WHO FOOD ADDITIVES SERIES: 55

Safety evaluation of certain contaminants in food

FAO FOOD AND NUTRITION PAPER 82

Prepared by the Sixty-fourth meeting of the Joint FAO/WHO Expert Committee on Food Additives (JECFA)

CADMIUM-IMPACT ASSESSMENT OF DIFFERENT MAXIMUM LIMITS
(pages 156-203)

World Health Organization, Geneva, 2006

Food and Agriculture Organization of the United Nations

IPCS-International Programme on Chemical Safety 2006

CADMIUM — IMPACT ASSESSMENT OF DIFFERENT MAXIMUM LIMITS

First draft prepared by

K. Egan,[1] T. Hambridge[2] and F. Kayama[3]

[1] Food and Drug Administration, College Park, Maryland, USA
[2] Food Standards Australia New Zealand, Canberra, Australia
[3] Jichi Medical School, Tochigi, Japan

Explanation 157
Assessment for the sixty-first JECFA 158
Assessment for the sixty-fourth JECFA 160
New cadmium data 160
Raw data 160
Aggregated data 164
Cadmium intake estimates 164
Comparison of new and previous concentration data 165
Impact of different possible MLs on cadmium concentrations 169
Impact of different possible MLs on cadmium intakes 172
Comments 185
Data on concentrations of cadmium in food 185
Assessment of the impact of different possible MLs on mean concentrations of cadmium 186
Assessment of the impact of different possible MLs on mean intakes of cadmium 186
Evaluation 187
References 190
Appendix A: Summary of raw data on cadmium concentrations in commodities, by country and region 191
Appendix B: Weighted means for aggregated cadmium data 195

1. EXPLANATION

The dietary intake of cadmium was evaluated by the Committee at its fifty-fifth and sixty-first meetings (Annex 1, references 149 and 166). In each of these assessments, intakes of cadmium were calculated from available data on concentrations and food consumption taken from the Global Environment Monitoring System Food Contamination Monitoring and Assessment Programme (GEMS/Food) regional diets. Total intakes of cadmium estimated by the Committee at its sixty-first meeting ranged from 2.8 to 4.2 µg/kg bw per week, which equate to 40–60% of the current provisional tolerable weekly intake (PTWI) of 7 µg/kg bw per week. The seven commodity groups that contributed significantly to total intake of cadmium included rice, wheat, root vegetables, tuber vegetables, leafy vegetables, other vegetables and molluscs. These commodities accounted for 40–85% of the total intake of cadmium in the five GEMS/Food regions.

Before the sixty-first meeting of the Committee, the Codex Committee on Food Additives and Contaminants (CCFAC) at its Thirty-sixth Session (CAC,

2004a) requested that the Committee evaluate the impact of different maximum levels (MLs) for cadmium in commodities that contribute significantly to intake, but this work could not be undertaken by the Committee at that time. CCFAC subsequently requested that this analysis be completed. Specifically, the Committee was asked:

- To conduct intake and impact assessments for the seven commodity groups, taking into account three possible MLs (i.e. the draft Codex ML proposed by CCFAC and one level lower and one level higher than the proposed ML). The draft proposed Codex MLs were as follows: rice, 0.4 mg/kg; wheat, 0.2 mg/kg; potatoes, 0.1 mg/kg; stem/root vegetables, 0.1 mg/kg; leafy vegetables, 0.2 mg/kg; other vegetables, 0.05 mg/kg; and molluscs (oysters, 3 mg/kg; other molluscs, 1 mg/kg).
- To evaluate the impact of three possible MLs on concentrations and intakes in subcategories of molluscs (i.e. bivalves, scallops and cephalopods) on the basis of the data submitted.

Table 1 summarizes the possible MLs (proposed, one level lower and one level higher) for each commodity group and the specific commodities included in each group as specified by CCFAC. JECFA evaluated one additional level (0.2 mg/kg) for rice, since this had been discussed previously by CCFAC as a possible ML. This assessment took into account the potential impact of each possible ML on the distribution of concentrations of cadmium in each commodity (i.e. how eliminating samples containing cadmium at concentrations greater than the ML affected the mean value of the resulting distribution, and the proportion of samples containing cadmium at concentrations greater than the ML) and the dietary intakes of cadmium from each individual commodity (i.e. how the mean concentrations of cadmium for each ML affected mean intake of cadmium).

2. ASSESSMENT FOR THE SIXTY-FIRST JECFA

For the sixty-first JECFA, most cadmium concentration data used in the assessment were aggregated (i.e. means or medians representing a number of samples). In addition to these aggregated data, the Japanese government submitted a substantial number of data on individual samples (raw data). Mean values were calculated from the Japanese data and then included with the other aggregated data.

As recommended in the guidelines for conducting exposure assessments for contaminants in foods (CAC, 2004b), regional cadmium intakes were calculated using regional average concentration data and the GEMS/Food regional diets (WHO, 2003). The concentration data were grouped by commodity and geographic region (as per the GEMS/Food regional diets), and mean concentrations were calculated as the average of mean/median values reported for that region. Since sample sizes were not reported for all data, it was not possible to calculate weighted means. Cadmium intakes were calculated by multiplying the unweighted regional average concentration for each commodity by the amount consumed of the commodity, as specified in the GEMS/Food regional diets.

Table 1. Commodities and MLs evaluated by sixty-fourth JECFA as requested by CCFAC

One level lower (mg/kg)	Proposed ML (mg/kg)	One level higher (mg/kg)	CCFAC commodity group	Sub-categories	Codex code	Codex code description
0.3	0.4	0.5	Rice, polished		CM 0649	Rice, polished
0.1	0.2	0.3	Wheat grain		GC 0654	Wheat grain
0.05	0.1	0.2	Potato		VR 0589	Potato
0.05	0.1	0.2	Stem and root vegetables (excluding potatoes and celeriac)		VR 0075	Roots and tubers
					VS 0078	Stalk and stem vegetables
0.1	0.2	0.3	Leafy vegetables		VL 0053	Leafy vegetables including brassica leafy
0.01	0.05	0.1	Other vegetables (excluding tomatoes and mushrooms)		VA 0035	Bulb vegetables
					VB 0040	Brassica vegetables
					VC 0045	Fruiting vegetables - cucurbits
0.5	1.0	2.0	Molluscs (including cephalopods)		IM 0150	
0.5	1.0	2.0		Marine bivalves	IM 0151	Clams, cockles, mussels, oysters, scallops
0.5	1.0	2.0		Scallops	IM 1005	
1.0	2.0	3.0		Cephalo-pods	IM 0152	Cuttlefish, octopus, squid
2.0	3.0	4.0		Oysters	IM 1004	

Estimated total cadmium intakes ranged from 2.8 to 4.2 µg/kg bw per week, which equate to approximately 40–60% of the current PTWI of 7 µg/kg bw per week. Commodities that contributed significantly to total cadmium intake (i.e. those contributing 10% or more of the PTWI from one GEMS/Food region, or 5% or more of the PTWI for two or more regions) included the following: rice, wheat, roots and tubers, leafy and other vegetables and molluscs. On average for the five

regional diets, these commodities accounted for about 65% of total cadmium intake.

3. ASSESSMENT FOR THE SIXTY-FOURTH JECFA

The present assessment took into account the potential impact of different possible MLs on the distribution of concentrations of cadmium in each commodity (i.e. how eliminating samples containing cadmium at concentrations greater than the ML affected the mean value of the resulting distribution, and the proportion of samples containing cadmium at concentrations greater than the ML) and the dietary intakes of cadmium from each individual commodity (i.e. how the mean concentrations of cadmium for each ML affected mean intake of cadmium). Cadmium intakes were calculated for the seven commodity groups only; estimates of total cadmium intake from the previous JECFA evaluation provided a benchmark for evaluating the impact of MLs on intakes.

Conducting this assessment of possible MLs required information about the distribution of cadmium levels in each commodity group. Ideally, data reporting individual analytical results for each sample (raw data) would be used for such an assessment, rather than aggregated data. (Note that these individual samples may be either single units or composites of several units, as is often the case with Total Diet Study samples.) Since the previous JECFA assessment was based primarily on aggregated data, a data call was sent to Codex member countries requesting that any new concentration data be submitted for this evaluation.

3.1 New cadmium data

A substantial number of new data (primarily raw data) were received for this assessment. Although data on many commodities were submitted, only the data for the seven commodity groups identified by CCFAC were included in this assessment. Some countries also submitted national estimates of cadmium intake.

3.1.1 Raw data

Raw data were submitted to the JECFA Secretariat by Australia, Canada, Germany, Japan, New Zealand, Norway and the United States (Table 2). Note that many countries submitted all available cadmium data, which included many foods that were not being considered in this assessment. The information below relates only to the data relevant to the seven commodity groups specified in CCFAC's request.

Australia submitted results from their Total Diet Surveys conducted every other year between 1992 and 2000. Each Total Diet Survey data point represented a composite of three individual retail samples. In addition to the Total Diet Survey data, Australia submitted results from the Algal Biotoxin Survey (1996) and the Victorian Produce Monitoring Program (1988–1996).

Table 2. Summary of raw data submitted for the sixty-fourth JECFA

Commodity	*n*							
	Total	Australia	Canada	Germany	Japan	New Zealand	Norway	USA
Grains								
Rice	37 547			131	37 250			166
Wheat	940	57		209	382	2		290
Vegetables								
Potatoes	643	114	163	69				297
Stem/root vegetables	1570	133		223	997	10		207
Leafy vegetables	2043	177		927	673	12		254
Other vegetables	3509	100		1335	1529	47		498
Molluscs								
Oysters	4478	31	2192		45	11	6	2193
Scallops	74				57		4	13
Other bivalves	2471	12		103	166	11	25	2154
Cephalopods	98				98			
Molluscs, other	30				30			
Grand total by country		624	2355	2997	41 227	93	35	6072

The Canadian government submitted data on cadmium levels in oysters from several different monitoring studies conducted on both the west coast (British Columbia) and the east coast (Nova Scotia and New Brunswick). The largest number of samples represented a study of oysters from the west coast conducted between 2001 and 2004; this was a collaborative effort involving the Department of Fisheries and Oceans, British Columbia Ministry of Agriculture, Food and Fisheries and Simon Fraser University. Additional data were reported by the Canadian Food Inspection Agency, representing oyster samples collected on both the east and west coasts between 1989 and 2000. And finally, the Department of Fisheries and Oceans, British Columbia Ministry of Agriculture, Fisheries and Food and Environment Canada analysed samples of wild oysters from beaches in British Columbia.

The German government (Federal Office of Consumer Protection and Food Safety, Berlin) submitted data for a variety of grains, vegetables and mussels. The samples had been collected and analysed between 2001 and 2004.

The Japanese government submitted a substantial number of monitoring data on a wide range of commodities, of which the majority were rice. The collection and analysis of foods were carried out by the Ministry of Agriculture, Forestry and Fisheries of Japan.

New Zealand submitted results from two Total Diet Surveys conducted in 1997–1998 and 2003–2004. The analytical results represented both individual sample and composites of up to five units per sample, depending upon the food.

