Table 2: Number of Incremental Samples to be Taken Depending on the Weight of the Lot

Lot weight tonnes – (T)	N° of incremental samples
T≤ 1	10
1 <T ≤ 5	40
5< T ≤ 10	60
10<T < 15	80

Incremental Sample Selection

6. Procedures used to take incremental samples from a peanut lot are extremely important. Every individual peanut in the lot should have an equal chance of being chosen. Biases will be introduced by the sample selection methods if equipment and procedures used to select the incremental samples prohibit or reduce the chances of any item in the lot from being chosen.

7. Since there is no way to know if the contaminated peanut kernels are uniformly dispersed through out the lot, it is essential that the aggregate sample be the accumulation of many small portions or increments of the product selected from different locations throughout the lot. If the aggregate sample is larger than desired, it should be blended and subdivided until the desired laboratory sample size is achieved.

Static Lots

8. A static lot can be defined as a large mass of peanuts contained either in a single large container such as a wagon, truck, or railcar or in many small containers such as sacks or boxes and the peanuts are stationary at the time a sample is selected. Selecting a truly random sample from a static lot can be difficult because the container may not allow access to all peanuts.

9. Taking a aggregate sample from a static lot usually requires the use of probing devices to select product from the lot. The probing devices used should be specially designed for the type of container. The probe should (1) be long enough to reach all product, (2) not restrict any item in the lot from being selected, and (3) not alter the items in the lot. As mentioned above, the aggregate sample should be a composite from many small increments of product taken from many different locations throughout the lot.

10. For lots traded in individual packages, the sampling frequency (SF), or number of packages that incremental samples are taken from, is a function of the lot weight (LT), incremental sample weight (IS), aggregate sample weight (AS) and the individual packing weight (IP), as follows :

Equation 1 : $SF = (LT \times IS)/(AS \times IP)$. The sampling frequency (SF) is the number of packages sampled. All weights should be in the same mass units such as kg.

Dynamic Lots

11. True random sampling can be more nearly achieved when selecting an aggregate sample from a moving stream of peanuts as the lot is transferred, for example, by a conveyor belt from one location to another. When sampling from a moving stream, take small increments of product from the entire length of the moving stream; composite the peanuts to obtain an aggregate sample; if the aggregate sample is larger than the required laboratory sample, then blend and subdivide the aggregate sample to obtain the desired size laboratory sample.

12. Automatic sampling equipment such as cross-cut samplers are commercially available with timers that automatically pass a diverter cup through the moving stream at predetermined and uniform intervals. When automatic equipment is not available, a person can be assigned to manually pass a cup though the stream at periodic intervals to collect incremental samples. Whether using automatic or manual methods, small increments of peanuts should be collected and composited at frequent and uniform intervals throughout the entire time peanuts flow past the sampling point.

13. Cross-cut samplers should be installed in the following manner: (1) the plane of the opening of the diverter cup should be perpendicular to the direction of flow; (2) the diverter cup should pass through the entire cross sectional area of the stream; and (3) the opening of the diverter cup should be wide enough to accept all items of interest in the lot. As a general rule, the width of the diverter cup opening should be about three times the largest dimensions of the items in the lot.

14. The size of the aggregate sample (S) in kg, taken from a lot by a cross cut sampler is :

Equation 2 : $S = (D \times LT) / (T \times V)$. D is the width of the diverter cup opening (in cm), LT is the lot size (in kg), T is interval or time between cup movement through the stream (in seconds), and V is cup velocity (in cm/sec).

15. If the mass flow rate of the moving stream, MR (kg/sec), is known, then the sampling frequency (SF), or number of cuts made by the automatic sampler cup is :

Equation 3 : $SF = (S \times V) / (D \times MR)$.

16. Equation 2 can also be used to compute other terms of interest such as the time between cuts (T). For example, the required time (T) between cuts of the diverter cup to obtain a 20 kg aggregate sample from a 30,000 kg lot where the diverter cup width is 5.08 cm (2 inches), and the cup velocity through the stream 30 cm/sec. Solving for T in Equation 2,

$T = (5.08 \text{ cm} \times 30{,}000 \text{ kg})/(20 \text{ kg} \times 30 \text{ cm/sec}) = 254 \text{ sec}$

17. If the lot is moving at 500 kg per minute, the entire lot will pass through the sampler in 60 minutes and only 14 cuts (14 incremental samples) will be made by the cup through the lot. This may be considered too infrequent, in that too much product passes through the sampler between the time the cup cuts through the stream.

Weight of the Incremental Sample

18. The weight of the incremental sample should be approximately 200 grams or greater, depending on the total number of increments, to obtain an aggregate sample of 20kg.

Packaging and transmission of samples

19. Each laboratory sample shall be placed in a clean, inert container offering adequate protection from contamination and against damage in transit. All necessary precautions shall be taken to avoid any change in composition of the laboratory sample which might arise during transportation or storage.

Sealing and labelling of samples

20. Each laboratory sample taken for official use shall be sealed at the place of sampling and identified. A record must be kept of each sampling, permitting each lot to be identified unambiguously and giving the date and place of sampling together with any additional information likely to be of assistance to the analyst.

C. Sample Preparation

Precautions

21. Daylight should be excluded as much as possible during the procedure, since aflatoxin gradually breaks down under the influence of ultra-violet light.

