ESTIMATION OF MAXIMUM RESIDUE LEVELS FOR PESTICIDES IN/ON SPICES

First draft prepared by Árpád Ambrus, Centre for Plant Protection and Soil Conservation Service, Hungary

EXPLANATION

The setting of MRLs for spices was discussed by the CCPR on several occasions. At the 35th Session there was considerable discussion on the spice industry's proposal to include dried chili peppers in the list of spices under Group 028 of the FAO Classification of Foods and Feeds. The CCPR noted that "MRLs existed for fresh chili peppers and other peppers for a number of pesticides and that GAP and trial data were required to establish MRLs for those commodities".

The 36th Session agreed that chili peppers fell outside the definition of spices for the purposes of setting Codex MRLs. However it requested the JMPR to review the existing MRLs on peppers with a view to setting MRLs for dried chili peppers using processing/dehydration factors as appropriate (ALINORM 04/07/24). The industry was encouraged to submit to the JMPR any processing study that would support the derivation of such dehydration factor(s).

Furthermore the CCPR recommended that for the establishment of MRLs for spices based on monitoring data (ALINORM 04/24):

- The commodity group 028 for spices be divided into sub-groups, and that MRLs should be set for these instead of for each of the pesticide/spice combinations.
- MRLs for spices could be established for pesticides that are already in the Codex system.

The 2002 JMPR prepared guidelines for the format of submission of monitoring data for evaluation.

The Indian Spice Board, the American Spice Trade Association (ASTA), the European Spice Association (ESA), and the government of Egypt provided data from pesticide monitoring programmes carried out from 1996 to 2003, and the delegation of South Africa co-ordinated the submission of the results to the JMPR.

The spice trade industry (IOSTA) provided the JMPR with the rationale for the use of the dehydration or concentration factor for estimating residues of pesticides in chili peppers derived from residues in fresh peppers.

Note: the term "dehydration factor" used by some authorities is the same as "concentration factor", i.e. the degree of concentration of the residues after drying.

The JMPR reviewed the reported data and estimated maximum residue levels for the spice sub-groups and for dried chili peppers based on the MRLs for peppers (VO 0051, VO 0444, VO 0445) adhering as closely as possible to the agreed criteria set forth by the CCPR.

Assessment of monitoring data

The residue data reported were obtained from the analysis of random spice samples submitted by exporting countries before shipment or by importing countries upon arrival of the consignments. No details were given of the sampling frequency or procedures or sample sizes.

The ESA also submitted residue data for several commodities that are not in the current Group 028 classification.

Analytical methods

The samples were analysed by ASTA and India by the multi-residue procedures summarised below in Table 1. Typical mean recoveries and limits of quantification, LOQs, are given in Tables 2 and 3.

Table 1. Multi-residue methods used in the monitoring programmes of ASTA and India.

Pesticides	Analytical method	Summary
Organophosphorus (OP)	U.S. Food and Drug Administration Pesticide Analytical Manual (FDA PAM) Vol.1, 3rd Edition, 1997, E4 and C5)	Extraction: acetone-water Clean-up: Florisil Detection: capillary GC with NP detector (PAM DG 17)
Organochlorine (OC)	Official Methods of AOAC International, Vol. 1, 17th Edition, 2000. Method 970.52	Extraction: acetonitrile-water Clean-up: sulfuric acid Detection: capillary GC with ECD detector (PAM DG 13)
Pyrethroid (PY)	Official Methods of AOAC International, Vol. 1, 17th Edition, 2000. Method 970.52	Extraction: acetonitrile-water Clean-up: Florisil (PAM C5) Detection: capillary GC with ECD detector (PAM DG 10)

Table 2. Average recovery data for four years.

Pesticide	Spike level, mg/kg	Recovery, %
Acephate	0.2	70
Azinphos-methyl	0.2	150
Chlorpyrifos	0.6	72
Cypermethrin	0.2	100
Diazinon	0.2	100
Dichlorvos	0.2	95
Dimethoate	0.2	100
Disulfoton	0.2	100
Endosulfan	0.05	102
Ethion	0.2	150
Fenitrothion	0.6	72
Malathion	0.6	72
Methamidophos	0.2	95
Mevinphos	0.2	105
Parathion	0.6	72
Parathion-methyl	0.2	100
Permethrin	0.05	118
Phorate	0.2	100
Pirimiphos-methyl	0.6	72
Quintozene	0.05	102

Table 3. Reported limits of quantification.

Pesticide	ESA (mg/kg)	ASTA/India (mg/kg)
Acephate	0.02	0.2
Azinphos-methyl	0.1	0.5
Chlorpyrifos	0.05	0.05
Cypermethrin	0.05	0.05
Diazinon	0.05	0.1
Dichlorvos (DDVP)	0.1	0.1
Dimethoate	0.05	0.1
Disulfoton	0.05	0.05
Endosulfan	0.1	0.03
Ethion	0.05	0.1
Fenitrothion	0.05	0.1
Malathion	0.05	0.1

Pesticide	ESA (mg/kg)	ASTA/India (mg/kg)
Methamidophos	0.01	0.1
Methyl parathion	0.1	0.1
Mevinphos	0.05	0.2
Parathion	0.1	0.1
Permethrin	0.05	0.05
Phorate	0.05	0.1
Pirimiphos-methyl	0.05	0.1
Quintozene	0.01	0.01

The spice samples in Egypt were analysed by a modified version of the AOAC Official Methods of Analysis (985.22, 1995). Dry samples of herbs, spices and cereals, which might contain considerable amounts of oils, were mixed with de-ionized water (10 g/50 ml). The analyses were then carried out for high-moisture samples. The residues in purified extracts were separated on apolar and medium polarity capillary columns and quantified with NP detectors. The average recoveries ranged from 80 to 106% with a relative standard deviation of <20%. The reported LOQs were between 0.05 and 0.5 mg/kg depending on the compound and sample.

Selection of residue data for evaluation

With the agreed 2004 CCPR criteria as a basis, the following data collation and preliminary analysis process was followed in deciding upon the list of pesticides for consideration of MRLs on spices.

- Only pesticides already in the Codex system were considered.
- Pesticides with national registrations on any commodity in either the exporting or importing country were included.
- Persistent pesticides that have been banned for use in crop protection (e.g. DDT, Aldrin, Heptachlor, Endrin, etc.) were excluded.
- Only residues on the spices in the modified Group 028 were considered. For example, data for herbs, dried onions, chilies, etc. were excluded.
- As poppy seed (SO 0698), mustard seeds (SO 0090) and sesame seed (SO 0700) are used as a major food ingredient in several countries, they were not considered among spices.
- Only those data bases were considered which included at least 58-59 data points (satisfying the 95th percentile coverage with 95% confidence), preferably for more than one sub-group of spices. Exceptions to this minimum requirement were made when all residues were below the LOQ. The 95% confidence limit was chosen as it better reflects usual practice and is also used as a criterion for establishing the variability factor for acute exposure assessment.

Nineteen organophosphorus, three organochlorine, two dicarboximide, one acylalanine, one carbamate and two synthetic pyrethroid pesticides were selected for the establishment of MRLs on spices. The selected compounds, the numbers of the Tables containing details of the residues of the selected compounds are given in Table 4.

Table 4. Pesticides selected for the establishment of MRLs for spices.

Pesticide	Table no.
Acephate	5
Azinphos-methyl	6
Chlorpyrifos	7
Chlorpyrifos-methyl	8
Cypermethrin	9

Pesticide	Table no.
Diazinon	10
Dichlorvos	11
Dicofol	12
Dimethoate	13
Disulfoton	14
Endosulfan	15
Ethion	16
Fenitrothion	17
Iprodione	18
Malathion	19
Metalaxyl	20
Methamidophos	21
Mevinphos	22
Parathion	23
Parathion-methyl	24
Permethrin	25
Phenthoate	26
Phorate	27
Phosalone	28
Pirimicarb	29
Pirimiphos-methyl	30
Quintozene	30
Vinclozolin	31

Each summary Table shows the origin of the spices, the year the data were compiled, the number and range of residues detected, the total number of samples for each sub-group, the highest residue (HR) and the median residue, which can be used in the same way as the STMR derived from supervised trials.

In the Tables the residue values reported as "0" are replaced by "<LOQ", the median was calculated from all reported residue values including <LOQ, and no data point was considered as an outlier.

Table 5. Summary of monitoring data for acephate residues in spices.

