codex alimentarius commission

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

WORLD HEALTH ORGANIZATION

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Agenda Item 16 A **CX/FAC 03/26**

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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

COMMENTS SUBMITTED ON THE DRAFT MAXIMUM LEVEL FOR LEAD IN FISH IN RESPONSE TO CL 2002/10-FAC

The following comments have been received from Czech Republic, Philippines, Denmark, WHO (from GEMS FOOD**:** Australia, Brazil, Canada, China, Denmark, Hungary, Ireland, Japan, Korea, Lithuania, Mexico, The Netherlands, New Zealand, Slovakia, Sweden, Thailand, United Kingdom and the USA).

DENMARK:

Draft Maximum Level for Lead in Fish

At the 34th session of CCFAC it was agreed that the discussion on MLs for lead in fish should be continued as there was potential health risk for consumers (especially children), consumption of fish took place worldwide and fish was extensively traded.

The committee decided that the proposed level of 0.2 mg/kg, as well as certain species for which the level might not apply, should be returned to step 6 with a request for comments by Circular Letter (CL 2002/10-FAC part C no. 10) on the following issues:

- Data on actual lead levels in fish (per specie and per treatment, e.g., canned, cooked and fresh fish) and species that should be included in the list of fish species not being able to meet the proposed maximum level for lead of 0.2 mg/kg;
- Information on analytical methods including detection limits
- Information on known or expected problems in trade and data on the relationship between lead exposure through fish consumption and health risks.

The delegate of Denmark offered to compile the above data into three annexes. The delegates of Australia, France, Italy, Korea, Norway, Philippines, Spain, Thailand, United Kingdom, and the EC offered to support Denmark in this work (Alinorm 03/12 paragraph 133 and 134).

Information and data have only been forwarded to Denmark from Czech Republic, Philippines and WHO. This information is enclosed in the attached annexes.

Annex I:

Data on actual lead levels in fish

Data on lead in fish are found in the attached excel file. The data has been submitted from WHO and originate from the GEMS/food database.

The file contains two sheets: In the first sheet the data are sorted by country and in the second the data are sorted by fish species (the fish identifier is described in the right column).

Besides the data from WHO the following data have been submitted from the Czech republic:

Results from the Czech TDS Prepared by: J.Ruprich, NIPH Prague, Oct 31,2002

TDS composite sample	Lead in edible portion mg/kg		
	N samples	Average	Maximum
Sea fish (1994-1998)	60	0.012	0.022
Freshwater fish (1994-1998)	60	0.009	0.029
Smoked and marinated sea fish (1994-1998)	60	0.036	0.101
Sea fish (1999-2001)	9	0.009	0.016
Freshwater fish (1999-2001)	9	0.011	0.019
Marinated sea fish (1999-2001)	9	0.018	0.051
Smoked sea fish (1999-2001)	9	0.011	0.019

Annex II:

Information on analytical methods including detection limits

PHILIPPINES:

The current AOAC method for Lead in Fish AOAC 972.23 was internationally validated in 1972 and was considered useful for the analysis of lead in fish at 1-11 ppm. Philippines have used this method to develop a procedure for lead in tuna. The results of in-house validation of the method for lead in tuna was:

Performance Characteristic Measured	Results
1. Limit of Detection (LOD)	0.10 mg/kg TUNA
2. Limit of Quantification (LOQ)	0.33 mg/kg TUNA
3. Accuracy	
3.1 Standard Addition	The amount of added Lead recovered in the range of 0.1, 0.5, 1.0, 2.0 and 5.0 mg/kg TUNA was a linear function of the concentration of analyte added, r = 0.9998.
3.2 Comparison with FAPAS* Test Material	Lead in the FAPAS test material of canned fish had an assigned value of 0.062 mg/kg. Lead found by the laboratory was 0.058 and 0.060 mg/kg which *is within* the acceptable range of 0.035-0.090 mg/kg. (4)
4. Recovery	The percent recovery obtained was 90-110% at 0.1 mg/kg TUNA, 90-95% at 0.2 mg/kg TUNA and 90-100% at 0.5 mg/kg TUNA. The percent recovery of added Lead *is within* the 80-110% range expected of an acceptable method of analysis, USDA, 1985, vol II (21).
5. Precision using repeatability	The %Relative Standard Deviation (%RSD) for the analysis of 10 samples of tuna of THE AOAC METHOD = 5.0%. The %RSD should be $\leq$ 12 for a method to be considered precise, USDA, 1985, vol II (21).

* FAPAS (Food Analysis Performance Assessment Scheme, Central Science Laboratory, Sand Hutton, York, YO41 1LZ, United Kingdom)

DENMARK:

During the past 15-20 years the content of lead in foods has generally decreased due to decreased environmental burden with this element. The content in individual food items however, may vary depending on e.g. the environmental exposure or on the ability of some foods to concentrate lead in its tissues. The content of lead in leafy vegetables grown close to lead emitting sources or lead bound to metallothioneines in animal's kidneys are examples of this. In general however, lead is present in foods at concentrations in the low ng/g range, including in fish muscle [1]. A noticeable exception to this is the lead content in some bivalves, which feed directly on contaminated ocean sediment. In this case the lead content may reach the order of 1000 ng/g wet tissue mass.

If not in full control, the analytical procedures used for determination of lead in fish etc. may cause contamination of the fish sample due to ubiquitous presence of lead as an environmental contaminant. This risk requires that the utmost care be observed to prevent contamination of the laboratory environment or the chemicals used. Therefore, in general the use of procedures that are simple, employ a minimum of chemicals and sample handling and use highly lead-specific and sensitive instrumental determination may result in accurate and precise chemical analyses.

Access to such methodologies however, does not *per se* ensure the analytical quality. The use of frequent procedural blanks (2 per 20 unknown samples), full double determinations, certified reference materials or recovery of lead spiked to the sample as well as participation in proficiency testing schemes such as FAPAS [2], may help the analyst to track down the sources of error and possibly reveal its causes.