Homogenisation -- Grinding

22. As the distribution of aflatoxin is extremely non-homogeneous, samples should be prepared - and especially homogenised - with extreme care. All laboratory sample obtained from aggregate sample is to be used for the homogenisation/grinding of the sample.

23. The sample should be finely ground and mixed thoroughly using a process that approaches as complete a homogenisation as possible.

24. The use of a hammer mill with a #14 screen (3.1 mm diameter hole in the screen) has been proven to represent a compromise in terms of cost and precision. A better homogenisation (finer grind – slurry) can be obtained by more sophisticated equipment, resulting in a lower sample preparation variance.

Test portion

25. A minimum test portion size of 100 g taken from the laboratory sample.

D. Analytical Methods

Background

26. A criteria-based approach, whereby a set of performance criteria is established with which the analytical method used should comply, is appropriate. The criteria-based approach has the advantage that, by avoiding setting down specific details of the method used, developments in methodology can be exploited without having to reconsider or modify the specified method. The performance criteria established for methods should include all the parameters that need to be addressed by each laboratory such as the detection limit, repeatability coefficient of variation, reproducibility coefficient of variation, and the percent recovery necessary for various statutory limits. Utilising this approach, laboratories would be free to use the analytical method most appropriate for their facilities. Analytical methods that are accepted by chemists internationally (such as AOAC) may be used. These methods are regularly monitored and improved depending upon technology.

Performance Criteria for Methods of Analysis

Table 3: Specific Requirements with which Methods of Analysis Should Comply

Criterion	Concentration Range	Recommended Value	Maximum Permitted Value
Blanks	All	Negligible	-
Recovery-Aflatoxins Total	1 - 15 µg/kg	70 to 110 %	
	> 15 µg/kg	80 to 110 %	
Precision RSD_R	All	As derived from Horwitz Equation	2 x value derived from Horwitz Equation
Precision RSD_r may be calculated as 0.66 times Precision RSD_R at the concentration of interest			

- The detection limits of the methods used are not stated as the precision values are given at the concentrations of interest;

- The precision values are calculated from the Horwitz equation, i.e.:

$$RSD_R = 2^{(1-0.5\log C)}$$

where:

* RSD_R is the relative standard deviation calculated from results generated under reproducibility conditions $[(s_R / \bar{x}) \times 100]$
* C is the concentration ratio (i.e. 1 = 100g/100g, 0.001 = 1,000 mg/kg)

27. This is a generalised precision equation which has been found to be independent of analyte and matrix but solely dependent on concentration for most routine methods of analysis.

AFLATOXIN M1

Reference to JECFA:	56 (2001)
Toxicological guidance:	Cancer potency estimates at specified residue levels (2001, Using worst-case assumptions, the additional risks for liver cancer predicted with use of proposed maximum levels of aflatoxin M1 of 0.05 and 0.5 µg/kg are very small. The potency of aflatoxin M1 appears to be so low in HBsAg- individuals that a carcinogenic effect of M1 intake in those who consume large quantities of milk and milk products in comparison with non-consumers of these products would be impossible to demonstrate. Hepatitis B virus carriers might benefit from a reduction in the aflatoxin concentration in their diet, and the reduction might also offer some protection in hepatitis C virus carriers.)
Residue definition:	Aflatoxin M1
Synonyms:	AFM1

Commodity/Product Code	Name	Level ug/kg	Suffix	Type	Reference	Notes/Remarks for Codex Alimentarius
ML 0106	Milk	0.5		ML		

PATULIN

Reference to JECFA:	35 (1989), 44 (1995)
Toxicological guidance:	PMTDI 0.0004 mg/kg bw (1995)
Residue definition:	patulin
Related Code of Practice:	Code of Practice for the Prevention and Reduction of Patulin Contamination in Apple Juice and Apple Juice Ingredients in Other Beverages (CAC/RCP 50-2003)

Commodity/Product Code	Name	Level ug/kg	Suffix	Type	Reference	Notes/Remarks for Codex Alimentarius
JF 0226	Apple juice	50		ML		The ML also covers apple juice as ingredient in other beverages.

Patulin is a low molecular weight hemiacetal lactone mycotoxin produced by species of the genera Aspergillus, Penicillium and Byssochlamys.

ARSENIC

Reference to JECFA:	5 (1960), 10 (1967), 27 (1983), 33 (1988)
Toxicological guidance:	PTWI 0.015 mg/kg bw (1988, For inorganic arsenic)
Residue definition:	Arsenic: total (As-tot) when not otherwise mentioned; inorganic arsenic (As-in); or other specification
Synonyms:	As
Related Code of Practice:	Code of Practice for Source Directed Measures to Reduce Contamination of Foods with Chemicals (CAC/RCP 49-2001)

Commodity/Product Code	Name	Level mg/kg	Suffix	Type	Reference	Notes/Remarks for Codex Alimentarius
	Edible fats and oils	0.1		ML	CS 19-1981	Edible fats and oils not covered by individual standards
	Margarine	0.1		ML	CS 32-1981	
	Minarine	0.1		ML	CS 135-1981	
	Named animal fats	0.1		ML	CS 211-1999	Lard, rendered pork fat, premier jus and edible tallow.
OR 0305	Olive oil, refined	0.1		ML	CS 33-1981	
OC 0305	Olive oil, virgin	0.1		ML	CS 33-1981	
OR 5330	Olive, residue oil	0.1		ML	CS 33-1981	Olive pomace oil
OC 0172	Vegetable oils, Crude	0.1		ML	CS 210-1999	Named vegeable oils from arachis, babassu, coconut, cottonseed, grapeseed, maize, mustardseed, palm kernel, palm, rapeseed, safflowerseed, sesameseed, soya bean, and sunflowerseed, and palm olein, stearin and superolein.
OR 0172	Vegetable oils, Edible	0.1		ML	CS 210-1999	Named vegeable oils from arachis, babassu, coconut, cottonseed, grapeseed, maize, mustardseed, palm kernel, palm, rapeseed, safflowerseed, sesameseed, soya bean, and sunflowerseed, and palm olein, stearin and superolein.
	Natural mineral waters	0.01		ML	CS 108-1981	Expressed in total As mg/l
	Salt, food grade	0.5		ML	CS 150-1985	