Spice		Country/ Year(s)	Residues (mg/kg) [1,2]			
Group	Name		No.	Median	Max	Detections
Seed	Anise	Canada, 1999 Syria, 2002-2003 Turkey, 1999-2003	15	<0.2	<0.2	0
Seed	Celery seed	India, 1999-2003 EU, 1996-1998	8	<0.11	<0.2	0
Seed	Coriander	Bulgaria, 1999 EU, 1996-1998 Canada, 1992	10	<0.02	<0.2	0
Seed	Cumin	EU., 1996-1998 India, 2000 Pakistan, 2000 Syria, 2001-2003 Turkey, 1999-2003	20	<0.2	<0.2	0
Seed	Dill seed	Australia, 1999 Canada, 1999/2001 India, 1999-2003	10	<0.2	<0.2	0
Seed	Fennel seed	EU, 1998 India, 2002-2003	5	<0.2	<0.2	0

Spice		Country/ Year(s)	Residues (mg/kg) [1,2]			
Group	Name		No.	Median	Max	Detections
Seed	Fenugreek	Canada, 2003 India, 2001-2003	4	<0.2	<0.2	0
Seed	Nutmeg	Guatemala, 2002-2003 Indonesia, 2000-2003 EU, 1998	7	<0.2	<0.2	0
SEEDS	TOTAL	1996-2003	79	0.2	0.2	0
Fruit or berry	Allspice	Jamaica, 1999 Mexico, 2003 EU, 1996-1998	4	<0.11	<0.2	0
Fruit or berry	Caraway	US, 2000-2001 EU, 1996-1998	12	<0.02	<0.2	0
Fruit or berry	Cardamom	India, 2001 EU, 1996-1998 Guatemala, 2001-2003	10	<0.02	<0.2	0
Fruit or berry	Juniper	EU, 1998	2	<0.02	<0.02	0
Fruit or berry	Pepper, black, white, pink	EU, 1996-1998; Brazil, 2001-2002 Ecuador, 1999 India, 2000-2003 Indonesia, 2001-2003 Malaysia, 2003 New Guinea, 1999 Vietnam, 1999-2002	48	<0.02	<0.2	0
Fruit or berry	Vanilla	EU, 1998	1	<0.02	<0.02	0
FRUITS	TOTAL	1996-2003	77	0.2	0.2	0
Roots/ Rhizome	Ginger	China, 2001; EU, 1996-1998 India, 2000-2001	30	<0.02	<0.2	0
Roots/ Rhizome	Turmeric	Brazil, 2003 EU, 1996-1998 India, 1999 Vietnam, 2003	12	<0.02	<0.2	0
ROOTS	TOTAL	1996-2003	42	0.02	0.2	0
Bark	Cassia	EU, 1998 Indonesia, 1999 Vietnam, 2001-2003	4	<0.2	<0.2	0
Bark	Cinnamon	EU, 1996–1998 Vietnam, 2001-2003	10	<0.2	<0.2	0
Buds	Cloves	Brazil, 2002 Madagascar, 99-2000	4	<0.2	<0.2	0
Aril	Mace	EU, 1996-1998 India, 2001-2003 Indonesia, 2002	9	<0.2	<0.2	0
BARK, BUDS, ARIL	TOTAL, MISC-	1996-2003	27	0.2	0.2	0

[1] Method described in Table 2 for organophosphorus screening.
[2] LOQ 0.2 mg/kg for data from ASTA and India; 0.02 for data from EU.

Table 6. Summary of monitoring data for azinphos-methyl residues in spices.

Spice		Country/ Year(s)	Residues (mg/kg) [1, 2]			
Group	Name		No.	Median	Max	Detections
Seed	Anise	Canada, 1999; Syria, 2002-2003 Turkey, 1999-2003 EU, 1998	16	<0.5	<0.5	0
Seed	Celery seed	EU, 1996-1998 India, 1999-2003	8	<0.3	<0.5	0
Seed	Coriander	Bulgaria, 1999 Canada, 1999 EU, 1996-1998	11	<0.1	<0.5	0

Spice		Country/ Year(s)	Residues (mg/kg) [1, 2]			
Group	Name		No.	Median	Max	Detections
Seed	Cumin	EU, 1996-1998 India, 2000 Pakistan, 2000 Syria, 2001-2003 Turkey, 1999-2003	24	<0.5	<0.5	0
Seed	Dill seed	Australia, 1999 Canada, 1999 India, 1999-2003	8	<0.5	<0.5	0
Seed	Fennel seed	EU, 1996-19998 India, 2002-2003	7	<0.1	<0.5	0
Seed	Fenugreek	Canada, 2000 India, 2001-2003 EU, 1996-1998	5	<0.5	<0.5	0
Seed	Nutmeg	Guatemala, 2002 –2003 EU, 1998 Indonesia, 2000-2003 US-2001	7	<0.5	<0.5	0
SEEDS	TOTAL	1996-2003	86	0.5	0.5	0
Fruit or berry	Allspice	EU, 1996-1998 Jamaica, 1999 Mexico, 2002	6	<0.1	<0.5	0
Fruit or berry	Caraway	US, 2000	15	<0.1	<0.5	0
Fruit or berry	Cardamom	EU, 1996-1998 Guatemala, 2002-2003 India, 2001	10	<0.1	<0.5	0
Fruit or berry	Juniper	EU, 1998	2	<0.1	<0.1	0
Fruit or berry	Pepper, black, white, pink	EU, 1996-1998 Brazil, 2001-2002 Ecuador, 1999 India, 2000-2003 Indonesia, 2001-2003 Malaysia, 2003 New Guinea, 1999 Vietnam, 1999-2002	58	<0.1	<0.5	0
Fruit or berry	Vanilla	EU, 1998	1	<0.1	<0.1	0
FRUITS	TOTAL	1996-2003	92	0.1	0.5	0
Roots/ Rhizome	Ginger	China, 2001 EU, 1996-1998 India, 2000-2001	32	<0.1	<0.5	0
Roots/ Rhizome	Turmeric	EU, 1996-1998 India, 1999 Vietnam, 2003	14	<0.1	<0.5	0
ROOTS	TOTAL	1996-2003	46	0.1	0.5	0
Aril	Mace	India, 2001-2003 Indonesia, 2002 EU, 1996-1998	10	<0.1	<0.5	0
Bark	Cassia	EU, 1996-1998 Indonesia, 1999 Vietnam, 2001-2003	12	<0.1	<0.5	0
Bark	Cinnamon	EU, 1996-1998 Vietnam, 2000-2003	10	<0.1	<0.5	0
Buds	Cloves	Madagascar, 1999 –2000 Brazil, 2002	4	<0.5	<0.5	0
BARK, BUDS, ARIL	TOTAL, MISC-	1996-2003	36	0.1	0.5	0

[1] Method described in Table 1 for organophosphorus screening.
[2] LOQ 0.5 mg/kg for data from ASTA and India; 0.1 for data from EU.

Table 7. Summary of monitoring data for chlorpyrifos residues in spices.

Spice		Country/ Year(s)	Residues (mg/kg) [1, 2]			
Group	Name		No.	Median	Max	Detections
Seed	Anise	Canada, 1999 EU, 1996-1998 Syria, 2002-2003 Turkey, 1999-2003	18	0.05	0.05	0.05
		Egypt 1996-2001	744	0.05	3.6	0.01, 0.01, 0.05, (11) , 0.06 (7), 0.07 (8), 0.08, (9), 0.09 (4), 0.1, 0.1, 0.11 (3), 0.13 (6), 0.14 (6), 0.15, 0.17, 0.17, 0.18, 0.21 (3), 0.22, 0.23, 0.32, 0.33, 0.36, 0.5, 0.5, 0.54, 0.9, 1.8, 2, 3, 3.6
Seed	Celery seed	EU, 1996-1998 India, 1999-2003	55	<0.05	0.18	0.18
Seed	Coriander	Bulgaria, 1999 Canada, 1999 EU, 1996-1998 India, 2000	49	<0.05	0.41	0.25, 0.41
Seed	Cumin	EU, 1996-1998 India, 2000-2003 Pakistan, 2000 Syria, 2001-2003 Turkey, 1999-2003	39	<0.05	0.54	0.12, 0.15, 0.16, 0.26, 0.44, 0.54 0.54
Seed	Dill seed	Australia, 1999 Canada, 1999-2001 EU, 1996-1998 India, 1999-2003	19	<0.05	<0.05	0
Seed	Fennel seed	EU, 1996-1998 India, 2002-2003	9	<0.05	<0.05	0
		Egypt	121 9	<0.05	1.4	0.05, 0.05, 0.06, 0.07, 0.08, 0.1, 0.1, 0.11 (5), 0.13, 0.14, 0.15, 0.22, 0.22, 1.4
Seed	Fenugreek	India, 2001-2003 Canada, 2000	5	<0.05	<0.05	0
Seed	Nutmeg	EU, 1996-1998 Guatemala, 2002-2003 India, 2003 Indonesia, 2000-2003 US, 2001	8	<0.05	<0.05	0
SEEDS	TOTAL	1996-2003	216 5	0.05	3.6	124/ (0.01-3.6)
Fruit or berry	Allspice	EU, 1996-1998 Jamaica, 1999 Mexico, 2002	7	<0.05	<0.05	0
Fruit or berry	Caraway	US, 2000-2002 EU, 1996-1998	18	<0.05	<0.05	0
Fruit or berry	Cardamom	EU, 1996-1998 Guatemala, 2001-2003 India, 2001-2003	14	<0.05	0.11	0.05, 0.06, 0.07, 0.11
Fruit or berry	Juniper	EU, 1996-1998	5	<0.05	<0.05	0
Fruit or berry	Pepper, black, white, pink	EU, 1996-1998 India, 2001-2002 Brazil, 2001-2002 Ecuador, 1999 Indonesia, 2001-2003 Malaysia, 2003 New Guinea, 1999 Vietnam, 1999-2002	104	<0.05	0.71	0.05, 0.08, 0.20, 0.54 0.71
Fruit or berry	Vanilla	EU, 1996-1998	7	<0.05	<0.05	0
FRUITS	TOTAL	1996-1998	155	0.05	0.71	9/ (0.05-0.71)

