codex alimentarius commission

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

WORLD HEALTH ORGANIZATION

JOINT OFFICE: Viale delle Terme di Caracalla 00100 ROME Tel: 39 06 57051 www.codexalimentarius.net Email: codex@fao.org Facsimile: 39 06 5705 4593

Agenda Item 16(g) **CX/FAC 03/32**
January 2003

JOINT FAO/WHO FOOD STANDARDS PROGRAMME

CODEX COMMITTEE ON FOOD ADDITIVES AND CONTAMINANTS

Thirty-fifth Session
Arusha, United Republic of Tanzania, 17 - 21 March 2003

POSITION PAPER ON DIOXINS AND DIOXIN-LIKE PCBs

Secretariat Note: Due to time constraints, comments are not being requested on the attached document and therefore, comment summary paper CX/FAC 03/32-Add. 1 will not be issued.

BACKGROUND

1. At the 31st and 32nd Session of the CCFAC the Netherlands presented a Discussion Paper on Dioxins. The paper described the risk assessment of polychlorinated dibenzo-p-dioxins (PCDDs) and dibenzofurans (PCDFs) (further referred to as 'dioxins') and dioxin-like PCBs. It summarised results from activities gathering information on the occurrence of dioxins and dioxin-like PCBs in the environment and the health risks of exposure to these substances through consumption of foods.

2. The 32nd Session of the CCFAC decided that this Discussion Paper should be used as a basis for the elaboration of an additional Position Paper on Dioxins and Dioxin-like PCBs. This Position Paper should include: the potential range of levels in the food products of interest (including feed stuffs), information on available methods of analyses and exploration of the arguments for and against setting maximum limits

3. At the 33rd Session of the CCFAC the additional Position Paper was presented. The paper contained information on recent intake assessments and present regulations of some countries. The Committee agreed that the delegation of the Netherlands would revise the Position Paper on dioxins and dioxin-like PCBs, for circulation, comments and consideration at the 34th CCFAC Session, taking into account the comments and data received, as well as the results of the JECFA evaluation on dioxins and dioxin-like PCBs in June 2001.

4. At the 34th Session of the CCFAC the additional Position Paper was presented. Many delegations indicated that the Position Paper should be kept on the agenda of CCFAC and asked The Netherlands to revise the document. The Committee agreed that it should not draft maximum levels at this time. It stressed however the need of collecting additional data on dioxin levels in food and feed, as well as exposure data from regions outside Europe.

5. A draft Paper for the 2003 CCFAC meeting was forwarded for comments to the members of the drafting group in 2002. The drafting group included Argentina, Belgium, Brazil, Canada, Iceland, Japan, Korea, Norway, The United Kingdom, The United States, the EC and FEFAC. The Position Paper was modified according to their comments.

INTRODUCTION

6. The present paper gives an overview of available information on sources and occurrence in food and feed, and the dietary intake of dioxins and dioxin-like PCBs. Besides the tolerable intake and comparison of the dietary intake with the PTMI, existing legislation in Codex Member Nations, and methods of analysis are presented. The data are summarized per region. Besides available data of trends of concentrations in time was included.

7. The information presented here is extracted from reports from SCOOP, SCAN, SCF and JECFA, and information presented at the 22nd International Symposium on Halogenated Environmental Pollutants and POPs: Dioxin 2002"symposium- held in August, 2002 at the "Dioxin" symposium in Barcelona (Spain), hereafter referred to as "Dioxin 2002 Symposium". Additionally data from the drafting group members was added.

SOURCES OF DIOXIN EMISSIONS

8. There are different sources of dioxins and dioxin-like PCB identified. These include both new releases and reservoirs in the environment from past releases. As PCB use has been banned in most countries, dioxin-like PCBs from the environmental reservoirs are a source for the food supply. Environmental reservoirs of dioxins are also likely to contribute to the dioxin levels in foods. New releases of dioxins and dioxin-like PCBs into air are the result of controlled and uncontrolled combustion processes. These processes include municipal, hospital and hazardous waste incinerators, metal smelters, wood and scrap burning and alike. Besides emissions of automobiles running on leaded gasoline may contain dioxins that are emitted to air. Substantial reductions of these sources have been realized in many countries over the past decades, giving substantial differences between countries and regions, depending in part on the stringency of national and regional emission controls.

9. Discharges of bleaching processes using elemental chlorine lead to contamination of underwater sediment with dioxins. Newer technologies have lead to a reduction of dioxin emissions in many areas from paper production.

10. The emissions of dioxins and dioxin-like PCBs into the atmosphere lead to surface contamination due to deposition of particles. As most dioxins and dioxin-like PCBs are persistent to degradation they continue to accumulate in soil and underwater sediments.

11. The rate of deposition of emissions of dioxins and dioxin-like PCBs depends on factors such a weather conditions, magnitude of the emission, and process conditions. This will lead to spatial variations of the rate of environmental contamination, showing local sites with increased levels of dioxins and dioxin-like PCBs in soil and sediment ('hot spots') in relation to the background contamination.

OCCURRENCE IN FEED

12. Due to the aerial deposition and the diffuse contamination of soil (including both reservoirs and new depositions) and potential hot spots in the vicinity of sources of emissions, dioxins and dioxin-like PCBs are found in roughages and other types of animal feed of vegetable origin. Contaminated surface waters and sediments lead to dioxins and dioxin-like PCBs in fish, and thus to contamination of fish meal and fish oils used as animal feed.

Europe

13. The Scientific Committee on Animal Nutrition (SCAN) of the European Commission has reported to the European Commission on the levels of dioxins and dioxin-like PCBs in feeding stuffs in November 2000.

14. The SCAN has obtained available published data and additional information from European Unions Member States and other sources about levels of dioxins in feedstuffs in the period of 1999 and 2000. Account has been taken of the environmental sources of pollution resulting in the background contamination of all feed materials and also of any contamination specifically introduced by production conditions, feed processing and during the transport and distribution of feed materials and feedstuffs.

15. Table I Ssummarises the dioxin contents of the main feed materials established by the SCAN, on the basis of the available data submitted by Member States to the European Commission or published, or referring to maximum permitted levels according to the European legislation applicable at the period of assessment. It includes the "low" and "high" levels identified, and the mean level fixed by the SCAN, as basis to estimate the total dioxin content of each species specific diet. As the database for dioxin-like PCBs is scarce, low, mean and high values were derived only for dioxins.

Table I. Dioxin contents of the basic feed materials evaluated by the SCAN from the available data (ng WHO-TEQ/kg dry matter (DM); dioxins only).

