations within this field in terms of establishing new maximum limits for mycotoxin contents in certain foods.

In addition to the monitoring of ochratoxin A in cereals, systematic long-term control/monitoring of mycotoxin contents in Danish foods has been carried out in only two other connections, i.e. the control for ochratoxin A in pigs and the monitoring of aflatoxin M_1 in Danish milk. These are briefly discussed in the following.

Control for ochratoxin A in pigs

Since 1978, the Danish Veterinary and Food Administration has carried out control for ochratoxin A in pigs. All slaughter pigs in Denmark are controlled on the slaughter line for macroscopic kidney lesions (porcine nephropathy). Whenever porcine nephropathy is found, the kidneys are collected for chemical analysis for contents of ochratoxin A. If the kidneys contain more than 25 μg/kg, the entire carcase is condemned (total condemnation), whereas contents between 10 and 25 μg/kg will result in condemnation of the organs only. The results from this control during the period 1983-1997 are seen in Appendix 9.5.5.

The results from the kidney control corresponds well with the results from the monitoring of ochratoxin A in cereals with respect to the influence of the harvest weather on the occurrence of porcine nephropathy and contents of ochratoxin A in kidneys. In the wet harvest years of the mid-eighties there was a very high frequency of porcine nephropathy and high contents of ochratoxin A in kidneys. In these years, also the highest contents of ochratoxin A were found in cereals (see Appendices 9.5.1 and 9.5.2).

As mentioned in section 6.4, pork products do not today contribute significantly to the Danish population's intake of ochratoxin A, since ochratoxin A contents in pigs are now relatively low. At present, on the background of recent years' results with low occurrences of porcine nephropathy and low contents of ochratoxin A in kidneys, the Danish Veterinary and Food Administration is considering whether the control shall be continued in its present design.

Monitoring of aflatoxin M_1 in milk

Since 1983, the dairy industry has carried out its own monitoring of aflatoxin M_1 in milk. Aflatoxin M_1 may be found in milk if the cows have been given feed containing aflatoxin B_1. In the 1980s, maximum limits for contents of aflatoxin B_1 in feedstuffs were introduced, and the control has been tightened up several times since then. The feedstuff control resulted in a significant reduction of aflatoxin M_1 levels in milk, and since the late 1980s, contents of aflatoxin M_1 in milk have been very low; see reference [92]. For a period during the mid-1990s, somewhat increased contents in milk were found, but this was adjusted by a further tightening of the Danish Plant Directorate's feedstuff control; among other measures, the results of analyses of feedstuffs from individual feedstuff producers were published, and in recent years, contents in milk have consistently been at a level below 10 ng/kg.

7. SUMMARY AND CONCLUSION

Chemical contaminants in foods have been comprised by the monitoring programme since its start in 1983; thus, some of the chemical contaminants dealt with in this sub-report 2 have now been followed through a period of 15 years.

The report covers results from analyses of contents of trace elements, nitrate, organic environmental contaminants, and mycotoxins in selected foods during the period 1993-1997, and comparisons with corresponding data on contents from previous monitoring periods.

The results from the chemical analyses are combined with data on the consumption of the foods concerned, in calculations of the adult Danish population's intake of the substances concerned. This provides a possibility of a safety assessment of the calculated intake of chemical contaminants.

Trace elements

The monitoring programme comprises the trace elements lead, cadmium, nickel, mercury, and arsenic. A wide selection of foods have been analysed, and the majority of these foods were analysed for contents of these five substances once during the five-year period 1993-1997.

Contents of *lead* in Danish foods in the 3rd monitoring period have decreased or remained unchanged in relation to the 2nd period. The most important source of lead in foods is atmospheric precipitation of lead. With the present knowledge of the harmful effects of lead, it is estimated that the adult Danish population's dietary intake of lead does not give rise to health concerns. Children will eat larger quantities of food in relation to bodyweight, and may thus potentially ingest relatively larger quantities of lead. The monitoring programme cannot provide any immediate answer to children's dietary exposure to lead; but on the basis of experience from other countries it is assumed that the lead intake of children is 2-3 times higher per kg bodyweight than that of adults. Based on this assumption it is estimated that the impact on the development of the central nervous system will be minimal and non-measurable.

Contents of *cadmium* have remained unchanged in the 3rd monitoring period in relation to the 2nd period in the majority of foods. Sources of cadmium in foods are partly atmospheric precipitation, partly assimilation in crops from the soil. The intake of cadmium comprises a substantial proportion of the tolerable intake which, moreover, has been established with a modest safety factor. Consequently, it is desirable to reduce the contents, and thereby the intake, of cadmium in foods.

Contents of *nickel* in foods have remained generally unchanged in the 3rd monitoring period in relation to the 2nd period. The nickel contents are still high in foods such as wholemeal bread and beans. Nickel in rye bread shows wide variations over the three rounds of the monitoring programme, but the cause is unknown. Likewise, nickel contents are high in

individual foods, e.g. avocadoes, peaches, and raspberries. The nickel contents found are probably due to natural causes and only to a limited extent to nickel pollution in the environment. For most people, the dietary intake of nickel does not lead to any health problems; but for some of those who already have developed a contact allergy towards nickel, large dietary intakes of this substance may cause allergic reactions. Therefore it is recommended for sensitive nickel allergic persons to avoid foods with high nickel contents and to follow the dietary advice issued by the Danish Veterinary and Food Administration in the form of a leaflet [14].

Mercury was monitored during the 3rd period in a limited number of foods from the groups of fish, meat, and offal. In these foods, the mercury contents were at the same concentration level as in the 2nd period. Contents in fish are still much higher than in other foods, which is mainly due to biological causes. The mercury pollutions previously observed in delimited waters are today reduced to an extent which does not give occasion for health concerns. The dietary intake of mercury has decreased from the 1st to the 3rd period, being now less than 10% of the maximum tolerable intake. Persons occasionally eating large quantities of fish, especially predatory fish such as tuna or sharks, may be exposed to considerable intakes of mercury. However, such large mercury intakes which take place occasionally are of lesser significance and constitute no health hazard for humans.

Arsenic was monitored exclusively in fish during the 3rd period, because this food group contributes with the major part of the total dietary intake of arsenic. The arsenic contents in fish depend on the fish species, and for certain species on the water where the fish was caught. This variation is probably due to exclusively natural causes, and in spite of frequent high contents of arsenic, the substance occurs mainly in organic chemical compounds that are non-toxic to humans. The content of the toxic inorganic arsenic in fish constitutes 1-5% of the total arsenic contents, which does not give occasion to any health hazard.

Nitrate

The contents of nitrate in leeks from this monitoring period are at the same level as the contents found during the previous two periods. In beetroots, the contents of nitrate have decreased, but increased in cabbage, lettuce, and potatoes when the previous periods are compared with the present period. The intake of nitrate from the vegetables included in the monitoring programme has increased from approx. 30 mg/day to approx. 37 mg/day, and this is primarily due to increased nitrate contents in potatoes.

The average dietary intake of nitrate, including drinking water, is calculated at 61 mg/day, and the 0.95 quantile intake is calculated at 113 mg/day. Thus, both these values lie somewhat below the established ADI value for nitrate, which is 256 mg/day for an adult person.

Organic environmental contaminants

The following organochlorine substances are included in the monitoring programme: DDT, including its metabolites DDE and DDD, aldrin, dieldrin, HCB, α-HCH, β-HCH, heptachlor epoxide, lindane, and PCB. None of these substances are permitted for use in Denmark any

longer; but, being slowly degradable, they are still present in the environment. These substances are characterized by their accumulation in the fatty tissues of animals and humans.

The contents of organochlorine environmental contaminants have been analysed in meat, fish, and dairy products. In the vast majority of samples, contents of the organochlorine substances under study were not detected, being below the limit of detection. For the calculation of average contents, a software programme has been developed which is able to estimate the distribution, and thus the average concentration, on the basis of that portion of the results which is above the limit of detection. The highest contents are found in cod liver and fat fish.

The contents of organochlorine environmental contaminants in fish during the present and the two previous monitoring periods have been compared, and a general downward tendency in concentrations is observed; but this does not apply to all types of fish and all substances. The development in contents of organochlorine environmental contaminants in products of animal origin is not so unambiguous.

The Danish population's average daily intake has been estimated at between 0.2 and 0.5 µg/day for the individual organochlorine pesticides and 2.2 µg/day for PCB. Persons having a relatively high intake of the substances (the 0.95 quantile) are estimated to ingest approximately twice as much, whereas persons with special intake patterns, e.g. a substantial consumption of cod liver, may have even higher intakes.

For purposes of safety assessment of these substances, ADI or TDI values are established. It must be pointed out that the ADI/TDI values do not indicate any danger limit, but the daily intake on a life-long basis which may take place with a high degree of safety. Furthermore, intakes above the ADI/TDI values through shorter or longer periods of time are not considered to involve any increased risk as long as the long-term average intake is kept on the safe side.

When the estimated intakes and the ADI/TDI values are compared, the found quantities of the organochlorine substances measured are not considered to give occasion for health concerns. In this context it may be mentioned, however, that the protection level for PCB is significantly lower than for the other organochlorine substances measured.

Mycotoxins

Ochratoxin A is the only mycotoxin that has formed a direct part of the monitoring programme. Since 1986, the occurrence of ochratoxin A in cereals from each harvest year has been analysed. The findings vary greatly according to the climatic conditions of individual harvest years; i.e. wet harvest years give higher contents of ochratoxin A in cereals if the grain is not dried sufficiently or soon enough after harvest.

In all years, organically-grown cereals have generally contained more ochratoxin A than conventionally-grown cereals; the difference has, however, tended to diminish in recent years.

Cereals are the most important source of the Danish population's intake of ochratoxin A. By consumption of conventionally-grown cereals, the total ochratoxin A intake of the population lies below the existing TDI value. Persons consuming exclusively organic cereals will be at risk of getting an intake above the TDI value. Calculating the intake on the basis of results from the 3rd monitoring period shows this risk to be modest, which is probably due partly to improved grain-drying, partly to generally dry harvest weather during this period.

Based on monitoring results, a maximum limit of 5 μg/kg in cereals was introduced in 1995 in order to reduce the Danish population's intake of ochratoxin A.

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9. APPENDICES

9.1 Appendix to Chapter 2: Introduction

9.1.1 Average consumption (g/day) of the 207 primary products/semi-products used in the dietary survey in 1995

Foodstuff	Food Id	Average consumption (g/day)
Full milk	156	59.55
Cocoa milk	159	10.37
Creme fraîche 18%	160	3.24
Creme fraîche 38%	161	0.78
Cream 13%	165	9.99
Cream 38%, double cream	166	5.39
Buttermilk	168	15.65
Low-fat milk	170	171.32
Skimmed milk	251	31.37
Low-fat junket, plain	331	8.92
Junket, plain	332	0.29
Yoghurt, plain	333	14.07
Low-fat yoghurt with juice	334	1.33
Yoghurt with fruit, unspecified	335	16.49
Skimmed-milk powder	366	0.00
Danbo cheese, 45+	258	29.40
Cottage cheese, 20+	260	0.78
Quark, 5+	261	0.26
Processed cheese, 45+	265	0.52
Brie cheese, 60+	759	2.30
Feta cheese, 50+	787	0.10
Ice cream	848	8.40
Cornflakes, unspecified	43	3.32
Wheat bran	86	0.27
Maize kernels, tinned	151	0.34
Maize kernels, frozen	152	1.90
Maize starch	173	0.09
Macaroni, spaghetti, raw	174	7.61
Rice flour	222	0.00
Rice, parboiled, raw	223	2.23
Rice, polished, raw	224	2.94
Popcorn (popped maize kernels)	469	0.44
White bread	528	70.50
Oatmeal, unspecified	530	5.38
Wheat flour	531	19.82
Marie bisquits	532	0.85
Breadcrumbs	534	0.89
Rye bread, dark	536	71.69
White bread, wholemeal	1009	23.67
Cornflakes, frosted	1011	0.47

Foodstuff	Food Id	Average consumption (g/day)
Muesli, unspecified	1012	3.10
Round-grain rice, polished, raw	1013	0.52
Crispbread, wheat, wholemeal type	1018	0.85
Cucumbers, raw	2	13.95
Asparagus, tinned	9	0.02
Aubergines, raw	10	0.95
Celery, raw	15	0.20
Cauliflower, unspecified, raw	17	3.94
Broccoli, raw	21	2.31
White beans, dried	25	0.41
Green beans, frozen	27	1.87
Brown beans, dried	29	0.23
Mushrooms, raw	37	1.14
Curly kale, raw	63	0.23
Carrots, unspecified, raw	65	25.78
Cabbage, raw	88	4.40
Garlic, raw	89	0.02
Potatoes, unspecified, raw	115	125.59
Potato flour	116	0.37
Chinese cabbage, Pe-tsai, raw	120	0.92
Onions, raw	148	9.61
Mushrooms, tinned	171	0.09
Sweet peppers, green, raw	206	2.31
Sweet peppers, red, raw	207	1.81
Parsley, raw	209	0.02
Leeks, raw	212	1.61
Chives, raw	213	0.03
Rhubarb, raw	216	0.42
Brussels sprouts, frozen	226	0.99
Beetroots, raw	232	0.16
Beetroots, tinned	233	0.74
Lettuce, head lettuce, raw	239	3.42
Celeriac, raw	243	1.24
Spinach, chopped, frozen	276	0.45
Spinach, raw	278	0.81
Tomatoes, unspecified, raw	306	16.25
Tomatoes, skinned, tinned	307	5.03
Tomato ketchup	309	0.83
Tomato purée	310	0.34
Green peas, frozen	343	5.71
Yellow peas (split peas), raw	345	0.14
Potato crisps (French fries)	443	2.59
Cucumbers, pickled	452	1.22
Squash, all types, raw	470	1.43
Lettuce, iceberg, raw	668	0.92
Pineapple, raw	3	0.55
Pineapple, tinned	4	0.40
Oranges, raw	5	15.90
Avocadoes, raw	11	0.66
Bananas, raw	14	15.86
Plums, raw	18	0.25
Lemon juice, freshly pressed	41	0.26