Spice		Country/ Year(s)	Residues (mg/kg) [1, 2]			
Group	Name		No.	Median	Max	Detections
Roots/ Rhizome	Ginger	EU, 1996-1998 China, 2001 India, 2000-2003	127	<0.05	0.37	0.05, 0.24, 0.28, 0.31, 0.37
Roots/ Rhizome	Turmeric	Brazil, 2003 India, 2000-2003 Vietnam, 2003 EU, 1996-1998	143	<0.05	0.72	0.13, 0.72
ROOTS	TOTAL	1996-2003	270	0.05	0.72	7/ (0.05-0.72)
Bark	Cassia	EU, 1996-1998 Indonesia, 1999 Vietnam, 2001-2003	12	<0.05	0.05	0.05
Bark	Cinnamon	EU, 1996-1998 India, 2003 Vietnam, 2000-2003	15	<0.05	0.05	0.05, 0.05
Buds	Cloves	Madagascar, 1999-2000 Brazil, 2002 India, 2003	5	<0.05	<0.05	0
Aril	Mace	India, 2001-2003 EU, 1996-1998 Indonesia, 2002	10	<0.05	<0.05	0
BARK, BUDS, ARIL	TOTAL, MISC-	1996-2003	42	0.05	0.05	3/ (0.05)

[1] Method as described in Table 2 for organophosphorus screening.
[2] LOQ 0.05 mg/kg for data from all sources.

Table 8. Summary of monitoring data for chlorpyrifos-methyl residues in spices.

Spice		Country/ Year(s)	Residues (mg/kg) [1,2]			Detections
Group	Name		No.	Median	Max	
Seed	Anise	EU	3		0.05	0.02, 0.02
		Egypt, 1996-2001	980	<0.05	0.39	0.05, 0.05, 0.06 (4), 0.07, 0.07, 0.08 (6), 0.09 (8), 0.1 (5), 0.11, 0.12, 0.12, 0.13 (3), 0.14, 0.15, 0.15, 0.16 (4), 0.17, 0.18, 0.18, 0.19, 0.2, 0.2, 0.22 (3), 0.24, 0.24, 0.25, 0.28, 0.3, 0.31, 0.32, 0.38, 0.39
Seed	Celery seed	EU	49	<0.05	0.05	0.01
Seed	Coriander	EU	19	<0.05	0.05	0.01
Seed	Cumin	EU Turkey 1999-2003	24	<0.05	0.05	0
Seed	Dill seed	EU	8	<0.05	0.05	0
Seed	Fennel seed	EU	6	<0.05	0.05	0
		Egypt, 1996-2001	339	<0.05	0.16	0.16, 0.12, 0.08, 0.07
Seed	Nutmeg	EU	2		0.050	0
		Indonesia 2000-2003	2		0.050	0
	SEEDS	TOTAL	1432	<0.05	0.39	66(0.01-0.39)
Fruit or berry	Allspice	EU	5	<0.05	0.05	0
Fruit or berry	Caraway	EU Egypt, 1996-2001	13 143	<0.05	0.05	0.1 0.06, 0.12
Fruit or berry	Cardamom	EU	8	<0.05	0.05	0
Fruit or berry	Juniper	EU	5	<0.05	0.05	0
Fruit or berry	Pepper	EU	42	<0.05	0.05	0.01
Fruit or berry	Vanilla	EU	7	<0.05	0.05	0
	FRUITS	TOTAL	223			4(0.01-0.12)
Roots/Rhizome	Ginger	EU	22	0.077	2.93	0.03, 0.03, 0.031, 0.034, 0.034, 0.037, 0.050, 0.060, 0.070, 0.071, 0.073, 0.082, 0.089,

Spice		Country/ Year(s)	Residues (mg/kg) [1,2]			Detections
Group	Name		No.	Median	Max	
						0.091, 0.098, 0.135, 0.138, 0.138, 0.161, 0.294, 0.390, 2.93
Roots/Rhizome	Turmeric	EU	120	<0.01	0.038	0.013 (12), 0.017, 0.038
	ROOTS	TOTAL	142	0.01	2.93	36/0.013-0.038
Bark	Cassia	EU	9	<0.05	0.05	0.05
Bark	Cinnamon	EU	10	<0.05	0.05	0.05, 0.05
Aril	Mace	EU	6	<0.05	0.05	0
	BARK, BUDS, ARIL	TOTAL	25	0.05	0.05	2(0.05)

[1] Method as described in Table 2 for organophosphorus screening.
[2] LOQ 0.05 mg/kg for data from all sources.

Table 9. Summary of monitoring data for cypermethrin residues in spices.

Spice		Country/ Year(s)	Residues (mg/kg) [1]			
Group	Name		No.	Median	Max	Detections
Seed	Anise	EU, 1998	1	<0.05	<0.05	0
Seed	Bishop's weed	India, 2003	1	<0.05	<0.05	0
Seed	Celery seed	EU, 1996-1998 India, 2002	6	<0.05	0.93	0.93
Seed	Coriander	India, 2001-2003	10	<0.05	0.15	0.15
Seed	Cumin	India, 2001-2003 Turkey, 1999-2003	10	<0.05	0.142	0.142
Seed	Dill seed	India, 2002	2	<0.05	0.076	0.076
Seed	Fennel seed	EU, 1996-1998 India, 2003	4	<0.05	<0.05	0
Seed	Fenugreek	India, 2001	2	<0.05	0.085	0.085
Seed	Nutmeg	Indonesia, 2000-2003	2	<0.05	<0.05	0
SEEDS	TOTAL	1996-2003	38	0.05	0.93	5/ (0.076-0.93)
Fruit or berry	Allspice	EU, 1996-1998	4	<0.05	<0.05	0
Fruit or berry	Cardamom	India, 2003	2	<0.05	<0.05	0
Fruit or berry	Juniper	EU, 1996	1	<0.05	<0.05	0
Fruit or berry	Pepper, black, white, pink	EU, 1996-1998 India, 2001-2003	57	<0.05	0.065	0.065
Fruit or berry	Vanilla	EU, 1998	1	<0.05	<0.05	0
FRUITS	TOTAL	1996-1998	65	0.05	0.065	1(0.065)
Roots/ Rhizome	Ginger	EU, 1996-1998 India, 2001-2003	6	<0.05	0.05	0.05
Roots/ Rhizome	Turmeric	India, 2000-2003	52	<0.05	0.118	0.11, 0.12
ROOTS	TOTAL	1996-2003	58	0.05	0.118	3/ (0.05–0.12)
Bark	Cassia	EU, 1996-1998	8	<0.05	<0.05	0
Bark	Cinnamon	EU, 1996-1998 India, 2003	4	<0.05	<0.05	0
Aril	Mace	EU, 1998	1	<0.05	<0.05	0
BARK, BUDS, ARIL	TOTAL, MISC-	1996-2003	13	0.05	<0.05	0

[1] LOQ 0.05 mg/kg for data from all sources.

Table 10. Summary of monitoring data for diazinon residues in spices.

Spice		Country/ Year(s)	Residues (mg/kg) [1, 2]			
Group	Name		No.	Median	Max	Detections
Seed	Anise	Canada, 1999 EU, 1996-1998 Syria, 2002-2003 Turkey, 1999-2003	18	<0.1	<0.1	0
		Egypt, 1996-2001	667	<0.05	3.6	0.05, 0.06 (4), 0.07, 0.08, 0.08, 0.09 (3), 0.1, 0.1, 0.11, 0.12, 0.12, 0.13, 0.14 (4), 0.15 (3), 0.16, 0.16, 0.17 (4), 0.18, 0.18, 0.19 (3), 0.21, 0.22, 0.24, 0.28, 0.3, 0.32, 0.32, 0.33, 0.33, 0.35, 0.37, 0.39, 0.41, 0.42, 0.42, 0.47, 0.473, 0.48, 0.51, 0.59, 0.6, 0.82, 0.88, 0.9, 1.1, 1.1, 1.2, 1.3, 1.8, 1.8, 2.1, 2.7, 3.5, 3.6
Seed	Celery seed	EU, 1996-1998 India, 1999-2003	53	<0.05	0.29	0.1, 0.14, 0.29
Seed	Coriander	Bulgaria, 1999 Canada, 1999 EU, 1996-1998	28	<0.05	<0.1	0
Seed	Cumin	EU, 1996-1998 India, 2000 Pakistan, 2000 Syria, 2001-2003 Turkey, 2000-2003	21	<0.1	0.1	0.1
Seed	Dill seed	Australia, 1999 Canada, 1999-2001 EU, 1996-1999 India, 1999-2003	18	<0.1	<0.1	0
Seed	Fennel seed	EU, 1996-1998 India, 2002-2003	9	<0.05	<0.1	0
		Egypt, 1996-2001	734			0.06 (3), 0.05, 0.05, 0.07, 0.07, 0.07, 0.08, 0.08, 0.1, 0.1, 0.1, 0.12, 0.17, 0.17, 0.19, 0.2, 0.21, 0.23, 0.24, 0.24, 0.26, 0.45, 0.59, 0.65, 0.72, 0.76, 0.77, 1.2, 1.7
Seed	Fenugreek	Canada, 2000 India, 2001-2003	4	<0.1	<0.1	0
Seed	Nutmeg	EU, 1998 Guatemala, 2002-2003 Indonesia, 2000-2003 US, 2001	7	<0.1	<0.1	0
SEEDS	TOTAL	1996-2003	1559	0.05	1.7	104/ (0.05-3.6)
Fruit or berry	Allspice	EU, 1996-1998 Jamaica, 1999 Mexico, 2002	7	<0.05	<0.1	0
Fruit or berry	Caraway	EU, 1996-1998 US, 2000	18	<0.05	<0.1	0
Fruit or berry	Cardamom	EU, 1996-1998 Guatemala, 2001-2003 India, 2001	12	<0.05	<0.1	0
Fruit or berry	Juniper	EU, 1996-1998	5	<0.05	<0.05	0
Fruit or berry	Pepper, black, white, pink	EU, 1996-1998 Brazil, 2001-2002 Ecuador, 1999 India, 2000-2003 Indonesia, 2001-2003 New Guinea, 1999 Malaysia, 2003 Vietnam, 1999-2003	66	<0.05	<0.1	0
Fruit or berry	Vanilla	EU, 1996-1998	7	<0.05	<0.05	0
FRUITS	TOTAL	1996-2003	115	0.05	0.1	0