Feed materials	**Dioxin levels in feed materials (ng WHO-TEQ/kg DM)**		
	Low	**Mean**	**High**
Roughages	0.1	0.2	6.6
Cereals and seeds (Legumes)	0.01	0.1	0.4
By-products from cereals, seeds and sugar	0.02	0.1	0.7
Vegetable oil	0.1	0.2	1.5
Fish meal Pacific (Chile, Peru)	0.02	0.14	0.25
Fish meal Europe	0.04	1.2	5.6
Fish oil Pacific (Chile, Peru)	0.16	0.61	2.6
Fish oil Europe	0.7	4.8	20
Mixed animal fat	0.5	1	3.3
Meat and bone meal	0.1	0.2	0.5
Milk by-products	0.06	0.12	0.48
Soil	0.5	5	87
Binders, anti-caking agents and coagulants	0.1	0.2	0.5
Trace elements, macro minerals	0.1	0.2	0.5
Premixes	0.02	0.2	0.5

1. On the basis of the data and using the percentage of the different feed ingredients in the diets, total contamination levels of typical diets have been calculated by SCAN.
2. The main conclusions of SCAN are:

- Fishmeal and fish oil concentrations show large variations. Products of European fish stocks (respective means of 1.2 and 4.8 ng I-TEQ[1]/kg DM) are more heavily contaminated than those from South Pacific (Chile, Peru) stock (respective means 0.14 and 0.61ng I-TEQ/kg DM).
- Animal fat (mean 1 ng I-TEQ/kg DM) is next in order of dioxins concentration. Values observed depend on the bioaccumulation of dioxins in fatty issues along the feed/food chain.
- All other feed materials of plant (roughages, cereals, legume seeds) and animal (milk by-products, meat and bone meal) origin contain mean concentrations of dioxins around or below 0.2 ng I-TEQ/kg DM.
- Roughages present a very wide range of dioxin concentrations depending on location, degree of contamination with soil and exposure to sources of aerial pollution. A worst-case assumption is used to calculate the mean and upper values, leading to relatively high levels.
- The limited data available on the contamination of feed materials by dioxin-like PCBs indicates that their inclusion would increase the TEQ value for feed by a factor of two or three.
- The contribution of individual feed materials to dioxin content of the whole diet for farmed animals depends on the intrinsic degree of contamination and the proportion used in the diet. Greatest concerns arise from the use of fishmeal and fish oil of European origin. These are most critical when used in diets for farmed fish and where fishmeal is incorporated in diets of other food-producing animals.
- The SCAN stresses that depending on the degree and position of chlorinating, the individual dioxins (congeners) exhibit different transfer rates, and that it is not scientifically correct to calculate transfer from feedstuffs to products of animal origin on a TEQ basis only. The exercise must consider the individual congeners.

[1] I-TEQ: according to the International TEF scheme (NATO-CCMS, 1988)

North America

16. Data from 2000 of the USA showed concentrations of 0.08 to 3.9 ppt TEQ[2] for dioxins and planar PCBs for mixed animals fats whereas levels in meat and bone meal from mixed animals were 0.09 to 0.3 ppt TEQ on a dry weight basis. Concentrations in fish meal ranges from 0.20 to 3.3 ppt TEQ. In cane and beet molasses 0.02 to 0.18 ppt TEQ was found.

Asia

17. In Korea commercially available feed form pigs, cattle and poultry was analysed on dioxins. The main ingredients were maize, soybean, wheat and maize gluten, and its mean concentration was 2.6 pg I-TEQ/g fat. The fat content of the feed was 3.6 to 6.9%.

TIME TREND

18. In a recent study of samples of straws harvested in 1954, 1962, 1970, 1974, 1981, and 2000 in Japan, a time trend for roughages was reported. In the straw of 1954 and 1962, a level of 2 pg TEQ (dioxins and dioxin-like PCBs) per gram dry weight was found. In 1970 a concentration of 9 pg was found, with a decrease down to 4 pg in 1974 and 1981. In 2000 the concentration was 1 pg TEQ/g dw.

OCCURRENCE IN FOOD

19. Due to aerial deposition and the diffuse contamination of air and soil, dioxins and dioxin-like PCBs are found in food items of vegetable origin. The contamination of animal feed, pastures and organisms at lower trophic levels lead to bioaccumulation of dioxins and dioxin-like PCBs in animal fats, and thus in food items containing animal fats such as meats, milk and dairy products, and eggs. The contamination of the marine environment sediment leads to accumulation of dioxins and dioxin-like PCBs in fish, shellfish and fishery products. Processed products from the food industry can be contaminated with dioxins and dioxin-like PCBs resulting from the use of fats of vegetable or animal origin.

20. In 'hot spots' around sources of emissions of dioxins or dioxin-like PCBs levels of dioxins in foods can be higher than the background situation contamination. Variation in dioxin and dioxin-like PCBs levels appears to occur as a function of emission controls that have been implemented over de past decades. For example, higher levels of dioxins and dioxin-like PCBs in cow's milk, beef and mutton, and eggs have been found in various countries in West Europe in the vicinity of local sources.

21. Source directed measures such as stack gas cleaning have demonstrated to be very efficient in case of local contamination of feed and food produced in the vicinity of sources of aerial emissions. Levels of dioxins and dioxin-like PCBs in feed and food will drop to background levels within a few years. Reduction of the background levels however will take many years after intervention, as the dioxins themselves will remain for decades in the soil due to a very slow degradation (more than 10 years).

SOURCES OF INFORMATION AND COLLECTION OF THE DATA

22. The following data are based on a series of studies or reports from various sources. It must be noted that in each study or evaluation considerable uncertainties can be identified, for example due to the limited amount of data, difference in sampling strategies, collection of consumption data and analytical methods, and the use of different TEF values. Consequently, the data in this paper give a global overview of the range of levels of dioxins and dioxin-like PCBs in various foodstuffs, rather than detailed information of variations of concentrations in time and space.

European Union

23. Information on the occurrence of PCDDs, PCDFs and dioxin-like PCBs in food in the European Union, as well as the dietary exposure to these compounds, has been obtained in Scientific Co-operation (EU SCOOP) Task 3.2.5 (SCOOP, 2000). The objectives of this specific task were to provide a scientific basis for the evaluation and management of risks to public health arising from exposure to dioxin and related compounds. Ten countries participated in this SCOOP task, *i.e.* Belgium, Denmark, Finland, France, Germany, Italy, The Netherlands, Norway, Sweden and the United Kingdom. The EU SCOOP database includes information on concentrations of dioxins and dioxin-like PCBs in samples of food products, taken from various sites, including rural and industrial sites, and collected in different years covering the period 1982 - 1999.

24. New data from Europe presented in Dioxin 2002 Symposium in Barcelona were included.

---

[2] TEQ: according to the WHO-TEF scheme (WHO, 1997)

North America

25. The data submitted by the USA are from a market basket survey carried out by the U.S. Food and Drug Administration (FDA). Samples from dairy products and commercial fish and shellfish, collected in 1998 and 1999, were analysed for 17 dioxin/furan congeners (2,3,7,8-congeners). The food products were selected based on 1) the their potential to be dietary sources for dioxins and 2) their relatively high consumption (1987-1988 Nation-wide Food Consumption Survey, United States Department of Agriculture), and 3) their having been dietary sources of dioxin in the past. New data from the USA presented in Dioxin 2002 Symposium in Barcelona were included, and additional US data were submitted to CCFAC in 2002.