Foodstuff	Food Id	Average consumption (g/day)
Peaches, raw	49	2.91
Peaches, tinned	50	0.40
Strawberries, raw	100	2.86
Coconut, shredded	126	0.01
Almonds, raw	181	0.48
Netted melons, raw	185	3.15
Hazel nuts, dried	192	0.34
Peanuts, dried	193	1.19
Pears, raw	214	0.34
Raisins, seedless	227	1.61
Prunes, raw	280	0.42
Grapes, raw	329	3.88
Apples, unspecified, raw	336	48.43
Orange juice, tinned	355	23.14
Jam/marmalade, unspecified	384	11.93
Fruit juice, mixed, sweetened, concentrated	390	14.94
Fruit juice, mixed, unsweetened, concentrated	391	9.24
Kiwi fruits, raw	465	2.92
Mangoes, mangosteens, raw	523	0.10
Persimmons, raw	634	0.10
Fruit bars, fig	685	0.10
Bacon, frying piece, raw	13	0.26
Black pudding	16	0.02
Lamb, unspecified, raw	138	0.79
Lamb, fore end, raw	139	0.79
Liver, calf, raw	144	0.31
Liver, pig, raw	146	1.22
Beef, unspecified, all lean, raw	199	2.40
Beef, unspecified, lean, raw	201	13.04
Beef, brisket, raw	202	20.80
Ham, boiled, tinned	248	4.48
Ham, smoked	249	0.05
Ham, smoked, boiled	250	2.20
Salami	274	3.51
Pork neck with rind, raw	284	5.45
Pork neck without rind, approx. 3 mm fat, raw	285	15.66
Pork tenderloin, trimmed, raw	286	5.66
Pork fore end with rind, raw	287	14.75
Frankfurt sausage	292	5.97
Mettwurst, raw	294	3.06
Pork roll	295	1.38
Saveloy	296	1.84
Liver paste	297	6.55
Fillet of pork, smoked	298	0.97
Beef, brisket, raw	438	1.51
Saddle of pork, smoked, boiled	548	1.41
Salt meat	549	1.77
Beef, brisket, boiled	551	1.38
Lamb, leg, trimmed, raw	941	1.05
Salmon, raw	135	0.69
Mackerel, raw	175	0.48
Mackerel, smoked	177	1.92

Foodstuff	Food Id	Average consumption (g/day)
Mackerel in tomato sauce, tinned	178	1.42
Shrimps, tinned	219	0.81
Plaice, raw	236	5.01
Herring, pickled	244	2.40
Herring, smoked	245	0.48
Herring, raw	246	189
Cod, fillet, raw	312	5.11
Cod roe, tinned	317	1.41
Tuna in water, tinned	318	1.42
Shrimps, frozen	910	0.07
Duck, meat and skin, raw	6	0.23
Duck, meat, raw	7	0.23
Goose, meat and skin, raw	66	0.06
Goose, meat, raw	67	0.06
Turkey, meat, raw	110	3.49
Chicken, meat, raw	131	6.53
Chicken, meat and skin, raw	132	6.84
Eggs, yolk, raw	339	0.90
Eggs, whole, raw	340	19.89
Eggs, white, raw	341	0.06
Eggs, whole, powdered	1032	0.00
Maize oil	153	0.23
Margarine, 80% fat	183	13.07
Mayonnaise	184	3.19
Peanut butter	195	0.04
Butter, salted	269	8.12
Sunflower oil	273	0.68
Lard, rendered	281	0.52
Low-fat spread, 40% fat, vegetable fat	290	1.85
Cod liver oil	315	0.01
Grape seed oil	328	1.83
Remoulade, unspecified	357	0.84
Margarine, 80% fat, spread, vegetable fat	370	3.33
Olive oil	482	1.23
Composite spread, 80% fat	1235	13.04
Milk chocolate	38	3.73
Dark chocolate	39	2.73
Sugar, granulated (sucrose)	154	21.90
Boiled sweets/drops, mixed	444	1.15
Marcipan	1103	0.13
Cocoa, powder	35	0.30
Coffee, ready to drink	105	748.02
Red wine	237	66.72
Tea, ready to drink	305	200.01
Water, for drinking, guideline values	327	596.62
Apple juice, unspecified	337	17.83
Beer, category 3, unspecified	348	5.43
Beer, lager, category 1, unspecified	349	203.78
Port	407	1.57
Spirits, average values	416	5.30
Mineral water, soda water, sugar added, unspecified	472	102.16

Foodstuff	Food Id	Average consumption (g/day)
Mineral water, soda water, no sugar added, unspecified	473	25.59
Mineral water, plain soda water, etc.	474	39.83
Spirits, average values	838	1.08
Beer, low-alcohol lager, untaxed, unspecified	979	7.00
Vinegar	46	0.06
Gelatine	58	0.11
Baking yeast, pressed, raw	68	0.56
Salt, stone salt, kitchen salt	387	2.24
Salt, table salt	388	0.17
Pepper, black	405	0.04
Curry, powder	406	0.01
Soy protein, concentrate, Procon 2000	512	0.00

9.2 Appendix to Chapter 3: Trace elements

9.2.1 Lead in selected foods (µg/kg fresh weight) in the 3rd monitoring period

	2nd period	3rd period					
Foodstuff	Average	Average	Minimum	Maximum	Median	0.90 quantile	Number of samples
Apples	10	<6	<6	10	<6	<6	84
Aubergines	<4	<8	<8	9	<8	<8	11
Avocadoes	6	11	<8	21	9	17	12
Bananas	<7	<8	<8	12	<8	10	19
Beans	9	12	<8	17	12	16	12
Beef	12	<16	<16	75	<16	22	48
Beer	1	<3	<3	<3	<3	<3	25
Beetroots	21	11	6	15	11	13	14
Black currants	24	18	4	76	16	25	23
Breakfast cereals	17	<36	<36	<36	<36	<36	20
Broccoli		11	<8	20	11	18	26
Brussel sprouts	2	16	6	25	18	21	13
Cabbage	5	5	<3	9	5	7	14
Carrots	20	11	<5	22	12	16	26
Cauliflower	18	12	<8	41	9	20	27
Celeriac	14	16	7	34	13	27	14
Celery	9	13	<8	20	13	19	24
Cherries	<7	<8	<8	14	<8	8	22
Chicken	7	<14	<14	<14	<14	<14	28
Chinese cabbage	4	6	<3	14	6	9	24
Clementines	<7	<8	<8	<8	<8	<7	7
Cod	<75	<9	<9	13	<9	11	50
Curly kale	95	69	26	164	51	142	13
Eel	<75	<9	<9	11	<9	10	10
Eggs	<26	<5	<5	6	<5	<5	30
Elderberries	31	25	13	62	20	42	12
Flounder	<75	<9	<9	33	<9	9	36
Garfish	<75	<9	<9	21	<9	13	20
Gooseberries	<7	<6	<6	14	<6	12	10
Grapefruits	7	<8	<8	<8	<8	<8	6
Grapes	12	<7	<7	12	<7	12	19
Herring	<75	18	<7	455	<9	<9	30
Iceberg lettuce	31	5	<5	13	5	9	26
Juice	<7	6	<4	20	<4	16	20
Kidney, calf	63	53	<16	102	50	90	26
Kidney, ox	95	89	28	326	71	173	49
Kidney, pig	25	<16	<16	21	<16	<16	60
Kiwi fruits	7	<8	<8	<8	<8	<8	19
Lamb	<8	<14	<14	28	<14	14	12
Leeks	7	9	<3	22	8	19	14
Lemons	13	<8	<8	11	<8	11	6
Lettuce	11	18	8	63	15	35	24
Liver, calf	30	17	<16	75	<16	32	26
Liver, chicken	<8	<16	<16	<16	<16	<16	25
Liver, duck	9	<16	<16	<16	<16	<16	6
Liver, ox	38	43	<16	106	39	78	49
Liver, pig	27	<16	<16	25	<16	<16	65
Liver, turkey	<8	<16	<16	<16	<16	<16	6

	2nd period	3rd period					
Foodstuff	Average	Average	Minimum	Maximum	Median	0.90 quantile	Number of samples
Mackerel	<75	<9	<9	11	<9	<9	30
Muesli	31	<36	<36	172	<36	126	19
Mushrooms	13	16	<8	22	15	21	14
Mutton	<8	<15	<15	15	<15	<15	10
Oatmeal		<36	<36	<36	<36	<36	5
Onions	16	4	<3	8	4	6	25
Oranges	<7	<8	<8	11	<8	11	6
Peaches		<8	<8	18	<8	14	19
Pears	8	<6	<6	14	<6	8	56
Peas	<4	<4	<4	7	<4	6	14
Persimmons		<7	7	7	<7	7	5
Plaice	<75	<9	<9	14	0	<9	34
Plums	<7	<8	<8	50	<8	9	42
Pork	<8	<15	<15	25	<15	<15	120
Potatoes	8	9	<7	30	<7	22	60
Raisins		132	<34	719	<34	719	6
Raspberries	13	8	<8	28	<8	15	18
Red wine	66	21	<4	39	18	37	15
Red currants		12	<8	22	12	15	12
Rhubarb	27	12	<6	38	12	26	29
Rye bread, dark	17	<24	<24	28	<24	<24	24
Rye bread, wholemeal	<10	<24	<24	<24	<24	<24	22
Soda water	3	<4	<4	8	4	<4	15
Spinach	28	32	<9	47	34	42	12
Squash	<4	5	<5	8	5	8	13
Strawberries	<7	<5	<5	8	<5	7	29
Sweet peppers	12	5	<3	8	5	8	26
Sweetened juice		<17	<17	19	<17	18	10
Trout	<75	<9	<9	11	<9	9	15
Turkey		<14	<14	<14	<14	<14	12
Veal	17	<14	<14	98	<14	16	52
White bread	<10	<24	<24	35	<24	<24	44
White bread, wholemeal	<10	<24	<24	<24	<24	<24	16
White wine	53	26	10	69	20	59	15

9.2.2 Cadmium in selected foods (µg/kg fresh weight) in the 3rd monitoring period

	2nd period	3rd period					
Foodstuff	Average	Average	Minimum	Maximum	Median	0.90 quantile	Number of samples
Apples	1	0.5	<0.5	2.2	<0.5	0.9	84
Aubergines	11	2.5	0.8	13.7	1.5	2.3	11
Avocadoes	2	4.7	1.6	13.5	4.1	6.0	12
Bananas	<0.4	<0.5	<0.5	0.9	<0.5	0.8	19
Beans	2	1.7	0.7	3.1	1.8	2.3	12
Beef	1	<1.0	<1.0	3.0	1.0	2.0	48
Beetroots	35	43.5	14.0	168	30.7	69.7	14
Blackcurrants	2	1.9	<0.5	5.1	1.9	3.3	23
Breakfast cereals	33	12.0	1.1	62.3	4.9	37.0	20
Broccoli		5.7	2.1	22.0	3.9	10.4	26
Brussels sprouts	14	8.0	5.0	12.1	7.3	10.6	13
Cabbage	3	3.0	1.5	5.4	3.2	5.3	14
Carrots	17	19.5	4.0	52.8	17.6	39.7	26
Cauliflower	7	4.7	1.8	8.3	4.5	7.3	27
Celeriac	72	90.4	10.0	267	62.3	256	14
Celery	15	21.9	2.3	122	14.5	43.2	24
Cherries	<0.4	0.5	<0.5	1.5	<0.5	1.0	22
Chicken	<1	<1	<0.5	2.0	0.0	1.0	28
Chinese cabbage	10	9.2	3.0	21.6	8.4	16.4	24
Clementines	<0.4	<0.5	<0.5	2.1	<0.5	2.1	7
Cod	13	<1	<1	4.5	<1	1.0	50
Curly kale	28	33.1	11.0	90.4	24.1	53.4	13
Eel	<13	2.7	<1	6	2.6	4	10
Eggs	2	<0.6	<0.6	1.0	<0.6	0.8	30
Elderberries	3	1.1	0.6	2.6	0.9	2.0	12
Flounder	18	1.0	<1.0	3.6	1.0	2.2	36
Garfish	17	2.8	2.6	4.7	2.6	4.4	20
Gooseberries	2	1.6	0.3	6.1	1.3	3.9	10
Grapefruits	<0.4	<0.5	<0.5	0.8	<0.5	0.8	6
Grapes	<0.4	<1	<1	1.2	<1	0.7	19
Herring	<13	5.8	2.0	17.2	4.1	13.7	30
Iceberg lettuce	14	13.7	1.2	40.2	10.4	31.0	26
Kidney, calf	167	198	32.0	774	153	430	51
Kidney, ox	708	785	213.0	2810	590	1690	49
Kidney, pig	248	261	54	811	220	378	60
Kiwi fruits	1	0.7	<0.5	3.9	0.5	1.1	19
Lamb	13	1.8	<1	10.9	<1	3.0	12
Leeks	27	21.6	10.0	53.6	20.7	28.2	14
Lemons	<0.4	<0.5	<0.5	1.1	<0.5	1.1	6
Lettuce	21	22.7	3.0	177	13.6	29.2	24
Liver, calf	42	42.0	7.0	188	36.4	78.2	51
Liver, chicken	13	24.0	7.0	52.7	23.0	36.0	25
Liver, duck	74	137	89.0	167	141	167	6
Liver, ox	124	105	31.0	181	105	152	24
Liver, pig	43	42.0	17.0	231	37.0	65.0	65
Liver, turkey	65	35.0	25.0	46.0	35.5	46.0	6
Mackerel	<13	4.7	2.0	14.0	3.8	7.3	30
Muesli	35	38.1	11.9	94.5	35.1	64.4	19
Mushrooms	23	14.9	3.4	25.7	16.5	24.6	14
Mutton	76	1.1	<1	4.0	1.0	2.0	22
Oatmeal		34.6	7.0	46.5	37.5	46.5	5
Onions	14	11.8	3.0	35.1	9.0	23.8	25

	2nd period	3rd period					
Foodstuff	Average	Average	Minimum	Maximum	Median	0.90 quantile	Number of samples
Oranges	<0.4	<0.5	<0.5	<0.5	<0.5	<0.5	6
Peaches	2	1.8	<0.5	6.4	1.0	5.9	19
Pears	4	5.5	1.0	18.6	4.3	10.6	56
Peas	3	1.5	<0.5	5.1	1.3	2.4	14
Persimmons		0.8	<0.5	1.6	<0.5	1.6	5
Plaice	<13	<1.0	<1.0	1.7	<1.0	1.3	34
Plums	1	0.7	<0.5	3.9	0.4	1.4	42
Pork	32	<1	<0.3	8.3	<1	<1	120
Potatoes	20	20.5	<1	62.0	14.5	40.5	60
Raisins		<1.8	<1.8	2.6	<1.8	2.6	6
Raspberries	9	12.8	2.6	58.0	11.0	22.9	18
Redcurrants		5.8	2.0	12.9	5.4	8.4	12
Rhubarb	22	12.5	3.0	29.3	10.9	24.2	29
Rye bread, dark	18	30.9	1.3	118	15.5	73.0	27
Rye bread, wholemeal	29	42.1	9.4	86.0	37.8	76.4	23
Spinach	80	65.0	31.0	97.6	60.5	95.1	12
Squash	2	2.2	<0.4	3.8	2.3	3.2	13
Strawberries	9	4.8	1.2	23.6	2.3	14.0	29
Sweet peppers	6	6.0	<0.5	18.8	4.2	16.3	26
Trout	<13	<1	<1	1.3	<1	1.0	15
Turkey		<1	<1	<1	<1	1.0	12
Veal	2	1.4	<1	13.0	1.0	3.0	52
White bread	39	35.7	16.4	64.0	35.2	50.5	44
White bread, wholemeal	37	39.1	<1	63.0	37.4	60.2	16