Spice		Country/ Year(s)	Residues (mg/kg) [1, 2]			
Group	Name		No.	Median	Max	Detections
Roots/ Rhizome	Ginger	EU, 1996-1998 India, 2000-2003 China, 2001	121	<0.05	<0.1	0
Roots/ Rhizome	Turmeric	Brazil, 2003 EU, 1996-1998 India, 1999 Vietnam, 2003	113	<0.05	0.26	0.23, 0.26
ROOTS	TOTAL	1996-2003	234	0.05	0.26	2/ (0.23-0.26)
Bark	Cassia	EU, 1996-1998 Indonesia, 1999 Vietnam, 2001-2003	12	<0.05	<0.1	0
Bark	Cinnamon	EU, 1996-1998 Vietnam, 2000-2003	14	<0.05	<0.1	0
Bud	Cloves	Madagascar, 1999-2000 Brazil, 2002	4	<0.1	<0.1	0
Aril	Mace	EU, 1996-1998 India, 2001-2003 Indonesia, 2002	10	<0.05	<0.1	0
BARK, BUDS, ARIL	TOTAL, MISC-	1996-2003	40	0.05	0.1	0

[1] Method as described in Table 2 for organophosphorus screening.
[2] LOQ 0.1 mg/kg for data from ASTA and India; 0.05 mg/kg for data from Egypt and EU.

Table 11. Summary of monitoring data for dichlorvos residues in spices.

Spice		Country/ Year(s)	Residues (mg/kg) [1, 2]			
Group	Name		No.	Median	Max	Detections
Seed	Anise	Canada, 1999 EU, 1996-1998 Syria, 2002-2003 Turkey, 1999-2003	16	<0.1	<0.1	0
Seed	Celery seed	EU, 1996-1998 India, 1999-2003	8	<0.1	<0.1	0
Seed	Coriander	Bulgaria, 1999 Canada, 1999 EU, 1996-1998	14	<0.1	<0.1	0
Seed	Cumin	EU, 1996-1998 India, 2000 Pakistan, 2000 Syria, 2001-2003 Turkey, 2000-2003	18	<0.1	<0.1	0
Seed	Dill seed	Australia, 1999 Canada, 1999-2001 India, 1999-2003	10	<0.1	<0.1	0
Seed	Fennel seed	EU, 1996-1998 India, 2002-2003	7	<0.1	<0.1	0
Seed	Fenugreek	Canada, 2000 India, 2001-2003	4	<0.1	<0.1	0
Seed	Nutmeg	EU, 1998 Guatemala, 2002-2003 Indonesia, 2000-2003 US, 2001	7	<0.1	<0.1	0
SEEDS	TOTAL	1996-2003	84	0.1	0.1	0
Fruit or berry	Allspice	EU, 1996-1998 Jamaica, 1999 Mexico, 2002	6	<0.1	<0.1	0
Fruit or berry	Caraway	EU, 1996-1998 US, 2000	15	<0.1	<0.1	0

Spice		Country/ Year(s)	Residues (mg/kg) [1, 2]			
Group	Name		No.	Median	Max	Detections
Fruit or berry	Cardamom	EU, 1996-1998 Guatemala, 2001-2003 India, 2001	10	<0.1	<0.1	0
Fruit or berry	Juniper	EU, 1996-1998	3	<0.1	<0.1	0
Fruit or berry	Pepper, black, white, pink	EU, 1996-1998 Brazil, 2001-2002 Ecuador, 1999 India, 2000-2003 Indonesia, 2001-2003 New Guinea, 1999 Malaysia, 2003 Vietnam, 1999-2003	58	<0.1	<0.1	0
Fruit or berry	Vanilla	EU,1998	1	<0.1	<0.1	0
FRUITS	TOTAL	1996-2003	93	0.1	0.1	0
Roots/ Rhizome	Ginger	EU, 1996-1998 India, 2000-2003 China, 2001	32	<0.1	<0.1	0
Roots/ Rhizome	Turmeric	Brazil, 2003 EU, 1996-1998 India, 1999 Vietnam, 2003	16	<0.1	<0.1	0
ROOTS	TOTAL	1996-2003	48	0.1	0.1	0
Bark	Cassia	EU, 1996-1998 Indonesia, 1999 Vietnam, 2001-2003	12	<0.1	<0.1	0
Bark	Cinnamon	EU, 1996-1998 Vietnam, 2000-2003	10	<0.1	<0.1	0
Bud	Cloves	Madagascar, 1999-2000 Brazil, 2002	4	<0.1	<0.1	0
Aril	Mace	EU, 1996-1998 India, 2001-2003 Indonesia, 2002	10	<0.1	<0.1	0
BARK, BUDS, ARIL	TOTAL, MISC-	1996-2003	36	0.1	0.1	0

[1] Method as described in Table 2 for organophosphorus screening.
[2] LOQ 0.1 mg/kg for data from all sources.

Table 12. Summary of monitoring data for dicofol residues in spices.

Spice		Country/ Year(s)	Residues (mg/kg) [1]			Detections
Group	Name		No.	Median	Max	
Seeds	Anis	EU	3		0.05	0
Seeds	Coriander	EU	25		0.05	0
Seeds	Cumin	EU	18		0.05	0
Seeds	Cumin	Turkey 1999-2003	5		0.05	0
Seeds	Dill seed	EU	8		0.05	0
Seeds	Fennel	EU	6		0.05	0
Seeds	Nutmeg	Indonesia	1		0.05	0
Seeds	Nutmeg	Indonesia	1		0.05	0
	SEEDS		67	0.05	0.05	0
Fruit or berry	Caraway	EU	13		0.05	0
Fruit or berry	Cardamom	EU	18		0.05	0
Fruit or berry	Juniper	EU	5		0.05	0
Fruit or berry	Pepper	EU	42		0.05	0.05
Fruit or berry	Vanilla	EU	7		0.05	0
	FRUITS		85	0.05	0.05	1/0.05
Roots	Ginger	EU	118	0.05	0.05	0.05
Roots	Turmeric	EU	112	0.05	0.05	0.02. 0.035. 0.036

Spice		Country/ Year(s)	Residues (mg/kg) [1]			Detections
Group	Name		No.	Median	Max	
	ROOTS		230	0.05	0.05	4/0.02-0.05
Bark	Cassia	EU	18		0.05	0.05. 0.05
Bark	Cinnamon	EU	10		0.05	0.05, 0.05
Aril	Mace	EU	6		0.05	0
	TOTAL, MISC		34	0.05	0.05	4/0.05

[1] LOQ 0.05 mg/kg for data from all sources

Table 13. Summary of monitoring data for dimethoate residues in spices.