From Norway, data were submitted on cadmium levels in bivalves. These were results from a surveillance programme conducted by the National Institute of Nutrition and Seafood Research between 2000 and 2003, in which samples were collected from the entire coast of Norway. The major focus of these studies was the blue mussel, although a small number of other molluscs (oysters and scallops) were included in the studies. For mussels, each data point represented a pooled sample of 25 mussels from different locations.

The United States submitted data for molluscs from monitoring programmes of the Food and Drug Administration and the National Oceanic and Atmospheric Administration. The Food and Drug Administration submitted data on a variety of molluscs (mussels, clams, oysters and scallops); these were results of compliance monitoring programmes conducted in 1989–1999. The Food and Drug Administration also submitted cadmium data for numerous vegetables and grains; these samples were collected and analysed between 1979 and 1981. The National Oceanic and Atmospheric Administration submitted results from its 1986–1998 Mussel Watch Program; these data included results for oysters as well as mussels.

When compiling the new data, only those for raw commodities were used. All data for products that were cooked or processed (as determined by the food description or by documentation that accompanied the data) were excluded. Each data record was then assigned to one of the seven commodity groups. For

molluscs, data were further classified by subcategory (oysters, mussels, scallops, etc.) so the data could be evaluated by subcategory as requested by CCFAC.

A number of records were censored (i.e. results were reported as being below the limit of detection [LOD] or limit of quantification [LOQ] or less than a certain value). The percentage of censored records was determined for each of the seven commodity groups (Table 3). For most groups, less than 10% of the data was censored. The greatest proportion (34%) of censored data occurred in results for the group "other vegetables." As per the WHO guidelines for handling censored data (WHO, 1995), when 60% or less of the results are censored, a value of LOD/2 should be used for those results when calculating the mean. Since the LODs were not reported for all data sets, the following values were used for assigning a value to the censored results:

- LOD/2 if the LOD was reported;
- LOQ/2 if only the LOQ was reported;
- if no LOD or LOQ was reported but the results were reported as <*x*, a value of *x*/2 was assumed; or
- if none of the above was reported, one half the lowest value reported for the commodity group/country was assumed.

Table 3. Censored data

Commodity	% of censored values
Rice	8
Wheat	1
Potatoes	2
Stem/root vegetables	21
Leafy vegetables	6
Other vegetables	34
Molluscs	<1

After values were assigned to all censored results, data for each commodity group were analysed (count, mean, standard deviation, minimum and maximum values) by country, by GEMS/Food region and for all data combined. Detailed results of these analyses are included in Appendix A. For most commodities, average cadmium levels across countries were comparable. For rice, average concentrations of Japanese samples were higher than those from other countries. With regard to data for molluscs, average values for oysters were considerably higher than for other subcategories, particularly for samples from Canada and New Zealand.

3.1.2 Aggregated data

The major source of aggregated data was a report compiled by European Union Member States in 2004 on dietary exposure to toxic elements (EC, 2004). The specificity of the data reported by countries varied; while some reported results for individual vegetables, others reported results by broader, less specific groups (e.g. all vegetables). Data were included in this JECFA assessment only if the description was specific enough to be grouped by the commodity groups specified by CCFAC.

Other aggregated data were submitted by Spain, Sweden, Thailand and the United Kingdom. Spain provided data from samples collected between 2001 and 2003; these were mainly finfish and shellfish, although some molluscs (cephalopods and mussels) were also included. Sweden's National Food Administration reported cadmium levels in retail samples of rice collected in 2001. Data were reported by Thailand and the United Kingdom; however, due to the nature of the data, they could not be incorporated in this assessment. Thailand provided data for molluscs, but the results were reported as ranges (i.e. the number of samples falling within a certain range) rather than the mean/median value for all samples. The United Kingdom provided a report of its 2000 Total Diet Study, but the cadmium concentrations were reported for broad categories rather than for the commodities of interest in this assessment.

The selected aggregated data were grouped by commodity, and weighted means were then calculated based on sample size. Appendix B provides details of the cadmium data for each commodity and the calculation of the weighted means. The weighted means for each commodity are summarized in Table 4 below.

3.1.3 Cadmium intake estimates

The previous (2003) cadmium assessment addressed estimates of total intake from all commodities, but the goal of the recent assessment undertaken was quite different in scope and methodology. The focus of the 2005 assessment was to estimate the impact of three or four possible MLs on cadmium concentrations and intakes from selected commodities rather than to estimate the total average cadmium intake from all commodities. National estimates of cadmium intakes were submitted by Australia, New Zealand and the United Kingdom, but the estimates did not take into account the impact of different MLs.

The Japanese government (Ministry of Health, Labour and Welfare and the Ministry of Agriculture, Forestry and Fisheries) submitted a probabilistic intake estimate for cadmium resulting from four possible MLs for rice. Since rice is a staple in the Japanese diet and also a major source of cadmium in their diet, this model provided estimates of the greatest potential impact on total cadmium intake by the Japanese population. The model incorporated national data on food consumption and cadmium levels in foods. Consumption data were obtained from Japan's National Nutrition Survey conducted from 1995 through 2000, which included records on approximately 53 000 adults 20 years of age and older. Conversion factors were applied to multi-ingredient foods reported in the survey to

allow for estimation of consumption of commodities. Cadmium concentration data for about 130 different foods were obtained from surveys conducted by the Ministry of Agriculture, Forestry and Fisheries. Since the number of foods reported in the consumption survey was greater than the number of foods analysed for cadmium levels, concentration values for similar foods were used as surrogates when there was not a one-to-one match between consumption and concentration data. The probabilistic estimates of cadmium intake were derived from a Monte Carlo simulation using the Japanese version of Crystal Ball 2000 (Kozo Keikaku Engineering, Inc.). Lognormal distributions were assumed for food consumption amounts, and a binary distribution was assumed for frequency of consumption (eaters versus non-eaters). For foods with cadmium levels above the LOQ, lognormal distributions were assumed if more than 100 samples exceeded the LOQ; for foods with fewer than 100 samples above the LOQ, medians were used as fixed values. For samples with analytical values below the LOQ, one half the value of the LOQ was substituted when less than 60% of the samples were below the LOQ, and the LOQ value was used when more than 60% of samples were below the LOQ. Four intake scenarios were performed — one for each of four possible MLs for cadmium in rice (0.2, 0.3, 0.4, 0.5 mg/kg). For all other foods, the MLs were fixed at the level currently proposed by CCFAC.

3.2 Comparison of new and previous concentration data

The previous JECFA assessment provided an estimate of total cadmium intake based on the five GEMS/Food regional diets and regional average cadmium concentrations calculated from aggregated data. Since the current assessment is an addendum to the previous work but is based on different cadmium data, it was important to show that the new data were comparable to those used previously.

Table 4 compares the new cadmium concentration data (both raw and aggregated data) with the aggregated data used in 2003. The data are reported by GEMS/Food region, since the regional diets are the basis for estimating cadmium intakes. Most data submitted for both the 2003 and 2005 assessments were from countries in the Far Eastern and European (which includes Australia, Canada, New Zealand and the United States) regions; a limited number of data from Middle Eastern countries were available in the previous assessment.

Average concentrations of cadmium based on the new data are reported in the left section of Table 4. For rice, average concentrations of cadmium were higher in Japanese samples (0.062 mg/kg) than in samples from other countries (0.017 mg/kg). The average concentration of cadmium in wheat was 0.054 mg/kg. Average concentrations of cadmium in vegetables ranged from 0.012 to 0.040 mg/kg. For molluscs, average concentrations of cadmium derived from more than 7000 samples were as follows: oysters, 1.38 mg/kg; mussels, 0.43 mg/kg; and other bivalves or cephalopods, 0.20 mg/kg.

All three sets of cadmium values are comparable, with a few exceptions:

Table 4. Comparison of cadmium concentration data from the sixty-first and sixty-fourth JECFA meetings

Commodity	64th JECFA (2005)			64th JECFA (2005)		61st JECFA (2003)[a]					
	Raw data			Aggregated data		Aggregated data					
	European + Far Eastern GEMS/Food region			European GEMS/Food region		European GEMS/Food region		Far Eastern GEMS/Food region		Middle Eastern GEMS/Food region	
	n	Mean (mg/kg)	SD	*n*	Mean (wtd) (mg/kg)	partial *n*	Mean (unwtd) (mg/kg)	partial *n*	Mean (unwtd) (mg/kg)	partial *n*	Mean (unwtd) (mg/kg)
GRAINS											
Rice											
- All data combined	37 547	0.061	0.062								
- Data by region:											
Far Eastern	37 250	0.062	0.062	86	0.046	108	0.010	37 350	0.070	10	0.006
European	297	0.017	0.026								
Wheat	940	0.054	0.048	716	0.038	752	0.026	410	0.030	53	0.034
VEGETABLES											
Potatoes	643	0.037	0.029	353	0.021						
Stem/root vegetables (excluding celeriac)	1570	0.028	0.033	60	0.052	448	0.025	460	0.015	12	0.022

Table 4. (contd)

Commodity		64th JECFA (2005)			64th JECFA (2005)		61st JECFA (2003)[a]					
		Raw data			Aggregated data		Aggregated data					
		European + Far Eastern GEMS/Food region			European GEMS/Food region		European GEMS/Food region		Far Eastern GEMS/Food region		Middle Eastern GEMS/Food region	
		n	Mean (mg/kg)	SD	*n*	Mean (wtd) (mg/kg)	partial *n*	Mean (unwtd) (mg/kg)	partial *n*	Mean (unwtd) (mg/kg)	partial *n*	Mean (unwtd) (mg/kg)
	Leafy vegetables	2043	0.040	0.044	112	0.047	9721	0.034	706	0.025	29	0.054
	Other vegetables except tomatoes and mushrooms	3509	0.012	0.021	108	0.049	8858	0.013	1817	0.020	143	0.024
MOLLUSCS												
	All molluscs combined	7151	1.013	1.120			289	0.799	316	0.208	35	0.250
By mollusc subcategory:[b]												
a.	All bivalves combined	7023	1.029	1.123								
	Bivalves by subcategory:											
	a.1. oysters	4478	1.384	1.242	848	0.360						
	a.2. mussels	2239	0.433	0.399	2341	0.177						
	a.3. scallops	74	0.181	0.311								

Table 4. (contd)

Commodity	64th JECFA (2005)			64th JECFA (2005)		61st JECFA (2003)[a]					
	Raw data			Aggregated data		Aggregated data					
	European + Far Eastern GEMS/Food region			European GEMS/Food region		European GEMS/Food region		Far Eastern GEMS/Food region		Middle Eastern GEMS/Food region	
	n	Mean (mg/kg)	SD	*n*	Mean (wtd) (mg/kg)	partial *n*	Mean (unwtd) (mg/kg)	partial *n*	Mean (unwtd) (mg/kg)	partial *n*	Mean (unwtd) (mg/kg)
a.4. bivalves, other	232	0.191	0.201	100	0.102						
b. Cephalopods	98	0.172	0.262	810	0.218						
c. Molluscs, other	30	0.043	0.025	145	0.239						
All molluscs excluding oysters	2673	0.391	0.389								

SD, standard deviation; unwtd, unweighted; wtd, weighted

[a] Notes regarding the 2003 data:
- Not all data submissions indicated the sample size for the reported mean/median values. The "partial *n*" indicates the total of the sample sizes that were reported.
- The means were calculated as the average of all mean/median values reported. They were not weighted by sample size.
- The data for molluscs were not specific enough to separate them by subcategories.