Based on experience gained during 20 years of practical use, pressurized wet ashing of the homogenized fish muscle tissue by pure nitric acid (pressurized closed bombs or microwave-assisted ashing) followed by dilution by ultra pure water prior to detection by graphite furnace atomic absorption spectrometry (AAS) is a method principle that may lead to successful analyses [3]. This additionally requires a highly skilled laboratory staff on all educational levels (technicians and academics) with emphasis on the understanding of sources of lead contamination in the laboratory as well as instrumental interferences occurring during detection of lead.

Use of the outlined methodology may lead to accurate analyses (use fish CRMs) that are not prone to uncontrolled laboratory contamination (use full double determinations) and that have limits of detection (based on double determination of procedural blanks) around 10 ng/g or 0.01 µg/g (wet sample mass) [3].

References:

1. 1. Larsen, E.H., Andersen, N.L., Møller, A., Petersen, A., Mortensen, G.K. and Petersen, J., Monitoring the content and intake of trace elements from food in Denmark, *Fd. Addit. Contamin*., 2002, **19**, 33-46.

2. Key, P.E., Patey, A.L., Rowling, S., Wilbourn, A. and Worner, F.M., 1997, International proficiency testing of analytical laboratories for foods and feeds from 1990 to 1996: The experiences of the United Kingdom Food Analysis Performance Assessment Scheme, *Journal of AOAC International*, **80**, 895-988.

3. Foodstuffs-Determination of trace elements-Determination of lead, cadmium, chromium and molybdenum by graphite furnace atomic absorption spectrometry (GF-AAS) after pressure digestion, European Committee for Standardization, prEN 14083:2002, rue de Strassart, 36, B-1050 Brussels, Belgium.

Annex III:

Information on known or expected problems in trade and data on the relationship between lead exposure through fish consumption and health risks.

CZECH REPUBLIC:

Looking on previous results the suggested limit 0.2 mg / kg is not restrictive for usual fish species mostly consumed in the Czech Rep. But take into account that fish consumption is very low in the Czech Republic (about 6 kg per capita and year) and fish on the market are not in very many species. Prices and consumption rate reality is supporting an idea to be open to accept ML higher than 0.2 mg / kg for some particular fish species.

DENMARK:

The adult Danes on average consume ca. 30 g of fish per day and capita. Combining this with the generally low mean content of lead in commonly eaten fish species at less than 9 ng/g fresh fish (the limit of detection), the mean intake of lead from fish is a few tenths of a microgram per person per day. In comparison with the mean daily lead intake from all foods at 18 µg per day illustrates that the contribution from fish to the total dietary lead intake is insignificant and does not pose any human health risk (Larsen, E.H., Andersen, N.L., Møller, A., Petersen, A., Mortensen, G.K. and Petersen, J., Monitoring the content and intake of trace elements from food in Denmark, *Food Addit. Contamin*., 2002, **19**, 33-46.)

PHILIPPINES:

Find no known problems in trade due to lead in fish. If an ML were established, trade problems could result due to the lack of an internationally validated method for lead in fish. Philippines are still reviewing data of known health risks from the consumption of lead in fish.
(Page 22 of the Report of the 34th CCFAC, Alinorm 03/12 paragraph 133)

133. The Committee decided that the proposed level of 0.2 mg/kg, as well as certain species for which the level might not apply, should be returned to Step 6 with a request for comments by Circular Letter to this report on the following issues (see Appendices XIII and XX)

- Data on actual lead levels in fish (per specie and per treatment, eg. canned, cooked and fresh fish) and species that should be included in the list of fish species not being able to meet the proposed maximum level for lead of 0.2 mg/kg.
- Information on analytical methods including detection limits
- Information on known or expected problems in trade and data on relationship between lead exposure through fish consumption and health risks

The delegate of Denmark offered to complete the above data into three annexes for next year's session. The delegates from Australia, France, Italy, Korea, Norway, Philippines, Spain, Thailand, United Kingdom and the EC offered to support Denmark in this work. The Committee also agreed that a discussion paper would not be prepared.

PHILIPPINE POSITION

1. Data on actual lead levels in fish (per specie and treatment) and species not being able to meet the proposed ML of 0.2 ppm:

1.1 We are not in agreement with the establishment of an ML for lead on a per fish specie basis because there is not enough data currently with the Committee to statistically identify an ML for lead in fish on a per fish specie basis. Based on the recent difficulties at CCFAC to obtain adequate and acceptable supporting data for an ML in seafoods, it is unlikely that such data for individual fish specie will be forthcoming.

1.2 We reiterate our recommendation made at the 34th CCFAC to discontinue the establishment of an ML for lead in fish at 0.2 ppm because:

a) Information in the scientific literature indicates that unlike mercury, "fish can regulate concentrations of inorganic forms of metals in muscle tissue and in these cases concentrations do not exceed regulatory or recommended limits even when fish are harvested from metal contaminated lakes" (Howgate: Review of public health safety of products from aquaculture, International Journal of Food Science and Technology 33:99-125). The Scientific Committee on Toxicity, Ecotoxicity and the Environment (CSTEE) of the European Commission Directorate General for Health and Consumer Protection also reported that lead is not biomagnified in terrestial and aquatic food chains. Biomagnification is limited to filtering organisms. (B2/JCD/csteeop/**PbDK50500/D**(00)

b) Risk assessment information does not support the establishment of an ML for lead in foods in general as indicated by the following reports:

- JECFA at its 53rd meeting (2002) stated that "levels of lead found currently in food would have negligible effects on the neurobehavioral development of infants and children" (WHO Technical Report Series 896).

- The Scientific Committee on Toxicity, Ecotoxicity and the Environment (CSTEE) of the European Commission Directorate General for Health and Consumer Protection stated in Brussels, 5 May 2000 that "information available to the CSTEE indicates that the Danish claim that lead exposure in children from dust and food ingestion is close to or exceeds the WHO Provisional Tolerable Weekly Intake (PTWI) value for acceptable exposure, is probably not correct at least for a great majority of children in Denmark. B2/JCD/csteeop/**PbDK50500**/D(00)

Based on the above, the setting of an ML for lead in fish is not in accordance with CODEX STAN 193 page 9, which states that ML's shall be set only for those contaminants that present both a significant risk to public health and a known or expected problem in trade.

c) The AOAC method for lead in fish (AOAC 972.23) has an LOQ of 0.33 ppm and therefore cannot reliably detect lead at the proposed Codex ML of 0.2 ppm.