26. Canada submitted information on dioxin-like compounds in market basket (total diet) food samples from 5 major cities, in the period 1992-1995. Data outlined below are mean values of the data from these 5 cities.

Australia and New Zealand

27. The New-Zealand ministry of for the Environment conducted a dietary study in 1995 with the objective to determine the level of PCDDs, PCDFs and PCBs contaminants in meat, dairy products and other key foods in the New Zealand market place, and to estimate the dietary intake for the New Zealand population of these compounds.

28. The sampling strategy for this survey was designed to assess the levels of PCDDs, PCDFs and PCBs in food products commonly eaten by New Zealanders and which are widely available through retail outlets nationally. The criteria for selection of foods for this dietary study were as follows:

- Foods found to be significant contributors to dietary exposure to PCDDs, PCDFs and PCBs from overseas surveys.
- Foods known to be significant sources of energy in the New Zealand diet
- Frequently consumed staple foods, some popular high fat foods such as 'take-away' foods, and foods such as livers and canned fish which, while not so popular, might be important contributors to the dietary exposure to PCDDs, PCDFs and PCBs.

South America

29. New data from South America were presented at the Dioxin 2002 Symposium by Brazil and Chile.

Asia

30. Recent data from Korea, Laos, Taiwan, and Vietnam as presented on the Dioxin 2002 Symposium is included.

Africa

31. From Africa there are no data on the occurrence of dioxins or dioxin-like PCBs in food.

OCCURRENCE OF DIOXINS AND DIOXIN-LIKE PCBS IN VARIOUS GROUPS OF FOODSTUFFS

32. A summary of the available information on the occurrence of dioxins and dioxin-like PCBs in several food groups is outlined below. The data comprise the range of levels of TEQ from dioxins or dioxin-like PCBs, or the total TEQ, compiled for the different regions. Concentrations of vegetables and fish are expressed on a product basis, whereas levels in animal products are expressed on a lipid basis.

Eggs

33. In Europe, eggs are characterised by a rather consistent PCDD and PCDF presence. Data from the US and Canada are comparable, assuming a fat content of 10% for eggs. Differences between lower-, medium, and upperbound levels[3] of eggs are small.

[3] upperbound : using the limit of quantification for the contribution of each non-quantified congener to the TEQ, mediumbound: using half of the limit of quantification for the contribution of each non-quantified congener to the TEQ, lowerbound using zero for the limit of quantification for the contribution of each non-quantified congener to the TEQ

	PCDD and PCDF pg TEQ/g fat	*Dioxin like PCBs pg WHO-TEQ/g fat*	*Dioxins and dioxin-like PCBs pg TEQ/g fat*
Europe	0.5-2.7	0.2-0.6	
North America	0.044-0.3 [1]	0.029 [1]	
South America			
Asia			
Australia-New Zealand	0.12	0.11	
Africa			

[1] pg per gram product

Time trend

34. The concentration of dioxins in pooled Dutch samples of eggs dropped from 2.0 pg I-TEQ/g fat in 1991 down to 1.2 pg I-TEQ/ g fat in 1999, and from 2.3 pg WHO-TEQ/g fat in 1991 down to 0.6 pg WHO-TEQ/g fat in 1999 for dioxin-like PCBs.

Eggs of free range chickens

35. In a study in The Netherlands increased concentrations of WHO-TEQ were found in eggs from organic farms in 2001. Levels of dioxins in four samples (out of eight) were above the EU standard of 3 pg WHO-TEQ/g fat, up to 8.2 pg. Levels of dioxin like PCBs in these samples were up to 5.1 pg WHO-TEQ/g fat. Dioxin levels in eggs of (not organic) free-range farms were not increased. Comparable information is available for eggs from Belgium: levels in eggs from organic farms showed increased levels up to 10 pg TEQ/g fat for dioxins and furans, and 5.4 pg TEQ/g fat for dioxin-like PCBs. Eggs of (not organic) free range farms contained dioxin levels that were equal to those of conventional chicken farms.

36. In a study of eggs from poultry reared on allotments in the UK high levels of dioxins were detected, due to exposure to incinerator ash. After removal of the ashes the dioxin levels had declined from 16 pg I-TEQ to 9 pg I-TEQ/g lipid, but remained still above the known background levels of dioxins in eggs.

<u>Fish</u>

37. Fish and fish-products form a most heterogeneous food group, due to the large number of different species and geographical differences in the level of contamination of the various fishing grounds. The concentrations of dioxins and dioxin-like PCBs vary considerably. Many fish species contain dioxins and dioxin-like PCBs at a level below 1 pg I-TEQ/g and 1 pg PCB-TEQ/g wet weight respectively. In some fish species however, such as crab, eel, and whitefish, higher concentrations can be found. In addition, fish caught in relatively polluted areas also have higher levels of dioxins and dioxin-like PCBs (SCOOP, 2000). In general, fish is more contaminated with PCBs than with dioxins, with a 2 tot 5-fold difference in general. Differences between lower-, medium, and upperbound levels of fish are small.

	PCDD and PCDF pg TEQ/g product	*Dioxin like PCBs pg WHO-TEQ/g product*	*Dioxins and dioxin-like PCBs pg TEQ/g product*
Europe	0.01-8.9	0.03-9	
North America	0.033-0.53	0.11-0.28	
South America			5-12.5
Asia	0.002- 10.2	0.004-2.0	
Australia-New Zealand	0.02-0.12	0.03-0.16	
Africa			

Meat

38. On average, poultry, beef and veal, and mutton contain dioxin levels in the range of 1 pg I-TEG/g fat (SCOOP 2000). For pork, most studies show lower levels than the concentrations in beef and mutton. Game and liver present dioxin levels significantly higher than the other meat subgroups. Differences between lower-, medium, and upperbound levels of meats are small.