Arsenic is a metalloid element which is normally occurring in mineral bound form in the earth's crust and which can become more easily available by natural sources such as volcanic activity and weathering of minerals, and by anthropogenic activity causing emissions in the environment, such as ore smelting, burning of coal and specific uses, such as arsenic-based wood preservatives, pesticides or veterinary or human medicinal drugs. As a result of naturally occurring metabolic processes in the biosphere arsenic occurs as a large number of organic or inorganic chemical forms in food (species). Especially in the marine environment arsenic is often found in high concentrations of organic forms, up to 50 mg/kg of arsenic on a wet weight basis in some seafood including seaweed, fish, shellfish and crustaceans. In fresh water and in the terrestrial environments arsenic is normally found in much lower levels (typically 0-20 ug/kg) in crop plants and in livestock. Higher levels may be found in rice, mushrooms and sometimes in poultry which is fed fish meal containing arsenic. The most toxic forms of arsenic are the inorganic arsenic (III) and (V) compounds; the inorganic arsenic trioxide is well known as a rat poison, which was also sometimes used for homicide. Methylated forms of arsenic have a low acute toxicity; arsenobetaine which is the principal arsenic form in fish and crustaceans is considered non-toxic. In shellfish, molluscs and seaweed dimethylarsinylriboside derivatives occur ("arsenosugars"), the possible toxicity of which is not known in detail. Only a few percent of the total arsenic in fish is present in inorganic form, which is the only form about which a PTWI has been developed by JECFA. The human epidemiological data used for this risk assessment is based on exposure to inorganic arsenic in drinking water. IARC has classified inorganic arsenic as a human carcinogen, and the estimated lifetime risk for arsenic-induced skin cancer which may be caused by drinking water at or in excess of the WHO guideline for arsenic in drinking water is estimated at 6x 10-4.

CADMIUM

Reference to JECFA:	16 (1972), 33 (1988), 41 (1993), 55 (2000), 61 (2003), 64 (2005)
Toxicological guidance:	PTWI 0.007 mg/kg bw (1988 (maintained in 2000 & 2003), The 64th JECFA 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.)
Residue definition:	Cadmium, total
Synonyms:	Cd
Related Code of Practice:	Code of Practice for Source Directed Measures to Reduce Contamination of Foods with Chemicals (CAC/RCP 49-2001)

Commodity/Product Code	Name	Level mg/kg	Suffix	Type	Reference	Notes/Remarks for Codex Alimentarius
VB 0040	Brassica vegetables	0.05		ML		
VA 0035	Bulb vegetables	0.05		ML		
VC 0045	Fruiting vegetables, cucurbits	0.05		ML		
VO 0050	Fruiting vegetables, other than cucurbits	0.05		ML		Excluding tomatoes and edible fungi.
VL 0053	Leafy vegetables	0.2		ML		
VP 0060	Legume vegetables	0.1		ML		
VR 0589	Potato	0.1		ML		Peeled
VD 0070	Pulses	0.1		ML		Excluding soya bean (dry)
VR 0075	Root and tuber vegetables	0.1		ML		Excluding potato and celeriac
VS 0078	Stalk and stem vegetables	0.1		ML		
GC 0081	Cereal grains, except buckwheat, cañihua and quinoa	0.1		ML		Excluding wheat and rice; and bran and germ
CM 0649	Rice, polished	0.4		ML		
GC 0654	Wheat	0.2		ML		
IM 0151	Marine bivalve molluscs	2		ML		Excluding oysters and scallops
IM 0152	Cephalopods	2		ML		Without viscera
	Natural mineral waters	0.003		ML	CS 108-1981	Expressed in mg/l
	Salt, food grade	0.5		ML	CS 150-1985	

Cadmium is a relatively rare element, released to the air, land, and water by human activities. In general, the two major sources of contamination are the production and utilization of cadmium and the disposal of wastes containing cadmium. Increases in soil cadmium content will result in an increase in the uptake of cadmium by plants; the pathway of human exposure from agricultural crops is thus susceptible to increases in soil cadmium. The cadmium uptake by plants from soil is greater at low soil pH. Edible free-living food organisms such as shellfish, crustaceans, and fungi are natural accumulators of cadmium. Similar to humans, there are increased levels of cadmium in the liver and kidney of horses and some feral terrestrial animals. Regular consumption of these items can result in increased exposure. Tobacco is an important source of cadmium uptake in smokers. (Environmental health criteria for cadmium; International Programme on Chemical Safety (IPCS); 1992)