[b] The subcategories are subsets of the data reported above for "all molluscs combined."

- As noted above, cadmium levels in rice samples from Japan are higher than those observed in other countries.
- For molluscs as a whole (all data combined), the mean concentration is higher than the regional averages from the 2003 JECFA assessment. This is mainly due to the fact that oysters accounted for more than half of the new raw data for molluscs. The previous averages were more similar to new data for "molluscs other than oysters."
- Slight differences are noted in the mean values for all categories of vegetables. These differences are most likely due to differences in the specific vegetables that were included in each grouping of data. For the current work, CCFAC was very specific in defining each commodity group (Table 1), whereas the previous assessment was more inclusive and was based on slightly different groupings of commodities (e.g. potatoes were included in "roots/tubers."

Since the assessment of the impact of different MLs requires use of raw data, aggregated data were not used in the assessment. Nevertheless, they provided information to confirm that both the new and previous data sets were comparable.

3.3 Impact of different possible MLs on cadmium concentrations

The purpose of this task was to estimate the change in mean cadmium values if samples exceeding a given possible ML were excluded from the calculation and to estimate the proportion of samples that contained cadmium concentrations greater than the ML. For five of the commodity groups (wheat, potatoes, stem/root vegetables, leafy vegetables and other vegetables), the data from different countries were sufficiently similar to allow all data to be combined for this assessment. Owing to the substantial difference in concentrations of cadmium in rice (by region) and in molluscs (by subcategory), the potential impact of MLs was evaluated separately for subsets of these data. Two estimates of the impact of MLs on concentrations of cadmium were calculated for rice (low estimates were based on European data only, and high estimates were based on all data combined) and for molluscs (low estimates were based on data for oysters and other molluscs separately, and high estimates were based on data for all molluscs combined). Although CCFAC requested that cephalopods be evaluated at a proposed ML of 2.0 mg/kg (Table 1), the data for cephalopods were combined with the group "molluscs excluding oysters" for the assessment, since the mean cadmium level was similar to that of other subcategories in this group.

For each commodity group or subgroup, a baseline mean concentration of cadmium was calculated from all data for the group. For each of the three or four possible MLs (proposed, one level higher and one or two levels lower), the mean was recalculated after excluding values greater than the ML, and the percentage reduction from the baseline mean was calculated. The number and percentage of total data points exceeding the ML were also calculated for each ML.

Results of the assessments for all commodities are summarized in Table 5. Results for each commodity are also reported separately in the graphs that follow (see Figure 1). The greatest impacts of MLs on concentrations of cadmium in individual commodities were seen for stem/root vegetables, other vegetables and molluscs excluding oysters, with reductions in mean values of 41%, 68% and 42%, respectively, when the lowest MLs were used.

Table 5. Impact of different MLs on cadmium concentrations: Summary of assessments

	ML (mg/kg)	*n* > ML	% > ML	mean (mg/kg)	% reduction from baseline (mean)
GRAINS					
RICE - ALL DATA COMBINED					
Total *n*: 37 547					
Level relative to proposed ML:					
Two levels lower	0.2	1243	3	0.054	12
One level lower	0.3	295	1	0.059	3
Proposed	0.4	94	<1	0.060	2
One level higher	0.5	39	<1	0.061	<1
Baseline (all data)				0.061	
RICE - DATA FOR EUROPEAN REGION					
Total *n*: 297					
Level relative to proposed ML:					
Two levels lower	0.2	2	1	0.015	12
One level lower	0.3	0		0.017	0
Proposed	0.4	0		0.017	0
One level higher	0.5	0		0.017	0
Baseline (all data)				0.017	
WHEAT GRAIN					
Total *n*: 940					
Level relative to proposed ML:					
One level lower	0.1	94	10	0.042	22
Proposed	0.2	13	1	0.051	6
One level higher	0.3	4	<1	0.052	3
Baseline (all data)				0.054	

Table 5. (contd)

	ML (mg/kg)	*n* > ML	% > ML	mean (mg/kg)	% reduction from baseline (mean)
VEGETABLES					
POTATOES					
Total *n*: 643					
Level relative to proposed ML:					
One level lower	0.05	163	25	0.022	39
Proposed	0.1	16	2	0.034	8
One level higher	0.2	2	<1	0.036	3
Baseline (all data)				0.037	
STEM AND ROOT VEGETABLES (excluding potatoes and celeriac)					
Total *n*: 1570					
Level relative to proposed ML:					
One level lower	0.05	242	15	0.017	41
Proposed	0.1	57	4	0.023	16
One level higher	0.2	5	<1	0.027	3
Baseline (all data)				0.028	
LEAFY VEGETABLES					
Total *n*: 2043					
Level relative to proposed ML:					
One level lower	0.1	143	7	0.031	22
Proposed	0.2	26	1	0.037	7
One level higher	0.3	7	<1	0.039	2
Baseline (all data)				0.040	
OTHER VEGETABLES (excluding tomatoes and fungi)					
Total *n*: 3509					
Level relative to proposed ML:					
One level lower	0.01	948	27	0.004	68
Proposed	0.05	149	4	0.009	27
One level higher	0.1	36	1	0.011	9
Baseline (all data)				0.012	

Table 5. (contd)

	ML (mg/kg)	*n* > ML	% > ML	mean (mg/kg)	% reduction from baseline (mean)
MOLLUSCS					
ALL MOLLUSCS COMBINED					
Total *n*: 7151					
Level relative to proposed ML:					
One level lower	0.5	4005	56	0.253	75
Proposed	1	2415	34	0.409	60
One level higher	2	1063	15	0.638	37
Baseline (all data)				1.010	
OYSTERS					
Total *n*: 4478					
Level relative to proposed ML:					
One level lower	2	1049	23	0.839	39
Proposed	3	424	9	1.082	22
One level higher	4	190	4	1.210	13
Baseline (all data)				1.384	
MOLLUSCS EXCLUDING OYSTERS					
Total *n*: 2673					
Level relative to proposed ML:					
One level lower	0.5	681	25	0.227	42
Proposed	1	173	6	0.321	18
One level higher	2	14	1	0.378	3
Baseline (all data)				0.391	

3.4 Impact of different possible MLs on cadmium intakes

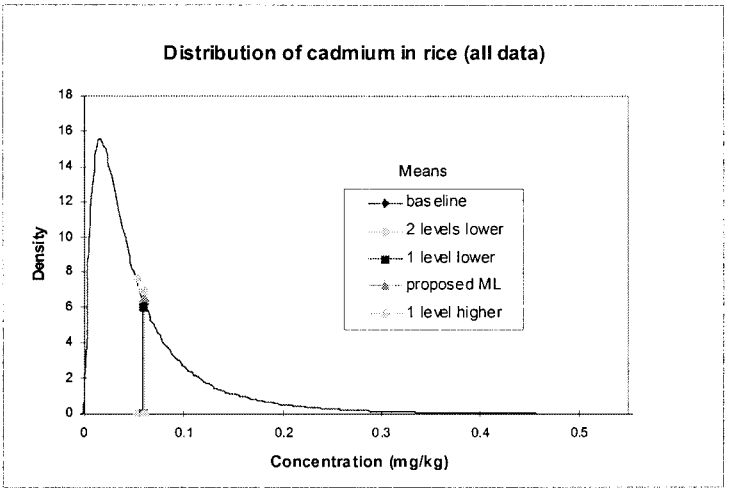
For the intake assessment completed by the Committee at its sixty-first meeting, intakes of cadmium, both by commodity and total, were calculated from the GEMS/Food regional diets and the regional average concentrations of cadmium derived from aggregated data. Total intakes ranged from 2.8 to 4.2 µg/kg bw per week, which corresponds to approximately 40–60% of the PTWI of 7 µg/kg bw per week.

Since the present assessment required the use of raw rather than aggregated data, it was necessary to recalculate the intakes using the average concentration

values derived from the new raw data. The GEMS/Food regional diets were used for the calculation, as they had been in the previous JECFA assessment. Slight differences in the intakes estimated for the previous and the current assessment resulted from differences in consumption amounts for the commodity groups. As noted previously, CCFAC was more specific in its definitions of the commodity groups for this assessment, so the consumption amounts used in each of the assessments were slightly different for some commodities (particularly for vegetables). Mean cadmium concentration values used for the two estimates were also somewhat different.

Figure 1. Impact of different possible MLs on cadmium concentrations in A) rice, B) wheat, C) potatoes, D) stem and root vegetables, E) leafy vegetables, F) other vegetables, G) oysters and H) molluscs other than oysters

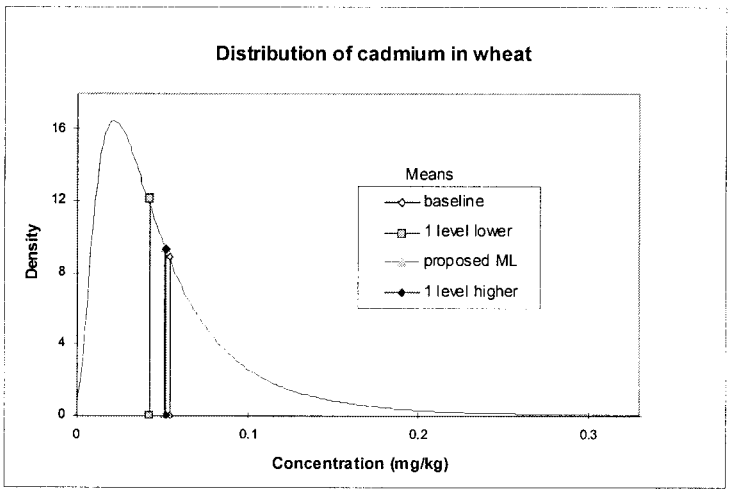
A. Impact of different MLs on cadmium concentrations in rice (all data)



Rice	Possible ML (mg/kg)	Mean (mg/kg)	Maximum value (mg/kg)	% samples > ML
Baseline (all data)		0.061	1.20	
Two levels lower	0.2	0.054		3
One level lower	0.3	0.059		1
Proposed ML	0.4	0.060		<1
One level higher	0.5	0.061		<1

Figure 1. (contd)

B. **Impact of different MLs on cadmium concentrations in wheat**



	Possible ML (mg/kg)	Mean (mg/kg)	Maximum value (mg/kg)	% samples > ML
Baseline (all data)		0.054	0.470	
One level lower	0.1	0.042		10
Proposed ML	0.2	0.051		1
One level higher	0.3	0.052		<1