Beef

	PCDD and PCDF pg TEQ/g fat	*Dioxin like PCBs pg WHO-TEQ/g fat*	*Dioxins and dioxin-like PCBs pg TEQ/g fat*
Europe	0.6-1 liver 0.9-3.3		
North America	0.5-4.1 0.28 [1]	0.5 0.058 [1]	
South America			
Asia	1.0		
Australia-New Zealand			
Africa			

[1] pg per gram product

Poultry

	PCDD and PCDF pg TEQ/g fat	*Dioxin like PCBs pg WHO-TEQ/g fat*	*Dioxins and dioxin-like PCBs pg TEQ/g fat*
Europe	0.6-0.9 liver 3.3	0.7	
North America	0.03-3.9	0.3	
South America			
Asia	0.67		
Australia-New Zealand			
Africa			

Pork

	PCDD and PCDF pg TEQ/g fat	*Dioxin like PCBs pg WHO-TEQ/g fat*	*Dioxins and dioxin-like PCBs pg TEQ/g fat*
Europe	0.2-1.4 liver 3.0	0.8	
North America	0.6-23 0.023 [1]	0.02-1.7	
South America			
Asia	0.8		
Australia-New Zealand			
Africa			

[1] pg per gram product

Trend

39. In pooled Dutch samples of beef dioxin levels have dropped from 1.8 pg to 0.7 pg I-TEQ/g fat between 1991 and 1999. For dioxin-like PCBs there was a decrease of 2.4 pg down to 1 pg WHO-TEQ/g fat in that period. For pork the levels decreased from 0.4 pg to 0.2 pg I-TEQ/g fat for dioxins, and from 0.2 pg to 0.1 pg WHO-TEQ/g fat for dioxin-like PCBs.

Milk and dairy products

40. Compared to other food samples, many data is available for cow's milk and dairy products. Expressed on a lipid basis the concentrations of dioxins and dioxin-like PCBs in the various foodstuffs such as cow's milk, butter and cheese, and other dairy products are comparable. The data refer mainly to background concentrations; concentrations in cow's milk from hot spots of local sources are substantially higher with levels up to 15 pg/g fat. Differences between lower-, medium, and upperbound levels of milk fat are small.

	PCDD and PCDF pg TEQ/g fat	*Dioxin like PCBs pg WHO-TEQ/g fat*	*Dioxins and dioxin-like PCBs pg TEQ/g fat*
Europe	0.3-2.5	0.2-1.8 (median 0.65)	
North America	0.3-0.9	0.5	
South America	0.01-2.8		
Asia	0.30-1.8		
Australia-New Zealand			
Africa			

Time trend

41. Recent data from Belgium show a decrease of median dioxin levels in cow's milk fat of 3 pg WHO-TEQ/g fat in 1994 down to 1 pg in 2001. For cow's milk from Switzerland a similar decrease was reported of 2.3 pg I-TEQ/g fat in 1984, 1.3 pg in 1990, and 0.5 pg in 2001. In The Netherlands a decrease of about 30 to 40 % was reported for dioxins and dioxin-like PCBs in butter and cheese between 1991 and 1999. Recent results from a Dutch monitoring programme show a decrease for cow's milk of a national mean of 2.3 pg WHO-TEQ/g fat for dioxins and 1.7 pg WHO-TEQ/g fat for dioxin-like PCBs in 1997, down to 0.3 pg WHO-TEQ/g fat for dioxins and 0.5 pg WHO-TEQ/g fat for dioxin-like PCBs in 2001.

Vegetables, fruits and cereals

42. The products of vegetable origin (fruit, vegetables and cereals with less than 2% fat) exhibit low dioxin contamination levels, in comparison with foods of animal origin. In many cases only a few congeners can be found on detectable levels. Consequently, the reported concentrations might vary substantially due to the detection limits of the various dioxins and dioxin-like PCBs. Consequently, the differences between lower-, medium, and upperbound levels of vegetable products are very large.

	PCDD and PCDF pg TEQ/g product	*Dioxin like PCBs pg WHO-TEQ/g product*	*Dioxins and dioxin-like PCBs pg TEQ/g product*
Europe	0.02-0.03	0.00-0.05 (median 0.015)	
North America			
South America			
Asia			0.001-0.026
Australia-New Zealand	0.001-0.016	0.002-0.004	
Africa			

Fats and oils

43. Many different types of fats and oils of either vegetable or animal origin are used in the food industry in the manufacturing of different food products. Differences between lower-, medium, and upperbound levels are small for fats from animal origin, whereas the differences will be substantial for vegetable fats.

44. Raw fish oil usually contains high levels of dioxins and dioxin-like PCBs. In refined fish oils used by the food industry levels of dioxins and dioxin-like PCB oils are substantially decreased. However, fish oil dietary supplements might contain such high levels, as they are usually not subject to a refinery step.

	PCDD and PCDF Pg TEQ/g fat	*Dioxin like PCBs pg WHO-TEQ/g fat*	*Dioxins and dioxin-like PCBs pg TEQ/g fat*
Europe	<1	Vegetable oil 0.03-0.25 (median 0.08) Fish oil 10-74 (median 28)	
North America			
South America			
Asia			0.16-1.1
Australia-New Zealand	0.04	0.016	
Africa			

DIETARY INTAKE

45. In the following chapter, the overall information on the intake of dioxins and dioxin-like PCBs is summarized. The total intake of the population is addressed as well as the relative contribution of different food groups to this intake.

46. Intake data can be calculated from consumption surveys in combination with levels of dioxins and dioxin-like PCBs in various foodstuffs. In general there is a lack of data of levels in the different foodstuffs. In many cases estimates of concentrations are used, for example in different sorts of vegetables. In combination with the large consumption of such foods, this might lead to a substantial uncertainty in the intake estimate. Consequently, data from food duplicate samples provide a more reliable number. In the latter however, one cannot calculate the relative contribution of the various food stuffs.

JECFA

47. Using the GEMS/Food regional diets, JECFA concluded that the estimated intake of TEQs for PCDDs and PCDFs is in the range of 7-68 pg/kg bw per month at the median, and 15-160 pg/kg bw per month a the 90th percentile of mean lifetime exposure. For co-planar (i.e. non-ortho) PCBs the estimates are 7 -57 pg/kg bw per month at the median and 19-150 pg/kg bw per month at the 90th percentile of consumption. The intake estimates from national food consumption surveys were lower, namely 33-42 pg/kg per month at the median and 81-100 pg/kg bw per month at the 90th percentile for dioxins. For the co-planar PCBs the intake estimates are 9-47 pg/kg bw per month and 25-130 pg/kg bw per month respectively. Estimates could not be made for the sum of dioxins, and co-planar PCBs because countries submitted data on concentrations separately.

48. Based on a review of body burden estimates and dietary intake in the JECFA report, contributions of PCBs to total TEQ range widely across countries. This might be caused by estimates of dioxin-like PCB intake as many foods have not been analysed for these PCBs. It could however also be due to differences in consumptions patterns.

Europe

49. The information from the SCOOP report can be summarised as follows:

- For the period after 1995, the average dietary intakes of dioxins ranged between 0.4-1.5 pg I-TEQ/kg bw/day. For surveys based on chemical analyses of foods collected in the 1970s and 1980s, intakes were estimated to be higher, ranging from 1.7-5.2 pg I-TEQ/kg bw/day). The 95-percentile (or 97.5-percentile) intake, based on data from the Netherlands and United Kingdom was 2-3 times the mean intake.
- For the TEQ contribution of dioxin-like PCBs, the average intakes were 0.8-1.8 pg PCB-TEQ/kg bw/day. In studies investigating both dietary intakes of PCDDs/PCDFs and PCBs, the TEQ contribution of dioxin-like PCBs was estimated to be almost equal (e.g. Finland, Netherlands, Sweden, United Kingdom) to approximately four times (Norway) the TEQ contribution of the dioxins.