9.2.3 Nickel in selected foods (µg/kg fresh weight) in the 3rd monitoring period

	2nd period	3rd period					
Foodstuff	Average	Average	Minimum	Maximum	Median	0.90 quantile	Number of samples
Apples	<13	<9	<9	36	<9	19	84
Aubergines	11	<9	<9	29	<9	<9	11
Avocadoes	282	388	74	2670	148	416	12
Bananas	35	42	<9	109	30	102	19
Beans	283	167	27	296	175	281	12
Beef	<12	14	<14	112	<14	28	48
Beetroots	36	49	<7	204	35	109	14
Blackcurrants	69	119	45	282	110	187	23
Breakfast cereals	546	270	<50	795	175	677	20
Broccoli		107	<9	464	46	277	26
Brussel sprouts	56	28	7	77	22	63	13
Cabbage	32	34	<7	93	26	87	14
Carrots	48	51	11	155	42	110	26
Cauliflower	66	25	<9	125	13	77	27
Celeriac	52	68	30	150	56	135	14
Celery	16	14	<9	40	12	22	24
Cherries	13	15	<9	40	14	25	22
Chicken	<12	17	<14	93	<14	42	28
Chinese cabbage	18	10	8	22	9	17	24
Clementines	27	28	9	54	28	54	7
Cod	<30	34	<13	146	22	87	50
Curly kale	135	102	23	619	50	158	13
Eel	46	25	<13	62	23	48	10
Eggs	<14	<13	<13	<13	<13	<13	30
Elderberries	43	51	26	116	47	66	12
Flounder	34	43	<13	81	45	74	36
Garfish	<30	20	8	144	13	25	20
Gooseberries	23	27	9	85	22	57	10
Grapefruits	17	41	19	111	25	111	6
Grapes	<13	7	<13	21	8	18	19
Herring	34	21	<13	68	19	35	30
Iceberg lettuce	25	24	<7	80	21	43	26
Kidney, calf	32	16	<14	139	<14	37	26
Kidney, ox	51	<14	<14	40	<14	27	24
Kidney, pig	38	42	<14	111	36	71	60
Kiwi fruits	<13	38	<9	139	26	127	19
Lamb	<17	18	<14	61	<14	61	9
Leeks	33	58	<7	388	31	79	14
Lemons	31	96	<9	239	50	239	6
Lettuce	34	12	<4	36	8	32	24
Liver, calf	<15	24	<14	151	19	41	26
Liver, chicken	21	26	<14	100	15	53	38
Liver, duck	<15	14	<14	30	<14	30	6
Liver, ox	63	<14	<14	38	<14	30	24
Liver, pig	<20	17	<14	139	<14	53	65
Liver, turkey	21	<14	<14	31	<14	31	6
Mackerel	<30	<13	<13	19	<13	13	30
Muesli	451	675	212	1190	635	1100	19
Mushrooms	3	<9	<9	14	<9	<9	14
Mutton	63	<14	<14	19	<14	18	10
Oatmeal		766	11	863	753	863	5
Onions	35	28	<7	61	26	51	25

	2nd period	3rd period					
Foodstuff	Average	Average	Minimum	Maximum	Median	0.90 quantile	Number of samples
Oranges	28	35	<8	101	23	101	6
Peaches	196	113	<9	331	85	290	19
Pears	88	88	11	287	78	155	56
Peas	204	287	157	417	270	399	14
Persimmons		218	129	361	180	361	5
Plaice	36	68	39	135	63	97	34
Plums	69	65	<9	184	60	123	42
Pork	<17	<25	<25	169	<25	49	120
Potatoes	63	50	<6	581	28	105	60
Raisins		181	<34	493	142	493	6
Raspberries	136	200	44	664	157	438	18
Redcurrants		87	23	179	82	145	12
Rhubarb	96	54	<7	193	46	93	29
Rye bread, dark	65	121	<34	473	67	358	24
Rye bread, wholemeal	141	225	<34	710	196	371	22
Spinach	43	32	12	72	20	60	12
Squash	46	42	11	87	40	83	13
Strawberries	53	27	<9	77	21	54	29
Sweet peppers	92	35	<7	95	31	74	26
Trout	<30	<13	<13	22	<13	19	15
Turkey		31	<11	114	<11	81	12
Veal	<12	17	<14	142	<14	37	52
White bread	67	101	11	341	85	183	44
White bread, wholemeal	110	129	19	258	115	255	16

9.2.4 Mercury in selected foods (µg/kg fresh weight) in the 3rd monitoring period

	2nd period	3rd period					
Foodstuff	Average	Average	Minimum	Maximum	Median	0.90 quantile	Number of samples
Beef	<4	<7	<7	10	<7	<7	48
Chicken	<4	<7	<7	<7	<7	<7	28
Cod	73	49	21	121	42	75	50
Eel	81	63	29	99	62	98	10
Eggs	6	2	0,4	7	1	2	30
Flounder	62	72	28	201	63	119	36
Garfish	97	80	45	143	76	114	20
Herring	34	33	12	84	27	56	30
Kidney, calf	4	<7	<7	17	<7	9	51
Kidney, ox	8	17	<7	391	8	17	49
Kidney, pig	8	8	<7	246	4	11	132
Lamb	5	<7	<7	<7	<7	<7	9
Liver, calf	<4	<7	<7	<7	<7	<7	26
Liver, chicken	3	<7	<7	12	<7	9	25
Liver, duck	2	<7	<7	<7	<7	<7	6
Liver, ox	<4	<7	<7	12	<7	<7	49
Liver, pig	<4	<7	<7	39	<7	<7	143
Liver, turkey	2	<7	<7	<7	<7	<7	6
Mackerel	54	42	12	125	34	68	30
Mutton	2	<7	7	<7	<7	<7	10
Plaice	37	27	11	97	19	45	34
Pork	3	<7	<7	7	<7	<7	120
Trout	55	54	16	122	42	118	15
Turkey		<7	<7	<7	<7	<7	12
Veal	<4	<7	<7	<7	<7	<7	52

9.2.5 Arsenic in selected foods (µg/kg fresh weight) in the 3rd monitoring period

	2nd period	3rd period					
Foodstuff	Average	Average	Minimum	Maximum	Median	0.90 quantile	Number of samples
Cod	3930	2960	150	11500	2930	4520	50
Eel	540	270	140	430	270	410	10
Flounder	2220	1090	170	3320	1090	1680	36
Garfish	690	390	150	910	366	740	20
Herring	1480	900	260	1440	960	1430	30
Mackerel	1260	1000	270	1770	1080	1610	30
Plaice	7350	4150	1370	8480	4040	6240	34
Trout	1130	610	370	1260	540	910	15

9.3 Appendix to Chapter 4: Nitrate

9.3.1 Contents of nitrate (mg/kg fresh weight) in the vegetables analysed

	Number of samples	Minimum	Maximum	Average	Median	0.90 quantile
1993						
Danish lettuce	81	331	7818	2756	2896	4125
Foreign lettuce	40	10	3346	1207	1022	2277
Danish potatoes	47	28	542	158	149	264
Foreign potatoes	18	126	691	319	307	604
Beetroots	32	190	3767	1505	1305	2945
Cabbage	38	0	679	296	297	569
Leeks	42	0	1448	198	122	434
Chinese cabbage	26	353	2500	1084	940	1624
1994						
Danish lettuce	101	108	5300	2610	2760	4220
Foreign lettuce	49	48	4090	1338	1100	3220
Danish potatoes	40	46	400	164	150	336
Foreign potatoes	19	52	484	250	233	444
Beetroots	41	262	4070	1590	1330	2700
Cabbage	42	33	1240	336	275	674
Leeks	48	0	2290	397	217	935
Dan. Chinese cabbage	60	111	1980	904	827	1595
For. Chinese cabbage	31	228	8050	1307	1040	1620
1995/96						
Danish lettuce	122	376	5830	2441	2570	3960
Foreign lettuce	52	384	4680	1281	1075	1650
Danish potatoes	40	7	304	110	101	219
Foreign potatoes	21	101	501	228	182	386
Beetroots	30	116	3170	1389	943	2875
Cabbage	40	9	859	395	412	702
Leeks	40	1	1130	330	287	813
Dan. Chinese cabbage	30	195	3160	1001	881	1960
For. Chinese cabbage	25	116	2550	1164	1130	1900

9.4 Appendix to Chapter 5: Organic environmental contaminants

9.4.1 Number of samples of different foods in the the monitoring period (1993-1997)

Foodstuff	1993 Number of samples	1994 Number of samples	1995 Number of samples	1996 Number of samples	1997 Number of samples	1993-97 Samples, total
Poultry fat	24	24	20	25	25	118
Turkey fat	-	-	3	-	-	3
Beef fat	119	105	117	120	120	581
Pork fat	111	121	120	120	120	592
Fats, composite	26	23	25	6	-	80
Cheese	76	73	64	66	-	279
Butter	110	98	108	105	-	421
Margarine	-	-	35	-	-	35
Vegetable oil	-	-	53	-	-	53
Eggs	16	16	48	49	-	129
Salmon	3	1	10	10	-	24
Mackerel	11	11	32	9	-	63
Herring	17	13	38	28	-	96
Cod liver	11	14	20	20	-	65
Eel	1	5	9	5	27	47
Tinned fish:						
Mackerel in tomato sauce	-	-	15	-	-	15
Tuna in water	-	-	12	-	-	12

9.4.2 Tables of average contents, etc.

The average contents of the analysed compounds in various foods are presented in the following tables which show the total number of samples for each of the foods analysed; the number of samples having contents above the detection/report limit; the average contents of the individual organochlorine compounds; a 95% confidence interval (stated only where the programme *Mean-BDL* [50] was used); and the maximum value.

The calculation methods used are described in section 5.3 (calculation of average contents).

ΣDDT is the sum of p,p'-DDT and its metabolites p,p'-DDE and p,p'-DDD. The limit of detection for DDE was used for the calculation of average contents, since it is predominantly DDE which is found in the samples.

As there are only three samples of turkey fat, these have been pooled with those for poultry fat. Thus, only one average for poultry is given in the tables, and this has been used for all poultry in the intake calculations.

All margarine types have been pooled, since the material was relatively small. Thirty-five samples have been analysed, distributed on 12 samples of margarine, 4 of vegetable margarine, 1 of low-fat spread, and 18 of margarines for industrial use.

'Fats, composite' refers to products in which butter fat and vegetable fat have been mixed.

a) Aldrin

Foodstuff	Number of samples	Samples >d.*	Average	Confidence interval (95%) from	to	Maximum**
			mg/kg***	mg/kg***	mg/kg***	mg/kg***
Fats, composite	80	0	0.003			< d.
Poultry fat	121	0	0.003			< d.
Margarine	35	0	0.002			< d.
Beef fat	581	1	0.003			0.005
Cheese, Danish	128	0	0.003			< d.
Cheese, foreign	151	0	0.003			< d.
Butter, Danish	410	0	0.003			< d.
Butter, foreign	11	0	0.002			< d.
Pork fat	592	0	0.003			< d.
Eggs	129	0	0.001			< d.
Tinned mackerel in t.	15	0	0.0005			< d.
Tinned tuna in water	12	0	0.0001			< d.
Salmon:						
North Sea	1	0	0.003			< d.
Baltic Sea	23	0	0.001			< d.
Mackerel:						
Kattegat	5	0	0.001			< d.
North Sea	14	0	0.001			< d.
Skagerrak	16	1	0.002			0.006
Unknown waters	28	0	0.001			< d.
Herring:						
Belts	1	0	0.001			< d.
Kattegat	15	0	0.001			< d.
Skagerrak	31	0	0.002			< d.
Baltic Sea	27	0	0.001			< d.
Unknown waters	22	0	0.000			< d.
Cod liver:						
Belts	3	0	0.001			< d.
Kattegat	7	0	0.001			< d.
North Sea	2	1	0.004			0.005
Skagerrak	27	1	0.001			0.003
Sound	2	0	0.001			< d.
Baltic Sea	19	0	0.001			< d.
Unknown waters	5	0	0.001			< d.
Eel	47	0	0.001			< d.