2. Information on analytical methods including detection limits

Enclosed as Table 1 is data on our in-house validation of the current AOAC method for lead in fish (AOAC 972.23), showing an LOQ of 0.33 mg/kg for the analysis of tuna. This is higher than the proposed level of 0.2 ppm. In 1996, Australia commented to CCFAC that "conventional lead analysis will have problems attaining a limit of determination of less than 0.2 ppm. To reach limits of determination of 0.1 ppm or less for lead will greatly increase analytical expense and will result in high margins of laboratory error."

Setting the ML at 0.2 ppm would therefore not be in accordance with CODEX STAN 193 page 9 which states that "ML's should not be lower than a level which can be analyzed with methods of analysis that can be readily applied in normal product control laboratories unless public health considerations necessitate a lower detection limit which can only be controlled by means of a more elaborate method of analysis."

3. Information on known or expected problems in trade and data on relationship between lead exposure through fish consumption and health risks

There are currently no known problems in trade due to the presence of lead in fish. If an ML were established at 0.2 ppm, trade problems could result due to the lack of a method for lead analysis at this level that is suitable to normal product control laboratories that is internationally validated.

Information on the relationship between lead exposure through fish contamination and health risks is dicussed in 1.2.b.

TABLE 1. RESULTS OF IN-HOUSE VALIDATION OF LEAD IN TUNA

Performance Characteristic Measured	Results
1. Limit of Detection (LOD)	0.10 mg/kg TUNA
2. Limit of Quantification (LOQ)	0.33 mg/kg TUNA
3. Accuracy 3.1 Standard Addition	 The amount of added Lead recovered in the range of 0.1, 0.5, 1.0, 2.0 and 5.0 mg/kg TUNA was a linear function of the concentration of analyte added, r = 0.9998.
3.2 Comparison with FAPAS* Test Material	Lead in the FAPAS test material of canned fish had an assigned value of 0.062 mg/kg. Lead found by the laboratory was 0.058 and 0.060 mg/kg which *is within* the acceptable range of 0.035-0.090 mg/kg. (4)
4. Recovery	The percent recovery obtained was 90-110% at 0.1 mg/kg TUNA, 90-95% at 0.2 mg/kg TUNA and 90-100% at 0.5 mg/kg TUNA. The percent recovery of added Lead *is within* the 80-110% range expected of an acceptable method of analysis, USDA, 1985, vol II (21).
5. Precision using repeatability	The %Relative Standard Deviation (%RSD) for the analysis of 10 samples of tuna of THE AOAC METHOD = 5.0% The %RSD should be $\leq$ 12 for a method to be considered precise, USDA, 1985, vol II (21).

* FAPAS (Food Analysis Performance Assessment Scheme, Central Science Laboratory, Sand Hutton, York, YO41 1LZ, United Kingdom)

DENMARK:

Danish comments on draft maximum level for lead in fish – alinorm 03/12 - appendix XIII.

At the working group meeting for contaminants prior to the 34th session of CCFAC the CCFAC secretariat presented a non-exhaustive list of fish species indicated by member states on the basis of not being able to meet the draft maximum level for lead of 0,2 mg/kg for lead in fish. The list of fish species was based on the tables containing data on lead in fish that Denmark had prepared for the meeting and is a kind of negative list.

Denmark would like to express a reservation towards the list of fish species that would not meet a limit of 0,2 mg/kg for lead. We find the concept of positive listing more appropriate in an international standard. Such a positive list should list fish species of importance in international trade and consumption.

The negative list from last year contains fish species that we find have very low concentrations of lead, i.e. herring, cod, mackerel, salmon and trout. Also, we find that the document prepared by Denmark for the 34th CCFAC does not substantiate all of the fish species being on the list requiring a higher ML.

As an example we take herring:

The document prepared for last years meeting only contained data on herring from Denmark:

Family	**Species**	**English name**	**No of samples**	**%<0.05 mg/kg**	**% < 0.1 mg/kg**	**% < 0.2 mg/kg**	**% < 0.3 mg/kg**	**% < 0.4 mg/kg**	**% < 0.5 mg/kg**	**Country**
Clupeidae	Clupea harengus	Herring	30	90					**100**	DK

These data show that 90% of the samples were below 0,05 mg/kg. However, one sample has a very high content of lead – and based on this herring ended up on the list of fish species that does not comply with a limit of 0,2 mg/kg – which we disagree with.

Statistically, contaminants normally have some kind of normal distribution – which is also the case with lead in herring based on the Danish data. The average content was 0.018 mg/kg; The median was < 0.009 mg/kg; the 90th percentile was 0.009 mg/kg – however, the highest concentration found was 0.455. The data in general show that the appropriate limit would be 0.2 mg/kg for lead in herring.

Therefore, if higher limits should be set for certain fish species, the list of fish species should be carefully evaluated.

In conclusion, we propose, based on the discussion that took place at the 34th CCFAC meeting that a positive list of those fish species that are traded internationally and evaluate weather they can comply with a limit of 0.2 mg/kg as a consequence of the fact that not all fish species are traded internationally and which through human consumption contributes to the intake of lead should be drawn up. This means that it would only be for instance the 50 mostly traded/consumed fish species that CCFAC would set ML's for.

WHO data on lead in fish (from GEMS food) : Sorted by country. Concentrations are in microgram/kilo