C. **Impact of different MLs on cadmium concentrations in potatoes**

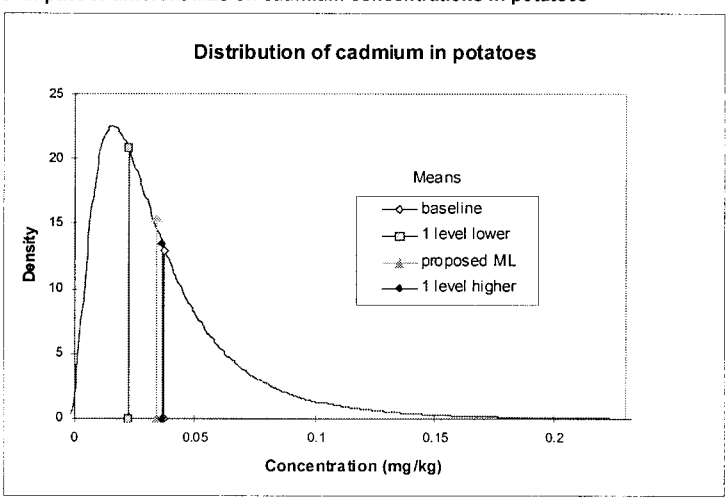
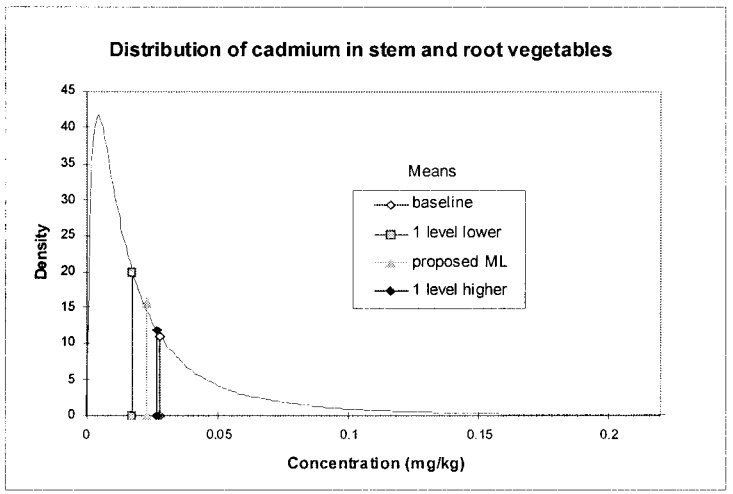


Figure 1. (contd)

	Possible ML (mg/kg)	Mean (mg/kg)	Maximum value (mg/kg)	% samples > ML
Baseline (all data)		0.037	0.220	
One level lower	0.05	0.022		25
Proposed ML	0.1	0.034		2
One level higher	0.2	0.036		<1

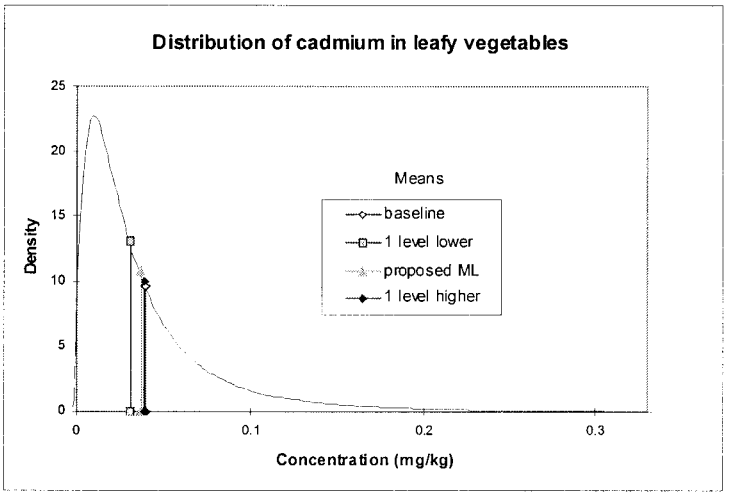
D. **Impact of different MLs on cadmium concentrations in stem and root vegetables**



	Possible ML (mg/kg)	Mean (mg/kg)	Maximum value (mg/kg)	% samples > ML
Baseline (all data)		0.028	0.330	
One level lower	0.05	0.017		15
Proposed ML	0.1	0.023		4
One level higher	0.2	0.027		<1

Figure 1. (contd)

E. **Impact of different MLs on cadmium concentrations in leafy vegetables**



	Possible ML (mg/kg)	Mean (mg/kg)	Maximum value (mg/kg)	% samples > ML
Baseline (all data)		0.040	0.490	
One level lower	0.1	0.031		7
Proposed ML	0.2	0.037		1
One level higher	0.3	0.039		<1

F. **Impact of different MLs on cadmium concentrations in other vegetables**

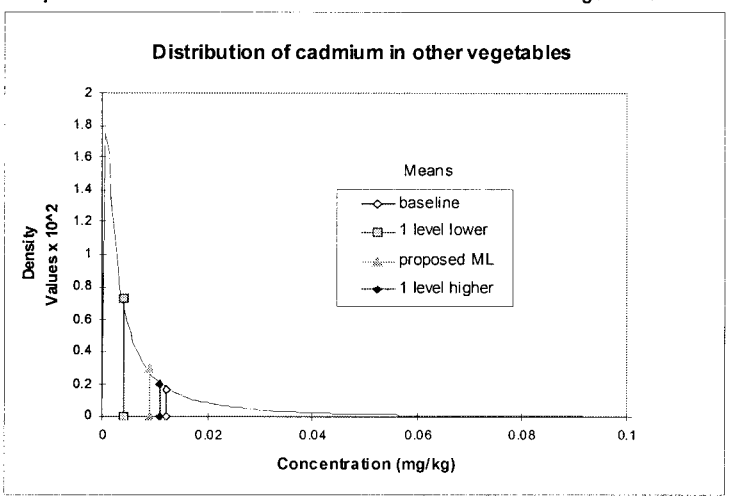
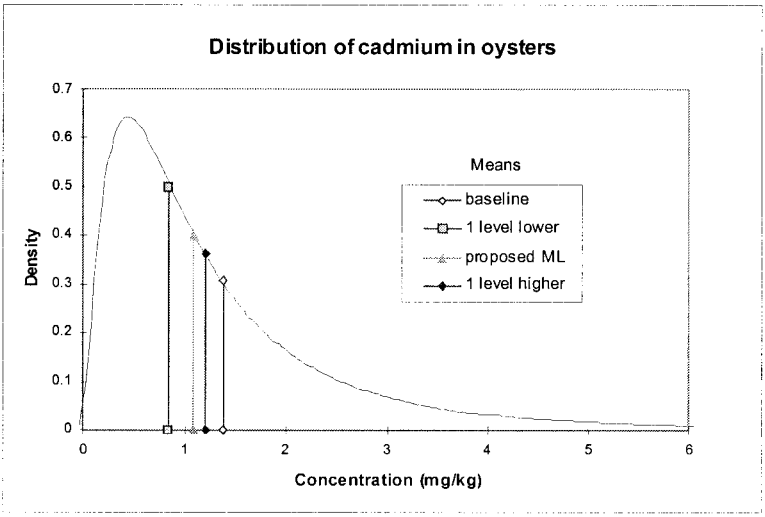


Figure 1. (contd)

	Possible ML (mg/kg)	Mean (mg/kg)	Maximum value (mg/kg)	% samples > ML
Baseline (all data)		0.012	0.240	
One level lower	0.01	0.004		27
Proposed ML	0.05	0.009		4
One level higher	0.1	0.011		1

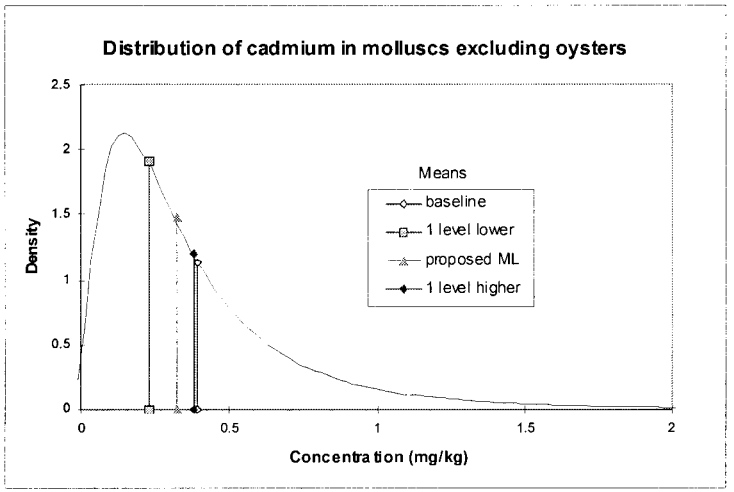
G. Impact of different MLs on cadmium concentrations in oysters



	Possible ML (mg/kg)	Mean (mg/kg)	Maximum value (mg/kg)	% samples > ML
Baseline (all data)		1.384	9.81	
One level lower	2	0.839		23
Proposed ML	3	1.082		9
One level higher	4	1.210		4

Figure 1. (contd)

H. Impact of different MLs on cadmium concentrations in molluscs other than oysters



	Possible ML (mg/kg)	Mean (mg/kg)	Maximum value (mg/kg)	% samples > ML
Baseline (all data)		0.391	9.0	
One level lower	0.5	0.227		25
Proposed ML	1	0.321		6
One level higher	2	0.378		1

An additional adjustment was made for estimating cadmium intake from molluscs. The GEMS/Food regional diets include total consumption amounts for "molluscs including cephalopods" but provide no information about consumption of mollusc subcategories. Since the new concentration data showed that cadmium levels in oysters tend to be higher than levels in other molluscs, it was preferable to calculate intake from oysters separately from other molluscs. National consumption data from Australia, France, New Zealand and the United States were used to derive average proportions of oyster and total mollusc consumption that could be applied to the regional diets (Table 6). Since mollusc consumption is highest for the GEMS/Food European region, data from these countries provided a good basis for deriving the adjustment factor. Oyster consumption was estimated to be about 16% of total mollusc consumption.

Table 7 summarizes the updated cadmium intake estimates for each commodity group. Intakes are expressed in terms of actual intake (µg/kg bw per day) and percentage of the daily equivalent of the PTWI of 7 µg/kg bw per week (i.e. 1 µg/kg bw per day). Baseline intakes for the five GEMS/Food regions, expressed as a percentage of the daily equivalent of the PTWI, ranged from 1% to 34% for rice, 3% to 29% for wheat, 1% to 15% for potatoes, <1% to 14% for stem/root

vegetables, <1% to 3% for leafy and other vegetables, <1% to 15% for all molluscs combined and <1% to 5% for subcategories of molluscs.