* d. = limit of detection. The limit of detection varies during the monitoring period; see Appendix 9.4.3.
** Maximum may be less than some of the limit of detection for the period, since the limit varies, as mentioned above.
*** mg/kg fish (salmon, mackerel, herring, eel), mg/kg cod liver, mg/kg eggs (fresh weight), mg/kg contents in tin, and mg/kg fat for the rest of the foods.

b) ΣDDT

Foodstuff	Number of samples	Samples >d.*	Average	Confidence interval (95%) from	to	Maximum**
			mg/kg***	mg/kg***	mg/kg***	mg/kg***
Fats, composite	80	1	0.005			0.005
Poultry fat	121	5	0.002	0.0008	0.0030	0.061
Margarine	35	1	0.002			0.016
Beef fat	581	146	0.006	0.0050	0.0061	0.069
Cheese, Danish	128	22	0.004	0.0038	0.0052	0.023
Cheese, foreign	151	15	0.007	0.0028	0.015	0.21
Butter, Danish	410	79	0.005	0.0045	0.0051	0.020
Butter, foreign	11	3	0.007	0.0019	0.029	0.052
Pork fat	592	122	0.005	0.0043	0.0053	0.075
Eggs	129	9	0.001	0.0006	0.0015	0.022
Tinned mackerel in t.	15	12	0.0014	0.0006	0.0032	0.0043
Tinned tuna in water	12	2	0.0001			0.0011
Salmon:						
North Sea	1	1	0.088			0.088
Baltic Sea	23	23	0.059	0.050	0.070	0.090
Mackerel:						
Kattegat	5	4	0.005	0.0022	0.011	0.010
North Sea	14	5	0.002	0.0015	0.0026	0.004
Skagerrak	16	6	0.005	0.0027	0.011	0.017
Unknown waters	28	16	0.003	0.0022	0.0033	0.005
Herring:						
Belts	1	1	0.004			0.004
Kattegat	15	7	0.002	0.0017	0.0027	0.004
Skagerrak	31	12	0.003	0.0021	0.0039	0.010
Baltic Sea	27	4	0.031	0.020	0.046	0.072
Unknown waters	22	17	0.004	0.0027	0.0051	0.012
Cod liver:						
Belts	3	3	0.30	0.19	0.47	0.48
Kattegat	7	7	0.19	0.14	0.26	0.34
North Sea	2	2	0.38	0.19	0.78	0.55
Skagerrak	27	27	0.098	0.072	0.13	0.31
Sound	2	2	0.59	0.35	0.97	0.78
Baltic Sea	19	19	0.72	0.57	0.91	1.6
Unknown waters	5	5	0.23	0.068	0.77	0.78
Eel	47	45	0.021	0.015	0.030	0.21

* d. = limit of detection. The limit of detection varies during the monitoring period; see Appendix 9.4.3.
** Maximum may be less than some of the limit of detection for the period, since the limit varies, as mentioned above.
*** mg/kg fish (salmon, mackerel, herring, eel), mg/kg cod liver, mg/kg eggs (fresh weight), mg/kg contents in tin, and mg/kg fat for the rest of the foods.

c) Dieldrin

Foodstuff	Number of samples	Samples >d.*	Average	Confidence interval (95%)		Maximum**
				from	to	
			mg/kg***	mg/kg***	mg/kg***	mg/kg***
Fats, composite	80	0	0.003			< d.
Poultry fat	121	4	0.004	0.0024	0.0053	0.012
Margarine	35	0	0.002			< d.
Beef fat	581	4	0.003			0.007
Cheese, Danish	128	0	0.003			< d.
Cheese, foreign	151	6	0.003	0.0021	0.0052	0.020
Butter, Danish	410	1	0.003			0.006
Butter, foreign	11	0	0.003			< d.
Pork fat	592	3	0.003			0.008
Eggs	129	0	0.001			< d.
Tinned mackerel in t.	15	0	0.0008			< d.
Tinned tuna in water	12	0	0.0002			< d.
Herring:						
North Sea	1	0	0.003			< d.
Baltic Sea	23	5	0.003	0.0026	0.0037	0.004
Mackerel:						
Kattegat	5	2	0.003	0.0017	0.0071	0.006
North Sea	14	0	0.002			< d.
Skagerrak	16	4	0.003	0.0016	0.0060	0.009
Unknown waters	28	0	0.002			0.003
Herring:						
Belts	1	0	0.002			< d.
Kattegat	15	0	0.002			< d.
Skagerrak	31	7	0.003	0.0021	0.0037	0.007
Baltic Sea	27	5	0.003	0.0018	0.0039	0.009
Unknown waters	22	8	0.004	0.0032	0.0045	0.006
Cod liver:						
Belts	3	3	0.028	0.024	0.031	0.032
Kattegat	7	7	0.026	0.017	0.040	0.042
North Sea	2	2	0.056	0.041	0.076	0.068
Skagerrak	27	27	0.056	0.040	0.078	0.17
Sound	2	2	0.034	0.015	0.077	0.051
Baltic Sea	19	19	0.039	0.025	0.061	0.070
Unknown waters	5	5	0.033	0.023	0.049	0.048
Eel	47	16	0.003	0.0019	0.0041	0.010

* d. = limit of detection. The limit of detection varies during the monitoring period; see Appendix 9.4.3.
** Maximum may be less than some of the limit of detection for the period, since the limit varies, as mentioned above.
*** mg/kg fish (salmon, mackerel, hering, eel), mg/kg cod liver, mg/kg eggs (fresh weight), mg/kg contents in tin, and mg/kg fat for the rest of the foods.

d) HCB

Foodstuff	Number of samples	Samples >d.*	Average	Confidence interval (95%)		Maximum**
				from	to	
			mg/kg***	mg/kg***	mg/kg***	mg/kg***
Fats, composite	80	0	0.003			< d.
Poultry fat	121	4	0.001	0.0007	0.0024	0.010
Margarine	35	0	0.001			< d.
Beef fat	581	156	0.004	0.0036	0.0043	0.056
Cheese, Danish	128	12	0.003	0.0022	0.0033	0.013
Cheese, foreign	151	22	0.003	0.0028	0.0043	0.022
Butter, Danish	410	80	0.004	0.0034	0.0040	0.013
Butter, foreign	11	3	0.003	0.0025	0.0035	0.004
Pork fat	592	5	0.003			0.031
Eggs	129	4	0.0006	0.0004	0.0009	0.002
Tinned mackerel in t.	15	10	0.0007	0.0006	0.0009	0.0012
Tinned tuna in water	12	1	0.0001			0.0002
Salmon:						
North Sea	1	0	0.003			< d.
Baltic Sea	23	12	0.001	0.0009	0.0012	0.002
Mackerel:						
Kattegat	5	0	0.001			< d.
North Sea	14	0	0.001			< d.
Skagerrak	16	0	0.002			< d.
Unknown waters	28	5	0.001			0.001
Herring:						
Belts	1	0	0.000			< d.
Kattegat	15	0	0.000			< d.
Skagerrak	31	0	0.001			< d.
Baltic Sea	27	7	0.001	0.0008	0.0014	0.002
Unknown waters	22	2	0.000			0.001
Cod liver:						
Belts	3	3	0.009	0.0062	0.014	0.014
Kattegat	7	7	0.010	0.0070	0.015	0.016
North Sea	2	2	0.013	0.011	0.015	0.014
Skagerrak	27	22	0.008	0.0054	0.012	0.016
Sound	2	2	0.024	0.022	0.026	0.025
Baltic Sea	19	19	0.019	0.015	0.024	0.036
Unknown waters	5	5	0.009	0.0038	0.021	0.025
Eel	47	21	0.0015	0.0011	0.0021	0.005

* d. = limit of detection. The limit of detection varies during the monitoring period; see Appendix 9.4.3.
** Maximum may be less than some of the limit of detection for the period, since the limit varies, as mentioned above.
*** mg/kg fish (salmon, mackerel, herring, eel), mg/kg cod liver, mg/kg eggs (fresh weight), mg/kg contents in tin, and mg/kg fat for the rest of the foods.

e) α-HCH

Foodstuff	Number of samples	Samples >d.*	Average	Confidence interval (95%) from	to	Maximum**
			mg/kg***	mg/kg***	mg/kg***	mg/kg***
Fats, composite	80	0	0.003			< d.
Poultry fat	121	4	0.001			0.003
Margarine	35	0	0.001			< d.
Beef fat	581	6	0.001			0.004
Cheese, Danish	128	1	0.003			0.003
Cheese, foreign	151	10	0.002	0.0015	0.0032	0.025
Butter, Danish	410	1	0.003			0.003
Butter, foreign	11	0	0.002			< d.
Pork fat	592	1	0.001			0.004
Eggs	129	0	0.001			< d.
Tinned mackerel in t.	15	1	0.0004			0.0012
Tinned tuna in water	12	0	0.0001			< d.
Salmon:						
North Sea	1	0	0.003			< d.
Baltic Sea	23	4	0.001	0.0011	0.0021	0.004
Mackerel:						
Kattegat	5	1	0.001			0.002
North Sea	14	4	0.002	0.0015	0.0022	0.003
Skagerrak	16	5	0.003	0.0017	0.0037	0.005
Unknown waters	28	7	0.002	0.0013	0.0021	0.003
Herring:						
Belts	1	0	0.001			< d.
Kattegat	15	0	0.001			< d.
Skagerrak	31	2	0.001	0.0007	0.0023	0.003
Baltic Sea	27	6	0.002	0.0014	0.0021	0.004
Unknown waters	22	5	0.002	0.0011	0.0021	0.004
Cod liver:						
Belts	3	3	0.007	0.0033	0.015	0.013
Kattegat	7	6	0.006	0.0038	0.0081	0.007
North Sea	2	2	0.018	0.016	0.020	0.019
Skagerrak	27	22	0.008	0.0063	0.0092	0.015
Sound	2	2	0.012	0.0034	0.045	0.020
Baltic Sea	19	18	0.016	0.013	0.020	0.033
Unknown waters	5	5	0.009	0.0052	0.016	0.018
Eel	47	12	0.002	0.0013	0.0021	0.005

* d. = limit of detection. The limit of detection varies during the monitoring period; see Appendix 9.4.3.
** Maximum may be less than some of the limit of detection for the period, since the limit varies, as mentioned above.
*** mg/kg fish (salmon, mackerel, herring, eel), mg/kg cod liver, mg/kg eggs (fresh weight), mg/kg contents in tin, and mg/kg fat for the rest of the foods.

f) β-HCH

Foodstuff	Number of samples	Samples >d.*	Average	Confidence interval (95%) from	to	Maximum**
			mg/kg***	mg/kg***	mg/kg***	mg/kg***
Fats, composite	80	1	0.003			0.010
Poultry fat	121	0	0.003			< d.
Margarine	35	0	0.003			< d.
Beef fat	581	8	0.003			0.027
Cheese, Danish	128	0	0.003			< d.
Cheese, foreign	151	2	0.003			0.015
Butter, Danish	410	0	0.003			< d.
Butter, foreign	11	0	0.003			< d.
Pork fat	592	0	0.003			< d.
Eggs	129	0	0.002			< d.
Tinned mackerel in t.	15	0	0.0001			< d.
Tinned tuna in water	12	0	0.0000			< d.
Salmon:						
North Sea	1	0	0.003			< d.
Baltic Sea	23	1	0.002			0.004
Mackerel:						
Kattegat	5	0	0.001			< d.
North Sea	14	0	0.002			< d.
Skagerrak	16	1	0.003			0.007
Unknown waters	28	2	0.003	0.0020	0.0044	0.005
Herring:						
Belts	1	0	0.001			< d.
Kattegat	15	0	0.001			< d.
Skagerrak	31	1	0.002			0.004
Baltic Sea	27	0	0.002			< d.
Unknown waters	22	0	0.001			< d.
Cod liver:						
Belts	3	3	0.007	0.0045	0.012	0.011
Kattegat	7	3	0.004	0.0027	0.0059	0.008
North Sea	2	2	0.011	0.0098	0.0112	0.011
Skagerrak	27	11	0.005	0.0040	0.0070	0.011
Sound	2	2	0.006	0.0048	0.0062	0.006
Baltic Sea	19	14	0.015	0.0095	0.024	0.025
Unknown waters	5	1	0.005			0.021
Eel	47	7	0.003	0.0020	0.0037	0.007

* d. = limit of detection. The limit of detection varies during the monitoring period; see Appendix 9.4.3.
** Maximum may be less than some of the limit of detection for the period, since the limit varies, as mentioned above.
*** mg/kg fish (salmon, mackerel, herring, eel), mg/kg cod liver, mg/kg eggs (fresh weight), mg/kg contents in tin, and mg/kg fat for the rest of the foods.

g) Heptachlor epoxide

Foodstuff	Number of samples	Samples >d.*	Average	Confidence interval (95%)		Maximum**
				from	to	
			mg/kg***	mg/kg***	mg/kg***	mg/kg***
Fats, composite	80	0	0.003			< d.
Poultry fat	121	0	0.003			< d.
Margarine	35	0	0.002			< d.
Beef fat	581	0	0.003			< d.
Cheese, Danish	128	0	0.003			< d.
Cheese, foreign	151	0	0.003			< d.
Butter, Danish	410	0	0.003			< d.
Butter, foreign	11	0	0.002			< d.
Pork fat	592	0	0.003			< d.
Eggs	129	0	0.001			< d.
Tinned mackerel in tomato sauce	15	0	0.0003			< d.
Tinned tuna in water	12	0	0.0001			< d.
Salmon:						
North Sea	1	0	0.003			< d.
Baltic Sea	23	0	0.001			< d.
Mackerel:						
Kattegat	5	0	0.001			< d.
North Sea	14	0	0.002			< d.
Skagerrak	16	2	0.002	0.0002	0.016	0.007
Unknown waters	28	0	0.001			< d.
Herring:						
Belts	1	0	0.001			< d.
Kattegat	15	0	0.001			< d.
Skagerrak	31	1	0.002			0.003
Baltic Sea	27	0	0.002			< d.
Unknown waters	22	0	0.001			< d.
Cod liver:						
Belts	3	1	0.006			0.016
Kattegat	7	6	0.006	0.0048	0.0080	0.009
North Sea	2	2	0.013	0.0025	0.065	0.021
Skagerrak	27	16	0.005	0.0038	0.0067	0.015
Sound	2	1	0.003			0.005
Baltic Sea	19	9	0.006	0.0036	0.011	0.045
Unknown waters	5	3	0.007	0.0037	0.013	0.013
Eel	47	0	0.001			< d.