Spice		Country/ Year(s)	Residues (mg/kg) [1, 2]			
Group	Name		No.	Median	Max	Detections
Seed	Anise	Canada, 1999 EU, 1998 Syria, 2002-2003 Turkey, 1999-2003	16	<0.1	<0.1	0
		Egypt, 1996-2001	728	<0.05	3	0.05 (3), 0.06 (5), 0.07 (3), 0.08, 0.08, 0.09, 0.09, 0.1, 0.1, 0.12 (3), 0.13 (3), 0.14, 0.15 (4), 0.17, 0.17, 0.18, 0.24, 0.24, 0.25 (4), 0.27, 0.27, 0.28, 0.28, 0.29, 0.29, 0.32, 0.35, 0.36, 0.39, 0.41, 0.42, 0.43, 0.44, 0.46, 0.53, 0.53, 0.57, 0.62, 0.9, 1.4, 2.5, 3
Seed	Celery seed	EU, 1996-1998 India, 1999-2003	8	<0.075	<0.1	0
Seed	Coriander	Bulgaria, 1999 Canada, 1999 EU, 1996-1998 India 2000-2003	29	<0.1	<0.1	0
Seed	Cumin	EU, 1996-1998 India, 2000-2001 Pakistan, 2000 Syria, 2000-2003 Turkey, 1999-2003	34	<0.1	<0.1	0
Seed	Dill seed	Australia, 1999 Canada, 1999-2001 India, 1999-2003	10	<0.1	<0.1	0
Seed	Fennel seed	EU, 1996-1998 India, 2002-2003	7	<0.05	<0.1	0
		Egypt, 1996-2001	1277	<0.05	1.4	0.03, 0.05 (4), 0.06 (4), 0.07 (6), 0.08 (4), 0.09 (4), 0.1 (3), 0.11, 0.12, 0.13, 0.14 (3), 0.15 (4), 0.16, 0.18, 0.18, 0.2, 0.2, 0.21, 0.25, 0.25, 0.3, 0.32 (4), 0.33, 0.33, 0.34, 0.35, 0.37, 0.38, 0.38, 0.43, 0.43, 0.51 (4), 0.53, 0.53, 0.54, 0.94, 1.1, 1.4, 1.4
Seed	Fenugreek	Canada, 2000 India, 2001-2003	5	<0.1	<0.1	0
Seed	Nutmeg	EU, 1998 Guatemala, 2002-2003 Indonesia, 2000-2003 US, 2001	7	<0.1	<0.1	0
SEEDS	TOTAL	1996-2003	2121	0.05	3	130(0.05-3)
Fruit or berry	Allspice	EU, 1996-1998 Jamaica, 1999 Mexico, 2002	6	<0.05	<0.1	0
Fruit or berry	Caraway	EU, 1996-1998 US, 2000	15	<0.05	<0.1	0

Spice		Country/ Year(s)	Residues (mg/kg) [1, 2]			
Group	Name		No.	Median	Max	Detections
		Egypt, 1996-2001	277	<0.05	0.22	0.08, 0.17, 0.17, 0.22, 0.22
Fruit or berry	Cardamom	EU, 1996-1998 Guatemala, 2001-2003 India, 2001	11	<0.05	<0.1	0
Fruit or berry	Pepper, black, white, pink	EU, 1996-1998 Brazil, 2001-2002 Ecuador, 1999 India, 2001-2003 Indonesia, 2001-2003 New Guinea, 1999 Malaysia, 2003 Vietnam, 1999-2002	72	<0.1	<0.1	0
FRUITS	TOTAL	1996-2003	381	0.05	0.1	5(0.08-0.22)
Roots/ Rhizome	Ginger	EU, 1996-1998 India, 2000-2001 China, 2001	35	<0.05	<0.1	0
Roots/ Rhizome	Turmeric	Brazil, 2003 EU, 1996-1998 India, 1999-2003 Vietnam, 2003	40	<0.1	<0.1	0
ROOTS	TOTAL	1996-2003	75	0.05	0.1	0
Bark	Cassia	EU, 1996-1998 Indonesia, 1999 Vietnam, 2001-2003	12	<0.05	<0.1	0
Bark	Cinnamon	EU, 1996-1998 Vietnam, 2000-2003	10	<0.05	<0.1	0
Bud	Cloves	Madagascar, 1999-2000 Brazil, 2002	4	<0.1	<0.1	0
Aril	Mace	EU, 1996-1998 India, 2001-2003 Indonesia, 2002	10	<0.05	<0.1	0
BARK, BUDS, ARIL	TOTAL, MISC-	1996-2003	36	0.05	0.1	0

[1] Method as described in Table 2 for organophosphorus screening.
[2] LOQ 0.1 mg/kg for data from ASTA and India; 0.05 mg/kg for data from EU.

Table 14. Summary of monitoring data for disulfoton residues in spices.

Spice		Country/ Year(s)	Residues (mg/kg) [1, 2]			
Group	Name		No.	Median	Max	Detections
Seed	Anise	EU, 1998	1	<0.05	<0.05	0
Seed	Celery seed	EU, 1996-1998	4	<0.05	<0.05	0
Seed	Coriander	EU, 1996-1998 India 2000-2003	26	<0.05	<0.05	0
Seed	Cumin	EU, 1996-1998 India, 2000-2001 Turkey, 1999-2003	25	<0.05	<0.05	0
Seed	Fennel seed	EU, 1996-1998	4	<0.05	<0.05	0
Seed	Fenugreek	India, 2001	1	<0.05	<0.05	0
Seed	Nutmeg	EU, 1998 Indonesia, 2000-2003	6	<0.05	<0.05	0
SEEDS	TOTAL	1996-2003	67	0.05	0.05	0
Fruit or berry	Caraway	EU, 1996-1998	10	<0.05	<0.05	0
Fruit or berry	Cardamom	EU, 1996-1998 India, 2001	7	<0.05	<0.05	0
Fruit or berry	Pepper, black, white, pink	EU, 1996-1998	49	<0.05	<0.05	0
FRUITS	TOTAL	1996-2003	66	0.05	0.05	0
Roots/ Rhizome	Ginger	EU, 1996-1998 India, 2001	32	<0.05	<0.05	0

Spice		Country/ Year(s)	Residues (mg/kg) [1, 2]			
Group	Name		No.	Median	Max	Detections
Roots/ Rhizome	Turmeric	EU, 1996-1998 India, 2000-2003	37	<0.05	<0.05	0
ROOTS	TOTAL	1996-2003	69	0.05	0.05	0
Bark	Cassia	EU, 1996-1998	9	<0.05	<0.05	0
Bark	Cinnamon	EU, 1996-1998	6	<0.05	<0.05	0
Aril	Mace	EU, 1996-1998	6	<0.05	<0.05	0
BARK, ARIL	TOTAL, MISC-	1996-2003	21	0.05	0.05	0

[1] Method as described in Table 2 for organophosphorus screening.
[2] LOQ 0.05 mg/kg for data from all sources.

Table 15. Summary of monitoring data for endosulfan residues in spices.

Spice		Country/ Year(s)	Residues (mg/kg) [1]			
Group	Name		No.	Median	Max	Detections
Seed	Anise	EU, 1996-1998 Canada, 1999 Syria, 2002-2003 Turkey, 1999-2003	18	<0.03	<0.03	0
Seeds	Bishop's weed	India, 2000-2002	7	<0.03	<0.03	0
Seed	Celery seed	EU, 1996-1998 India, 2000– 2002	56	<0.1	0.20	0.1 (10), 0.12, 0.14, 0.20
Seed	Coriander	Bulgaria, 1999 Canada, 1999 EU, 1996-1998 India 2000-2003	95	<0.03	0.34	0.1, 0.34
Seed	Cumin	EU, 1996-1998 India, 2000-2003 Pakistan, 2000 Syria, 2001-2002 Turkey, 1999-2003	75	<0.03	0.63	0.035, 0.035, 0.038, 0.63
Seed	Dill seed	Australia, 1999 Canada, 1999-2001 EU, 1996-1998 India, 1999-2003	20	<0.03	0.45	0.45
Seed	Fennel seed	EU, 1996-1998 India, 2000-2003	38	<0.03	<0.1	0
Seed	Fenugreek	Canada, 2000 India, 2000-2003	15	<0.03	<0.03	0
Seed	Nutmeg	Guatemala, 2002-2003 Indonesia, 2000-2001 EU, 1998 US, 2001	7	<0.03	<0.1	0
SEEDS	TOTAL	1996-2003	331	0.03	0.63	20/ (0.035-0.63)
Fruit or berry	Allspice	Jamaica, 1999 Mexico, 2002, EU, 1996-1998	7	<0.1	<0.1	0
Fruit or berry	Caraway	EU, 1996-1998 US, 2000	18	<0.1	<0.1	0
Fruit or berry	Cardamom	Guatemala, 2001-2003 EU, 1996-1998 India, 2000-2003	28	<0.085	0.12	0.04, 0.075, 0.081, 0.089, 0.092, 0.093, 0.10, 0.12
Fruit or berry	Juniper	EU, 1996-1998	5	<0.1	<0.1	0

Spice		Country/ Year(s)	Residues (mg/kg) [1]			
Group	Name		No.	Median	Max	Detections
Fruit or berry	Pepper, black, white, pink	Brazil, 2001-2002 Ecuador, 1999 EU, 1996-1998 India, 2000-2003 Indonesia, 2001-2003 Malaysia, 2003 New Guinea, 1999 Vietnam, 1999-2003	143	<0.03	3.2	0.031, 0.086 0.11, 0.12, 0.12, 3.1, 3.2
Fruit or berry	Vanilla	EU, 1996-1998	7	<0.03	<0.03	0
FRUITS	TOTAL	1996-2003	208	0.03	3.2	15/ (0.031-3.2)
Roots/ Rhizome	Ginger	China, 2001 EU, 1996-1998 India, 2000-2003	154	<0.1	0.24	0.084, 0.24
Roots/ Rhizome	Turmeric	Brazil, 2003 EU, 1996-1998 India, 1999-2003 Vietnam, 2003	247	<0.1	0.1	0.038, 0.041, 0.061, 0.1
ROOTS	TOTAL	1996-2003	401	0.1	0.24	6/ (0.038-0.24)
Bark	Cassia	EU, 1996-1998 Indonesia, 1999 Vietnam, 2001-2003	12	<0.1	<0.1	0
Bark	Cinnamon	EU, 1996-1998 Vietnam, 2001-2003	14	<0.1	<0.1	0
Buds	Cloves	Brazil, 2002 Madagascar, 2001-2003	4	<0.03	<0.03	0
Aril	Mace	EU, 1996-1998	7	<0.1	<0.1	0
BARK, BUDS, ARIL	TOTAL, MISC-	1996-2003	41	0.1	0.1	0

[1] LOQ 0.03 mg/kg for data from ASTA and India; 0.1 mg/kg for data from ESA.