Table 6. Proportional consumption of molluscs by subcategory based on national consumption data

Country	Percentage of total mollusc consumption					
	Bivalves				Cephalopods	Other molluscs
	Oysters	Scallops	Mussels	Clams		
France	24	6	70	nr	nr	nr
Australia	14	19	14	2	51	nr
New Zealand	19	7	47	3	14	9
USA	8	8	4	67	9	4
Average	16	10	34	18	19	3

nr, not reported; assumed 0 when calculating average

The impact of different possible MLs on cadmium intakes was evaluated for commodities/regions for which intakes were significant (i.e. 10% or more of the daily equivalent of the PTWI in one region or 5% or more of the daily equivalent of the PTWI in two or more regions). The remaining commodities/regions contributed minimally to total cadmium intake, and it was assumed that different MLs would have little or no impact on intakes. For rice, only the intake estimates based on all concentration data combined were assessed, since they provided a more conservative estimate. For molluscs, assessments were conducted for oysters and other molluscs only; since the majority of data for molluscs were for oysters, the combined data set was not considered representative of molluscs as a whole. Results of this assessment are reported in Table 8. Baseline intake for each commodity group, calculated from the mean of all concentration data for that commodity, is reported in terms of µg/kg bw per day and as a percentage of the daily equivalent of the PTWI. Intakes for each scenario (total intake and reduction from baseline) are reported in terms of percentage of the daily equivalent of the PTWI. The lowest MLs generated reductions in intakes as follows, expressed here as a percentage of the PTWI: rice, 4%; wheat, 6%; potatoes, 6%; stem/root vegetables, 5%; oysters, 1%; and other molluscs, 2%. The proposed ML and one level higher had little or no impact on mean intakes of cadmium.

Results of the probabilistic intake assessment submitted by the Japanese government are presented in Tables 9 and 10. In this case, the impact on total cadmium intake was assessed for four possible MLs for rice only. Intakes were originally reported on a weekly basis but were converted for this assessment to a daily basis for comparability to the intakes calculated from the GEMS/Food regional diets. Total mean daily cadmium intake was estimated to be 45% and 48% of the daily equivalent of the PTWI at the lowest and highest possible MLs, respectively (Table 9). The lowest ML for rice (0.2 mg/kg) resulted in a slight reduction (3% of the daily equivalent of the PTWI) in total mean intake. There was

Table 7. Baseline cadmium intakes from selected commodities[a]

	Commodity	Middle Eastern GEMS/Food region		Far Eastern GEMS/Food region		African GEMS/ Food region		Latin American GEMS/Food region		European GEMS/Food region	
		µg/kg bw per day	% $PTWI_d$[b]	µg/kg bw per day	% $PTWI_d$	µg/kg bw per day	% $PTWI_d$	µg/kg bw per day	% $PTWI_d$	µg/kg bw per day	% $PTWI_d$
High estimate:	Rice - all data	0.050	5	0.341	34	0.105	11	0.088	9	0.012	1
	Rice - Japan only	0.050	5	0.346	35	0.107	11	0.089	9	0.012	1
Low estimate:	Rice - other countries	0.014	1	0.095	9	0.029	3	0.025	2	0.003	0
	Wheat	0.295	29	0.124	12	0.025	3	0.105	11	0.160	16
	Potatoes	0.036	4	0.014	1	0.013	1	0.025	3	0.148	15
	Stem and root vegetables (excluding potatoes and celeriac)	0.004	0	0.052	5	0.140	14	0.059	6	0.016	2
	Leafy vegetables	0.005	1	0.008	1	0.000	0	0.011	1	0.034	3
	Other vegetables (excluding tomatoes and mushrooms)	0.025	2	0.012	1	0.004	0	0.013	1	0.027	3
High estimate:	All molluscs including cephalopods	0.000	0	0.081	8	0.008	1	0.014	1	0.154	15
Low estimate:	Oysters only	0.000	0	0.018	2	0.002	0.2	0.003	0.3	0.034	3

Table 7. (contd)

	Commodity	Middle Eastern GEMS/Food region		Far Eastern GEMS/Food region		African GEMS/ Food region		Latin American GEMS/Food region		European GEMS/Food region	
		µg/kg bw per day	% $PTWI_d$[b]	µg/kg bw per day	% $PTWI_d$	µg/kg bw per day	% $PTWI_d$	µg/kg bw per day	% $PTWI_d$	µg/kg bw per day	% $PTWI_d$
Low estimate:	Molluscs other than oysters	0.000	0	0.026	3	0.003	0.3	0.004	0.4	0.050	5
Subtotal intake from seven commodities based on 2005 cadmium data:											
	High estimate:	0.41	41	0.63	63	0.30	30	0.31	31	0.55	55
	Low estimate:	0.38	38	0.35	35	0.22	22	0.24	24	0.47	47
Total intakes as per 2003 JECFA		0.428	40	0.617	60	0.47	50	0.378	40	0.548	50

[a] Baseline intake is based on mean concentration of all data for a given commodity and GEMS/Food regional diets.
[b] $PTWI_d$ = daily equivalent of the PTWI = 1 µg/kg bw per day (derived from PTWI of 7 µg/kg bw per week).

Table 8. Impact of different possible MLs on cadmium intakes: Summary of scenarios[a]

Commodity	GEMS/ Food region	GEMS/ Food regional diets – consumption (g/kg bw per day)	Cadmium intakes based on mean concentrations for baseline and each ML scenario													
			Baseline (all data)		Two levels lower			One level lower			Proposed ML			One level higher		
			Intake (µg/kg bw per day)	Intake as % $PTWI_d$[b]	Intake (µg/kg bw per day)	Intake as % $PTWI_d$	Δ[c]	Intake (µg/kg bw per day)	Intake as % $PTWI_d$	Δ	Intake (µg/kg bw per day)	Intake as % $PTWI_d$	Δ	Intake (µg/kg bw per day)	Intake as % $PTWI_d$	Δ
Rice (based on mean of all data combined)	Middle Eastern	0.81	0.050	5	0.044	4	−1	0.048	5	0	0.049	5	0	0.050	5	0
	Far Eastern	5.59	0.341	34	0.302	30	−4	0.330	33	−1	0.335	34	0	0.341	34	0
	African	1.72	0.105	11	0.093	9	−2	0.102	10	−1	0.103	10	−1	0.105	11	0
	Latin American	1.44	0.088	9	0.078	8	−1	0.085	9	0	0.087	9	0	0.088	9	0
Wheat	Middle Eastern	5.46	0.295	29				0.229	23	−6	0.278	28	−1	0.284	28	−1
	Far Eastern	2.30	0.124	12				0.096	10	−2	0.117	12	0	0.119	12	0
	Latin American	1.95	0.105	11				0.082	8	−3	0.099	10	−1	0.101	10	−1
	European	2.97	0.160	16				0.125	12	−4	0.151	15	−1	0.154	15	−1
Potatoes	European	4.01	0.148	15				0.088	9	−6	0.136	14	−1	0.144	14	−1

Table 8. (contd)

Commodity	GEMS/ Food region	GEMS/ Food regional diets – consumption (g/kg bw per day)	Cadmium intakes based on mean concentrations for baseline and each ML scenario												
			Baseline (all data)		Two levels lower			One level lower			Proposed ML			One level higher		
			Intake (µg/kg bw per day)	Intake as % $PTWI_d$[b]	Intake (µg/kg bw per day)	Intake as % $PTWI_d$	Δ[c]	Intake (µg/kg bw per day)	Intake as % $PTWI_d$	Δ	Intake (µg/kg bw per day)	Intake as % $PTWI_d$	Δ	Intake (µg/kg bw per day)	Intake as % $PTWI_d$	Δ
Stem/root vegetables (excluding potatoes, celeriac)	Far Eastern	1.85	0.052	5				0.031	3	−2	0.043	4	−1	0.050	5	0
	African	5.01	0.140	14				0.085	9	−5	0.115	12	−2	0.135	14	0
	Latin American	2.11	0.059	6				0.036	4	−2	0.049	5	−1	0.057	6	0
Molluscs																
- Oysters only	European	0.02	0.034	3				0.020	2	−1	0.026	3	0	0.029	3	0
- All other molluscs	European	0.13	0.050	5				0.029	3	−2	0.041	4	−1	0.048	5	0
- Oysters only	Far Eastern	0.01	0.018	2				0.010	1	−1	0.013	1	−1	0.015	1	−1
- All other molluscs	Far Eastern	0.07	0.026	3				0.015	2	−1	0.022	2	−1	0.026	3	0

[a] Includes only commodities/regions for which baseline intake estimates = 5% or > $PTWI_d$.
[b] $PTWI_d$ = daily equivalent of the PTWI = 1 µg/kg bw per day (calculated from PTWI of 7 µg/kg bw per week).
[c] Δ = change from baseline (% $PTWI_d$).

Table 9. Japanese model: impact of different possible MLs for rice on total cadmium

Intake percentile	Total cadmium intake											
	Two levels lower (0.2 mg/kg for rice)			One level lower (0.3 mg/kg for rice)			Proposed ML (0.4 mg/kg for rice)			One level higher (0.5 mg/kg for rice)		
	µg/kg bw per week	µg/kg bw per day	% PTWI/ $PTWI_d$[a]	µg/kg bw per week	µg/kg bw per day	% PTWI/ $PTWI_d$	µg/kg bw per week	µg/kg bw per day	% PTWI/ $PTWI_d$	µg/kg bw per week	µg/kg bw per day	% PTWI/ $PTWI_d$
Mean	3.18	0.45	45	3.29	0.47	47	3.33	0.48	48	3.35	0.48	48
50	2.79	0.40	40	2.85	0.41	41	2.86	0.41	41	2.86	0.41	41
75	3.85	0.55	55	3.94	0.56	56	3.97	0.57	57	3.98	0.57	57
90	5.21	0.74	74	5.45	0.78	78	5.54	0.79	79	5.57	0.80	80
95	6.27	0.90	90	6.67	0.95	95	6.85	0.98	98	6.93	0.99	99
97.5	7.38	1.05	105	8.01	1.14	114	8.32	1.19	119	8.46	1.21	121

[a] $PTWI_d$ = daily equivalent of the PTWI = 1 µg/kg bw per day, derived from a PTWI of 7 µg/kg bw per week.

no impact on total mean intake at the proposed and higher MLs. Greater reductions in total intake were seen at the upper percentiles.

Total mean intake from rice was estimated to be about 20% of the PTWI in the Japanese model (Table 10), compared with the highest estimates based on the GEMS/Food regional diets of 33–34% of the PTWI from rice. The consumption values in the GEMS/Food regional diets, which are based on Food Balance Sheet data, are generally assumed to be about 15% higher than values for actual average food consumption (WHO, 2003). Despite the difference in actual estimates of intake of cadmium from rice, both the probabilistic model and the GEMS/Food estimates demonstrated that each of the four possible MLs for rice had little or no impact on mean cadmium intake.

Table 10. Japanese model: contribution of commodities to total cadmium intake

Commodity	Cadmium intake (µg/kg bw per week)[a]	Percentage of total intake	Percentage of PTWI
Fishery products	0.45	13	6
Meat	0.09	3	1
Fruits	0.10	3	1
Vegetables	0.69	21	10
Soya beans	0.21	6	3
Wheat	0.36	11	5
Rice	1.39	42	20
Other cereals and beans	0.05	1	1

[a] Results of scenario based on proposed ML for rice (0.4 mg/kg).