* d. = limit of detection. The limit of detection varies during the monitoring period; see Appendix 9.4.3.
** Maximum may be less than some of the limit of detection for the period, since the limit varies, as mentioned above.
*** mg/kg fish (salmon, mackerel, herring, eel), mg/kg cod liver, mg/kg eggs (fresh weight), mg/kg contents in tin, and mg/kg fat for the rest of the foods.

h) Lindane

Foodstuff	Number of samples	Samples >d.*	Average	Confidence interval (95%)		Maximum**
				from	to	
			mg/kg***	mg/kg***	mg/kg***	mg/kg***
Fats, composite	80	0	0.003			< d.
Poultry fat	121	18	0.004	0.0025	0.0050	0.098
Margarine	35	0	0.002			< d.
Beef fat	581	9	0.003			0.050
Cheese, Danish	128	1	0.003			0.006
Cheese, foreign	151	49	0.010	0.0076	0.013	0.14
Butter, Danish	410	0	0.003			< d.
Butter, foreign	11	4	0.007	0.0030	0.018	0.029
Pork fat	592	0	0.003			< d.
Eggs	129	1	0.001			0.002
Tinned mackerel in t.	15	3	0.0006	0.0000	0.034	0.0011
Tinned tuna in water	12	0	0.0000			< d.
Salmon:						
North Sea	1	0	0.003			< d.
Baltic Sea	23	0	0.002			< d.
Mackerel:						
Kattegat	5	2	0.002	0.0010	0.0036	0.003
North Sea	14	3	0.004	0.0032	0.0043	0.005
Skagerrak	16	5	0.002	0.0011	0.0029	0.003
Unknown waters	28	5	0.004	0.0033	0.0040	0.005
Herring:						
Belts	1	0	0.001			< d.
Kattegat	15	1	0.001			0.004
Skagerrak	31	1	0.002			0.005
Baltic Sea	27	0	0.002			< d.
Unknown waters	22	0	0.002			< d.
Cod liver:						
Belts	3	2	0.006	0.0036	0.0094	0.008
Kattegat	7	6	0.005	0.0041	0.0059	0.007
North Sea	2	2	0.013	0.010	0.016	0.015
Skagerrak	27	14	0.008	0.0055	0.011	0.024
Sound	2	2	0.011	0.0054	0.023	0.016
Baltic Sea	19	15	0.013	0.0085	0.019	0.022
Unknown waters	5	4	0.015	0.0047	0.046	0.039
Eel	47	10	0.002	0.0016	0.0032	0.006

* d. = limit of detection. The limit of detection varies during the monitoring period; see Appendix 9.4.3.
** Maximum may be less than some of the limit of detection for the period, since the limit varies, as mentioned above.
*** mg/kg fish (salmon, mackerel, herring, eel), mg/kg cod liver, mg/kg eggs (fresh weight), mg/kg contents in tin, and mg/kg fat for the rest of the foods.

i) PCB28

Foodstuff	Number of samples	Samples >d.*	Average	Confidence interval (95%) from	to	Maximum**
			mg/kg***	mg/kg***	mg/kg***	mg/kg***
Fats, composite	54	0	0.003			< d.
Poultry fat	97	0	0.003			< d.
Margarine	35	0	0.002			< d.
Beef fat	462	0	0.003			< d.
Cheese, Danish	93	0	0.003			< d.
Cheese, foreign	110	0	0.003			< d.
Butter, Danish	300	1	0.003			0.011
Butter, foreign	11	0	0.003			< d.
Pork fat	481	0	0.003			< d.
Eggs	113	0	0.001			< d.
Tinned mackerel in t.	15	0	0.0006			< d.
Tinned tuna in water	12	0	0.0000			< d.
Salmon:						
Baltic Sea	21	0	0.001			< d.
Mackerel:						
Kattegat	5	2	0.006	0.0016	0.022	0.017
North Sea	11	0	0.001			< d.
Skagerrak	9	3	0.004	0.0023	0.0067	0.008
Unknown waters	27	0	0.001			< d.
Herring:						
Belts	1	0	0.001			< d.
Kattegat	15	1	0.002			0.004
Skagerrak	21	0	0.001			< d.
Baltic Sea	20	1	0.001			0.004
Unknown waters	22	0	0.001			< d.
Cod liver:						
Belts	3	3	0.017			0.022
Kattegat	7	7	0.034			0.047
North Sea	2	2	0.006			0.006
Skagerrak	21	19	0.016	0.010	0.024	0.049
Sound	2	2	0.017			0.019
Baltic Sea	15	12	0.017	0.010	0.027	0.037
Unknown waters	4	3	0.018	0.0033	0.100	0.045
Eel	46	0	0.001			< d.

* d. = limit of detection. The limit of detection varies during the monitoring period; see Appendix 9.4.3.
** Maximum may be less than some of the limit of detection for the period, since the limit varies, as mentioned above.
*** mg/kg fish (salmon, mackerel, herring, eel), mg/kg cod liver, mg/kg eggs (fresh weight), mg/kg contents in tin, and mg/kg fat for the rest of the foods.

j) PCB52

Foodstuff	Number of samples	Samples >d.*	Average	Confidence interval (95%)		Maximum**
				from	to	
			mg/kg***	mg/kg***	mg/kg***	mg/kg***
Fats, composite	54	0	0.003			< d.
Poultry fat	97	0	0.003			< d.
Margarine	35	0	0.004			< d.
Beef fat	462	0	0.003			< d.
Cheese, Danish	93	0	0.003			< d.
Cheese, foreign	110	0	0.003			< d.
Butter, Danish	300	0	0.003			< d.
Butter, foreign	11	0	0.003			< d.
Pork fat	481	0	0.003			< d.
Eggs	113	0	0.002			< d.
Tinned mackerel in t.	15	0	0.0033			< d.
Tinned tuna in water	12	0	0.0010			< d.
Salmon:						
Baltic Sea	21	0	0.004			< d.
Mackerel:						
Kattegat	5	0	0.004			< d.
North Sea	11	0	0.004			< d.
Skagerrak	9	0	0.004			< d.
Unknown waters	27	0	0.004			< d.
Herring:						
Belts	1	0	0.004			< d.
Kattegat	15	0	0.004			< d.
Skagerrak	21	0	0.004			< d.
Baltic Sea	20	1	0.004			0.012
Unknown waters	22	0	0.004			< d.
Cod liver:						
Belts	3	1	0.007			0.014
Kattegat	7	5	0.014	0.011	0.017	0.018
North Sea	2	0	0.004			< d.
Skagerrak	21	2	0.005			0.014
Sound	2	2	0.019	0.012	0.030	0.025
Baltic Sea	15	11	0.016			0.029
Unknown waters	4	1	0.007			0.015
Eel	46	0	0.004			< d.

* d. = limit of detection. The limit of detection varies during the monitoring period; see Appendix 9.4.3.
** Maximum may be less than some of the limit of detection for the period, since the limit varies, as mentioned above.
*** mg/kg fish (salmon, mackerel, herring, eel), mg/kg cod liver, mg/kg eggs (fresh weight), mg/kg contents in tin, and mg/kg fat for the rest of the foods.

k) PCB101

Foodstuff	Number of samples	Samples >d.*	Average	Confidence interval (95%) from	to	Maximum**
			mg/kg***	mg/kg***	mg/kg***	mg/kg***
Fats, composite	54	0	0.003			< d.
Poultry fat	97	0	0.003			< d.
Margarine	35	2	0.005			0.019
Beef fat	462	0	0.003			< d.
Cheese, Danish	93	0	0.003			< d.
Cheese, foreign	110	0	0.003			< d.
Butter, Danish	300	1	0.003			0.011
Butter, foreign	11	0	0.003			< d.
Pork fat	481	1	0.003			0.014
Eggs	113	0	0.001			< d.
Tinned mackerel in t.	15	0	0.0021			< d.
Tinned tuna in water	12	0	0.0006			< d.
Salmon:						
Baltic Sea	21	16	0.005	0.0044	0.0057	0.007
Mackerel:						
Kattegat	5	0	0.001			< d.
North Sea	11	0	0.001			< d.
Skagerrak	9	2	0.003	0.0021	0.0049	0.006
Unknown waters	27	0	0.001			< d.
Herring:						
Belts	1	0	0.001			< d.
Kattegat	15	0	0.001			< d.
Skagerrak	21	0	0.001			< d.
Baltic Sea	20	5	0.003	0.0027	0.0043	0.006
Unknown waters	22	0	0.001			< d.
Cod liver:						
Belts	3	3	0.045	0.036	0.055	0.055
Kattegat	7	7	0.032	0.024	0.044	0.045
North Sea	2	2	0.022	0.020	0.024	0.023
Skagerrak	21	18	0.019	0.012	0.029	0.050
Sound	2	2	0.084	0.064	0.11	0.099
Baltic Sea	15	15	0.066	0.052	0.084	0.13
Unknown waters	4	4	0.017	0.012	0.024	0.024
Eel	46	11	0.003	0.0023	0.0045	0.014

* d. = limit of detection. The limit of detection varies during the monitoring period; see Appendix 9.4.3.
** Maximum may be less than some of the limit of detection for the period, since the limit varies, as mentioned above.
*** mg/kg fish (salmon, mackerel, herring, eel), mg/kg cod liver, mg/kg eggs (fresh weight), mg/kg contents in tin, and mg/kg fat for the rest of the foods.

l) PCB105

Foodstuff	Number of samples	Samples >d.*	Average	Confidence interval (95%) from	to	Maximum**
			mg/kg***	mg/kg***	mg/kg***	mg/kg***
Fats, composite	54	0	0.002			< d.
Poultry fat	97	0	0.002			< d.
Margarine	35	2	0.002			0.010
Beef fat	462	0	0.002			< d.
Cheese, Danish	93	0	0.002			< d.
Cheese, foreign	110	0	0.002			< d.
Butter, Danish	300	0	0.002			< d.
Butter, foreign	11	0	0.002			< d.
Pork fat	481	0	0.002			< d.
Eggs	113	0	0.001			< d.
Tinned mackerel in t.	15	0	0.0006			< d.
Tinned tuna in water	12	0	0.0000			< d.
Salmon:						
Baltic Sea	21	14	0.003	0.0029	0.0037	0.006
Mackerel:						
Kattegat	5	0	0.001			< d.
North Sea	11	0	0.001			< d.
Skagerrak	9	0	0.001			< d.
Unknown waters	27	0	0.001			< d.
Herring:						
Belts	1	0	0.001			< d.
Kattegat	15	0	0.001			< d.
Skagerrak	21	0	0.001			< d.
Baltic Sea	20	4	0.002	0.0017	0.0032	0.005
Unknown waters	22	0	0.001			< d.
Cod liver:						
Belts	3	3	0.018	0.015	0.023	0.021
Kattegat	7	7	0.019	0.013	0.028	0.029
North Sea	2	2	0.011	0.0064	0.017	0.014
Skagerrak	21	16	0.014	0.0073	0.026	0.047
Sound	2	2	0.038	0.032	0.044	0.042
Baltic Sea	15	15	0.032	0.025	0.041	0.077
Unknown waters	4	4	0.013	0.0063	0.027	0.030
Eel	46	5	0.001	0.0007	0.0032	0.023

* d. = limit of detection. The limit of detection varies during the monitoring period; see Appendix 9.4.3.
** Maximum may be less than some of the limit of detection for the period, since the limit varies, as mentioned above.
*** mg/kg fish (salmon, mackerel, herring, eel), mg/kg cod liver, mg/kg eggs (fresh weight), mg/kg contents in tin, and mg/kg fat for the rest of the foods.

m) PCB118

Foodstuff	Number of samples	Samples >d.*	Average	Confidence interval (95%) from	to	Maximum**
			mg/kg***	mg/kg***	mg/kg***	mg/kg***
Fats, composite	54	0	0.002			< d.
Poultry fat	97	0	0.002			< d.
Margarine	35	2	0.003			0.015
Beef fat	462	3	0.002			0.007
Cheese, Danish	93	0	0.002			< d.
Cheese, foreign	110	0	0.002			0.002
Butter, Danish	300	1	0.002			0.006
Butter, foreign	11	0	0.002			< d.
Pork fat	481	1	0.002			0.015
Eggs	113	1	0.001			0.002
Tinned mackerel in t.	15	0	0.0009			< d.
Tinned tuna in water	12	0	0.0003			< d.
Salmon:						
Baltic Sea	21	20	0.006	0.0056	0.0071	0.010
Mackerel:						
Kattegat	5	0	0.001			< d.
North Sea	11	0	0.001			< d.
Skagerrak	9	1	0.002			0.009
Unknown waters	27	0	0.001			< d.
Herring:						
Belts	1	0	0.001			< d.
Kattegat	15	0	0.001			< d.
Skagerrak	21	0	0.001			< d.
Baltic Sea	20	6	0.003	0.0019	0.0036	0.006
Unknown waters	22	0	0.001			< d.
Cod liver:						
Belts	3	3	0.055	0.046	0.065	0.064
Kattegat	7	7	0.054	0.040	0.074	0.084
North Sea	2	2	0.026	0.0096	0.072	0.041
Skagerrak	21	16	0.068	0.021	0.22	0.18
Sound	2	2	0.072	0.042	0.12	0.098
Baltic Sea	15	15	0.066	0.048	0.090	0.14
Unknown waters	4	4	0.024	0.014	0.042	0.042
Eel	46	26	0.006	0.0042	0.0091	0.066

* d. = limit of detection. The limit of detection varies during the monitoring period; see Appendix 9.4.3.
** Maximum may be less than some of the limit of detection for the period, since the limit varies, as mentioned above.
*** mg/kg fish (salmon, mackerel, herring, eel), mg/kg cod liver, mg/kg eggs (fresh weight), mg/kg contents in tin, and mg/kg fat for the rest of the foods.

n) PCB138

Foodstuff	Number of samples	Samples >d.*	Average	Confidence interval (95%) from	to	Maximum**
			mg/kg***	mg/kg***	mg/kg***	mg/kg***
Fats, composite	54	0	0.002			< d.
Poultry fat	97	0	0.002			< d.
Margarine	35	2	0.003			0.022
Beef fat	462	16	0.001	0.0009	0.0020	0.021
Cheese, Danish	93	1	0.002			0.010
Cheese, foreign	110	1	0.002			0.007
Butter, Danish	300	0	0.002			< d.
Butter, foreign	11	1	0.003			0.007
Pork fat	481	15	0.002			0.032
Eggs	113	4	0.001	0.0004	0.0020	0.008
Tinned mackerel in t.	15	2	0.0009	0.0002	0.0031	0.0050
Tinned tuna in water	12	0	0.0001			< d.
Salmon:						
Baltic Sea	21	20	0.011	0.0092	0.013	0.018
Mackerel:						
Kattegat	5	1	0.002			0.007
North Sea	11	0	0.001			< d.
Skagerrak	9	2	0.005	0.0006	0.048	0.018
Unknown waters	27	4	0.003	0.0021	0.0041	0.006
Herring:						
Belts	1	0	0.001			< d.
Kattegat	15	0	0.001			< d.
Skagerrak	21	4	0.003	0.0022	0.0043	0.006
Baltic SEa	20	9	0.006	0.0038	0.0099	0.014
Unknown waters	22	3	0.003	0.0016	0.0043	0.007
Cod liver:						
Belts	3	3	0.13	0.12	0.15	0.15
Kattegat	7	7	0.098	0.085	0.11	0.12
North Sea	2	2	0.064	0.051	0.080	0.074
Skagerrak	21	21	0.089	0.059	0.13	0.34
Sound	2	2	0.16	0.12	0.21	0.19
Baltic Sea	15	15	0.13	0.11	0.17	0.27
Unknown waters	4	4	0.063	0.043	0.092	0.089
Eel	46	35	0.011	0.0082	0.014	0.082

* d. = limit of detection. The limit of detection varies during the monitoring period; see Appendix 9.4.3.
** Maximum may be less than some of the limit of detection for the period, since the limit varies, as mentioned above.
*** mg/kg fish (salmon, mackerel, herring, eel), mg/kg cod liver, mg/kg eggs (fresh weight), mg/kg contents in tin, and mg/kg fat for the rest of the foods.