- The main contributors to the average daily intake of dioxins (I-TEQ) in the participating countries are milk and dairy products (contributions ranged from 16-39%), and meat and meat products (6-32%). Fish is prominent for the average intake in Italy, Norway and Finland, but also for the individuals with a higher intake than average in other countries such as Belgium.
- As to the above point, it should be noted that the relative contribution of the food groups to the total intake of I-TEQ differed from country to country. These differences may result from different food consumption habits in the participating countries. On the other hand, other factors may also be involved. These include factors related to the applied sampling strategy (e.g. differences in the coverage of products collected to represent the whole food group) and the large variations in concentrations of dioxin related substances in some of the food groups (e.g. vegetables and fruits, eggs and fish).
- In most countries, young children will have a higher intake per kg body weight than adults. This is especially true during the breast-feeding period as concentrations of dioxins in mother's milk are higher than in most foods. On a body weight basis, the intake of breast-fed infants has been estimated to be 1 to 2 orders of magnitude higher than the average adult intake. For young children exposed to dioxins via food the intake is about twice the intake of adults per kg bodyweight.

North America

50. Using mean TEQs from 5 cities and food daily intakes, the mean intake of dioxins and non-ortho PCBs was calculated in Canada. The mean intake of dioxins was 0.80 pg TEQ/kg bw/day, and of the PCBs 0.26 pg TEQ/kg bw/day, and the mean total TEQ intake was estimated to be 1.06 pg/kg bw/day. Dairy products and meat were the main contributors to the total TEQ intake.

South America

51. There are no data on the intake of dioxins or dioxin-like PCBs in South America.

Australia-New Zealand

52. The Ministry for the Environment of New Zealand has estimated the dietary intake of PCDDs, PCDFs and dioxin-like PCBs in 1997 for adult males and adolescent males. The dietary intake of PCDDs and PCDFs for an adult male was 0.18 pg I-TEQ/kg bw/day (mediumbound) and for an adolescent male 0.44 pg I-TEQ/kg bw/day. For the dioxin-like PCBs the intake was estimated 0.15 pg WHO TEQ/kg bw/day for an adult male and 0.32 pg WHO TEQ/kg bw/day for an adolescent male (mediumbound). The main contributor to the intake of dioxins was meat (35%), followed by dairy (19%) and fish (17%). With respect to the intake of the dioxin-like PCBs the pattern of contributions of the different food groups to the total intake is similar to that of the intake of dioxins.

Asia

53. A few industrialized countries in Asia report estimates of dietary intake.

- The daily intake of dioxins by Taiwan adults was calculated to be 0.44 pg TEQ/kg bw/day for male and 0.36 pg/kg bw/day for females (mediumbound levels) in 2001. Fresh water fish and saltwater fish were the major contributors, and beef and milk (including milk powder) to a lesser extend.
- In Korea the average intake by adults is 0.49 pg TEQ/kg bw/day for dioxins and dioxin like PCBs, based on data of 1998 to 2000. The major contributor here is also fish and shellfish.
- Data from Japan for 2000 show an average daily intake of 129 pg TEQ/day (2.6 pg TEQ/kg.day) for dioxins and planar PCBs, based on “mediumbound” levels. The “lowerbound” estimate was 71 pg/day (1.4 pg TEQ/kg.day). The most relevant food group was fish and shellfish, with a contribution of more than 50%. The results of the analysis in rice and the vegetables were responsible for the differences between lowerbound en mediumbound levels.

Africa

54. There is no data on the intake of dioxins or dioxin-like PCBs in Africa

TIME TREND

Europe

55. In some countries it is shown that the intake of dioxins has decreased in the recent past (SCOOP 2000). According to Dutch data of food duplicates, the median intake of dioxins and dioxin-like PCBs has dropped from 10 pg WHO-TEQ/kg bw/day in 1978 down to 2 pg WHO-TEQ/kg bw/day in 1994 in The Netherlands. Similar data are reported for the UK and Germany; the estimated mean intake for dioxins dropped here from 4.6 down to 0.9 pg TEQ/kg bw/day between 1982 and 1997. The calculated intake of dioxins in Finland decreased from 95 pg TEQ/day in 1992 to 46 pg TEQ/day in 1999.

North America

56. According to estimates of the USEPA the mean dietary intake of dioxins in the USA has decreased from 1.7 pg TEQ/kg bw/day in the late 1980s to 0.6 pg TEQ/kg bw/day in about 1996.

Asia

57. The total dietary intake in (Midwest District of) Japan has dropped from 9.4 pg TEQ/kg.day (from dioxins and planar PCBs) in 1977, down to 2.6 pg TEQ/kg.day (on the basis of "mediumbound" levels). It was concluded that the contamination levels of dioxin in meat, egg and dairy products have decreased remarkably , with a less pronounced decrease in fish and shellfish, from 1977 to 2000.

CONCENTRATIONS IN MOTHER'S MILK

58. As a result of the dietary intake, dioxins and dioxin-like PCBs accumulate in adipose tissue of humans. The concentrations of the various compounds depend on the intake, and on the age of the subject. Therefore the levels of dioxins and dioxin-like PCBs in mother's milk are well suited to evaluate differences of exposure between populations if samples are balanced for confounders such as mother's age and number of children previously breast-fed.

59. Recently the WHO presented the result of a study of dioxins and dioxin-like PCBs in mother's milk from 19 countries worldwide. Samples were taken in the period of 2000 to 2002. The results are presented in Table II.

Table II Levels of PCDDs, PCDFs and dioxin-like PCBs in human milk (2001/2002) as reported by the WHO

	Dioxins median pg WHO-TEQ/g fat	*Dioxins range pg WHO-TEQ/g fat*	*Dioxin-like PCBs median pg WHO-TEQ/g fat*	*Dioxin-like PCBs range pg WHO-TEQ/g fat*	*N Samples /pools*
Australia	5.65	5.50–5.79	3.09	2.48–3.69	2
Brazil	3.93	2.73–5.34	1.81	1.30–12.30	9
Bulgaria	6.14	5.08–7.11	4.21	3.74–4.70	3
Croatia	6.40	5.99–6.80	7.17	6.82–7.52	2
Czech Republic	7.78	7.44–10.73	15.24	14.32–28.48	3
Egypt	22.79	17.16–51.50	6.01	4.43–8.26	7
Finland	9.44	9.35–9.52	5.85	5.66–6.03	2
Hungary	6.79	5.26–7.46	2.87	2.38–4.24	3
Ireland	6.91	6.19–8.54	4.66	2.72–5.19	3
Italy	12.66	9.40–14.83	16.29	11.02–19.33	4
New Zealand	6.86	6.08–7.00	3.92	3.50–4.71	3
Norway	7.30	7.16–7.43	8.08	6.56–9.61	2
Romania	8.86	8.37–12.00	8.06	8.05–8.11	3
Russia	8.88	7.46–12.93	15.68	13.38–22.95	4
Slovak Republic	9.07	7.84–9.87	12.60	10.72–19.49	4
Spain	11.90	10.41–18.32	11.65	9.96–16.97	3
Sweden	9.58	–	9.71	–	1
The Netherlands	18.27	17.09–21.29	11.57	10.90–13.08	3
Ukraine	10.04	8.38–10.16	19.95	14.10–22.00	3