4. COMMENTS

4.1 Data on concentrations of cadmium in food

In order to conduct this assessment, information about the distribution of concentrations of cadmium in each commodity group (e.g. analytical results for each sample, or raw data) was required. Raw data were submitted by Australia, Canada, Germany, Japan, New Zealand, Norway and the United States. Some aggregated data were also submitted by the European Union, Spain, Sweden and Thailand.

Average concentrations of cadmium, based on the new data on individual samples, were similar to those used in the intake assessment completed by the Committee at its sixty-first meeting (Table 4). For rice, average concentrations of cadmium were higher in samples from Japan (0.062 mg/kg) than in samples from other countries (0.017 mg/kg). The average concentration of cadmium in wheat was 0.054 mg/kg. Average concentrations of cadmium in vegetables ranged from

0.012 to 0.040 mg/kg. For molluscs, average concentrations of cadmium derived from more than 7000 samples were as follows: oysters, 1.38 mg/kg; mussels, 0.43 mg/kg; and other bivalves or cephalopods, 0.20 mg/kg.

4.2 *Assessment of the impact of different possible MLs on mean concentrations of cadmium*

For five of the commodity groups (wheat, potatoes, stem/root vegetables, leafy vegetables and other vegetables), the data from different countries were sufficiently similar to allow all data to be combined for this assessment. Owing to the substantial difference in concentrations of cadmium in rice (by region) and in molluscs (by subcategory), the potential impact of MLs was evaluated separately for subsets of these data. Two estimates of the impact of MLs on concentrations of cadmium were calculated for rice (low estimates were based on European data only, and high estimates were based on all data combined) and for molluscs (low estimates were based on data for oysters and other molluscs separately, and high estimates were based on data for all molluscs combined).

For each commodity group or subgroup, a baseline mean concentration of cadmium was calculated from all data on concentrations. For each of the three or four MLs (proposed, one level higher and one level or two levels lower), the mean was recalculated after excluding values greater than that ML, and the percentage reduction from the baseline mean was calculated. The number and percentage of total data points exceeding the ML were also calculated for each ML (Table 5). The greatest impacts of MLs on concentrations of cadmium in individual commodities were seen for stem/root vegetables, other vegetables and molluscs (41%, 68%, and 42%, respectively, when the lowest MLs were used).

4.3 *Assessment of the impact of different possible MLs on mean intakes of cadmium*

For the intake assessment completed by the Committee at its sixty-first meeting (Annex 1, reference 166), intakes of cadmium, both by commodity and total, were calculated from the GEMS/Food regional diets and the regional average concentrations of cadmium derived from aggregated data. Total intakes ranged from 2.8 to 4.2 µg/kg bw per week, which corresponds to 40–60% of the PTWI of 7 µg/kg bw per week.

For the present assessment, intakes of cadmium were recalculated for the seven commodity groups on an individual basis; total intakes of cadmium calculated in the previous intake assessment were used as benchmarks (Table 7). Baseline intakes were calculated from food consumption reported in the GEMS/Food regional diets, as in the previous assessment, and values for average baseline concentrations of cadmium were derived from the new raw data. Intakes were recalculated based on the mean concentration of cadmium from each of the MLs. The impact of each ML on intake of cadmium was reported in terms of the reduction from baseline intake.

Baseline intakes for the five GEMS/Food regions, which were calculated as daily intakes and expressed as a percentage of the daily equivalent of the PTWI, ranged from 1% to 34% for rice, 3% to 29% for wheat, 1% to 15% for potatoes, <1% to 14% for stem/root vegetables, <1% to 3% for leafy vegetables, <1% to 3% for other vegetables, <1% to 3% for oysters and <1% to 5% for other molluscs (Tables 8 and 11). The lowest MLs generated reductions in intakes as follows, expressed here as a percentage of the daily equivalent of the PTWI: rice, 4%; wheat, 6%; potatoes, 6%; stem/root vegetables, 5%; oysters, 1%; and other molluscs, 2%. The proposed ML and one level higher had little or no impact on mean intakes of cadmium.

A probabilistic intake assessment for cadmium in rice using national data from Japan was submitted to the Committee. This intake assessment considered four different possible MLs and showed results similar to those based on the GEMS/Food regional diets. Total mean intake of cadmium from rice was estimated to be about 1.4 µg/kg bw per week, or 20% of the PTWI, compared with daily equivalent estimates based on the GEMS/Food diets of 33–34% of the PTWI from rice. The consumption values in the GEMS/Food diets, which are based on data from Food Balance Sheets, are generally assumed to be about 15% higher than values for actual average food consumption (WHO, 2003). Despite the difference in actual estimates of intake of cadmium from rice, both the probabilistic model and the GEMS/Food estimates demonstrated little or no impact on mean intake of cadmium from rice for the four possible MLs.

5. EVALUATION

The Committee concluded that the effect of different MLs on overall intake of cadmium would be very small. At the proposed Codex MLs, mean intake of cadmium would be reduced by approximately 1% of the PTWI. The imposition of MLs one level lower would result in potential reductions in intake of cadmium of no more than 6% (wheat grain, potatoes) of the PTWI. At the proposed Codex MLs, no more than 9% of a commodity would be violative (oysters). MLs one level below those proposed would result in approximately 25% of molluscs, potatoes and other vegetables being violative.

The use of different possible MLs to truncate the tail of the distribution of a contaminant in commodities has little impact on the intake of the contaminant from that commodity, unless a large proportion of the commodity is excluded by the ML. The Committee noted that in its previous assessment (Annex 1, reference 166), the total intake of cadmium was only 40–60% of the PTWI of 7 µg/kg bw per week; therefore, a variation of 1–6% attributable to the use of the proposed Codex MLs, and one level higher or lower, is of no significance in terms of risk to human health.

Table 11. Summary of impact of different MLs for cadmium

		Level relative to proposed ML	ML	Impact on cadmium concentration		Impact on cadmium intakes
				% reduction from baseline mean	% samples > ML	Reduction in highest intakes (as % $PTWI_d$)[a]
Rice - all data combined						
Baseline mean concentration (mg/kg)	0.061	Two levels lower	0.2	12	3	4
Highest baseline intake (% $PTWI_d$)	34	One level lower	0.3	3	1	1
		Proposed	0.4	2	<1	1
		One level higher	0.5	<1	<1	0
Wheat grain						
Baseline mean concentration (mg/kg)	0.054	One level lower	0.1	22	10	6
Highest baseline intake (% $PTWI_d$)	29	Proposed	0.2	6	1	1
		One level higher	0.3	3	<1	1
Potatoes						
Baseline mean concentration (mg/kg)	0.037	One level lower	0.05	39	25	6
Highest baseline intake (% $PTWI_d$)	15	Proposed	0.1	8	2	1
		One level higher	0.2	3	<1	1
Stem and root vegetables (excluding potatoes and celeriac)						
Baseline mean concentration (mg/kg)	0.028	One level lower	0.05	41	15	5
Highest baseline intake (% $PTWI_d$)	14	Proposed	0.1	16	4	2
		One level higher	0.2	3	<1	0

Table 11. (contd)

		Level relative to proposed ML	ML	Impact on cadmium concentration		Impact on cadmium intakes
				% reduction from baseline mean	% samples > ML	Reduction in highest intakes (as % $PTWI_d$)[a]
Leafy vegetables						
Baseline mean concentration (mg/kg)	0.040	One level lower	0.1	22	7	not evaluated
Highest baseline intake (% $PTWI_d$)	<5	Proposed	0.2	7	1	
		One level higher	0.3	2	<1	
Other vegetables (excluding tomatoes and fungi)						
Baseline mean concentration (mg/kg)	0.012	One level lower	0.01	68	27	not evaluated
Highest baseline intake (% $PTWI_d$)	<5	Proposed	0.05	27	4	
		One level higher	0.1	9	1	
Molluscs						
- Oysters						
Baseline mean concentration (mg/kg)	1.384	One level lower	2	39	23	1
Highest baseline intake (% $PTWI_d$)	3	Proposed	3	22	9	1
- Molluscs excluding oysters						
Baseline mean concentration (mg/kg)	0.391	One level lower	0.5	42	25	2
Highest baseline intake (% $PTWI_d$)	5	Proposed	1	18	6	1
		One level higher	2	3	1	0

[a] This represents the reduction in intake for the GEMS/Food region with the highest intake from this commodity. $PTWI_d$ = daily equivalent of the PTWI = 1 µg/kg bw per day, derived from a PTWI of 7 µg/kg bw per week.

6. REFERENCES

CAC (2004a) *Report of the Thirty-sixth Session of the Codex Committee on Food Additives and Contaminants, Rotterdam, The Netherlands, 22–26 March 2004*. Rome: Food and Agriculture Organization of the United Nations, Codex Alimentarius Commission (ALINORM 04/27/12; http://www.codexalimentarius.net/web/archives.jsp?lang=en).

CAC (2004b) Draft CCFAC policy for exposure assessment of contaminants and toxins in foods or food groups. In: *Report of the Thirty-sixth Session of the Codex Committee on Food Additives and Contaminants, Rotterdam, The Netherlands, 22–26 March 2004*. Rome: Food and Agriculture Organization of the United Nations, Codex Alimentarius Commission (ALINORM 04/27/12; http://www.codexalimentarius.net/web/archives.jsp?lang=en).

EC (2004) *SCOOP 3.2.11. Assessment of the Dietary Exposure to Arsenic, Cadmium, Lead and Mercury of the Population of the EU Member States*. Report of experts participating in Scientific Cooperation on Food Task 3.2.11, March 2004. Brussels: European Commission.

WHO (1995) *Report on the Second Workshop on Reliable Evaluation of Low-level Contamination of Food, 26–27 May 1995, Kulmbach, Federal Republic of Germany*. Geneva, World Health Organization, GEMS/Food-EURO.

WHO (2003) *GEMS/Food Regional Diets. Regional Per Capita Consumption of Raw and Semi-processed Agricultural Commodities*. Geneva: World Health Organization (http://www.who.int/foodsafety/chem/en/gems_regional_diet.pdf).