o) PCB153

Foodstuff	Number of samples	Samples >d.*	Average	Confidence interval (95%) from	to	Maximum**
			mg/kg***	mg/kg***	mg/kg***	mg/kg***
Fats, composite	54	0	0.002			< d.
Poultry fat	97	1	0.002			0.008
Margarine	35	2	0.003			0.018
Beef fat	462	17	0.003			0.025
Cheese, Danish	93	0	0.002			< d.
Cheese, foreign	110	1	0.002			0.006
Butter, Danish	300	1	0.002			0.006
Butter, foreign	11	0	0.002			< d.
Pork fat	481	7	0.002			0.035
Eggs	113	1	0.001			0.002
Tinned mackerel in t.	15	1	0.0007			0.0023
Tinned tuna in water	12	0	0.0002			< d.
Salmon:						
Baltic Sea	21	20	0.013	0.011	0.016	0.020
Mackerel:						
Kattegat	5	2	0.003	0.0020	0.0049	0.005
North Sea	11	2	0.002	0.0011	0.0040	0.004
Skagerrak	9	2	0.003	0.0006	0.018	0.010
Unknown waters	27	13	0.003	0.0028	0.0043	0.007
Herring:						
Belts	1	0	0.001			< d.
Kattegat	15	1	0.001			0.003
Skagerrak	21	0	0.001			< d.
Baltic Sea	20	16	0.008	0.0056	0.011	0.014
Unknown waters	22	4	0.002	0.0012	0.0034	0.007
Cod liver:						
Belts	3	3	0.20	0.16	0.26	0.25
Kattegat	7	7	0.15	0.12	0.18	0.20
North Sea	2	2	0.066	0.059	0.073	0.071
Skagerrak	21	21	0.10	0.065	0.17	0.42
Sound	2	2	0.21	0.11	0.40	0.30
Baltic Sea	15	15	0.16	0.12	0.21	0.25
Unknown waters	4	4	0.066	0.043	0.10	0.094
Eel	46	42	0.015	0.011	0.020	0.11

* d. = limit of detection. The limit of detection varies during the monitoring period; see Appendix 9.4.3.
** Maximum may be less than some of the limit of detection for the period, since the limit varies, as mentioned above.
*** mg/kg fish (salmon, mackerel, herring, eel), mg/kg cod liver, mg/kg eggs (fresh weight), mg/kg contents in tin, and mg/kg fat for the rest of the foods.

p) PCB156

Foodstuff	Number of samples	Samples >d.*	Average	Confidence interval (95%) from	to	Maximum**
			mg/kg***	mg/kg***	mg/kg***	mg/kg***
Fats, composite	54	0	0.002			< d.
Poultry fat	97	0	0.002			< d.
Margarine	35	0	0.002			< d.
Beef fat	462	0	0.002			< d.
Cheese, Danish	93	0	0.002			< d.
Cheese, foreign	110	0	0.002			< d.
Butter, Danish	300	0	0.002			< d.
Butter, foreign	11	0	0.002			< d.
Pork fat	481	0	0.002			< d.
Eggs	113	0	0.001			< d.
Tinned mackerel in t.	15	0	0.0001			< d.
Tinned tuna in water	12	0	0.0000			< d.
Salmon:						
Baltic Sea	21	1	0.001			0.005
Mackerel:						
Kattegat	5	0	0.001			< d.
North Sea	11	0	0.001			< d.
Skagerrak	9	0	0.001			< d.
Unknown waters	27	0	0.001			< d.
Herring:						
Belts	1	0	0.001			< d.
Kattegat	15	0	0.001			< d.
Skagerrak	21	0	0.001			< d.
Baltic Sea	20	0	0.001			< d.
Unknown waters	22	0	0.001			< d.
Cod liver:						
Belts	3	3	0.013	0.010	0.017	0.017
Kattegat	7	5	0.008	0.0051	0.013	0.013
North Sea	2	2	0.007	0.0058	0.0072	0.007
Skagerrak	21	12	0.006	0.0034	0.012	0.038
Sound	2	2	0.016	0.0081	0.030	0.022
Baltic Sea	15	14	0.014	0.010	0.019	0.027
Unknown waters	4	1	0.002			0.004
Eel	46	1	0.001			0.013

* d. = limit of detection. The limit of detection varies during the monitoring period; see Appendix 9.4.3.
** Maximum may be less than some of the limit of detection for the period, since the limit varies, as mentioned above.
*** mg/kg fish (salmon, mackerel, herring, eel), mg/kg cod liver, mg/kg eggs (fresh weight), mg/kg contents in tin, and mg/kg fat for the rest of the foods.

q) PCB170

Foodstuff	Number of samples	Samples >d.*	Average	Confidence interval (95%) from	to	Maximum**
			mg/kg***	mg/kg***	mg/kg***	mg/kg***
Fats, composite	54	0	0.002			< d.
Poultry fat	97	0	0.002			< d.
Margarine	35	0	0.001			< d.
Beef fat	462	0	0.002			< d.
Cheese, Danish	93	0	0.002			< d.
Cheese, foreign	110	0	0.002			< d.
Butter, Danish	300	0	0.002			< d.
Butter, foreign	11	0	0.001			< d.
Pork fat	481	0	0.002			< d.
Eggs	113	1	0.001			0.003
Tinned mackerel in t.	15	0	0.0002			< d.
Tinned tuna in water	12	0	0.0001			< d.
Salmon:						
Baltic Sea	21	0	0.001			< d.
Mackerel:						
Kattegat	5	0	0.001			< d.
North Sea	11	0	0.001			< d.
Skagerrak	9	0	0.001			< d.
Unknown waters	27	0	0.001			< d.
Herring:						
Belts	1	0	0.001			< d.
Kattegat	15	0	0.001			< d.
Skagerrak	21	0	0.001			< d.
Baltic Sea	20	0	0.001			< d.
Unknown waters	22	0	0.001			< d.
Cod liver:						
Belts	3	2	0.007	0.0032	0.016	0.012
Kattegat	7	7	0.009	0.0068	0.013	0.014
North Sea	2	1	0.008			0.013
Skagerrak	21	12	0.007	0.0046	0.010	0.018
Sound	2	2	0.013	0.0083	0.020	0.017
Baltic Sea	15	14	0.013	0.0091	0.018	0.023
Unknown waters	4	2	0.007	0.0020	0.022	0.016
Eel	46	4	0.002	0.0009	0.0034	0.009

* d. = limit of detection. The limit of detection varies during the monitoring period; see Appendix 9.4.3.
** Maximum may be less than some of the limit of detection for the period, since the limit varies, as mentioned above.
*** mg/kg fish (salmon, mackerel, herring, eel), mg/kg cod liver, mg/kg eggs (fresh weight), mg/kg contents in tin, and mg/kg fat for the rest of the foods.

r) PCB180

Foodstuff	Number of samples	Samples >d.*	Average	Confidence interval (95%) from	to	Maximum**
			mg/kg***	mg/kg***	mg/kg***	mg/kg***
Fats, composite	54	0	0.001			< d.
Poultry fat	97	0	0.001			< d.
Margarine	35	1	0.001			0.004
Beef fat	462	6	0.002			0.017
Cheese, Danish	93	0	0.001			< d.
Cheese, foreign	110	0	0.001			< d.
Butter, Danish	300	0	0.001			< d.
Butter, foreign	11	0	0.002			< d.
Pork fat	481	1	0.001			0.008
Eggs	113	2	0.001			0.005
Tinned mackerel in t.	15	0	0.0004			< d.
Tinned tuna in water	12	0	0.0001			< d.
Salmon:						
Baltic Sea	21	17	0.004	0.0035	0.0047	0.007
Mackerel:						
Kattegat	5	0	0.001			< d.
North Sea	11	0	0.001			< d.
Skagerrak	9	1	0.001			0.004
Unknown waters	27	0	0.001			< d.
Herring:						
Belts	1	0	0.001			< d.
Kattegat	15	0	0.001			< d.
Skagerrak	21	0	0.001			< d.
Baltic Sea	20	7	0.003	0.0022	0.0033	0.006
Unknown waters	22	1	0.001			0.003
Cod liver:						
Belts	3	3	0.035	0.022	0.057	0.056
Kattegat	7	7	0.022	0.021	0.024	0.025
North Sea	2	2	0.007	0.0047	0.0090	0.008
Skagerrak	21	19	0.015	0.0094	0.022	0.079
Sound	2	2	0.048	0.026	0.088	0.067
Baltic Sea	15	15	0.037	0.029	0.047	0.073
Unknown waters	4	4	0.012	0.0079	0.017	0.018
Eel	46	20	0.004	0.0028	0.0051	0.026

* d. = limit of detection. The limit of detection varies during the monitoring period; see Appendix 9.4.3.
** Maximum may be less than some of the limit of detection for the period, since the limit varies, as mentioned above.
*** mg/kg fish (salmon, mackerel, herring, eel), mg/kg cod liver, mg/kg eggs (fresh weight), mg/kg contents in tin, and mg/kg fat for the rest of the foods.

s) ΣPCB

Foodstuff	Number of samples	Average*
		mg/kg**
Fats, composite	54	0.022
Poultry fat	97	0.022
Margarine	35	0.026
Beef fat	462	0.023
Cheese, Danish	93	0.022
Cheese, foreign	110	0.022
Butter, Danish	300	0.022
Butter, foreign	11	0.023
Pork fat	481	0.022
Eggs	113	0.011
Tinned mackerel in t.	15	0.010
Tinned tuna in water	12	0.002
Salmon:		
Baltic Sea	21	0.050
Mackerel:		
Kattegat	5	0.021
North Sea	11	0.014
Skagerrak	9	0.026
Unknown waters	27	0.017
Herring:		
Belts	1	0.013
Kattegat	15	0.014
Skagerrak	21	0.015
Baltic Sea	20	0.032
Unknown waters	22	0.016
Cod liver:		
Belts	3	0.534
Kattegat	7	0.439
North Sea	2	0.219
Skagerrak	21	0.342
Sound	2	0.679
Baltic Sea	15	0.554
Unknown waters	4	0.228
Eel	46	0.048

* Average is the sum of the averages from the previous Appendices i) to r).
** mg/kg fish (salmon, mackerel, herring, eel), mg/kg cod liver, mg/kg eggs (fresh weight), mg/kg contents in tin, and mg/kg fat for the rest of the foods.

t) Total PCB

Foodstuff	Number of samples	Samples >d.*	Averahe	Confidence interval (95%) from	to	Maximum**
			mg/kg***	mg/kg***	mg/kg***	mg/kg***
Fats, composite	80	0	0.033			< d.
Poultry fat	96	0	0.033			< d.
Margarine	35	0	0.033			< d.
Beef fat	461	0	0.033			< d.
Cheese, Danish	128	0	0.033			< d.
Cheese, foreign	151	0	0.033			< d.
Butter, Danish	410	0	0.033			< d.
Butter, foreign	11	0	0.033			< d.
Pork fat	472	0	0.033			< d.
Eggs	129	0	0.033			< d.
Tinned mackerel in t.	15	2	0.0050	0.0019	0.0133	0.019
Tinned tuna in water	12	0	0.0009			< d.
Salmon:						
North Sea	1	0	0.033			< d.
Baltic Sea	23	13	0.072	0.056	0.093	0.150
Mackerel:						
Kattegat	5	2	0.050	0.039	0.064	0.065
North Sea	14	0	0.020			< d.
Skagerrak	16	4	0.051	0.040	0.066	0.076
Unknown waters	28	0	0.017			< d.
Herring:						
Belts	1	0	0.017			< d.
Kattegat	15	0	0.017			< d.
Skagerrak	31	0	0.022			< d.
Baltic Sea	27	6	0.046	0.041	0.052	0.069
Unknown waters	22	0	0.017			< d.
Cod liver:						
Belts	3	3	0.59	0.43	0.80	0.81
Kattegat	7	7	0.42	0.34	0.52	0.55
North Sea	2	2	0.27	0.24	0.31	0.30
Skagerrak	27	26	0.42	0.29	0.62	1.20
Sound	2	2	0.75	0.42	1.34	1.03
Baltic Sea	19	19	0.65	0.52	0.82	1.19
Unknown waters	5	5	0.32	0.180	0.57	0.60
Eel	47	23	0.076	0.055	0.105	0.62

* d. = limit of detection. The limit of detection varies during the monitoring period; see Appendix 9.4.3.
** Maximum may be less than some of the limit of detection for the period, since the limit varies, as mentioned above.
*** mg/kg fish (salmon, mackerel, herring, eel), mg/kg cod liver, mg/kg eggs (fresh weight), mg/kg contents in tin, and mg/kg fat for the rest of the foods.

9.4.3 Tables of limit of detections

These tables show report limits and limit of detections for the 18 substances in analysis of a) fish, b) meat, c) composite fats, butter, and cheese, d) margarine, and e) eggs. The limit of detection for DDE has been used for ΣDDT.