Country code	Food identifier	Food origin	Sampling period	Number of samples	Number of samples less than the LOQ	Median or best estimate	90th Percentile	Fish Species name in English
AUS	WD121	U	01/1998-12/1998	9		5.000		Salmon, Pacific
AUS	WS125	U	01/1998-12/1998	21		0.000		Marine fish
AUS	WS132		01/1990-09/1990	9	0	0	0	Tuna and Bonito
AUS	WS132		01/1980-12/1980	23		178	380	Tuna and Bonito
AUS	WS132	D	01/1981-12/1981	21		170	400	Tuna and Bonito
AUS	WS132	D	01/1982-12/1982	21		73	250	Tuna and Bonito
AUS	WS132	D	01/1983-12/1983	21		50	180	Tuna and Bonito
AUS	WS132	B	01/1984-12/1984	21		90	300	Tuna and Bonito
AUS	WS132	B	01/1981-12/1981	20		80	150	Tuna and Bonito
BRA	WF115	B	01/1997-06/2002	49	47			Freshwater fish
BRA	WS125	D	01/1998-06/2002	46	44			Marine fish
CAN	WD121	D	01/1982-12/1982	15		50	80	Salmon, Pacific
CAN	WD121	D	01/1982-12/1982	15		50	230	Salmon, Pacific
CAN	WS132	B	01/1983-12/1983	8		58	110	Tuna and Bonito
CHN	WS125	CHN	10/1992-11/1992	62	14	20	130	Marine fish
DEN	WS927	D	01/1988-12/1988	50		10	60	Cod
DEN	WS932	D	01/1989-12/1989	30		0	40	Flounders
DEN	WS933	D	01/1988-12/1988	13		20	107	Garfish
DEN	WS937	D	01/1988-12/1988	32		0	60	Herring
DEN	WS941		01/1988-12/1988	19		20	80	Mackerel

DEN	WS945	D	01/1988-12/1988	33		30	127	Plaice
HUN	WF115	D	01/1985-12/1985	27		240	400	Freshwater fish
HUN	WS130	I	01/1984-12/1984	19		272	500	Sardines and Sardine-type fishes
HUN	WS4981	I	01/1984-12/1984	14		122	245	Mackerel, Atlantic, see Mackerel
HUN	WS4981	I	01/1985-12/1985	10		155	330	Mackerel, Atlantic, see Mackerel
IRE	WS125	D	01/1976-12/1976	40				Marine fish
IRE	WS927	D	01/1977-12/1977	6			100	Cod
IRE	WS927	D	01/1977-12/1977	20				Cod
IRE	WS937	D	01/1977-12/1977	5				Herring
IRE	WS937	D	01/1977-12/1977	7			300	Herring
JPN	WD121	D	01/1980-12/1980	12	12			Salmon, Pacific
JPN	WD894	D	01/1980-12/1980	11		35	250	Shad
JPN	WS130	D	01/1986-12/1986	18		22.5	50	Sardines and Sardine-type fishes
JPN	WS130	D	01/1988-12/1988	14		25	170	Sardines and Sardine-type fishes
JPN	WS130	D	01/1980-12/1980	24		160	250	Sardines and Sardine-type fishes
JPN	WS130	D	01/1981-12/1981	24		30	130	Sardines and Sardine-type fishes
JPN	WS130	D	01/1982-12/1982	32		100	680	Sardines and Sardine-type fishes
JPN	WS130	D	01/1983-12/1983	17		25	150	Sardines and Sardine-type fishes
JPN	WS130	D	01/1984-12/1984	26		10	270	Sardines and Sardine-type fishes
JPN	WS130	D	01/1985-12/1985	16		18	70	Sardines and Sardine-type fishes
JPN	WS4973	D	01/1986-12/1986	13		10	25	Horse mackerel, see Jack Mackerel
JPN	WS4973	D	01/1980-12/1980	24		35	170	Horse mackerel, see Jack Mackerel
JPN	WS4973	D	01/1981-12/1981	16		38	250	Horse mackerel, see Jack Mackerel
JPN	WS4973	D	01/1982-12/1982	13		25	130	Horse mackerel, see Jack Mackerel
JPN	WS4973	D	01/1983-12/1983	12		25	210	Horse mackerel, see Jack Mackerel

JPN	WS927	D	01/1982-12/1982	12		260	280	Cod
JPN	WS928	D	01/1980-12/1980	24		35	250	Conger or Conger eel
JPN	WS941	D	01/1980-12/1980	17		70	250	Mackerel
JPN	WS949	D	01/1980-12/1980	14			120	Sea bass
JPN	WS950	D	01/1980-12/1980	13		200	250	Sea bream
KOR	WS125	KOR	02/1989-11/1989	20	0	0	0	Marine fish
KOR	WS125	KOR	02/1991-11/1991	8	0	0	0	Marine fish
KOR	WS125	KOR	02/1989-11/1989	24	0	0	500	Marine fish
KOR	WS125	KOR	02/1991-11/1991	8	0	0	0	Marine fish
KOR	WS125	KOR	02/1991-11/1991	8	0	0	0	Marine fish
KOR	WS125	KOR	02/1991-11/1991	8	0	0	0	Marine fish
KOR	WS125	KOR	02/1989-11/1989	24	0	0	450	Marine fish
KOR	WS125	KOR	02/1991-11/1991	8	0	0	0	Marine fish
KOR	WS125	KOR	02/1989-11/1989	24	0	0	430	Marine fish
KOR	WS125	KOR	02/1991-11/1991	8	0	0	0	Marine fish
KOR	WS125	KOR	02/1991-11/1991	8	0	0	0	Marine fish
KOR	WS125	KOR	02/1991-11/1991	8	0	0	0	Marine fish
KOR	WS125	KOR	02/1989-11/1989	24	0	0	310	Marine fish
KOR	WS125	D	01/1985-12/1985	9		460	776	Marine fish
KOR	WS125	D	01/1985-12/1985	5		280	585	Marine fish
KOR	WS125	KOR	02/1989-11/1989	24	0	0	500	Marine fish
KOR	WS125	KOR	02/1991-11/1991	8	0	0	0	Marine fish
KOR	WS125	KOR	02/1991-11/1991	8	0	0	0	Marine fish
KOR	WS125	KOR	02/1989-11/1989	24	0	0	460	Marine fish
KOR	WS125	KOR	02/1991-11/1991	8	0	0	0	Marine fish