LEAD

Reference to JECFA:	10 (1966), 16 (1972), 22 (1978), 30 (1986), 41 (1993), 53 (1999)
Toxicological guidance:	PTWI 0.025 mg/kg bw (1987 for infants and young children, extended to all age groups in 1993, maintained 1999)
Residue definition:	Lead, total
Synonyms:	Pb
Related Code of Practice:	Code of Practice for the Prevention and Reduction of Lead Contamination in Foods (CAC/RCP 56-2004) Code of Practice for Source Directed Measures to Reduce Contamination of Foods with Chemicals (CAC/RCP 49-2001)

Commodity/Product Code	Name	Level mg/kg	Suffix	Type	Reference	Notes/Remarks for Codex Alimentarius
FT 0026	Assorted (sub)tropical fruits, edible peel	0.1		ML		
FI 0030	Assorted (sub)tropical fruits, inedible peel	0.1		ML		
FB 0018	Berries and other small fruits	0.2		ML		
FC 0001	Citrus fruits	0.1		ML		
FP 0009	Pome fruits	0.1		ML		
FS 0012	Stone fruits	0.1		ML		
VB 0040	Brassica vegetables	0.3		ML		Excluding kale
VA 0035	Bulb vegetables	0.1		ML		
VC 0045	Fruiting vegetables, Cucurbits	0.1		ML		
VO 0050	Fruiting vegetables, other than Cucurbits	0.1		ML		Excluding mushrooms
VL 0053	Leafy vegetables	0.3		ML		Including Brassica leafy vegetables but excluding spinach.
VP 0060	Legume vegetables	0.2		ML		
VD 0070	Pulses	0.2		ML		
VR 0075	Root and tuber vegetables	0.1		ML		Including peeled potatoes
	Canned fruit cocktail	1		ML	CS 78-1981	
	Canned grapefruit	1		ML	CS 15-1981	
	Canned mandarin oranges	1		ML	CS 68-1981	
	Canned mangoes	1		ML	CS 159-1987	
	Canned pineapple	1		ML	CS 42-1981	
	Canned raspberries	1		ML	CS 60-1981	
	Canned strawberries	1		ML	CS 62-1981	
	Canned tropical fruit salad	1		ML	CS 99-1981	
	Jams (fruit preserves) and jellies	1		ML	CS 79-1981	
	Mango chutney	1		ML	CS 160-1987	
	Table olives	1		ML	CS 66-1981	
	Canned asparagus	1		ML	CS 56-1981	
	Canned carrots	1		ML	CS 116-1981	

Commodity/Product Code	Name	Level mg/kg	Suffix	Type	Reference	Notes/Remarks for Codex Alimentarius
	Canned green beans and canned wax beans	1		ML	CS 16-1981	
	Canned green peas	1		ML	CS 58-1981	
	Canned mature processed peas	1		ML	CS 81-1981	
	Canned mushrooms	1		ML	CS 55-1981	
	Canned palmito	1		ML	CS 144-1985	
	Canned sweet corn	1		ML	CS 18-1981	
	Canned tomatoes	1		ML	CS 13-1981	
	Pickled cucumbers (cucumber pickles)	1		ML	CS 115-1981	
	Processed tomato concentrates	1.5		ML	CS 57-1981	
JF 0175	Fruit juices	0.05		ML		Including nectars; Ready to drink
GC 0081	Cereal grains, except buckwheat, cañihua and quinoa	0.2		ML		
	Canned chestnuts and canned chestnuts puree	1		ML	CS 145-1985	
MM 0097	Meat of cattle, pigs and sheep	0.1		ML		Also applies to the fat from meat
PM 0110	Poultry meat	0.1		ML		
MO 0812	Cattle, Edible offal of	0.5		ML		
MO 0818	Pig, Edible offal of	0.5		ML		
PO 0111	Poultry, Edible offal of	0.5		ML		
	Edible fats and oils	0.1		ML	CS 19-1981	Edible fats and oils not covered by individual standards
	Fish	0.3		ML		
	Margarine	0.1		ML	CS 32-1981	
	Minarine	0.1		ML	CS 135-1981	
	Named animal fats	0.1		ML	CS 211-1999	Lard, rendered pork fat, premier jus and edible tallow.
OR 0305	Olive oil, refined	0.1		ML	CS 33-1981	
OC 0305	Olive oil, virgin	0.1		ML	CS 33-1981	
OR 5330	Olive, residue oil	0.1		ML	CS 33-1981	Olive pomace oil
PF 0111	Poultry fats	0.1		ML		
OC 0172	Vegetable oils, Crude	0.1		ML	CS 210-1999	Oils of arachis, babasu, coconut, cottonseed, grapeseed, maize, mustardseed, palm kernel, palm, rapeseed, safflowerseed, sesameseed, soya bean, and sunflowerseed, and palm olein, stearin and superolein and other oils but excluding cocoa butter.
OR 0172	Vegetable oils, Edible	0.1		ML	CS 210-1999	Oils of arachis, babasu, coconut, cottonseed, grapeseed, maize, mustardseed, palm kernel, palm, rapeseed, safflowerseed, sesameseed, soya bean, and sunflowerseed, and palm olein, stearin and superolein and other oils but excluding cocoa butter.
ML 0106	Milks	0.02		ML		A concentration factor applies to partially or wholly dehydrated milks.