Table 16. Summary of monitoring data for ethion residues in spices.

Spice		Country/ Year(s)	Residues (mg/kg) [1, 2]			
Group	Name		No.	Median	Max	Detections
Seed	Anise	Canada, 1999 EU, 1998 Syria, 2002-2003 Turkey, 1999-2003	18	<0.1	1.8	1.8
Seed	Celery seed	EU, 1996-1998 India, 1999-2003	55	<0.05	<0.1	0
Seed	Coriander	Bulgaria, 1999 Canada, 1999 EU, 1996-1998 India 2000-2003	49	<0.1	0.21	0.21
Seed	Cumin	EU, 1996-1998 India, 2000-2001 Pakistan, 2000 Syria, 2000-2003 Turkey, 1999-2003	35	<0.1	0.13	0.11, 0.13
Seed	Dill seed	Australia, 1999 Canada, 1999-2001 India, 1999-2003	11	<0.1	<0.1	0
Seed	Fennel seed	EU, 1996-1998 India, 2002-2003	9	<0.05	<0.1	0
Seed	Fenugreek	Canada, 2000 India, 2001-2003	5	<0.1	<0.1	0

Spice		Country/ Year(s)	Residues (mg/kg) [1, 2]			
Group	Name		No.	Median	Max	Detections
Seed	Nutmeg	EU, 1998 Guatemala, 2002-2003 India, 2003 Indonesia, 2000-2003 US, 2001	8	<0.1	<0.1	0
SEEDS	TOTAL	1996-2003	190	<0.1	1.8	4/ (0.11-1.8)
Fruit or berry	Allspice	EU, 1996-1998 Jamaica, 1999 Mexico, 2002	7	<0.05	<0.05	0
Fruit or berry	Caraway	EU, 1996-1998 US, 2000	18	<0.05	<0.1	0
Fruit or berry	Cardamom	EU, 1996-1998 Guatemala, 2001-2003 India, 2001	14	<0.1	0.12	0.12
Fruit or berry	Juniper	EU, 1996-1998	5	<0.05	<0.05	0
Fruit or berry	Pepper, black, white, pink	EU, 1996-1998 Brazil, 2001-2002 Ecuador, 1999 India, 2001-2003 Indonesia, 2001-2003 New Guinea, 1999 Malaysia, 2003 Vietnam, 1999-2003	104	<0.1	3.1	0.33, 3.1
Fruit or berry	Vanilla	EU, 1996-1998	7	<0.05	<0.05	0
FRUITS	TOTAL	1996-2003	155	<0.1	3.1	3/ (0.12-3.1)
Roots/ Rhizome	Ginger	China, 2001 EU, 1996-1998 India, 2000-2003	224	<0.05	0.15	0.11, 0.15
Roots/ Rhizome	Turmeric	Brazil, 2003 EU, 1996-1998 India, 1999-2003 Vietnam, 2003	143	<0.05	<0.1	0
ROOTS	TOTAL	1996-2003	367	<0.05	0.15	2/ (0.11-0.15)
Bark	Cassia	EU, 1996-1998 Indonesia, 1999 Vietnam, 2001-2003	12	<0.05	<0.1	0
Bark	Cinnamon	EU, 1996-1998 Vietnam, 2000-2003 India, 2003	15	<0.05	<0.1	0
Buds	Cloves	Madagascar, 1999-2000 Brazil, 2002 India, 2003	5	<0.1	<0.1	0
Aril	Mace	EU, 1996-1998 India, 2001-2003 Indonesia, 2002	10	<0.05	<0.1	0
BARK, BUDS, ARIL	TOTAL, MISC-	1996-2003	42	<0.05	<0.1	0

[1] Method as described in Table 2 for organophosphorus screening.
[2] LOQ 0.1 mg/kg for data from ASTA and India; 0.05 mg/kg for data from ESA.

Table 17. Summary of monitoring data for fenitrothion residues in spices.

Spice		Country/ Year(s)	Residues (mg/kg) [1]			
Group	Name		No.	Median	Max	Detections
Seed	Anise	Canada, 1999 EU, 1998 Syria, 2002-2003 Turkey, 1999-2003	18	<0.05	<0.1	0

Spice		Country/ Year(s)	Residues (mg/kg) [1]			
Group	Name		No.	Median	Max	Detections
		Egypt, 1996-2001	756	0.05	5.4	0.05, 0.08, 0.08, 0.1, 0.12, 0.12, 0.13, 0.15, 0.25, 0.4, 0.4, 0.41, 0.41, 0.87, 0.88, 1, 1, 1, 1.4, 1.4, 2, 5.4
Seed	Celery seed	EU, 1996-1998 India, 1999-2003	53	<0.05	0.168	0.168
Seed	Coriander	Bulgaria, 1999 Canada, 1999 EU, 1996-1998	28	<0.05	1.45	1.45
Seed	Cumin	EU, 1996-1998 India, 2000-2001 Pakistan, 2000 Syria, 2000-2003 Turkey, 1999-2003	28	<0.1	0.19	0.19
Seed	Dill seed	Australia, 1999 Canada, 1999-2001 EU, 1996-1998 India, 1999-2003	18	<0.1	<0.1	0
Seed	Fennel seed	EU, 1996-1998 India, 2002-2003	9	<0.05	<0.1	0
		Egypt, 1996-2001	999			0.05, 0.05, 0.09, 0.09, 0.09, 0.1, 0.22
Seed	Fenugreek	Canada, 2000 India, 2001-2003	4	<0.1	<0.1	0
Seed	Nutmeg	EU, 1998 Guatemala, 2002-2003 India, 2003 Indonesia, 2000-2003 US, 2001	7	<0.1	<0.1	0
SEEDS	TOTAL	1996-2003	1920	0.05	5.4	32/ (0.05-5.4)
Fruit or berry	Allspice	EU, 1996-1998 Jamaica, 1999 Mexico, 2002	7	<0.1	<0.1	0
Fruit or berry	Caraway	EU, 1996-1998 US, 2000	20	<0.05	0.40	0.10, 0.40
		Egypt 1996-2001	113	<0.05	0.12	0.05, 0.12
Fruit or berry	Cardamom	EU, 1996-1998 Guatemala, 2001-2003 India, 2001	12	<0.05	<0.1	0
Fruit or berry	Juniper	EU, 1996-1998	5	<0.05	<0.05	0
Fruit or berry	Pepper, black, white, pink	EU, 1996-1998 Brazil, 2001-2002 Ecuador, 1999 India, 2001-2003 Indonesia, 2001-2003 New Guinea, 1999 Malaysia, 2003 Vietnam, 1999-2003	66	<0.05	<0.1	0
Fruit or berry	Vanilla	EU, 1996-1998	7	<0.05	<0.05	0
FRUITS	TOTAL	1996-2003	230	0.05	0.40	4/ (0.10-0.40)
Roots/ Rhizome	Ginger	China, 2001 EU, 1996-1998 India, 2000-2003	121	<0.05	<0.1	0
Roots/ Rhizome	Turmeric	Brazil, 2003 EU, 1996-1998 India, 1999-2003 Vietnam, 2003	113	<0.05	<0.1	0

Spice		Country/ Year(s)	Residues (mg/kg) [1]			
Group	Name		No.	Median	Max	Detections
ROOTS	TOTAL	1996-2003	234	0.05	0.1	0
Bark	Cassia	EU, 1996-1998 Indonesia, 1999 Vietnam, 2001-2003	12	<0.05	<0.1	0.1
Bark	Cinnamon	EU, 1996-1998 Vietnam, 2000-2003	14	<0.05	<0.1	0.1
Buds	Cloves	Madagascar, 1999-2000 Brazil, 2002	4	<0.1	<0.1	0.1
Aril	Mace	EU, 1996-1998 India, 2001-2003 Indonesia, 2002	10	<0.05	<0.1	0.1
BARK, BUDS, ARIL	TOTAL, MISC-	1996-2003	40	0.05	0.1	0.1

[1] Method as described in Table 2 for organophosphorus screening.
[2] LOQ 0.1 mg/kg for data from ASTA and India; 0.05 mg/kg for data from ESA.

Table 18. Summary of monitoring data for iprodione residues in spices.