1. Recent data of other studies of levels of dioxins or dioxin-like PCBs in human milk are compiled in Table III.

Table III
Levels of PCDDs, PCDFs and dioxin-like PCBs in human milk (2001/2002) as reported by various countries

	Dioxins median pg WHO-TEQ/g fat	*Dioxins range pg WHO-TEQ/g fat*	*Dioxin-like PCBs median pg WHO-TEQ/g fat*	*Dioxin-like PCBs range pg WHO-TEQ/g fat*	*Total TEQ pg WHO-TEQ/g fat*	*Range pg WHO-TEQ/g fat*	*N*
Portugal	10.8	4.8-19.9					21
Portugal [1]	12.4	5.5-46					19
Germany	13.1		13.1		26.7		69
Luxemburg		11.5-22.7					22
USA (1995)	9.3			2.1[3]			5
India					12	7-17	8
Cambodia					7.8	1.9-15	16
Vietnam					12	6.5-19	10
Korea [2]	10.1		2.6		12.7		66
Taiwan					14.6±9.3		37
Laos		0.39-1.16		0.2-0.46 [3]			3

[1] In the vicinity of a MSWI
[2] Five days after delivery
[3] Non ortho PCBs only

60. The data show that the highest levels of dioxins and dioxin-like PCBs in mother's milk are found in West Europe, and in Egypt. In the Egypt samples the levels of dioxin-like PCBs are low in comparison with the data from West Europe. The concentrations of dioxins are lower in East Europe but it shows higher levels of dioxin-like PCBs. Lower levels of both dioxins and dioxin-like PCBs are found in the USA, and in most Asian countries, and Australia and New Zealand. Levels in Laos and Brazil are very low.

TIME TREND

61. For a series of countries, temporal trends of levels of dioxins can be derived. Available data of dioxins and dioxin-like PCBs in human breast milk demonstrate a decrease of the concentration of these compounds in time. The median levels in The Netherlands are dropped in the order of 25% between 1993 and 1998. Data from Norway show a decrease of about 50% in the period of 1992 to 2001.

RISK ASSESSMENT

TOLERABLE DAILY INTAKE

62. In May 1998, a consultation convened by the WHO-ECEH and IPCS evaluated available information on the toxicology of dioxins and dioxin-like PCBs, and derived a tolerable daily intake (TDI) range of 1-4 pg TEQs/kg body weight for dioxins and dioxin-like PCBs. The TDI was based upon effects (LOAELs) in experimental animals, namely endometriosis, developmental neurobehavioral and developmental reproductive effects, and immunotoxicity, on the assumption that there is a threshold for all effects..

63. The Scientific Committee on Food (SCF) of the European Commission has re-evaluated the toxicity of dioxins and dioxin-like PCBs in November 2000. Their evaluation was based on the WHO evaluation of 1998 and an expanded database containing studies published since then. For 2,3,7,8,-TCDD and related compounds, such as other dioxins and dioxin-like PCBs that have long half-lives in the human body, the SCF found it more appropriate to establish a temporary tolerable weekly intake (t-TWI) instead of a tolerable daily intake (TDI). The SCF established a group t-TWI of 7 pg WHO TEQ/kg bw for dioxins and the dioxin-like PCBs. On the basis of new scientific information the SCF updated the evaluation in May 2001. The SCF concluded that 14 pg WHO-TEQ/kg bw/week should be considered as the tolerable intake, based on a LOAEL for developmental effects in male rat offspring.

64. In June 2001 the Joint FAO/WHO Expert Committee on Food Additives (JECFA) derived a Provisional Tolerable Monthly Intake (PTMI) of 70 pg WHO TEQ/kg for dioxins, and dioxin-like PCBs. It is based upon the lowest LOAEL and a NOAEL for developmental effects in male rat offspring. Because of the long half-lives of dioxins and dioxin-like PCBs in humans, JECFA established a PTMI instead of a tolerable daily or weekly intake. JECFA concluded, that the tolerable intake could be established on the basis of the assumption that there is a threshold for all effects, including cancer. Carcinogenicity of 2,3,7,8-TCDD was not linked to genotoxic properties, and the Committee concluded that a tolerable intake based on non-cancer effects would also address any carcinogenic risk.

65. The U.S. Environmental Protection Agency (EPA) released a draft review of health aspects of 2,3,7,8-tetrachlorodibenzodioxin (TCDD) in 1999. In the risk assessment EPA has assumed that there is no threshold for cancer. In this regard the EPA policy position for dioxin's dose response differs deeply from that of the SCF, WHO and JECFA. It was concluded that the margin of exposure between background levels in terms of TEQs, and levels where non-cancer effects are detectable in humans is small. With regard to carcinogenicity, the evaluation of cancer potency has resulted in an upper bound risk-specific dose estimate (risk of one additional cancer in one million exposed) of approximately 0.01 pg TEQ/kg body weight/day.

DIETARY INTAKE IN RELATION TO THE PTMI

66. The median intakes estimated by JECFA using national food consumption surveys are 33 to 42 pg/kg/month for dioxins and furans, and 9 to 47 pg/kg/month for coplanar PCBs. The PTMI of 70 pg/kg/month derived by JECFA is based on total TEQ exposure, e.g. dioxins, furans and dioxin-like PCBs together. Several sources of uncertainty were identified which suggest that both median levels of the intake and the 90th percentile are likely to be overestimates. However, the results suggest that a fraction of the population will have long term mean intake above the PTMI. This certainly holds true for the consumers in the upper part of the intake distribution, since the 90th percentile of the lifelong mean intake is estimated be 81 to 100 pg/kg/month for dioxins and furans, and 25 to 130 pg/kg/month for coplanar PCBs. Based on the uncertainties in the derivation of the TDI the JECFA meeting concluded that long term intake slightly above the PTMI will not necessarily result in adverse health effects but would erode the safety factor build in the PTMI.

67. Given the average dietary intakes of dioxins and dioxin-like PCBs in the European countries of 1.2 - 3 pg TEQ/kg bw/day, a proportion of the European population exceeds the PTMI derived by JECFA or the PTWI derived by the SCF. The Committee also stated that this does not necessary mean that there is an appreciable risk to the health of individuals, because the PTWI includes a safety factor. According to the SCF exceeding the PTWI leads to an erosion of the protection embedded in that safety factor.