Commodity/Product Code	Name	Level mg/kg	Suffix	Type	Reference	Notes/Remarks for Codex Alimentarius
LS	Secondary milk products	0.02		ML		As consumed
	Natural mineral waters	0.01		ML	CS 108-1981	Expressed in mg/l
	Infant formula	0.02		ML		Ready to use
	Salt, food grade	2		ML	CS 150-1985	
	Wine	0.2		ML		

MERCURY

Reference to JECFA:	10 (1966), 14 (1970), 16 (1972), 22 (1978)
Toxicological guidance:	PTWI 0.005 mg/kg bw (1978)
Residue definition:	Mercury, Total
Synonyms:	Hg
Related Code of Practice:	Code of Practice for Source Directed Measures to Reduce Contamination of Foods with Chemicals (CAC/RCP 49-2001)

Commodity/Product Code	Name	Level mg/kg	Suffix	Type	Reference	Notes/Remarks for Codex Alimentarius
	Natural mineral waters	0.001		ML	CS 108-1981	Expressed in mg/l
	Salt, food grade	0.1		ML	CS 150-1985	

Mercury is a naturally occurring metallic element which can be present in foodstuffs by natural causes; elevated levels can also occur due to e.g. environmental contamination by industrial or other uses of mercury. Methylmercury and also total mercury levels in terrestrial animals and plants are usually very low; the use of fish meal as animal feed can however also lead to higher methyl mercury levels in other animal products.

METHYLMERCURY

Reference to JECFA: 22 (1978), 33 (1988), 53 (1999), 61 (2003)
Toxicological guidance: PTWI 0.0016 mg/kg bw (2003)
Residue definition: Methylmercury
Related Code of Practice: Code of Practice for Source Directed Measures to Reduce Contamination of Foods with Chemicals (CAC/RCP 49-2001)

Commodity/Product Code	Name	Level mg/kg	Suffix	Type	Reference	Notes/Remarks for Codex Alimentarius
	Fish	0.5		GL		Except predatory fish The Guideline levels are intended for methylmercury in fresh or processed fish and fish products moving in international trade.
	Predatory fish	1		GL		Predatory fish such as shark (WS 0131), swordfish, tuna (WS 0132), pike (WF 0865) and others. The Guideline level for methylmercury in fresh or processed fish and fish products moving in international trade.

Lots should be considered as being in compliance with the guideline levels if the level of methylmercury in the analytical sample, derived from the composite bulk sample, does not exceed the above levels. Where these Guideline levels are exceeded, governments should decide whether and under what circumstances, the food should be distributed within their territory or jurisdiction and what recommendations, if any, should be given as regards restrictions on consumption, especially by vulnerable groups such as pregnant women.
Methylmercury is the most toxic form of mercury and is formed in aquatic environments. Methylmercury therefore is found mainly in aquatic organisms. It can accumulate in the food chain; the levels in large predatory fish species are therefore higher than in other species and fish is the predominant source of human exposure to methylmercury.
Methylmercury and also total mercury levels in terrestrial animals and plants are usually very low; the use of fish meal as animal feed can however also lead to higher methyl mercury levels in other animal products.

TIN

Reference to JECFA: 10 (1966), 14 (1970), 15 (1971), 19 (1975), 22 (1978), 26(1982), 33(1988), 55 (2000), 64 (2005)
Toxicological guidance: PTWI 14 mg/kg bw (1988, Expressed as Sn; includes tin from food additive uses; maintained in 2000.)
Residue definition: Tin, total (Sn-tot) when not otherwise mentioned; inorganic tin (Sn-in); or other specification
Synonyms: Sn
Related Code of Practice: Code of Practice for the Prevention and Reduction of Inorganic Tin Contamination in Canned Foods (CAC/RCP 60-2005)
Code of Practice for Source Directed Measures to Reduce Contamination of Foods with Chemicals (CAC/RCP 49-2001)

Commodity/Product Code	Name	Level mg/kg	Suffix	Type	Reference	Notes/Remarks for Codex Alimentarius
	Canned foods (other than beverages)	250	C	ML		
	Canned beverages	150	C	ML		
	Canned fruit cocktail	250	C	ML	CS 78-1981	
	Canned grapefruit	250	C	ML	CS 15-1981	
	Canned mandarin oranges	250	C	ML	CS 68-1981	
	Canned mangoes	250	C	ML	CS 159-1987	
	Canned pineapple	250	C	ML	CS 42-1981	
	Canned raspberries	250	C	ML	CS 60-1981	
	Canned strawberries	250	C	ML	CS 62-1981	
	Canned tropical fruit salad	250	C	ML	CS 99-1981	
	Jams (fruit preserves) and jellies	250	C	ML	CS 79-1981	
	Mango chutney	250	C	ML	CS 160-1987	
	Table olives	250	C	ML	CS 66-1981	
	Canned asparagus	250	C	ML	CS 56-1981	
	Canned carrots	250	C	ML	CS 116-1981	
	Canned green and wax beans	250	C	ML	CS 16-1981	
	Canned green peas	250	C	ML	CS 58-1981	
	Canned mature processed peas	250	C	ML	CS 81-1981	
	Canned mushrooms	250	C	ML	CS 55-1981	
	Canned palmito	250	C	ML	CS 144-1985	
	Canned sweet corn	250	C	ML	CS 18-1981	
	Canned tomatoes	250	C	ML	CS 13-1981	
	Pickled cucumber	250	C	ML	CS 115-1981	
	Processed tomato concentrates	250	C	ML	CS 57-1981	
	Canned chestnuts and chestnut purée	250	C	ML	CS 145-1985	
	Cooked cured chopped meat	250	C	ML	CS 98-1981	For products in tinplate containers
	Cooked cured chopped meat	50		ML	CS 98-1981	For products in other containers
	Cooked cured ham	50		ML	CS 96-1981	For products in other containers
	Cooked cured ham	250	C	ML	CS 96-1981	For products in tinplate containers