APPENDIX A: SUMMARY OF RAW DATA ON CADMIUM CONCENTRATIONS IN COMMODITIES, BY COUNTRY AND REGION

Commodity		*n*	Cadmium concentration (mg/kg)			
			Mean	SD	Min	Max
RICE						
All data combined		37 547	0.061	0.062	<0.001	1.200
By region:	European	297	0.017	0.026	<0.001	0.226
	Far Eastern	37 250	0.062	0.062	0.005	1.200
By country:	Germany	131	0.023	0.019	0.002	0.109
	Japan	37 250	0.062	0.062	0.005	1.200
	USA	166	0.012	0.029	<0.001	0.226
WHEAT						
All data combined:		940	0.054	0.048	0.001	0.470
By region:	European	558	0.041	0.034	0.003	0.347
	Far Eastern	382	0.072	0.057	0.001	0.047
By country:	Australia	57	0.033	0.038	0.003	0.170
	Germany	209	0.041	0.032	0.005	0.347
	Japan	382	0.072	0.057	0.001	0.470
	New Zealand	2	0.027	0.002	0.025	0.028
	USA	290	0.043	0.035	0.003	0.207
POTATOES						
All data combined		643	0.037	0.029	0.001	0.220
By region:	European	574	0.038	0.031	0.001	0.220
	Far Eastern	69	0.023	0.012	0.003	0.058
By country:	Australia	114	0.083	0.027	0.055	0.220
	Germany	163	0.019	0.015	0.001	0.092
	Japan	69	0.023	0.012	0.003	0.058
	USA	297	0.031	0.020	0.002	0.182
STEM/ROOT VEGETABLES						
All data combined		1570	0.028	0.033	0.001	0.330
By region:	European	573	0.027	0.028	0.001	0.160
	Far Eastern	997	0.028	0.035	0.003	0.330
By country:	Australia	133	0.045	0.037	0.003	0.160

Appendix A (contd)

Commodity		*n*	Cadmium concentration (mg/kg)			
			Mean	SD	Min	Max
	Germany	223	0.016	0.018	0.001	0.120
	Japan	997	0.028	0.035	0.003	0.330
	New Zealand	10	0.020	0.012	0.006	0.045
	USA	207	0.028	0.025	0.002	0.132
LEAFY VEGETABLES						
All data combined		2043	0.040	0.044	0.001	0.490
By region:	European	1370	0.036	0.040	0.001	0.370
	Far Eastern	673	0.049	0.050	0.003	0.490
By country:	Australia	177	0.023	0.043	0.003	0.320
	Germany	927	0.038	0.041	0.001	0.370
	Japan	673	0.049	0.050	0.003	0.490
	New Zealand	12	0.018	0.007	0.008	0.030
	USA	254	0.042	0.036	0.001	0.195
OTHER VEGETABLES						
All data combined		3509	0.012	0.021	0.000	0.240
By region:	European	1980	0.007	0.016	0.000	0.240
	Far Eastern	1529	0.019	0.025	0.003	0.220
By country:	Australia	100	0.021	0.049	0.002	0.240
	Germany	1335	0.006	0.013	0.001	0.240
	Japan	1529	0.019	0.025	0.003	0.220
	New Zealand	47	0.003	0.004	0.000	0.022
	USA	498	0.007	0.008	0.001	0.054
MOLLUSCS, ALL						
All data combined		7151	1.013	1.120	0.000	9.810
By region:	European	6755	1.062	1.132	0.000	9.810
	Far Eastern	396	0.176	0.211	0.005	1.300
By country:	Australia	43	0.518	0.356	0.100	2.000
	Canada	2192	2.163	1.286	0.040	9.810
	Germany	103	0.159	0.123	0.000	0.839
	Japan	396	0.176	0.211	0.005	1.300
	New Zealand	22	1.757	2.225	0.078	6.700

Appendix A (contd)

Commodity		*n*	Cadmium concentration (mg/kg)			
			Mean	SD	Min	Max
	Norway	35	0.541	0.781	0.100	4.100
	USA	4360	0.536	0.459	0.001	9.000
MOLLUSCS - BY SUBCATEGORY						
BIVALVES, ALL	*(See breakout by bivalve subcategory below)*					
All data combined		7023	1.029	1.123	0.000	9.810
By region:	European	6755	1.062	1.132	0.000	9.810
	Far Eastern	268	0.193	0.196	0.010	0.770
By country:	Australia	43	0.518	0.356	0.100	2.000
	Canada	2192	2.163	1.286	0.040	9.810
	Germany	103	0.159	0.123	0.000	0.839
	Japan	268	0.193	0.196	0.010	0.770
	New Zealand	22	1.757	2.225	0.078	6.700
	Norway	35	0.541	0.781	0.100	4.100
	USA	4360	0.536	0.459	0.001	9.000
CEPHALOPODS						
All data combined		98	0.172	0.262	0.005	1.300
By region:	Far Eastern	98	0.172	0.262	0.005	1.300
By country:	Japan	98	0.172	0.262	0.005	1.300
MOLLUSCS, OTHER						
All data combined		30	0.043	0.025	0.005	0.100
By region:	Far Eastern	30	0.043	0.025	0.005	0.100
By country:	Japan	30	0.043	0.025	0.005	0.100
SUBCATEGORIES - BIVALVES						
OYSTERS						
All data combined		4478	1.384	1.242	0.001	9.810
By region:	European	4433	1.395	1.244	0.001	9.810
	Far Eastern	45	0.301	0.155	0.100	0.680
By country:	Australia	31	0.531	0.364	0.160	2.000
	Canada	2192	2.163	1.286	0.040	9.810
	Japan	45	0.301	0.155	0.100	0.680
	New Zealand	11	3.272	2.309	0.265	6.700

Appendix A (contd)

Commodity		*n*	Cadmium concentration (mg/kg)			
			Mean	SD	Min	Max
	Norway	6	0.772	0.326	0.480	1.350
	USA	2193	0.633	0.497	0.001	6.752
SCALLOPS						
All data combined		74	0.181	0.311	0.010	2.100
By region:	European	17	0.401	0.565	0.062	2.100
	Far Eastern	57	0.115	0.125	0.010	0.560
By country:	Japan	57	0.115	0.125	0.010	0.560
	Norway	4	0.950	0.889	0.200	2.100
	USA	13	0.232	0.312	0.062	1.220
MUSSELS						
All data combined		2239	0.433	0.399	0.000	9.000
By region:	European	2239	0.433	0.399	0.000	9.000
By country:	Australia	7	0.600	0.294	0.200	1.100
	Germany	103	0.159	0.123	0.000	0.839
	New Zealand	11	0.242	0.128	0.078	0.455
	Norway	25	0.420	0.829	0.100	4.100
	USA	2093	0.447	0.397	0.001	9.000
OTHER BIVALVES						
All data combined		232	0.191	0.201	0.008	1.000
By region:	European	66	0.194	0.168	0.008	1.000
	Far Eastern	166	0.190	0.213	0.020	0.770
By country:	Australia	5	0.320	0.383	0.100	1.000
	Japan	166	0.190	0.213	0.020	0.770
	USA	61	0.183	0.139	0.008	0.723

Max, maximum; Min, minimum; SD, standard deviation

APPENDIX B: WEIGHTED MEANS FOR AGGREGATED CADMIUM DATA

Data source	Country	GEMS region	Group #	Commodity	*n*	Cadmium concentration (mg/kg)				Year
						Mean	Mean * n	Min	Max	
EU SCOOP report	Italy	EUR	1	rice	42	0.070	2.940		0.360	1997–2002
memo to FAO	Sweden	EUR	1	rice, polished	44	0.024	1.056	<0.001	0.088	2001
				sum:	86		3.996			
				weighted mean:		0.046				
EU SCOOP report	Ireland	EUR	2	flour	2	0.050	0.100	0.050	0.050	1999
EU SCOOP report	Netherlands	EUR	2	flour	8	0.030	0.240	0.018	0.038	1997
EU SCOOP report	Netherlands	EUR	2	flour	70	0.038	2.660	0.009	0.084	2000
EU SCOOP report	Netherlands	EUR	2	flour	176	0.045	7.920	0.010	0.130	2001
EU SCOOP report	Netherlands	EUR	2	flour	5	0.021	0.105	0.009	0.050	2002
EU SCOOP report	Finland	EUR	2	wheat	36	0.036	1.296	0.009	0.094	1991
EU SCOOP report	Italy	EUR	2	wheat flour	2	0.030	0.060	0.020	0.040	1997–1998
EU SCOOP report	Italy	EUR	2	wheat, durum grain	239	0.037	8.843	0.009	0.076	1996
EU SCOOP report	Italy	EUR	2	wheat, soft grain	178	0.035	6.230	0.011	0.081	1996
				sum:	716		27.454			
				weighted mean:		0.038				
EU SCOOP report	Finland	EUR	3	potato	100	0.010	1.000	0.003	0.043	2000

Appendix B (contd)

Data source	Country	GEMS region	Group #	Commodity	*n*	Cadmium concentration (mg/kg)				Year
						Mean	Mean * n	Min	Max	
EU SCOOP report	Ireland	EUR	3	potatoes	13	0.069	0.892	0.015	0.160	2000–2001
EU SCOOP report	Netherlands	EUR	3	potatoes	69	0.022	1.518	0.007	0.082	1997
EU SCOOP report	Netherlands	EUR	3	potatoes	7	0.018	0.126	0.007	0.033	2002
EU SCOOP report	Portugal	EUR	3	potatoes	53	0.038	2.019	<0.007	<0.1	1998–2000
EU SCOOP report	Sweden	EUR	3	potatoes	75	0.010	0.750	0.001	0.028	2000
EU SCOOP report	United Kingdom	EUR	3	potatoes	20	0.026	0.512	0.007	0.129	1997
				sum:	353		6.817			
				weighted mean:		0.021				
EU SCOOP report	Netherlands	EUR	4	beetroot, red	1	0.080	0.080			1998
EU SCOOP report	Netherlands	EUR	4	beetroot, red	1	0.006	0.006			2002
EU SCOOP report	Finland	EUR	4	carrot	33	0.031	1.023	0.005	0.150	1993
EU SCOOP report	Netherlands	EUR	4	carrot	1	0.029	0.029			2001
EU SCOOP report	Netherlands	EUR	4	carrot	1	0.083	0.083			2002
EU SCOOP report	Netherlands	EUR	4	carrot	1	0.020	0.020			1997
EU SCOOP report	Netherlands	EUR	4	carrot	1	0.013	0.013			1999
EU SCOOP report	Netherlands	EUR	4	carrot	3	0.019	0.057	0.005	0.011	2002
EU SCOOP report	Ireland	EUR	4	carrots	3	0.120	0.360	0.060	0.179	2000–2001
EU SCOOP report	Italy	EUR	4	celery	5	0.090	0.450	0.060	0.190	1997–1998

Appendix B (contd)

Data source	Country	GEMS region	Group #	Commodity	*n*	Cadmium concentration (mg/kg)				Year
						Mean	Mean * n	Min	Max	
EU SCOOP report	Netherlands	EUR	4	celery	1	0.010	0.010			1997
EU SCOOP report	Netherlands	EUR	4	celery	1	0.510	0.510			1998
EU SCOOP report	Ireland	EUR	4	parsnips	2	0.075	0.150	0.050	0.100	2000–2001
EU SCOOP report	Netherlands	EUR	4	radish	2	0.025	0.050	0.020	0.030	1997
EU SCOOP report	Ireland	EUR	4	rhubarb	3	0.087	0.261	0.022	0.200	2000–2001
EU SCOOP report	Netherlands	EUR	4	tuber	1	0.010	0.010			1997
				sum:	60		3.112			
				weighted mean:		0.052				
EU SCOOP report	Netherlands	EUR	5	chard	1	0.380	0.380			1998
EU SCOOP report	Netherlands	EUR	5	chicory	5	0.005	0.025	0.005	0.005	1997
EU SCOOP report	Finland	EUR	5	Chinese cabbage	30	0.005	0.150	0.001	0.032	1993
EU SCOOP report	Italy	EUR	5	endive	5	0.030	0.150	<0.01	0.050	1997–1998
EU SCOOP report	Netherlands	EUR	5	endive	1	0.025	0.025			1999
EU SCOOP report	Netherlands	EUR	5	endive	1	0.042	0.042			2001
EU SCOOP report	Netherlands	EUR	5	endive	4	0.034	0.136	0.021	0.046	2002
EU SCOOP report	Finland	EUR	5	lettuce	28	0.013	0.364	0.005	0.068	1993
EU SCOOP report	Ireland	EUR	5	lettuce	9	0.151	1.363	0.026	0.440	2000–2001