Spice		Country/ Year(s)	Residues (mg/kg) [1.2]			Detections
Group	Name		No.	Median	Max	
Seeds	Cumin	Turkey 1999.-2003.	5		0.05	0
	Mustard seed	Canada 2000.	1		0.05	0
	Nutmeg	Indonesia 2003.	1		0.05	
	Nutmeg	Indonesia 2000.	1		0.05	0
	Anise	EU	3		0.05	0
	Cumin	EU	7		0.05	0
	Dill seed	EU	8		0.05	0
	Fennel seed	EU	5		0.05	0
	Coriander seed	EU	16		0.05	0
	Celery seed	EU	46		0.05	0
SEEDS		TOTAL	93	0.05	0.05	0
Fruits	Caraway	EU	7		0.05	0
	Cardamom	EU	2		0.05	0
	Juniper berries	EU	2		0.05	0
	Pepper	EU	1		0.05	0.05
	Pfeffer	EU	20		0.05	0
	Vanila pod	EU	6		0.05	0
FRUITS		TOTAL	38	0.05	0.05	1(0.05)
Roots						
	Ginger	EU	92		0.05	0.05
	Turmeric	EU	100		0.05	0
ROOTS		TOTAL	192	0.05	0.05	1(0.05)
	Cassia	EU	6		0.05	0
	Cassia, lignea	EU	2		0.05	0.05, 0.05
	Cinnamon	EU	5		0.05	0
	Cinnamon	EU	2		0.05	0.05, 0.05
	Mace	EU	1		0.05	0
BARK, BUDS, ARIL		TOTAL	16	0.05	0.05	4(0.05)

[1] LOQ of 0.05 mg/kg was reported from all sources.

Table 19. Summary of monitoring data for malathion residues in spices.

Spice		Country/ Year(s)	Residues (mg/kg) [1, 2]			
Group	Name		No.	Median	Max	Detections
Seed	Anise	Canada, 1999 EU, 1996-1998 Syria, 2002-2003 Turkey, 1999-2003	18	<0.1	0.38	0.38
Seed	Celery seed	EU, 1996-1998 India, 1999-2003	53	<0.05	0.86	0.16, 0.48, 0.86
Seed	Coriander	Bulgaria, 1999 Canada, 1999 EU, 1996-1998 India 2000-2003	28	<0.05	<0.1	0
Seed	Cumin	EU, 1996-1998 India, 2000-2001 Pakistan, 2000 Syria, 2000-2003 Turkey, 1999-2003	29	<0.1	0.58	0.16, 0.16, 0.58
Seed	Dill seed	Australia, 1999 Canada, 1999-2001 EU, 1996-1998 India, 1999-2003	18	<0.1	<0.1	0
Seed	Fennel seed	EU, 1996-1998 India, 2002-2003 Egypt, 2001-2003	12	0.075	0.22	0.16, 0.18, 0.22
Seed	Fenugreek	Canada, 2000 India, 2001-2003	4	<0.1	<0.1	0
Seed	Nutmeg	EU, 1998 Guatemala, 2002-2003 Indonesia, 2000-2003 US, 2001	7	<0.1	0.32	0.32
SEEDS	TOTAL	1996-2003	169	0.1	0.86	11/ (0.16-0.86)
Fruit or berry	Allspice	EU, 1996-1998 Jamaica, 1999 Mexico, 2002	7	<0.05	<0.1	0
Fruit or berry	Caraway	EU, 1996-1998 US, 2000	18	<0.05	<0.1	0
		Egypt 1996-2001				0.05, 0.05, 0.06, 0.06, 0.07, 0.07, 0.07, 0.07, 0.09, 0.09, 0.1, 0.19, 0.26, 0.3, 0.31, 0.33, 0.46
Fruit or berry	Cardamom	EU, 1996-1998 Guatemala, 2001-2003 India, 2001	12	<0.05	<0.1	0
Fruit or berry	Juniper	EU, 1996-1998	5	<0.05	<0.05	0
Fruit or berry	Pepper, black, white, pink	EU, 1996-1998 Brazil, 2001-2002 Ecuador, 1999 India, 2001-2003 Indonesia, 2001-2003 New Guinea, 1999 Malaysia, 2003 Vietnam, 1999-2003	66	<0.05	0.48	0.1, 0.42, 0.48
Fruit or berry	Vanilla	EU, 1996-1998	7	<0.05	<0.05	0
FRUITS	TOTAL	1996-2003	115	0.05	0.48	3/ (0.1-0.48)
Roots/ Rhizome	Ginger	China, 2001 EU, 1996-1998 India, 2000-2003	121	<0.05	0.1	0.1

Spice		Country/ Year(s)	Residues (mg/kg) [1, 2]			
Group	Name		No.	Median	Max	Detections
Roots/ Rhizome	Turmeric	Brazil, 2003 EU, 1996-1998 India, 1999-2003 Vietnam, 2003	113	<0.05	0.16	0.12, 0.16
ROOTS	TOTAL	1996-2003	234	0.05	0.16	3/ (0.1-0.16)
Bark	Cassia	EU, 1996-1998 Indonesia, 1999 Vietnam, 2001-2003	12	0.075	0.14	0.1, 0.12, 0.14
Bark	Cinnamon	EU, 1996-1998 Vietnam, 2000-2003	14	<0.05	0.1	0.1, 0.1
Buds	Cloves	Madagascar, 1999-2000 Brazil, 2002	4	<0.1	<0.1	0.1
Aril	Mace	EU, 1996-1998 India, 2001-2003 Indonesia, 2002	17	<0.1	2	0.3, 0.48, 0.96, 1.02, 1.04, 1.88, 1.96, 2
BARK, BUDS, ARIL	TOTAL, MISC-	1996-2003	47	0.1	2	14/ (0.1-2)

[1] Method as described in Table 2 for organophosphorus screening.
[2] LOQ 0.1 mg/kg for data from ASTA and India; 0.05 mg/kg for data from ESA.

Table 20. Summary of monitoring data for metalaxyl residues in spices.

Spice		Country/ Year(s)	Residues (mg/kg) [1]			
Group	Name		No.	Median	Max	Detections
Seed	Anise	Egypt, 1996-2001	411	<0.05	0.38	0.2, 0.22, 0.4, 0.47, 0.64, 0.65
Seed	Fennel seed	Egypt, 2001-2003	895	<0.05	3.2	0.17, 0.29, 0.4, 3.2
SEEDS	TOTAL	1996-2003	1306	0.1	0.86	10/ (0.2-3.2)

[1] LOQ 0.05 mg/kg

Table 21. Summary of monitoring data for methamidophos residues in spices.

Spice		Country/ Year(s)	Residues (mg/kg) [1, 2]			
Group	Name		No.	Median	Max	Detections
Seed	Anise	Canada, 1999 EU, 1998 Syria, 2002-2003 Turkey, 1999-2003	16	<0.1	<0.1	0
Seed	Celery seed	EU, 1996-1998 India, 1999-2003	8	<0.055	<0.1	0
Seed	Coriander	Bulgaria, 1999 Canada, 1999 EU, 1996-1998 India 2000-2003	11	<0.01	<0.1	0
Seed	Cumin	EU, 1996-1998 India, 2000-2001 Pakistan, 2000 Syria, 2000-2003 Turkey, 1999-2003	23	<0.1	<0.1	0
Seed	Dill seed	Australia, 1999 Canada, 1999-2001 India, 1999-2003	10	<0.1	<0.1	0
Seed	Fennel seed	EU, 1996-1998 India, 2002-2003	7	<0.1	<0.1	0
Seed	Fenugreek	Canada, 2000 India, 2001-2003	4	<0.1	<0.1	0

Spice		Country/ Year(s)	Residues (mg/kg) [1, 2]			
Group	Name		No.	Median	Max	Detections
Seed	Nutmeg	EU, 1998 Guatemala, 2002-2003 Indonesia, 2000-2003	7	<0.1	<0.1	0
SEEDS	TOTAL	1996-2003	86	0.1	0.1	0
Fruit or berry	Allspice	EU, 1996-1998 Jamaica, 1999 Mexico, 2002	6	<0.01	<0.1	0
Fruit or berry	Caraway	EU, 1996-1998 US, 2000	15	<0.01	<0.1	0
Fruit or berry	Cardamom	EU, 1996-1998 Guatemala, 2001-2003 India, 2001	10	<0.01	<0.1	0
Fruit or berry	Juniper	EU, 1998	2	<0.01	<0.1	0
Fruit or berry	Pepper, black, white, pink	EU, 1996-1998 Brazil, 2001-2002 Ecuador, 1999 India, 2001-2003 Indonesia, 2001-2003 New Guinea, 1999 Malaysia, 2003 Vietnam, 1999-2003	58	<0.01	<0.1	0
Fruit or berry	Vanilla	EU, 1998	1	<0.01	<0.01	0
FRUITS	TOTAL	1996-2003	92	0.01	0.1	0
Roots/ Rhizome	Ginger	China, 2001 EU, 1996-1998 India, 2000-2003	32	<0.01	<0.1	0
Roots/ Rhizome	Turmeric	Brazil, 2003 EU, 1996-1998 India, 1999-2003 Vietnam, 2003	14	<0.01	<0.1	0
ROOTS	TOTAL	1996-2003	46	0.01	0.1	0
Bark	Cassia	EU, 1996-1998 Indonesia, 1999 Vietnam, 2001-2003	12	<0.01	<0.1	0
Bark	Cinnamon	EU, 1996-1998 Vietnam, 2000-2003	10	<0.01	<0.1	0
Buds	Cloves	Madagascar, 1999-2000 Brazil, 2002	4	<0.1	<0.1	0
Aril	Mace	EU, 1996-1998 India, 2001-2003 Indonesia, 2002	10	<0.01	<0.1	0
BARK, BUDS, ARIL	TOTAL, MISC-	1996-2003	36	0.01	0.1	0

[1] Method as described in Table 2 for organophosphorus screening.
[2] LOQ 0.1 mg/kg for data from ASTA and India; 0.01 mg/kg for data from ESA.