Commodity/Product Code	Name	Level mg/kg	Suffix	Type	Reference	Notes/Remarks for Codex Alimentarius
	Cooked cured pork shoulder	50		ML	CS 97-1981	For products in other containers
	Cooked cured pork shoulder	250	C	ML	CS 97-1981	For products in tinplate containers
	Corned beef	50		ML	CS 88-1981	For products in other containers
	Corned beef	250	C	ML	CS 88-1981	For products in tinplate containers
	Luncheon meat	250	C	ML	CS 89-1981	For products in tinplate containers
	Luncheon meat	50		ML	CS 89-1981	For products in other containers

Tin is mainly used in tinplated containers, but it is also extensively used in solders, in alloys including dental amalgams. Inorganic tin compounds, in which the element may be present in the oxidation states of +2 or +4, are used in a variety of industrial processes for the strengthening of glass, as a base for colours, as catalysts, as stabilizers in perfumes and soaps, and as dental anticariogenic agents. On the whole, contamination of the environment by tin is only slight. Food is the main source of tin for man. Small amounts are found in fresh meat, cereals, and vegetables. Larger amounts of tin may be found in foods stored in plain cans and, occasionally, in foods stored in lacquered cans. Some foods such as asparagus, tomatoes, fruits, and their juices tend to contain high concentrations of tin if stored in unlaquered cans (Environmental health criteria for tin; International Programme on Chemical Safety (IPCS); 1980). Inorganic tin is found in food in the +2 and +4 oxidation states; it may occur in a cationic form (stannous and stannic compounds) or as inorganic anions (stannites or stannates).

RADIONUCLIDES

Commodity Code	Product Name	Representative radionuclides	Dose per unit intake factor in Sv/Bq	Level in Bq/kg	Type	Reference	Notes/Remarks for Codex Alimentarius
	Infant foods*	^{238}Pu, ^{239}Pu, ^{240}Pu, ^{241}Am		1	GL		
	Infant foods *	^{90}Sr, ^{106}Ru, ^{129}I, ^{131}I, ^{235}U		100	GL		
	Infant foods *	^{35}S**, ^{60}Co, ^{89}Sr, ^{103}Ru, ^{134}Cs, ^{137}Cs, ^{144}Ce, ^{192}Ir		1000	GL		
	Infant foods *	^{3}H***, ^{14}C, ^{99}Tc		1000	GL		
	Foods other than infant foods	^{238}Pu, ^{239}Pu, ^{240}Pu, ^{241}Am		10	GL		
	Foods other than infant foods	^{90}Sr, ^{106}Ru, ^{129}I, ^{131}I, ^{235}U		100	GL		
	Foods other than infant foods	^{35}S**, ^{60}Co, ^{89}Sr, ^{103}Ru, ^{134}Cs, ^{137}Cs, ^{144}Ce, ^{192}Ir		1000	GL		
	Foods other than infant foods	^{3}H***, ^{14}C, ^{99}Tc		10000	GL		

* When intended for use as such.
** This represents the value for organically bound sulphur.
*** This represents the value for organically bound tritium.

Scope: The Guideline Levels apply to radionuclides contained in foods destined for human consumption and traded internationally, which have been contaminated following a nuclear or radiological emergency[1]. These guideline levels apply to food after reconstitution or as prepared for consumption, i.e., not to dried or concentrated foods, and are based on an intervention exemption level of 1 mSv in a year.

Application: As far as generic radiological protection of food consumers is concerned, when radionuclide levels in food do not exceed the corresponding Guideline Levels, the food should be considered as safe for human consumption. When the Guideline Levels are exceeded, national governments shall decide whether and under what circumstances the food should be distributed within their territory or jurisdiction. National governments may wish to adopt different values for internal use within their own territories where the assumptions concerning food distribution that have been made to derive the Guideline Levels may not apply, e.g., in the case of wide-spread radioactive contamination. For foods that are consumed in small quantities, such as spices, that represent a small percentage of total diet and hence a small addition to the total dose, the Guideline Levels may be increased by a factor of 10.

Radionuclides: The Guideline Levels do not include all radionuclides. Radionuclides included are those important for uptake into the food chain; are usually contained in nuclear installations or used as a radiation source in large enough quantities to be significant potential contributors to levels in foods, and; could be accidentally released into the environment from typical installations or might be employed in malevolent actions. Radionuclides of natural origin are generally excluded from consideration in this document.

[1] For the purposes of this document, the term "emergency" includes both accidents and malevolent actions.

In the Table, the radionuclides are grouped according to the guideline levels rounded logarithmically by orders of magnitude. Guideline levels are defined for two separate categories "infant foods" and "other foods". This is because, for a number of radionuclides, the sensitivity of infants could pose a problem. The guideline levels have been checked against age-dependent ingestion dose coefficients defined as committed effective doses per unit intake for each radionuclide, which are taken from the "International Basic Safety Standards" (IAEA, 1996)[2].

Multiple radionuclides in foods: The guideline levels have been developed with the understanding that there is no need to add contributions from radionuclides in different groups. Each group should be treated independently. However, the activity concentrations of each radionuclide within the same group should be added together[3].