KOR	WS125	KOR	02/1991-11/1991	8	0	0	0	Marine fish
KOR	WS125	KOR	02/1991-11/1991	8	0	0	0	Marine fish
KOR	WS125	KOR	02/1991-11/1991	8	0	0	0	Marine fish
KOR	WS125	KOR	02/1989-11/1989	28	0	0	390	Marine fish
KOR	WS125	KOR	02/1991-11/1991	4	0	0	0	Marine fish
KOR	WS125	KOR	02/1989-11/1989	24	0	0	310	Marine fish
KOR	WS125	KOR	02/1991-11/1991	8	0	0	0	Marine fish
KOR	WS125	KOR	02/1991-11/1991	8	0	0	0	Marine fish
KOR	WS125	KOR	02/1991-11/1991	8	0	0	0	Marine fish
KOR	WS125	KOR	02/1991-11/1991	4	0	0	0	Marine fish
KOR	WS125	KOR	02/1989-11/1989	24	0	0	480	Marine fish
KOR	WS125	KOR	02/1991-11/1991	8	0	0	0	Marine fish
KOR	WS125	KOR	02/1991-11/1991	8	0	0	0	Marine fish
KOR	WS4983	D	01/1985-12/1985	14		510	1008	Mackerel, Chub, see Mackerel
KOR	WS920	D	01/1985-12/1985	6		330	594	Anchovies
KOR	WS932	D	01/1985-12/1985	5		400	550	Flounders
KOR	WS941	D	01/1985-12/1985	10		450	1130	Mackerel
KOR	WS943	D	01/1985-12/1985	7		400	728	Mullets
KOR	WS946	D	01/1985-12/1985	7		350	630	Pollack
KOR	WS947	D	01/1985-12/1985	6		390	662	Pomfret, Atlantic
LIT	WF115	D	01/1999-12/1999	6	2	10.000	24.000	Freshwater fish
LIT	WS125	D	01/1999-12/1999	8	5	0.000	50.000	Marine fish
MEX	WS130	D	01/1980-12/1980	62			1600	Sardines and Sardine-type fishes
MEX	WS132	D	01/1980-12/1980	48			1900	Tuna and Bonito
NET	WS937	B	01/1985-12/1985	7		45		Herring

NET	WS941	B	01/1985-12/1985	15		44		Mackerel
NEZ	WD121	B	08/1997-06/1998	10	10			Salmon, Pacific
NEZ	WD121	I	01/1981-12/1981	25		100	400	Salmon, Pacific
NEZ	WS125	D	08/1997-06/1998	8	4	4.1	35.1	Marine fish
NEZ	WS130	I	01/1981-12/1981	25		200	1200	Sardines and Sardine-type fishes
SVK	WD120	I	01/1997-12/1997	3	0	28.000	42.000	Diadromous fish
SVK	WD120	I	01/1999-12/1999	13	0	20.000	48.000	Diadromous fish
SVK	WD120	I	01/1998-12/1998	13	0	20.000	45.000	Diadromous fish
SVK	WD121	I	01/2002-7/2002	1	0	430.000	430.000	Salmon, Pacific
SVK	WD123	B	01/2000-12/2000	28	8	54.000	82.000	Trout
SVK	WD4871	D	01/1995-12/1995	18	0	82.000	371.000	Brown trout, see Trout
SVK	WD4871	B	01/1999-12/1999	26	0	62.000	98.000	Brown trout, see Trout
SVK	WD4871	B	01/1997-12/1997	31	0	31.000	95.000	Brown trout, see Trout
SVK	WD4871	B	01/2000-12/2000	38	4	45.000	96.000	Brown trout, see Trout
SVK	WD4871	D	01/2001-12/2001	20	5	26.000	102.000	Brown trout, see Trout
SVK	WD4871	D	01/2002-7/2002	5	2	6.000	119.000	Brown trout, see Trout
SVK	WD4871	B	01/1996-12/1996	24	0	25.000	80.000	Brown trout, see Trout
SVK	WD4871	B	01/1998-12/1998	32	0	20.000	48.000	Brown trout, see Trout
SVK	WD4871	D	01/1996-12/1996	1	0	25.000	25.000	Brown trout, see Trout
SVK	WD4871	D	01/1999-12/1999	2	0	20.000	20.000	Brown trout, see Trout
SVK	WD4871	D	01/1998-12/1998	5	0	10.000	33.000	Brown trout, see Trout
SVK	WD4875	B	01/1995-12/1995	15	0	40.000	266.000	Cherry salmon, See Subgroup Salmon, Pacific
SVK	WD4875	I	01/2000-12/2000	8	1	26.000	170.000	Cherry salmon, See Subgroup Salmon, Pacific
SVK	WD4875	I	01/1998-12/1998	25	0	30.000	90.000	Cherry salmon, See Subgroup Salmon, Pacific
SVK	WD4875	I	01/1997-12/1997	18	0	45.000	95.000	Cherry salmon, See Subgroup Salmon, Pacific

SVK	WD4875	B	01/2001-12/2001	4	2	21.000	77.000	Cherry salmon, See Subgroup Salmon, Pacific
SVK	WD4875	I	01/1996-12/1996	12	1	20.000	57.000	Cherry salmon, See Subgroup Salmon, Pacific
SVK	WD4875	I	01/1999-12/1999	28	0	20.000	53.000	Cherry salmon, See Subgroup Salmon, Pacific
SVK	WD890	D	01/1995-12/1995	4	0	21.000	115.000	Eels
SVK	WD890	B	01/1996-12/1996	5	0	40.000	48.000	Eels
SVK	WD890	I	01/1998-12/1998	1	0	30.000	30.000	Eels
SVK	WD890	I	01/2001-12/2001	1	0	24.000	24.000	Eels
SVK	WD890	I	01/2000-12/2000	2	0	20.000	28.000	Eels
SVK	WD890	I	01/2002-7/2002	1	0	10.000	10.000	Eels
SVK	WF115	I	01/1996-12/1996	29	0	40.000	306.000	Freshwater fish
SVK	WF115	D	01/1995-12/1995	19	0	58.000	91.000	Freshwater fish
SVK	WF115	I	01/2002-7/2002	2	0	61.000	101.000	Freshwater fish
SVK	WF115	D	01/1999-12/1999	27	0	30.000	124.000	Freshwater fish
SVK	WF115	D	01/1997-12/1997	12	0	30.000	165.000	Freshwater fish
SVK	WF115	D	01/1998-12/1998	20	0	30.000	113.000	Freshwater fish
SVK	WF115	D	01/2001-12/2001	19	6	26.000	82.000	Freshwater fish
SVK	WF115	I	01/2000-12/2000	4	1	10.000	10.000	Freshwater fish
SVK	WF115	B	01/2000-12/2000	37	5	20.000	58.000	Freshwater fish
SVK	WF4837	I	01/2000-12/2000	1	0	80.000	80.000	Amur pike, see Pike
SVK	WF4837	B	01/1996-12/1996	17	0	20.000	102.000	Amur pike, see Pike
SVK	WF4837	I	01/1995-12/1995	6	0	34.000	80.000	Amur pike, see Pike
SVK	WF4837	I	01/1999-12/1999	14	0	20.000	44.000	Amur pike, see Pike
SVK	WF4837	I	01/1997-12/1997	8	0	20.000	33.000	Amur pike, see Pike
SVK	WF4837	I	01/1998-12/1998	2	0	12.000	18.000	Amur pike, see Pike
SVK	WF4837	I	01/2001-12/2001	1	1	3.000	3.000	Amur pike, see Pike