68. A Dutch intake study shows that the PTWI of 14 pg/kg bw per week established by the SCF is exceeded by 8% of the Dutch population.

69. In New Zealand the estimated intake is below the 1 pg TEQ/kg bw/day for the majority of the general population.

RISK MANAGEMENT

70. Among the Codex Member Nations there is agreement on the necessity to develop and implement source directed measures with the aim of reducing dioxin contamination of foods. A Position Paper about this issue was prepared by Germany and was presented at the 34th Session of the CCFAC. A revised Paper will be presented at the 35th CCFAC meeting. Consequently the issue of source directed measures is not addressed in this Position Paper

PRESENT REGULATION IN CODEX MEMBER NATIONS

Europe

71. The Council of the European Union has derived maximum levels for dioxins in food (Council Regulation 2375/2001 of 29 November 2001) and feed (Council Directive 2001/102/EC of 27 November 2001). The Maximum Levels (MLs) for food (Table IV) and feed (Table V) are adopted by the Member States of the European Union since 1 July 2002. The Commission will review the maximum levels for food and feed by 31 December 2004 at the latest, with a view to include dioxin-like PCBs in the levels to be set. The MLs shall be further reviewed by 31 December 2006 with the aim of significantly reducing the MLs and possibly laying down maximum levels for other foodstuffs.

Table IV. Maximum levels in food in the EU as apply since 1 July 2002.

Product	Maximum level[(1) (3)]
Meat and meat products originating from:	
- ruminants (bovine animals, sheep)	3 pg WHO-PCDD/F-TEQ/g fat
- poultry and farmed game	2 pg WHO-PCDD/F-TEQ/g fat
- pigs	1 pg WHO-PCDD/F-TEQ/g fat
Liver and derived products	6 pg WHO-PCDD/F-TEQ/g fat
Muscle meat of fish and fishery products and products thereof	4 pg WHO-PCDD/F-TEQ/g fresh weight
Milk and milk products, including butter fat	3 pg WHO-PCDD/F-TEQ/g fat
Hen eggs and egg products[(2)]	3 pg WHO-PCDD/F-TEQ/g fat
Oils and fats:	
Animal fat from:	
- ruminants	3 pg WHO-PCDD/F-TEQ/g fat
- poultry and farmed game	2 pg WHO-PCDD/F-TEQ/g fat
- pigs	1 pg WHO-PCDD/F-TEQ/g fat
- mixed animal fat	2 pg WHO-PCDD/F-TEQ/g fat
Vegetable oil	0.75 pg WHO-PCDD/F-TEQ/g fat
Fish oil intended for human consumption	2 pg WHO-PCDD/F-TEQ/g fat

(1) Upperbound concentrations
(2) Free-range or semi-intensive eggs must comply with the maximum level laid down as from 1 January 2004.
(3) The MLs are not applicable for food products containing <1 %fat.

Table V. Maximum levels in feed in the EU as apply since 1 July 2002.

Product	Maximum level[(1)]
All feed materials of plant origin including vegetable oils and by-products	0.75 ng WHO-PCDD/F-TEQ//kg
Minerals	1.0 ng WHO-PCDD/F-TEQ//kg
Animal fat, including milk fat and egg fat	2.0 ng WHO-PCDD/F-TEQ//kg
Other land animal products including milk and milk products and eggs and egg products.	0.75 ng WHO-PCDD/F-TEQ//kg
Fish oil	6 ng WHO-PCDD/F-TEQ//kg
Fish, other aquatic animals, their products And by-products with the exception of fish oil	1.25 ng WHO-PCDD/F-TEQ//kg
Compound feedingstuffs, with the exception of feedingstuffs for fur animals and feedingstuff for fish.	0.75 ng WHO-PCDD/F-TEQ//kg
Feedingstuffs for fish	2.25 ng WHO-PCDD/F-TEQ//kg

(1) Upperbound concentrations

Korea

72. The Republic of Korea has notified temporary maximum dioxin levels for beef, pork, chicken meats and eggs of 5 pg WHO-PCDD/F-TEQ/g fat by the Committee on Sanitary and Phytosanitary Measures of the World Trade Organization (G/SPS/N/KOR/84, 29 January 2001).

METHODS OF ANALYSIS

73. The European Commission has established a Commission Directive laying down the sampling and methods of analysis for the official control of dioxins and the determination of dioxin-like PCBs in foodstuffs (2002/69/EC of 29 July 2002) and feedingstuffs (2002/70/EC of 26 July 2002). It describes requirements for methods of analysis used for screening and for GC/MS methods to be complied for screening or confirmatory purposes.

GC/MS ANALYSIS

74. The analytical method for dioxins and planar PCBs is based on an extensive clean up followed by the use of a high-resolution or ion-trap mass spectrometer. Following isolation of fat, dioxins are purified by combinations of gel permeation chromatography, acid/base silica, aluminium oxide or activated carbon. Labelled standards are added to compensate for recovery losses and quantification (isotope dilution).

75. High-resolution gas chromatography in combination with high-resolution or ion-trap mass spectrometry is used for the separation and identification of the 17 dioxin and 4 non-ortho PCB congeners. Mono-ortho PCBs can be analysed on a low-resolution mass-spectrometer. Several international ring-trials have been performed for the dioxin analysis. The results have demonstrated that the variations of the chemical analysis of dioxins do not deviate from the analysis of most other chemical compounds.

76. For dibenzo-(p)-dioxins and -furans, and dioxin-like PCBs in foodstuffs detectable quantities have to be in the picogram (10^{-12} g) range.

77. The EU legislation provides that insofar the used analytical procedure is possible, the analytical results should contain the levels of the various congeners individually, in addition to the total concentration in TEQs. The total dioxin content is calculated by multiplication of the levels of individual congeners with their corresponding TEF values, and summarisation to yield a total TEQ-level. According to the European Commission, for non quantified congeners "upperbound " (using the limit of quantification for the contribution of each non-quantified congener to the TEQ), "mediumbound" (using half of the limit of quantification for the contribution of each non-quantified congener to the TEQ),, and "lowerbound" levels (using zero for the limit of quantification for the contribution of each non-quantified congener to the TEQ) should each be used to calculate the total of TEQs, as this provides information about the uncertainty of the data due to the different detection limits of the various congeners.

ALTERNATIVE METHODS FOR DIOXIN ANALYSIS

78. Because of the relatively high costs and low sample throughput of the GC/MS analysis, several alternative methods have been developed.

79. Immunoassays have been developed for this purpose, but at present their limited sensitivity does not allow their use for feed and food samples. More promising is the use of bioassays, which are based on the detection of dioxin (-like) compounds by the effects that underlay their toxicity. As a result, the tests detect total TEQ rather than individual congeners. Since some other non dioxin-like compounds are capable of binding to the Ah-receptor, a clean-up procedure (e.g. acid silica) is required to increase the specificity. These bioassays can be used as a rapid screening-method. Positive samples may then require confirmation by the GC/MS reference method.