Annex 1

SCIENTIFIC JUSTIFICATION FOR PROPOSED DRAFT REVISED GUIDELINE LEVELS FOR RADIONUCLIDES IN FOODS CONTAMINATED FOLLOWING A NUCLEAR OR RADIOLOGICAL EMERGENCY

The proposed draft revised Guideline Levels for Radionuclides in Foods and specifically the values presented in Table 1 above are based on the following general radiological considerations and experience of application of the existing international and national standards for control of radionuclides in food.

Significant improvements in the assessment of radiation doses resulting from the human intake of radioactive substances have become available since the Guideline Levels were issued by the Codex Alimentarius Commission in 1989[4] (CAC/GL 5-1989).

Infants and adults: The levels of human exposure resulting from consumption of foods containing radionuclides listed in Table 1 at the suggested guideline levels have been assessed both for infants and adults and checked for compliance with the appropriate dose criterion.

In order to assess public exposure and the associated health risks from intake of radionuclides in food, estimates of food consumption rates and ingestion dose coefficients are needed. According to Ref. (WHO, 1988) it is assumed that 550 kg of food is consumed by an adult in a year. The value of infant food and milk consumption during first year of life used for infant dose calculation equal to 200 kg is based on contemporary human habit assessments (F. Luykx, 1990[5]; US DoH, 1998[6]; NRPB, 2003[7]). The most conservative values of the radionuclide-specific and age-specific ingestion dose coefficients, i.e. relevant to the chemical forms of radionuclides which are most absorbed from the gastro-intestinal tract and retained in body tissues, are taken from the (IAEA, 1996).

Radiological criterion: The appropriate radiological criterion, which has been used for comparison with the dose assessment data below, is a generic intervention exemption level of around 1 mSv for individual annual dose from radionuclides in major commodities, e.g. food, recommended by the International Commission on Radiological Protection as safe for members of the public (ICRP, 1999)[8].

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2 Food and Agriculture Organization of the United Nations, International Atomic Energy Agency, International Labour Office, OECD Nuclear Energy Agency, Pan American Health Organization, World Health Organization (1996) International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources, IAEA, Vienna.

3 For example, if ^{134}Cs and ^{137}Cs are contaminants in food, the guideline level of 1000 Bq/kg refers to the summed activity of both these radionuclides.

4 The Codex Alimentarius Commission at its 18th Session (Geneva 1989) adopted Guideline Levels for Radionuclides in Foods Following Accidental Nuclear Contamination for Use in International Trade (CAC/GL 5-1989) applicable for six radionuclides (^{90}Sr, ^{131}I, ^{137}Cs, ^{134}Cs, ^{239}Pu and ^{241}Am) during one year after the nuclear accident.

5 F. Luykx (1990) Response of the European Communities to environmental contamination following the Chernobyl accident. In: Environmental Contamination Following a Major Nuclear Accident, IAEA, Vienna, v.2, 269-287.

6 US DoHHS (1998) Accidental Radioactive Contamination of Human Food and Animal Feeds: Recommendations for State and Local Agencies. Food and Drug Administration, Rockville.

7 K. Smith and A. Jones (2003) Generalised Habit Data for Radiological Assessments. NRPB Report W41.

8 International Commission on Radiological Protection (1999). Principles for the Protection of the Public in Situations of Prolonged Exposure. ICRP Publication 82, Annals of the ICRP.

Naturally occurring radionuclides: Radionuclides of natural origin are ubiquitous and as a consequence are present in all foodstuffs to varying degrees. Radiation doses from the consumption of foodstuffs typically range from a few tens to a few hundreds of microsieverts in a year. In essence, the doses from these radionuclides when naturally present in the diet are unamenable to control; the resources that would be required to affect exposures would be out of proportion to the benefits achieved for health. These radionuclides are excluded from consideration in this document as they are not associated with emergencies.

One-year exposure assessment: It is conservatively assumed that during the first year after major environmental radioactive contamination caused by a nuclear or radiological emergency it might be difficult to readily replace foods imported from contaminated regions with foods imported from unaffected areas. According to FAO statistical data the mean fraction of major foodstuff quantities imported by all the countries worldwide is 0.1. The values in Table 1 as regards foods consumed by infants and the general population have been derived to ensure that if a country continues to import major foods from areas contaminated with radionuclides, the mean annual internal dose of its inhabitants will not exceed around 1 mSv (see Annex 2). This conclusion might not apply for some radionuclides if the fraction of contaminated food is found to be higher than 0.1, as might be the case for infants who have a diet essentially based on milk with little variety.

Long-term exposure assessment: Beyond one year after the emergency the fraction of contaminated food placed on the market will generally decrease as a result of national restrictions (withdrawal from the market), changes to other produce, agricultural countermeasures and decay.

Experience has shown that in the long term the fraction of imported contaminated food will decrease by a factor of a hundred or more. Specific food categories, e.g. wild forest products, may show persistent or even increasing levels of contamination. Other categories of food may gradually be exempted from controls. Nevertheless, it must be anticipated that it may take many years before levels of individual exposure as a result of contaminated food could be qualified as negligible.

Annex 2

ASSESSMENT OF HUMAN INTERNAL EXPOSURE WHEN THE GUIDELINE LEVELS ARE APPLIED

For the purpose of assessment of the mean public exposure level in a country caused by the import of food products from foreign areas with residual radioactivity, in implementing the present guideline levels the following data should be used: annual food consumption rates for infants and adults, radionuclide- and age-dependent ingestion dose coefficients and the import/production factors. When assessing the mean internal dose in infants and adults it is suggested that due to monitoring and inspection the radionuclide concentration in imported foods does not exceed the present guideline levels. Using cautious assessment approach it is considered that all the foodstuffs imported from foreign areas with residual radioactivity are contaminated with radionuclides at the present guideline levels.