SVK	WF855	B	01/1997-12/1997	4	0	81.000	304.000	Barbs
SVK	WF855	D	01/1995-12/1995	9	0	74.000	331.000	Barbs
SVK	WF855	D	01/1998-12/1998	1	0	90.000	90.000	Barbs
SVK	WF855	D	01/1999-12/1999	14	0	29.000	85.000	Barbs
SVK	WF858	D	01/1996-12/1996	2	0	75.000	87.000	Bream
SVK	WF858	D	01/1999-12/1999	4	0	70.000	93.000	Bream
SVK	WF858	D	01/1995-12/1995	4	0	35.000	68.000	Bream
SVK	WF858	D	01/1998-12/1998	4	0	15.000	24.000	Bream
SVK	WF858	D	01/1997-12/1997	1	0	1.000	1.000	Bream
SVK	WF859	B	01/1995-12/1995	10	0	44.000	142.000	Carps
SVK	WF859	B	01/1997-12/1997	23	0	40.000	165.000	Carps
SVK	WF859	B	01/1999-12/1999	20	0	20.000	120.000	Carps
SVK	WF859	B	01/1998-12/1998	21	0	24.000	71.000	Carps
SVK	WF859	B	01/1996-12/1996	32	0	23.000	46.000	Carps
SVK	WF859	B	01/2000-12/2000	32	1	20.000	57.000	Carps
SVK	WF859	B	01/2001-12/2001	26	18	3.000	35.000	Carps
SVK	WF859	I	01/2002-7/2002	1	0	10.000	10.000	Carps
SVK	WF861	I	01/1997-12/1997	1	0	90.000	90.000	Catfishes (freshwater)
SVK	WF861	D	01/1995-12/1995	1	0	76.000	76.000	Catfishes (freshwater)
SVK	WF861	I	01/2002-7/2002	2	0	45.000	73.000	Catfishes (freshwater)
SVK	WF861	B	01/1996-12/1996	3	0	40.000	56.000	Catfishes (freshwater)
SVK	WF861	I	01/2000-12/2000	4	0	10.000	59.000	Catfishes (freshwater)
SVK	WF861	B	01/1999-12/1999	4	0	25.000	37.000	Catfishes (freshwater)
SVK	WF861	I	01/2001-12/2001	8	5	3.000	63.000	Catfishes (freshwater)
SVK	WF862	D	01/1997-12/1997	2	0	93.000	167.000	Gobies, Freshwater

SVK	WF862	D	01/1995-12/1995	1	0	64.000	64.000	Gobies, Freshwater
SVK	WF865	B	01/1996-12/1996	10	0	30.000	64.000	Pike
SVK	WF865	I	01/2002-7/2002	2	0	45.000	65.000	Pike
SVK	WF865	D	01/1998-12/1998	4	0	35.000	57.000	Pike
SVK	WF865	D	01/1995-12/1995	4	0	31.000	42.000	Pike
SVK	WF865	B	01/1997-12/1997	8	0	20.000	53.000	Pike
SVK	WF865	B	01/1999-12/1999	4	0	20.000	38.000	Pike
SVK	WF865	I	01/2000-12/2000	5	0	10.000	50.000	Pike
SVK	WF865	B	01/2001-12/2001	9	5	3.000	40.000	Pike
SVK	WF866	I	01/2000-12/2000	7	0	40.000	116.000	Pike-perch
SVK	WF866	I	01/2002-7/2002	3	0	40.000	72.000	Pike-perch
SVK	WF866	D	01/1996-12/1996	2	0	40.000	48.000	Pike-perch
SVK	WF866	B	01/1999-12/1999	8	0	38.000	60.000	Pike-perch
SVK	WF866	D	01/1995-12/1995	2	0	31.000	54.000	Pike-perch
SVK	WF866	B	01/1998-12/1998	7	0	20.000	57.000	Pike-perch
SVK	WF866	B	01/1997-12/1997	5	0	20.000	26.000	Pike-perch
SVK	WF867	D	01/1995-12/1995	25	0	56.000	630.000	Roaches
SVK	WF867	D	01/1996-12/1996	14	0	50.000	502.000	Roaches
SVK	WF867	D	01/1997-12/1997	16	0	88.000	243.000	Roaches
SVK	WF867	D	01/2000-12/2000	34	4	43.000	107.000	Roaches
SVK	WF867	D	01/1999-12/1999	33	0	37.000	99.000	Roaches
SVK	WF867	D	01/1998-12/1998	25	0	23.000	86.000	Roaches
SVK	WF867	D	01/2002-7/2002	2	0	11.000	18.000	Roaches
SVK	WF869	B	01/1995-12/1995	225	0	50.000	160.000	Cod, Murray
SVK	WF869	B	01/1996-12/1996	151	0	30.000	100.000	Cod, Murray