80. The results of the CALUX bioassay were validated for the analysis of dioxins and dioxin-like PCBs in feed and food, by a comparison with results of GC-MS analysis of a great number of identical food and food samples. The detection limit of the CALUX method in foods is in the order of 1 pg/g. A negligible chance of false negative samples has been demonstrated for feed, in comparison with results of the GC/MS analysis. Food data available indicate less than 1 % false negative samples. The percentage of false positives varies, as different non dioxin-like compounds are known to interact with the CALUX assay.

REFERENCES

EUROPEAN COMMISSION

Directorate-General Health & Consumer Protection. Report of the Task 3.2.5. of the Scientific Co-operation; Assessment of dietary intake of dioxins and related PCBs by the population of EU Member States. April 2000.

EUROPEAN COMMISSION

Directorate-General Health & Consumer Protection. The opinion of the Scientific Committee on Animal Nutrition on the Dioxin Contamination of Feedingstuffs and their Contribution to the Contamination of Food of Animal Origin. November 2000.

EUROPEAN COMMISSION

Directorate-General Health & Consumer Protection. The opinion of the Scientific Committee on Food on the Risk Assessment of Dioxins and Dioxin-like PCBs in Food. November 2000.

CODEX COMMITTEE ON FOOD ADDITIVES AND CONTAMINANTS

Discussion-Paper Dioxins and Dioxin-like PCBs, CX/FAC 00/26. 1999

FOOD AND DRUG ADMINISTRATION (FDA)

Information and data of the Food and Drug Administration; Centre for Food Safety and Applied Nutrition Office of Plant and Dairy Food and Beverages.

MINISTRY FOR THE ENVIRONMENT, NEW ZEALAND.

Organochlorines in New Zealand. Concentrations of PCDDs, PCDFs and PCBs in retail foods and an assessment of dietary intake for New Zealanders. September 1998.

JOINT FAO/WHO EXPERT COMMITTEE ON FOOD ADDITIVES (JECFA)

Summary and Conclusions of the Fifty-seventh Meeting. June 2001.

EUROPEAN COMMISSION

Directorate-General Health & Consumer Protection, The opinion of the Scientific Committee on Food (SCF). The Risk assessment of dioxins and dioxin-like PCBs in food. 30 may 2001.

ORGANOHALOGEN COMPOUNDS volume 55, 57, 58

Proceedings of the 22nd International Symposium on Halogenated Environmental Organic Pollutants and POPs, Dioxin 2002 Barcelona, August 11-16, 2002

OPINION OF THE SCIENTIFIC COMMITTEE ON ANIMAL NUTRITION on the „Dioxin Contamination of feedingstuffs and their contribution to the contamination of food of animal origin"; adopted on 06 November 2000.
http://europa.eu.int/comm/food/fs/sc/scan/out55_en.pdf

OPINION OF THE SCIENTIFIC COMMITTEE ON FOOD on the Risk Assessment of Dioxins and Dioxin-like PCBs in Food; adopted on 22 November 2000. http://europa.eu.int/comm/food/fs/sc/scf/out78_en.pdf

OPINION OF THE SCIENTIFIC COMMITTEE ON FOOD on the Risk Assessment of Dioxins and Dioxin-like PCBs in Food – Update based on new scientific information available since the adoption of the Scientific Committee on Food opinion of 22nd November 2000; adopted on 30 May 2001.
http://europa.eu.int/comm/food/fs/sc/scf/out90_en.pdf

SUMMARY OF THE FIFTY-SEVENTH MEETING OF THE JOINT FAO/WHO EXPERT COMMITTEE ON FOOD ADDITIVES (JECFA)
http://www.who.int/pcs/jecfa/Summary57-corr.pdf

Assessment of the health risk of dioxins: re-evaluation of the Tolerable Daily Intake (TDI) – Executive summary, WHO Consultation May 25-29 1998, Geneva, Switzerland.
Food Additives and Contaminants, Vol. 17, No 4, 223 – 240 (editors: *Van Leeuwen* & *Younes*).
http://www.who.int/pcs/pubs/dioxin-exec-sum/exe-sum-final.html

Assessment of dietary intake of dioxins and related PCBs by the population of EU Member States. Reports on tasks for scientific co-operation, Task 3.2.5., 7 June 2000
http://europa.eu.int/comm/dgs/health_consumer/library/pub/pub08_en.pdf

COMMUNICATION FROM THE COMMISSION TO THE COUNCIL, THE EUROPEAN PARLIAMENT AND THE ECONOMIC AND SOCIAL COMMITTEE on a Community strategy for dioxins, furans and polychlorinated biphenyls (COM (2001) 593 final).
Official Journal of the European Communities, C322, 17.11.2002, p 2-18
http://europa.eu.int/eur-lex/pri/en/oj/dat/2001/c_322/c_32220011117en00020018.pdf

COUNCIL DIRECTIVE 2001/102/EC of 27 November 2001 amending Directive 1999/29/EC on the undesirable substances and products in animal nutrition
Official Journal of the European Communities, L6, 10.1.2002, p. 45 - 49
http://europa.eu.int/eur-lex/pri/en/oj/dat/2002/l_006/l_00620020110en00450049.pdf

COUNCIL REGULATION (EC) No 2375/2001 of 29 November 2001 amending Commission Regulation (EC) No 466/2001 setting maximum levels for certain contaminants in foodstuffs. *Official Journal of the European Communities*, L321, 06.12.2002, p. 1 - 5
http://europa.eu.int/eur-lex/pri/en/oj/dat/2001/l_321/l_32120011206en00010005.pdf

COMMISSION RECOMMENDATION 2002/201/EC OF 4 MARCH 2002 ON THE REDUCTION OF THE PRESENCE OF DIOXINS, FURANS AND DIOXIN-LIKE PCBS IN FEEDINGSTUFFS AND FOODSTUFFS.
Official Journal of the European Communities, L 67, 9.3.2002, p. 69-73.
http://europa.eu.int/eur-lex/pri/en/oj/dat/2002/l_067/l_06720020309en00690073.pdf

COMMISSION DIRECTIVE 2002/70/EC of 26 July 2002 establishing requirements for the determination of levels of dioxins and dioxin-like PCBs in feedingstuffs
Official Journal of the European Communities, L209, 06.08.2002, p. 15 -21
http://europa.eu.int/eur-lex/en/dat/2002/l_209/l_20920020806en00150021.pdf

COMMISSION DIRECTIVE 2002/69/EC of 29 July 2002 laying down the sampling methods and the methods of analysis for the official control of dioxins and the determination of dioxin-like PCBs in foodstuffs.
Official Journal of the European Communities, L209, 06.08.2002, p. 5 - 14
http://europa.eu.int/eur-lex/en/dat/2002/l_209/l_20920020806en00050014.pdf