Appendix B (contd)

Data source	Country	GEMS region	Group #	Commodity	*n*	Cadmium concentration (mg/kg)				Year
						Mean	Mean * n	Min	Max	
EU SCOOP report	Italy	EUR	5	lettuce	13	0.030	0.390	0.010	0.060	1997–1998
EU SCOOP report	Netherlands	EUR	5	lettuce	9	0.036	0.324	0.016	0.087	2002
EU SCOOP report	Netherlands	EUR	5	lettuce, crinkly	1	0.069	0.069			2002
EU SCOOP report	Ireland	EUR	5	spinach	2	0.550	1.100	0.330	0.770	2000–2001
EU SCOOP report	Italy	EUR	5	spinach	5	0.160	0.800	0.090	0.290	1997–1998
EU SCOOP report	Netherlands	EUR	5	spinach	4	0.047	0.188	0.013	0.061	2002
				sum:	118		5.506			
				weighted mean:		0.047				
EU SCOOP report	Ireland	EUR	6	cabbage	13	0.086	1.121	0.020	0.179	2000–2001
EU SCOOP report	Netherlands	EUR	6	cabbage, white	2	0.005	0.010	0.005	0.005	1997
EU SCOOP report	Netherlands	EUR	6	cabbage, white	1	0.040	0.040			1998
EU SCOOP report	Netherlands	EUR	6	cabbage, white	3	0.004	0.012	0.004	0.005	2002
EU SCOOP report	Netherlands	EUR	6	cauliflower	1	0.010	0.010			1997
EU SCOOP report	Netherlands	EUR	6	cauliflower	1	0.260	0.260			1998
EU SCOOP report	Netherlands	EUR	6	cauliflower	1	0.013	0.013			1999
EU SCOOP report	Netherlands	EUR	6	cauliflower	15	0.020	0.300	0.005	0.032	2001
EU SCOOP report	Netherlands	EUR	6	cauliflower	4	0.025	0.100	0.005	0.053	2002
EU SCOOP report	Netherlands	EUR	6	cucumber	1	0.002	0.002			2002

Appendix B (contd)

Data source	Country	GEMS region	Group #	Commodity	*n*	Cadmium concentration (mg/kg)				Year
						Mean	Mean * n	Min	Max	
sent to FAO	New Zealand	EUR	6	cucumber	2	0.004	0.008	<0.0006	<0.0008	1997–1998
EU SCOOP report	Netherlands	EUR	6	leek	15	0.068	1.020	0.009	0.430	2002
EU SCOOP report	Netherlands	EUR	6	onion	1	0.002	0.002			2002
EU SCOOP report	Netherlands	EUR	6	onion	1	0.010	0.010			1997
EU SCOOP report	Netherlands	EUR	6	onion	1	0.040	0.040			1998
EU SCOOP report	Netherlands	EUR	6	onion	4	0.065	0.260	0.005	0.005	2002
EU SCOOP report	Ireland	EUR	6	onion, spring	1	0.090	0.090	0.090	0.090	2000–2001
EU SCOOP report	Ireland	EUR	6	onions	10	0.129	1.288	0.020	0.660	2000–2001
EU SCOOP report	Italy	EUR	6	pepper, guinea	13	0.030	0.390	0.020	0.050	1997–1998
EU SCOOP report	Netherlands	EUR	6	peppers	20	0.015	0.300	0.010	0.020	2002
sent to FAO	New Zealand	EUR	6	pumpkin	2	0.007	0.014	0.005	0.009	1997–1998
				sum:	112		5.290			
				weighted mean:		0.047				
EU SCOOP report	France	EUR	7	molluscs	145	0.239	34.655	<0.0005	3.450	2000
EU SCOOP report	Portugal	EUR	7A	bivalve molluscs	34	0.104	3.546	<0.01	0.380	1998–2002
EU SCOOP report	Greece	EUR	7A	bivalve molluscs, fresh	14	0.186	2.604	0.022	0.456	2000–2002
EU SCOOP report	Netherlands	EUR	7A4	cockle	15	0.024	0.360	0.005	0.080	1999

Appendix B (contd)

Data source	Country	GEMS region	Group #	Commodity	*n*	Cadmium concentration (mg/kg)				Year
						Mean	Mean * n	Min	Max	
EU SCOOP report	United Kingdom	EUR	7A4	cockles, winkles	7	0.130	0.910	0.030	0.230	1996–1997
EU SCOOP report	Italy	EUR	7A	molluscs, bivalve	30	0.091	2.730	0.366		2001
letter to JECFA	Spain	EUR	7A3	mussel, blue	25	0.141	3.525		0.270	2002
letter to JECFA	Spain	EUR	7A3	mussel, blue	6	0.128	0.768		0.150	2002
letter to JECFA	Spain	EUR	7A3	mussel, blue	2	0.055	0.110		0.060	2002
letter to JECFA	Spain	EUR	7A3	mussel, blue	12	0.209	2.508		0.296	nr
EU SCOOP report	Finland	EUR	7A3	mussels	5	0.077	0.385	0.054	0.091	2002
EU SCOOP report	Greece	EUR	7A3	mussels	57	0.696	39.655	0.048	2.450	1999–2002
EU SCOOP report	Ireland	EUR	7A3	mussels	2150	0.166	357.330	0.050	0.440	1996–2001
EU SCOOP report	Italy	EUR	7A3	mussels	30	0.100	3.000			1995
EU SCOOP report	Netherlands	EUR	7A3	mussels	1	0.793	0.793			1998
EU SCOOP report	Netherlands	EUR	7A3	mussels	47	0.079	3.713	0.040	0.310	1999
sent to FAO	New Zealand	EUR	7A3	mussels	6	0.282	1.694	0.046	0.521	1997–1998
letter to JECFA	Spain	EUR	7A1	oyster	11	0.197	2.167		0.257	2003
EU SCOOP report	Greece	EUR	7A1	oysters	1	0.492	0.492	0.492	0.492	2002
EU SCOOP report	Ireland	EUR	7A1	oysters	1	0.247	0.247	0.247	0.247	1996–2001
EU SCOOP report	Netherlands	EUR	7A1	oysters	11	0.131	1.441	0.060	0.620	1999

Appendix B (contd)

Data source	Country	GEMS region	Group #	Commodity	*n*	Cadmium concentration (mg/kg)				Year
						Mean	Mean * n	Min	Max	
EU SCOOP report	Ireland	EUR	7A1	oysters, Pacific	549	0.333	182.543	0.098	0.631	1996–2001
EU SCOOP report	Ireland	EUR	7A1	oysters, flat	275	0.429	118.003	0.260	0.590	1996–2001
				sum:	3289		728.523			
				all bivalves - weighted mean:		0.222				
				sum:	2341		413.481			
				mussels only – weighted mean:		0.177				
				sum:	848		304.892			
				oysters only – weighted mean:		0.360				
EU SCOOP report	Greece	EUR	7B	cephalopods	2	0.002	0.004	<0.002	0.004	2001
EU SCOOP report	Italy	EUR	7B	cephalopods	42	0.002	0.088	0.198		2001
EU SCOOP report	Greece	EUR	7B	cuttlefish	10	0.436	4.360	0.050	1.300	1999–2000
EU SCOOP report	Greece	EUR	7B	cuttlefish	10		0.000			
EU SCOOP report	Netherlands	EUR	7B	cuttlefish	1	2.520	2.520			1998
EU SCOOP report	Netherlands	EUR	7B	cuttlefish	19	0.153	2.907	0.020	0.260	1999
EU SCOOP report	Netherlands	EUR	7B	cuttlefish	6	0.585	3.510	0.090	1.591	2001
letter to JECFA	Spain	EUR	7B	cuttlefish	4	0.048	0.192		0.071	2002

Appendix B (contd)

Data source	Country	GEMS region	Group #	Commodity	*n*	Cadmium concentration (mg/kg)				Year
						Mean	Mean * n	Min	Max	
letter to JECFA	Spain	EUR	7B	cuttlefish	10	0.021	0.210		0.080	2002
letter to JECFA	Spain	EUR	7B	cuttlefish	8	0.033	0.264		0.070	2002
letter to JECFA	Spain	EUR	7B	cuttlefish	7	0.003	0.021		0.004	2001
letter to JECFA	Spain	EUR	7B	cuttlefish	6	0.142	0.852		0.336	2002
letter to JECFA	Spain	EUR	7B	cuttlefish	16	0.069	1.104		0.124	2002
letter to JECFA	Spain	EUR	7B	cuttlefish	10	0.303	3.030		0.594	2003
EU SCOOP report	Greece	EUR	7B	octopus	37	0.156	5.757	<0.002	1.300	1999–2001
letter to JECFA	Spain	EUR	7B	octopus	8	nr			0.002	2001
letter to JECFA	Spain	EUR	7B	octopus	8	0.273	2.184		0.715	2001
letter to JECFA	Spain	EUR	7B	octopus	8	0.004	0.032		0.015	2001
letter to JECFA	Spain	EUR	7B	octopus	7	0.145	1.015		0.252	2002
letter to JECFA	Spain	EUR	7B	octopus	8	0.043	0.344		0.075	2002
letter to JECFA	Spain	EUR	7B	octopus	4	0.156	0.624		0.425	nr
EU SCOOP report	Italy	EUR	7B	octopus, spider	300	0.400	120.000	0.140	1.040	1996
EU SCOOP report	Greece	EUR	7B	squid	2	0.386	0.772	0.058	0.715	2001
letter to JECFA	Spain	EUR	7B	squid	5	0.010	0.050		0.016	2001
letter to JECFA	Spain	EUR	7B	squid	4	0.144	0.576		0.206	2003
letter to JECFA	Spain	EUR	7B	squid	28	0.142	3.976		0.336	2003

Appendix B (contd)

Data source	Country	GEMS region	Group #	Commodity	*n*	Cadmium concentration (mg/kg)				Year
						Mean	Mean * n	Min	Max	
letter to JECFA	Spain	EUR	7B	squid	8	0.073	0.584		0.200	2002
letter to JECFA	Spain	EUR	7B	squid	7	0.004	0.028		0.008	2001
letter to JECFA	Spain	EUR	7B	squid	8	0.017	0.136		0.053	2001
letter to JECFA	Spain	EUR	7B	squid	5	1.290	6.450		2.180	nr
EU SCOOP report	Italy	EUR	7B	squid, broadtail	212	0.070	14.840	0.040	0.100	1997
				sum:	810		176.431			
				weighted mean:		0.218				

EU, European Union; EUR, European region; FAO, Food and Agriculture Organization of the United Nations; JECFA, Joint FAO/WHO Expert Committee on Food Additives; Max, maximum; Min, minimum; nr, not reported; SCOOP, Scientific Cooperation on Food