SVK	WF869	I	01/1999-12/1999	116	0	31.000	107.000	Cod, Murray
SVK	WF869	B	01/2001-12/2001	142	50	29.000	90.000	Cod, Murray
SVK	WF869	B	01/1998-12/1998	155	0	32.000	90.000	Cod, Murray
SVK	WF869	B	01/1997-12/1997	273	0	20.000	78.000	Cod, Murray
SVK	WF869	B	01/2000-12/2000	267	5	20.000	80.000	Cod, Murray
SVK	WF869	B	01/2002-7/2002	124	8	10.000	60.000	Cod, Murray
SVK	WF870	D	01/1995-12/1995	6	0	62.000	714.000	Perch, Golden
SVK	WF870	B	01/1996-12/1996	5	0	79.000	257.000	Perch, Golden
SVK	WF870	B	01/1997-12/1997	8	0	41.000	126.000	Perch, Golden
SVK	WF870	B	01/1999-12/1999	11	0	35.000	130.000	Perch, Golden
SVK	WF870	B	01/1998-12/1998	9	0	30.000	106.000	Perch, Golden
SVK	WF870	D	01/2000-12/2000	2	1	15.000	25.000	Perch, Golden
SVK	WF870	I	01/2001-12/2001	1	1	3.000	3.000	Perch, Golden
SVK	WR140	I	01/2001-12/2001	1	0	820.000	820.000	Fish roe
SVK	WR140	I	01/1995-12/1995	7	0	307.000	496.000	Fish roe
SVK	WR140	I	01/1996-12/1996	7	0	140.000	272.000	Fish roe
SVK	WR140	I	01/1997-12/1997	13	0	90.000	482.000	Fish roe
SVK	WR140	I	01/2000-12/2000	5	0	13.000	408.000	Fish roe
SVK	WR140	I	01/1998-12/1998	9	0	40.000	189.000	Fish roe
SVK	WR140	I	01/1999-12/1999	15	0	40.000	127.000	Fish roe
SVK	WS125	B	01/1995-12/1995	31	0	50.000	120.000	Marine fish
SVK	WS125	I	01/1996-12/1996	65	0	21.000	110.000	Marine fish
SVK	WS125	I	01/1999-12/1999	17	0	30.000	130.000	Marine fish
SVK	WS125	I	01/1997-12/1997	170	0	17.000	83.000	Marine fish
SVK	WS125	I	01/2001-12/2001	15	6	33.000	74.000	Marine fish

SVK	WS125	I	01/1998-12/1998	21	0	21.000	54.000	Marine fish
SVK	WS125	I	01/2002-7/2002	9	4	14.000	51.000	Marine fish
SVK	WS125	I	01/2000-12/2000	16	0	17.000	48.000	Marine fish
SVK	WS126	I	01/1996-12/1996	73	0	40.000	165.000	Cod and Cod-like fishes
SVK	WS126	B	01/1995-12/1995	50	0	44.000	213.000	Cod and Cod-like fishes
SVK	WS126	I	01/1997-12/1997	131	0	30.000	170.000	Cod and Cod-like fishes
SVK	WS126	I	01/2000-12/2000	46	3	50.000	127.000	Cod and Cod-like fishes
SVK	WS126	I	01/2001-12/2001	34	9	32.000	130.000	Cod and Cod-like fishes
SVK	WS126	I	01/2002-7/2002	15	3	26.000	87.000	Cod and Cod-like fishes
SVK	WS126	B	01/1999-12/1999	221	0	20.000	87.000	Cod and Cod-like fishes
SVK	WS126	I	01/1998-12/1998	135	0	26.000	74.000	Cod and Cod-like fishes
SVK	WS127	I	01/1996-12/1996	1	0	78.000	78.000	Flat-fishes
SVK	WS127	I	01/1995-12/1995	1	0	70.000	70.000	Flat-fishes
SVK	WS127	I	01/1998-12/1998	2	0	70.000	117.000	Flat-fishes
SVK	WS127	I	01/1999-12/1999	3	0	10.000	10.000	Flat-fishes
SVK	WS128	I	01/1995-12/1995	41	0	50.000	190.000	Mackerel and Mackerel-like Fishes
SVK	WS128	B	01/2000-12/2000	67	0	30.000	84.000	Mackerel and Mackerel-like Fishes
SVK	WS128	B	01/1996-12/1996	43	2	34.000	93.000	Mackerel and Mackerel-like Fishes
SVK	WS128	B	01/1999-12/1999	78	0	30.000	90.000	Mackerel and Mackerel-like Fishes
SVK	WS128	B	01/1998-12/1998	45	0	30.000	70.000	Mackerel and Mackerel-like Fishes
SVK	WS128	B	01/1997-12/1997	30	0	29.000	80.000	Mackerel and Mackerel-like Fishes
SVK	WS128	I	01/2002-7/2002	26	3	17.000	60.000	Mackerel and Mackerel-like Fishes
SVK	WS128	I	01/2001-12/2001	27	11	20.000	76.000	Mackerel and Mackerel-like Fishes
SVK	WS130	B	01/1996-12/1996	86	1	32.000	148.000	Sardines and Sardine-type fishes
SVK	WS130	B	01/2000-12/2000	151	6	45.000	150.000	Sardines and Sardine-type fishes

SVK	WS130	B	01/1995-12/1995	55	0	50.000	128.000	Sardines and Sardine-type fishes
SVK	WS130	B	01/1997-12/1997	62	0	32.000	117.000	Sardines and Sardine-type fishes
SVK	WS130	B	01/1999-12/1999	149	0	30.000	122.000	Sardines and Sardine-type fishes
SVK	WS130	B	01/2001-12/2001	81	19	36.000	118.000	Sardines and Sardine-type fishes
SVK	WS130	B	01/1998-12/1998	102	0	31.000	79.000	Sardines and Sardine-type fishes
SVK	WS130	I	01/2002-7/2002	34	2	19.000	88.000	Sardines and Sardine-type fishes
SVK	WS131	I	01/1995-12/1995	1	0	319.000	319.000	Sharks
SVK	WS131	I	01/2000-12/2000	16	0	20.000	110.000	Sharks
SVK	WS131	I	01/1997-12/1997	3	0	57.000	131.000	Sharks
SVK	WS131	I	01/2001-12/2001	15	3	50.000	86.000	Sharks
SVK	WS131	I	01/1996-12/1996	2	0	43.000	65.000	Sharks
SVK	WS131	I	01/1998-12/1998	15	0	30.000	69.000	Sharks
SVK	WS131	I	01/1999-12/1999	17	0	20.000	34.000	Sharks
SVK	WS935	I	01/1995-12/1995	14	0	108.000	573.000	Hakes
SVK	WS935	I	01/1997-12/1997	2	0	132.000	221.000	Hakes
SVK	WS935	I	01/1996-12/1996	13	0	40.000	259.000	Hakes
SVK	WS935	I	01/1999-12/1999	12	0	35.000	86.000	Hakes
SVK	WS935	I	01/1998-12/1998	15	0	30.000	62.000	Hakes
SVK	WS935	I	01/2000-12/2000	9	0	5.000	72.000	Hakes
SVK	WS935	I	01/2002-7/2002	6	5	1.000	10.000	Hakes
SVK	WS935	I	01/2001-12/2001	1	1	3.000	3.000	Hakes
SVK	WS937	B	01/2000-12/2000	109	60	55.000	63.000	Herring
SVK	WS941	D	01/2000-12/2000	32	4	47.000	109.000	Mackerel
SVK	WS949	I	01/1997-12/1997	1	0	30.000	30.000	Sea bass
SVK	WS949	I	01/2000-12/2000	1	0	20.000	20.000	Sea bass