a) Fish: Salmon, mackerel, herring, cod liver, and eel

Substance	Limit of detection	Year	Report limit	Year
	mg/kg fish (liver)		mg/kg fish (liver)	
Total PCB	0.05	1994,1995,1996	0.1	1993
ΣDDT	0.002	1994,1995,1996	0.02	1993
HCB	0.002	1994	0.01	1993
	0.001	1995,1996		
Lindane	0.001	1994	0.01	1993
	0.004	1995,1996		
α-HCH	0.002	1994,1995,1996	0.01	1993
β-HCH	0.004	1994,1995,1996	0.01	1993
Dieldrin	0.002	1994,1996	0.01	1993
	0.004	1995		
Heptachlor	0.001	1994	0.01	1993
epoxide	0.003	1995		
	0.004	1996		
Aldrin	0.003	1994	0.01	1993
	0.001	1995		
	0.002	1996		
PCB28	0.004	1994,1995,1996		
PCB52	0.011	1994,1995,1996		
PCB101	0.004	1994,1995,1996		
PCB118	0.003	1994,1995,1996		
PCB105	0.003	1994,1995,1996		
PCB153	0.003	1994,1995,1996		
PCB138	0.004	1994,1995,1996		
PCB156	0.003	1994, 1995		
	0.004	1996		
PCB180	0.003	1994,1995,1996		
PCB170	0.004	1994,1995,1996		

b) Meat: Poultry fat, pork fat, beef fat, and turkey fat

Substance	Limit of detection	Year	Report limit	Year
	mg/kg fat		mg/kg fat	
Total PCB			0.1	1993, 1994, 1995, 1996
ΣDDT	0.004	1996,1997	0.02 0.01	1993, 1994 1995
HCB	0.003	1996, 1997	0.01	1993, 1994, 1995
Lindane	0.004	1996, 1997	0.01	1993, 1994, 1995
a-HCH	0.003	1996, 1997	0.01	1993, 1994, 1995
b-HCH	0.007	1996, 1997	0.01	1993, 1994, 1995
Dieldrin	0.006	1996, 1997	0.01	1993, 1994, 1995
Heptachlor epoxide	0.004	1996, 1997	0.01	1993, 1994, 1995
Aldrin	0.003 0.005	1996 1997	0.01	1993, 1994, 1995
PCB28	0.009 0.007	1994,1995 1996,1997		
PCB52	0.008 0.011 0.007 0.005	1994 1995 1996 1997		
PCB101	0.008 0.009 0.007	1994 1995 1996,1997		
PCB118	0.007 0.006 0.005	1994 1995 1996,1997		
PCB105	0.006 0.004	1994,1995 1996,1997		
PCB153	0.007 0.006	1994,1995 1996,1997		
PCB138	0.007 0.008 0.006	1994 1995 1996,1997		
PCB156	0.007 0.006	1994, 1995 1996, 1997		
PCB180	0.004 0.005	1994,1995,1996 1997		
PCB170	0.004 0.005	1996 1994,1995,1997		

c) Fats, butter, and cheese

Substance	Limit of detection	Year	Report limit	Year
	mg/kg fat		mg/kg fat	
Total PCB			0.1	1993, 1994, 1995, 1996
ΣDDT	0.004	1996	0.02 0.01	1993, 1994 1995
HCB	0.003	1996	0.01	1993, 1994, 1995
Lindane	0.004	1996	0.01	1993, 1994, 1995
α-HCH	0.003	1996	0.01	1993, 1994, 1995
β-HCH	0.007	1996	0.01	1993, 1994, 1995
Dieldrin	0.006	1996	0.01	1993, 1994, 1995
Heptachlor epoxide	0.004	1996	0.01	1993, 1994, 1995
Aldrin	0.003	1996	0.01	1993, 1994, 1995
PCB28	0.009 0.007	1994,1995 1996		
PCB52	0.008 0.011 0.007	1994 1995 1996		
PCB101	0.008 0.009 0.007	1994 1995 1996		
PCB118	0.007 0.006 0.005	1994 1995 1996		
PCB105	0.006 0.004	1994,1995 1996		
PCB153	0.007 0.006	1994,1995 1996		
PCB138	0.007 0.008 0.006	1994 1995 1996		
PCB156	0.007 0.006	1994, 1995 1996		
PCB180	0.004	1994,1995,1996		
PCB170	0.005 0.004	1994,1995 1996		

d) Margarine

Substance	Limit of detection	Year
	mg/kg margarine	
Total PCB	0.1	1995
ΣDDT	0.005	1995
HCB	0.004	1995
Lindane	0.005	1995
α-HCH	0.004	1995
β-HCH	0.010	1995
Dieldrin	0.005	1995
Heptachlor epoxide	0.005	1995
Aldrin	0.005	1995
PCB28	0.006	1995
PCB52	0.011	1995
PCB101	0.012	1995
PCB118	0.006	1995
PCB105	0.006	1995
PCB153	0.006	1995
PCB138	0.006	1995
PCB156	0.006	1995
PCB180	0.003	1995
PCB170	0.004	1995

e) Eggs

Substance	Limit of detection	Year	Report limit	Year
	mg/kg whole eggs		mg/kg whole eggs	
Total PCB	0.1	1995,1996	0.1	1993, 1994
ΣDDT	0.003 0.002	1995 1996	0.02	1993, 1994
HCB	0.002 0.001	1995 1996	0.01	1993, 1994
Lindane	0.002	1995, 1996	0.01	1993, 1994
α-HCH	0.002 0.001	1995 1996	0.01	1993, 1994
β-HCH	0.006 0.003	1995 1996	0.01	1993, 1994
Dieldrin	0.002 0.003	1995 1996	0.01	1993, 1994
Heptachlor epoxide	0.002	1995, 1996	0.01	1993, 1994
Aldrin	0.002 0.001	1995 1996	0.01	1993, 1994
PCB28	0.004 0.005 0.005 0.003	1994(1st q) 1994(3rd q) 1995 1996		
PCB52	0.004 0.006 0.005 0.007 0.003	1994(1st q) 1994(3rd q) 1995(1st q) 1995(3rd q) 1996		
PCB101	0.004 0.005 0.007 0.003	1994(1st q) 1994(3rd q),1995(1st q) 1995(3rd q) 1996		
PCB118	0.002 0.003 0.004	1994(1st q),1996 1994(3rd q),1995(1st q) 1995(3rd q)		
PCB105	0.002 0.004 0.003	1994(1st q),1996 1994(3rd q) 1995		
PCB153	0.003 0.004 0.002	1994(1st q),1995 1994(3rd q) 1996		
PCB138	0.003 0.004	1994(1 q),1995(3 q),1996 1994(3rd q),1995(1st q)		
PCB156	0.003 0.004	1994(1q),1995(1q),1996 1994(3rd q),1995(3rd q)		
PCB180	0.002	1994,1995,1996		
PCB170	0.002 0.003	1994(1 q),1995(1 q),1996 1994(3rd q),1995(3rd q)		

q: quarter

9.4.4 Table of data on contents from a project with 41 different fish species

Fish	Al-drin	α-HCH	β-HCH	ΣDDT	Dieldrin	HCB	Heptachlor epoxide	Lindane	Total PCB
	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
Brill medium				6.2					14
Catfish medium				38	10.8				32
Coalfish lean									
Cod lean									
Cusk lean									
Dab lean		2.4		3.5					25
Eel fat		6.5	4.8	53	8.0	1.9		6.1	120
Eelpout lean									11
Flounder lean				7.6					18
Garfish medium				27					62
Greenl. halibut fat		4.3		15	4.4	3.8			12
Grey mullet med.				4.5					49
Gurnard medium				11	3.2				45
Haddock lean									
Hake lean				7.6					14
Halibut medium									
Herring fat				15	7.0			2,4	37
Lavaret medium				47	2.1	2.2			74
Ling lean									
Lumpsucker fat		4.9		31	5.9	4.1		4.6	17
Mackerel fat		2.9		14	6.2	2.0		5.3	36
Nor. haddock lean				27	2.1				37
Perch lean				2.2					13
Pike lean									
Piked dogfish fat		2.3		20	4.3			2.2	49
Plaice lean									
Pollack lean									
Porbeagle lean				23					60
Ray wing lean									
Salmon (Baltic) fat		3.1	5,9	250	19	7.1		4.9	196
Salmon fat				2.9	2.1				11
Sea devil lean									
Smear dab lean									
Sole lean									

Fish	Al-drin	α-HCH	β-HCH	ΣDDT	Dieldrin	HCB	Heptachlor epoxide	Lindane	Total PCB
	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
Swordfish [fat]				25					
Trout [medium]				6.4	2.6				16
Tuna [lean]									
Turbot [medium]				2.6					18
Weever [med]				9.5					39
Whiting [lean]									
Zander [lean]				17	4.0				52
Average* (lean)	0.7	0.8	0.7	4.5	0.9	0.7	0.7	0.7	13
Average* (medium fat)	0.7	0.7	0.7	15	2.3	0.8	0.7	0.7	35

References: [5,65,66]

The grouping into lean, medium-fat, and fat were based on the following fat contents:
< 2 g per 100 g fish: lean
2-10 g per 100 g fish: medium-fat
> 10 g per 100 g fish: fat

The limit of detection is 2 µg/kg for all substances except total PCB for which it is 10 µg/kg.

The average was calculated by using one-third of the limit of detection for those samples in which no contents were found.

* For fat fish, the results for the individual fish species were used; see Appendix 9.4.2.

9.4.5 Correlation between different methods for the determination of PCB

As mentioned in sections 5.1 og 5.2, PCB has been determined by means of two different analytical methods. During the previous monitoring periods and up through 1996, PCB was determined as total PCB (using Aroclor 1260 as a reference), which provides a measure for the total contents of PCB.

From 1994 and onward, a newer analytical method has been employed, using determinations of the individual PCB congeners (where the ΣPCB indicates the sum of 10 PCB congeners); in the future, only this method will be used. The two analytical methods were used in parallel in order to determine the correlation between the two methods, which will provide the possibility of following the development in PCB contents over time across the change.

In products of animal origin, no total PCB was found in the present monitoring period (see Appendix 9.4.2). Total PCB has been determined in several samples of fish, but only for cod liver is the number of findings sufficient to permit a determination of the correlation between total PCB and ΣPCB.

The figure shows a comparison between PCB determined by the older method (total PCB) and PCB determined as the sum of congeners. In view of the technical difference between the two methods, a very high degree of correlation is revealed. Therefore, in future studies carried out exclusively by congener-specific analyses, the development in the PCB levels over time can still be followed in spite of the change in analytical method.

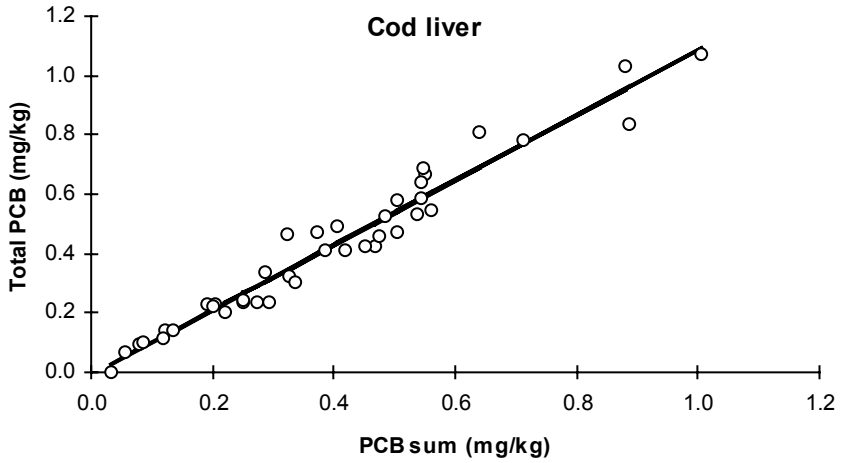

Figure 33. *Comparison between measurings of PCB in cod liver, determined as ΣPCB (the sum of 10 PCB congeners: PCB28, PCB52, PCB101, PCB105, PCB118, PCB138, PCB153, PCB156, PCB170, and PCB180) and as total PCB (using Aroclor 1260 as reference), respectively. Regression line: Total PCB= -0.01+1.09· ΣPCB,* R^2*=0.955.*

9.4.6 Commodity types used in the calculation of daily intakes of organic environmental contaminants

Foodstuff	FoodId	g fat/100 g foodstuff	Commodity type used in calculation (see Appendices 9.4.1 and 9.4.4)
Full milk	156	3.5	butter*
Cocoa milk	159	1.8	butter*
Creme fraîche 18%	160	18.6	butter*
Creme fraîche 38%	161	38.4	butter*
Cream 13%	165	13.5	butter*
Cream 38%, double cream	166	38.1	butter*
Buttermilk	168	0.5	butter*
Low-fat milk	170	1.6	butter*
Skimmed milk	251	0.3	butter*
Low-fat junket, plain	331	1.8	butter*
Junket, plain	332	3.4	butter*
Yoghurt, plain	333	3.6	butter*
Low-fat yoghurt with juice	334	1.6	butter*
Yoghurt with fruit, unspec.	335	3.2	butter*
Skimmed-milk powder	366	1.7	butter*
Danbo cheese, 45+	258	25.3	cheese**
Cottage cheese, 20+	260	5.4	cheese**
Quark, 5+	261	0.4	cheese**
Processed cheese, 45+	265	24.5	cheese**
Brie cheese, 60+	759	33.6	cheese**
Feta cheese, 50+	787	25.2	cheese**
Ice cream	848	10.0	butter*
Bacon, roasting piece	13	42.0	pork fat
Black pudding	16	20.8	pork fat
Lamb, unspec., raw	138	30.5	beef/pork***
Lamb, fore end, raw	139	13.3	beef/pork***
Liver, calf, raw	144	3.9	beef fat
Liver, pig, raw	146	3.2	pork fat
Beef, unspec., all-lean, raw	199	4.3	beef fat
Beef, unspec., lean, raw	201	7.8	beef fat
Beef brisket, raw	202	15.1	beef fat
Ham, boiled, tinned	248	5.4	pork fat
Ham, smoked	249	13.0	pork fat
Ham, smoked, boiled	250	14.0	pork fat
Salami	274	43.8	pork fat
Pork neck with rind, raw	284	18.3	pork fat
Pork neck, no rind, approx. 3 mm fat, raw	285	12.2	pork fat
Pork tenderloin, trimmed, raw	286	3.7	pork fat
Pork shoulder with rind, raw	287	12.9	pork fat
Frankfurt sausage	292	23.2	pork fat
Mettwurst, raw	294	17.4	pork fat
Pork roll	295	25.2	pork fat
Saveloy	296	25.4	beef/pork***
Liver paste	297	22.7	pork fat
Pork fillet, smoked	298	2.2	pork fat

Foodstuff	FoodId	g fat/100 g foodstuff	Commodity type used in calculation (see Appendices 9.4.1 and 9.4.4)
Beef brisket, raw	438	27.8	beef fat
Saddle of pork, smoked, boiled	548	10.0	pork fat
Salt meat	549	3.0	beef fat
Beef brisket, boiled	551	22.1	beef fat
Lamb leg, trimmed, raw	941	5.5	beef/pork***
Salmon, raw	135	10.0	salmon
Mackerel, raw	175	24.0	mackerel
Mackerel, smoked	177	23.3	mackerel
Mackerel in tomato sauce, tinned	178	15.5	mackerel in tomato sauce
Shrimps, tinned	219	1.2	lean fish
Plaice, raw	236	1.5	lean fish
Herring, pickled	244	15.9	herring
Herring, smoked	245	12.3	herring
Herring, raw	246	13.1	herring
Cod fillet, raw	312	0.6	lean fish
Cod roe, tinned	317	3.7	medium-fat fish
Tuna in water, tinned	318	1.0	tuna in water
Shrimps, frozen	910	1.1	lean fish
Duck, meat and skin, raw	6	39.3	poultry fat
Duck, meat, raw	7	5.1	poultry fat
Goose, meat and skin, raw	66	33.6	poultry fat
Goose, meat, raw	67	7.1	poultry fat
Turkey, meat, raw	110	2.2	poultry fat
Chicken, meat, raw	131	5.7	poultry fat
Chicken, meat and skin, raw	132	11.8	poultry fat
Eggs, yolk, raw	339	30.9	eggs
Eggs, whole, raw	340	11.2	eggs
Eggs, white, raw	341		eggs
Eggs, whole, powdered	1032	41.8	eggs
Maize oil	153	100.0	vegetable oil
Margarine, 80% fat,	183	81.9	margarine
Butter, salted	269	81.2	butter*
Sunflower oil	273	100.0	vegetable oil
Lard, rendered	281	99.0	pork fat
Low-fat spread, 40% fat, vegetable fat	290	41.3	margarine
Grapeseed oil	328	100.0	vegetable oil
Margarine, 80% fat, spread, vegetable fat	370	82.6	margarine
Olive oil	482	100.0	vegetable oil
Easy-spread composite product, 80% fat	1235	80.0	fats, composite
Milk chocolate	38	29.2	fats, composite
Dark chocolate	39	29.1	fats, composite

* Based on contents in Danish butter.