Then, the mean internal dose of the public, E (mSv), due to annual consumption of imported foods containing radionuclides can be estimated using the following formula:

$$E = GL(A) \cdot M(A) \cdot e_{ing}(A) \cdot IPF$$

where:

$GL(A)$ is the Guideline Level (Bq/kg)

$M(A)$ is the age-dependent mass of food consumed per year (kg)

$e_{ing}(A)$ is the age-dependent ingestion dose coefficient (mSv/Bq)

IPF is the import/production factor[9] (dimensionless).

Assessment results presented in Table 2 both for infants and adults demonstrate that for all the twenty radionuclides doses from consumption of imported foods during the 1st year after major radioactive contamination do not exceed 1 mSv. It should be noted that the doses were calculated on the basis of a value for the IPF equal to 0.1 and that this assumption may not always apply, in particular to infants who have a diet essentially based on milk with little variety.

It should be noted that for ^{239}Pu as well as for a number of other radionuclides the dose estimate is conservative. This is because elevated gastro-intestinal tract absorption factors and associated ingestion dose coefficients are applied for the whole first year of life whereas this is valid mainly during suckling period recently estimated by ICRP to be as average first six months of life (ICRP, 2005[10]). For the subsequent six months of the first year of life the gut absorption factors are much lower. This is not the case for ^{3}H, ^{14}C, ^{35}S, iodine and caesium isotopes.

As an example, dose assessment for ^{137}Cs in foods is presented below for the first year after the area contamination with this nuclide.

For adults: $E = 1000$ Bq/kg $\cdot 550$ kg $\cdot 1.3 \cdot 10^{-5}$ mSv/Bq $\cdot 0.1 = 0.7$ mSv;

For infants: $E = 1000$ Bq/kg $\cdot 200$ kg $\cdot 2.1 \cdot 10^{-5}$ mSv/Bq $\cdot 0.1 = 0.4$ mSv

9 The import/production factor (*IPF*) is defined as the ratio of the amount of foodstuffs imported per year from areas contaminated with radionuclides to the total amount produced and imported annually in the region or country under consideration.

10 International Commission on Radiological Protection (2005) Doses to Infants from Radionuclides Ingested in Mothers Milk. To be published.

TABLE 2

ASSESSMENT OF EFFECTIVE DOSE FOR INFANTS AND ADULTS FROM INGESTION OF IMPORTED FOODS IN A YEAR

Radionuclide	Guideline Level (Bq/kg)		Effective dose (mSv)	
	Infant foods	Other foods	1st year after major contamination	
			Infants	Adults
^{238}Pu			**0.08**	**0.1**
^{239}Pu	**1**	**10**	**0.08**	**0.1**
^{240}Pu			**0.08**	**0.1**
^{241}Am			**0.07**	**0.1**
^{90}Sr			**0.5**	**0.2**
^{106}Ru			**0.2**	**0.04**
^{129}I	**100**	100	**0.4**	**0.6**
^{131}I			**0.4**	**0.1**
^{235}U			**0.7**	**0.3**
^{35}S*			**0.2**	**0.04**
^{60}Co			**1**	**0.2**
^{89}Sr			**0.7**	**0.1**
^{103}Ru	**1000**	**1000**	**0.1**	**0.04**
^{134}Cs			**0.5**	**1**
^{137}Cs			**0.4**	**0.7**
^{144}Ce			**1**	**0.3**
^{192}Ir			**0.3**	**0.08**
^{3}H**			**0.002**	**0.02**
^{14}C	**1000**	**10000**	**0.03**	**0.3**
^{99}Tc			**0.2**	**0.4**

* This represents the value for organically bound sulphur.
** This represents the value for organically bound tritium.
See for "Scientific justification for the Guideline Levels" (Annex 1) and the "Assessment of human internal exposure when the Guideline Levels are applied" (Annex 2).

VINYL CHLORIDE MONOMER

Reference to JECFA:	28 (1984)
Toxicological guidance:	Provisional Acceptance (1984, the use of food-contact materials from which vinyl chloride may migrate is provisionally accepted, on condition that the amount of the substance migrating into food is reduced to the lowest level technologically
Residue definition:	Vinylchloride monomer
Synonyms:	Monochloroethene, chloroethylene; abbreviation VC or VCM
Related Code of Practice:	Code of Practice for Source Directed Measures to Reduce Contamination of Foods with Chemicals (CAC/RCP 49-2001)

Commodity/Product Code	Name	Level mg/kg	Suffix	Type	Reference	Notes/Remarks for Codex Alimentarius
	Food	0.01		GL		The GL in food packaging material is 1.0 mg/kg.

Vinylchloride monomer is the main starting substance for the manufacture of polymers which are used as resins, as packaging material for foods. Vinyl chloride is not known to occur as a natural product. Residues of VCM may be still present in the polymer. Vinyl chloride is considered by IARC to be a human carcinogen (as has been shown in occupational exposure situations).

SCHEDULE II – MAXIMUM AND GUIDELINE LEVELS FOR CONTAMINANTS AND TOXINS IN FOODS

(to be developed after finalisation of the Food Category System)