SWE	WS126	D	01/1983-12/1983	10		19	62	Cod and Cod-like fishes
THA	WS130	D	01/1982-12/1982	30		750	1060	Sardines and Sardine-type fishes
THA	WS130	D	01/1983-12/1983	24		480	690	Sardines and Sardine-type fishes
THA	WS132	D	01/1983-12/1983	12		280	350	Tuna and Bonito
THA	WS132	D	01/1982-12/1982	10		460	570	Tuna and Bonito
THA	WS132	D	01/1983-12/1983	14		280	350	Tuna and Bonito
THA	WS941	D	01/1983-12/1983	10		940	1180	Mackerel
UNK	WD121	I	01/1981-12/1981	15	15			Salmon, Pacific
UNK	WS130	I	01/1983-12/1983	6		1750		Sardines and Sardine-type fishes
USA	WS132	D	01/1984-12/1984	20		40	60	Tuna and Bonito
USA	WS132	D	01/1985-12/1985	20		20	60	Tuna and Bonito
USA	WS132	D	01/1980-12/1980	26		670	2020	Tuna and Bonito
USA	WS132	D	01/1980-12/1980	25		230	730	Tuna and Bonito
USA	WS132	D	01/1981-12/1981	31		100	1160	Tuna and Bonito
USA	WS132	D	01/1981-12/1981	26		300	1420	Tuna and Bonito
USA	WS132	D	01/1982-12/1982	29		680	1200	Tuna and Bonito
USA	WS132	D	01/1982-12/1982	22		20	380	Tuna and Bonito
USA	WS132	D	01/1983-12/1983	14		40	70	Tuna and Bonito
USA	WS132	D	01/1983-12/1983	10		655	1800	Tuna and Bonito
USA	WS132	D	01/1983-12/1983	25		690	1700	Tuna and Bonito
USA	WS132	D	01/1983-12/1983	36		20	76	Tuna and Bonito
USA	WS132	D	01/1984-12/1984	2				Tuna and Bonito
USA	WS132	D	01/1985-12/1985	6		150	640	Tuna and Bonito
USA	WS132	D	01/1988-12/1988	19		10	160	Tuna and Bonito

KOREA:

Lead Levels in Fish(edible portion ug/kg)

Year	Name	Unit	No	LQ	<LOQ	Min	Max	Mean
1987	*Chub Mackerel*	? /kg	28	10		30	430	230
1987	*Hair tail*	? /kg	24	10		140	870	330
1987	*Pomfret, Atlantic*	? /kg	24	10		40	710	280
1987	*Anchovies*	? /kg	24	10		270	630	400
1987	*Mackerel*	? /kg	24	10		170	540	340
1987	*Alaska Pollack*	? /kg	20	10		110	570	300
1987	*Saury*	? /kg	20	10		100	410	290
1987	*Flounders, Plaice*	? /kg	24	10		150	430	280
1987	*Yellow corvina*	? /kg	24	10		140	630	300

USA:

The United States offers the following comments in response to CL 2002/10-FAC – Part C, No. 10: Draft Maximum Levels for Lead in Fish (ALINORM 03/12, para. 133 and Appendices XIII and XX).

At the 34th Session of the Codex Committee on Food Additives and Contaminants (CCFAC) (Rotterdam, The Netherlands, 11-15 March 2002), the Committee decided that the proposed draft maximum level (ML) of 0.2 mg/kg for lead in fish should be returned to Step 6 with a request for additional information on 1) lead levels in specific fish species, 2) analytical methods for the determination of lead in fish including detection limits, and 3) health risks associated with lead exposure from fish consumption. In response to the Committee's request, the U.S. offers the following information.

Lead Levels in Fish Species

In response to CL 2001/13-FAC (April 2001), in November 2001, the U.S. provided all currently available data for lead levels in various fish species for discussion at the 34th Session of CCFAC.

Analytical Methods for Lead Analysis

Analytical methods employed by the U.S. Food and Drug Administration for the determination of lead in fish include a graphite furnace atomic absorption spectroscopy (GFAAS) method similar to AOAC methods 999.10 and 999.11. Though the limit of quantification may vary depending on the instrumentation and analytical portion, a typical limit of quantification for lead analysis by GFAAS (4 g analytical portion) is 0.006 mg/kg. Therefore, the U.S. believes that determination of lead at levels below the proposed ML of 0.2 mg/kg in fish is highly feasible with GFAAS. The U.S. also believes that with technological advances over the years, instrumentation for GFAAS is widely available and relatively affordable, and recommends that countries with large export or import markets for fish use GFAAS in their quality control programs for determining lead levels in fish.

Lead Exposure From Fish Consumption – Health Implications

Over the years, the U.S. has emphasized that infants and small children are more vulnerable than adults to lead poisoning because they absorb lead more readily and consume more food on a body weight basis than adults. Consequently, infants and children can develop neurological problems at lower lead levels with relatively short-term exposure (within weeks to months). If a child consumes large amounts of fish with elevated lead levels over several weeks, an increase in blood lead level will occur. Therefore, the U.S. supports the establishment of the lowest feasible maximum lead levels for foods (such as tuna) consumed by this population group and supports the proposed ML of 0.2 mg/kg lead in fish, particularly tuna. Based on the U.S. lead data in tuna (domestic and imported samples) that were provided to CCFAC in November 2001, we believe that the proposed lead level of 0.2 mg/kg in tuna is feasible.