** Based on 70% of contents in Danish cheese and 30% of contents in foreign cheese.

*** Based on an average of average contents in beef fat and pork fat.

9.5 Appendix to Chapter 6: Mycotoxins

9.5.1 Occurrence of ochratoxin A in wheat kernels of Danish origin, in relation to harvest years (1986-1997) and method of cultivation (conventional and organic)

Product	Harvest year* (estimated harvest conditions)	Num-ber of samp-les	Number of samples containing ochratoxin A in the interval (μg/kg)			Average (μg/kg)	Median (μg/kg)	Maximum (μg/kg)
			**d.-4.9	5.0-25	>25			
Conventionally - grown wheat kernels	1986 (medium)	61	25	3		0.9	<d.	24
	1987 (very wet)	41	22	2	2	2.8	0.3	37
	1988 (dry)	63	13			0.2	<d.	2.6
	1989 (very dry)	68	17	1	1	1.0	<d.	51
	1990 (very dry)	63	7			0.1	<d.	4.7
	1991 (very dry)	69	22			0.1	<d.	1.7
	1992 (very dry)	65	29	2		0.4	<d.	9.3
	1993 (medium)	56	38		1	0.8	0.05	32
	1994 (dry)	67	43			0.1	0.04	0.5
	1995 (very dry)	51	10			0.1	<d.	0.6
	1996 (very dry)	46	20	1		0.3	0.04	8.0
	1997 (very dry)	27	11			0.1	<d.	0.3
	Total 1986-92	430				0.7		
	Total 1993-97	247				0.3		
Organically-grown wheat kernels	1986 (medium)	10	5			0.6	0.1	4.9
	1987 (very wet)	10	4	2		2.9	0.2	21
	1988 (dry)	8	2			0.2	<d.	1.2
	1989 (very dry)	17	3			0.2	<d.	2.9
	1990 (very dry)	11	6		1	3.8	0.1	36
	1991 (very dry)	16	5	1		0.5	<d.	6.8
	1992 (very dry)	2	1			0.04		0.08
	1993 (medium)	3	2			0.5	0.01	1.4
	1994 (dry)	2	2			0.2		0.2
	1997 (very dry)	1	1			0.2		0.2
	Total 1986-92	74				1.2		
	Total 1993-97	6				0.3		

* Harvest conditions in harvest years were estimated as one of five gradings: very wet, wet, medium, dry, and very dry. For further details, see reference [77].
** d.: limit of detection.

9.5.2 Occurrence of ochratoxin A in rye kernels of Danish origin, related to harvest years (1986-1997) and method of cultivation (conventional and organic)

Product	Harvest year* (estimated harvest conditions)	Number of samples	Number of samples containing ochratoxin A in the interval (μg/kg)			Average (μg/kg)	Median (μg/kg)	Maximum (μg/kg)
			**d.-4.9	5.0-25	>25			
Conventionally - grown rye kernels	1986 (medium)	102	35	4	3	2.5	<d.	77
	1987 (very wet)	40	17	6	1	5.3	0.2	121
	1988 (dry)	89	19	3		0.5	<d.	12
	1989 (very dry)	97	29	1		0.3	<d.	9.2
	1990 (very dry)	64	11	1		0.2	<d.	8.4
	1991 (very dry)	69	38	1		0.4	<d.	7.2
	1992 (very dry)	64	27	2	1	0.7	<d.	26
	1993 (medium)	60	40	5	2	2.1	0.16	33
	1994 (dry)	60	48			0.3	0.20	4.2
	1995 (very dry)	53	42			0.2	0.05	3.1
	1996 (very dry)	45	28			0.2	0.05	2.6
	1997 (very dry)	29	15			0.2	0.10	2.6
	Total 1986-92	525				1.2		
	Total 1993-97	247				0.7		
Organically-grown rye kernels	1986 (medium)	12	8		1	9.1	0.5	100
	1987 (very wet)	22	11	7	2	13	2.4	120
	1988 (dry)	11	7	1		2.1	0.1	20
	1989 (very dry)	14	5	2		1.0	0.1	6.4
	1990 (very dry)	16	10	2	1	3.8	0.1	37
	1991 (very dry)	16	14			0.5	0.3	1.4
	1992 (very dry)	1	1			4.8		4.8
	1993 (medium)	2	2			0.3		0.5
	1994 (dry)	1	1			1.3		1.3
	1995 (very dry)	1	1			1.3		1.3
	1997 (very dry)	2	1	1		4.0		7.8
	Total 1986-92	92				5.4		
	Total 1993-97	6				1.9		

* Harvest conditions in harvest years were estimated as one of five gradings: very wet, wet, medium, dry, and very dry. For further details, see reference [77].
** d.: limit of detection.

9.5.3 Occurrence of ochratoxin A in wheat flour and rye flour on the Danish retail market, in relation to harvest years (1993-1997) and method of cultivation (conventional and organic)

Product	Harvest year* (estimated harvest conditions)	Num-ber of samp-les	Number of samples containing ochratoxin A in the interval (μg/kg)			Average (μg/kg)	Median (μg/kg)	Maximum (μg/kg)
			**d.-4.9	5.0-25	>25			
Conventionally - grown wheat flour	1993 (medium)	55	38			0.2	0.13	1.5
	1994 (dry)	11	10	1		1.7	0.27	16
	1995 (very dry)	20	10			0.2	0.13	0.5
	1996 (very dry)	20	16			0.3	0.14	1.1
	1997 (very dry)	10	7			0.4	0.34	0.9
	Total 1993-97	116				0.4		
Organically-grown wheat flour	1993 (medium)	18	14	1		1.6	0.15	19
	1994 (dry)	9	9			0.5	0.13	0.6
	1995 (very dry)	21	19			0.1	0.09	0.4
	1996 (very dry)	21	21			0.4	0.21	1.0
	1997 (very dry)	11	10			0.4	0.26	1.5
	Total 1993-97	81				0.6		
Conventionally -grown rye flour	1993 (medium)	17	16		1	2.7	0.82	30
	1994 (dry)	15	13			0.3	0.22	0.8
	1995 (very dry)	30	27			0.2	0.11	0.8
	1996 (very dry)	30	25	2		0.7	0.24	9.8
	1997 (very dry)	15	10	2		1.1	0.24	8.4
	Total 1993-97	107				0.9		
Organically-grown rye flour	1993 (medium)	8	6			0.5	0.22	1.3
	1994 (dry)	14	12	1	1	6.1	1.00	68
	1995 (very dry)	27	26	1		1.0	0.37	5.7
	1996 (very dry)	32	29	2		1.3	0.44	5.9
	1997 (very dry)	15	13	1		1.0	0.36	5.1
	Total 1993-97	96				1.8		

* Harvest conditions in harvest years were estimated as one of five gradings: very wet, wet, medium, dry, and very dry. For further details, see reference [77].
** d.: limit of detection.

9.5.4 Occurrence of ochratoxin A in cereals from the harvest years 1986-1994

Product	Harvest year	Number of samples	Number of samples containing ochratoxin A in the interval (μg/kg)			Average (μg/kg)	Median (μg/kg)	Maximum (μg/kg)
			*d.-4.9	5.0-25	>25			
Imported conventionally - grown wheat kernels	1986-1994	56	24	1		0.8	<d.	13
Danish conventionally - grown wheat bran	1986-1994	153	102	2		0.7	0.2	12
Danish organically-grown wheat bran	1986-1993	24	17			0.6	0.3	2.6
Imported conventionally - grown rye kernels	1986-1992	22	8			0.1	<d.	0.7
Danish conventionally - grown oat kernels	1986-1994	63	29	1		0.4	<d.	5.6
Danish organically-grown oat kernels	1986-1992	17	6			0.3	<d.	4.2
Imported conventionally - grown oat kernels	1986-1994	30	16			0.4	<d.	4.6
Danish conventionally - grown barley kernels	1986-1994	62	20	5		0.9	<d.	14
Danish organically-grown barley kernels	1986-1994	22	6	2		0.9	<d.	13

* d.: limit of detection

9.5.5 Occurrence of pigs' kidneys with macroscopic lesions (porcine nephropathy), contents of ochratoxin A in pigs' kidneys, and condemnations

Year	Number of pigs slaughtered (millions)	Number of porcine nephropathy kidneys collected	Porcine nephropathy kidneys collected (‰ of pigs slaughtered)	Number of organ condemnations 10<X<25 μg/kg	Organ condemnations (% of kidney samples collected)	Number of total condemnations X>25μg/kg	Total condemnations (% of kidney samples collected)	Number of total condemnations without lab. examination
1983	15.0	7639	0.51	1155	15.1	2190	28.7	47
1984	14.6	1298	0.09	54	4.16	128	9.86	17
1985	15.1	816	0.05	36	4.41	79	9.68	8
1986	16.0	5264	0.33	842	16.0	1302	24.7	29
1987	16.0	8705	0.54	1432	16.5	2114	24.3	24
1988	16.1	33481	2.08	2993	8.94	4520	13.5	90
1989	15.8	6809	0.43	1258	18.5	667	9.80	47
1990	16.3	3138	0.19	97	3.09	31	0.99	19
1991	16.8	2614	0.16	41	1.57	13	0.50	13
1992	18.3	2181	0.12	10	0.46	7	0.32	7
1993	19.6	1630	0.08	5	0.31	5	0.31	3
1994	20.5	1961	0.10	29	1.48	28	1.43	7
1995	20.2	1915	0.09	11	0.57	7	0.37	2
1996	20.3	1523	0.08	10	0.66	1	0.07	2
1997	20.1	990	0.05	4	0.40	0	0.00	0

9.5.6 Estimates of ochratoxin A contents (μg/kg) in foods included in intake calculations

Foodstuff (FoodId)	Wet harvest (1986-92) Conventional (μg/kg)	Medium harvest (1986-97) Conventional (μg/kg)	Dry harvest (1993-1997) Conventional (μg/kg)	Wet harvest (1986-92) Organic (μg/kg)	Medium harvest (1986-97) Organic (μg/kg)	Dry harvest (1993-97) Organic (μg/kg)
Wheat bran (86)a	0.7	0.7	0.7	0.7	0.7	0.7
Pasta (174)b	0.49	0.35	0.21	0.84	0.63	0.42
White bread (528)b	0.49	0.35	0.21	0.84	0.63	0.42
Oatmeal (530)a	0.4	0.4	0.4	0.4	0.4	0.4
Wheat flour (531)c	0.7	0.5	0.3	1.2	0.9	0.6
Marie bisquits (532)b	0.49	0.35	0.21	0.84	0.63	0.42
Breadcrumbs (534)b	0.49	0.35	0.21	0.84	0.63	0.42
Rye bread (536)d	0.84	0.70	0.56	3.78	2.52	1.26
White bread, wholemeal (1009)b	0.49	0.35	0.21	0.84	0.63	0.42
Crispbread (1018)b	0.49	0.35	0.21	0.84	0.63	0.42
Raisins (227)e	1.0	1.0	1.0	1.0	1.0	1.0
Pork products (16,146,248-50, 284-87,292,294-98,548-49)f	0.15	0.15	0.15	0.15	0.15	0.15
Poultry products (6,7,66,67,110,131,132)g	0.03	0.03	0.03	0.03	0.03	0.03
Coffee (105)h	0.035	0.035	0.035	0.035	0.035	0.035
Red wine (237)i	0.3	0.3	0.3	0.3	0.3	0.3
Beer (348,349,979)j	0.05	0.05	0.05	0.05	0.05	005

a) Calculated on the basis of all samples of imported as well as conventional and organic samples because of the relatively low number of samples analysed during that period. Therefore, contents were estimated to the same in all six intake calculations.

b) Calculated on the basis of all samples of both wheat kernels and wheat flour during the periods concerned, and a factor of 70% for contents of kernels/flour in the product.

c) Calculated on the basis of all samples of both wheat kernels and wheat flour during the periods concerned.

d) Calculated on the basis of all samples of both rye kernels and rye flour during the periods concerned, and a factor of 70% for contents of kernels/flour in bread.

e) Data for raisins are very limited. 52 samples of raisins were analysed by the Danish Veterinary and Food Administration (not published), and British and German studies are available. Contents were estimated on the basis of an assessment and a weighting of these studies.

f) Data for these products are very limited. The value used was estimated on the basis of data for pork [89] and pig kidneys [87], and the same value was used for all pork products.

g) Data for poultry are very limited. The value given in [89] was used for all poultry products.

h) Danish data for coffee are very limited [89], but many data from other European countries are available, and it is presumed that coffee on the European market corresponds quite well to that in Denmark. Generally similar levels are found, and therefore contents in coffee are reasonably well estimated.

i) Data for red wine are very limited. 31 samples of red wine were analysed by the Danish Veterinary and Food Administration (not published), and German, Swiss, and British studies are available. Contents were estimated on the background of an assessment and a weighting of these studies.

j) Data for beer are relatively limited. Few Danish data exist [89], and the average values from these were used, since quite comprehensive data from Germany [88] are in good accordance with these.

10. LIST OF ABBREVIATIONS

PTWI	Provisional tolerable weekly intake
PMTDI	Provisional maximum tolerable daily intake
TDI	Tolerable daily intake
ADI	Acceptable daily intake
PCB	Polychlorinated biphenyls
DDD	1,1´-(2,2-dichloroethyl)-bis[4-chlorobenzene]
DDE	1,1´-(2,2-dichloroethen)-bis[4-chlorobenzene]
DDT	1,1´-(2,2,2-trichloroethyl)-bis[4-chlorobenzene]
HCB	Hexachlorobenzene
HCH	Hexachlorocyclohexane
JECFA	Joint Expert Committee on Food Additives (FAO/WHO)
JMPR	Joint Meeting on Pesticide Residues (FAO/WHO)
SCF	Scientific Committee on Food (EU)
IARC	International Agency for Research on Cancer
IPCS	International Programme on Chemical Safety (WHO)
ATSDR	Agency for Toxic Substances and Disease Registry (USA)
FAPAS	Food Analysis Performance Assessment Scheme (UK)
µg/g	Micrograms per gram
µg/kg	Micrograms per kilogram
ng/g	Nanograms per gram
ng/kg	Nanograms per kilogram
FoodId	Food Identification number. Number for primary products/semi-products; refers to the composition of food [5].