Table 22. Summary of monitoring data for mevinphos residues in spices.

Spice		Country/ Year(s)	Residues (mg/kg) [1, 2]			
Group	Name		No.	Median	Max	Detections
Seed	Anise	Canada, 1999 EU, 1998 Syria, 2002-2003 Turkey, 1999-2003	17	<0.2	<0.2	0
Seed	Celery seed	EU, 1996-1998 India, 1999-2003	53	<0.05	2.9	2.9
Seed	Coriander	Bulgaria, 1999 Canada, 1999 EU, 1996-1998	25	<0.05	<0.2	0

Spice		Country/ Year(s)	Residues (mg/kg) [1, 2]			
Group	Name		No.	Median	Max	Detections
Seed	Cumin	EU, 1996-1998 India, 2000-2001 Pakistan, 2000 Syria, 2000-2003 Turkey, 1999-2003	27	<0.2	<0.2	0
Seed	Dill seed	Australia, 1999 Canada, 1999-2001 India, 1999-2003 EU, 1996-1998	18	<0.2	<0.2	0
Seed	Fennel seed	EU, 1996-1998 India, 2002-2003	9	<0.05	<0.2	0
Seed	Fenugreek	Canada, 2000 India, 2001-2003	4	<0.2	<0.2	0
Seed	Nutmeg	EU, 1998 Indonesia, 2000-2003 US, 2001	5	<0.2	<0.2	0
SEEDS	TOTAL	1996-2003	158	0.05	2.9	1/ (2.9)
Fruit or berry	Allspice	EU, 1996-1998 Jamaica, 1999 Mexico, 2002	12	<0.05	<0.2	0
Fruit or berry	Caraway	EU, 1996-1998 US, 2000	44	<0.05	<0.2	0
Fruit or berry	Cardamom	EU, 1996-1998 Guatemala, 2001-2003 India, 2001	47	<0.05	<0.2	0
Fruit or berry	Juniper	EU, 1998	4	<0.05	<0.05	0
Fruit or berry	Vanilla	EU, 1998	7	<0.05	<0.05	0
FRUITS	TOTAL	1996-2003	114	0.05	0.2	0
Roots/ Rhizome	Ginger	China, 2001 EU, 1996-1998 India, 2000-2003	121	<0.05	0.47	0.21, 0.22, 0.3, 0.37, 0.39, 0.41, 0.47
Roots/ Rhizome	Turmeric	Brazil, 2003 EU, 1996-1998 India, 1999-2003 Vietnam, 2003	111	<0.05	0.40	0.2, 0.24, 0.27, 0.34, 0.40
ROOTS	TOTAL	1996-2003	232	0.05	0.47	13/ (0.2-0.47)
Bark	Cassia	EU, 1996-1998 Indonesia, 1999 Vietnam, 2001-2003	12	<0.05	<0.2	0
Bark	Cinnamon	EU, 1996-1998 Vietnam, 2000-2003	14	<0.05	<0.2	0
Buds	Cloves	Madagascar, 1999-2000 Brazil, 2002	4	<0.2	<0.2	0
Aril	Mace	EU, 1996-1998 India, 2001-2003 Indonesia, 2002	10	<0.05	<0.2	0
BARK, BUDS, ARIL	TOTAL, MISC-	1996-2003	40	0.05	0.2	0

[1] Method as described in Table 2 for organophosphorus screening.
[2] LOQ 0.2 mg/kg for data from ASTA and India; 0.05 mg/kg for data from ESA.

Table 23. Summary of monitoring data for parathion residues in spices.

Spice		Country/ Year(s)	Residues (mg/kg) [1, 2]			
Group	Name		No.	Median	Max	Detections
Seed	Anise	Canada, 1999 EU, 1998 Syria, 2002-2003 Turkey, 1999-2003	16	<0.1	<0.1	0
Seed	Celery seed	EU, 1996-1998 India, 1999-2003	8	<0.1	<0.1	0
Seed	Coriander	Bulgaria, 1999 Canada, 1999 India, 2000-2003 EU, 1996-1998	27	<0.1	<0.1	0
Seed	Cumin	EU, 1996-1998 India, 2000-2001 Pakistan, 2000 Syria, 2000-2003 Turkey, 1999-2003	34	<0.1	<0.1	0
Seed	Dill seed	Australia, 1999 Canada, 1999-2001 India, 1999-2003	10	<0.1	<0.1	0
Seed	Fennel seed	EU, 1996-1998 India, 2002-2003	7	<0.1	<0.1	0
Seed	Fenugreek	Canada, 2000 India, 2001-2003	5	<0.1	<0.1	0
Seed	Nutmeg	EU, 1998 Guatemala, 2002-2003 India, 2003 Indonesia, 2000-2003 US, 2001	7	<0.1	<0.1	0
SEEDS	TOTAL	1996-2003	114	0.1	0.1	0
Fruit or berry	Allspice	EU, 1996-1998 Jamaica, 1999 Mexico, 2002	6	<0.1	<0.1	0
Fruit or berry	Caraway	EU, 1996-1998 US, 2000	15	<0.1	<0.1	0
Fruit or berry	Cardamom	EU, 1996-1998 Guatemala, 2001-2003 India, 2001	11	<0.1	<0.1	0
Fruit or berry	Juniper	EU, 1998	3	<0.1	<0.1	0
Fruit or berry	Pepper, black, white, pink	EU, 1996-1998 Brazil, 2001-2002 Ecuador, 1999 India, 2001-2003 Indonesia, 2001-2003 New Guinea, 1999 Malaysia, 2003 Vietnam, 1999-2003	69	<0.1	0.1	0.1
Fruit or berry	Vanilla	EU, 1998	1	<0.1	<0.1	0
FRUITS	TOTAL	1996-2003	105	0.1	0.1	1/ (0.1)
Roots/ Rhizome	Ginger	China, 2001 EU, 1996-1998 India, 2000-2003	35	<0.1	0.1	0.1
Roots/ Rhizome	Turmeric	Brazil, 2003 EU, 1996-1998 India, 1999-2003 Vietnam, 2003	39	<0.1	<0.1	0
ROOTS	TOTAL	1996-2003	74	0.1	0.1	1(0.1)
Bark	Cassia	EU, 1996-1998 Indonesia, 1999 Vietnam, 2001-2003	12	<0.1	0.1	0.1

Spice		Country/ Year(s)	Residues (mg/kg) [1, 2]			
Group	Name		No.	Median	Max	Detections
Bark	Cinnamon	EU, 1996-1998 Vietnam, 2000-2003	10	<0.1	0.1	0.1, 0.1
Buds	Cloves	Madagascar, 1999-2000 Brazil, 2002	4	<0.1	<0.1	0
Aril	Mace	EU, 1996-1998 India, 2001-2003 Indonesia, 2002	10	<0.1	<0.1	0
BARK, BUDS, ARIL	TOTAL, MISC-	1996-2003	36	0.1	0.1	3(0.1)

[1] Method as described in Table 2 for organophosphorus screening.
[2] LOQ 0.1 mg/kg for data from all sources.

Table 24. Summary of monitoring data for parathion-methyl residues in spices.

Spice		Country/ Year(s)	Residues (mg/kg) [1, 2]			
Group	Name		No.	Median	Max	Detections
Seed	Anise	Canada, 1999 EU, 1998 Syria, 2002-2003 Turkey, 1999-2003	18	<0.1	0.24	0.24
Seed	Celery seed	EU, 1996-1998 India, 1999-2003	54	<0.1	0.86	0.14, 0.16, 0.21 0.31, 0.86
Seed	Coriander	Bulgaria, 1999 Canada, 1999 India, 2000-2003 EU, 1996-1998	45	<0.1	1.2	0.1, 0.33, 1.2
Seed	Cumin	EU, 1996-1998 India, 2000-2001 Pakistan, 2000 Syria, 2000-2003 Turkey, 1999-2003	40	<0.1	2.4	0.13, 0.2, 0.23, 0.24, 0.36, 0.51, 0.97, 1.13, 2.4, 2.4
Seed	Dill seed	Australia, 1999 Canada, 1999-2001 India, 1999-2003 EU, 1996-1998	19	<0.1	<0.1	0
Seed	Fennel seed	EU, 1996-1998 India, 2002-2003 Egypt, 1996-2001	9 161	<0.1	0.43	0.1, 0.37, 0.38, 0.43
Seed	Fenugreek	Canada, 2000 India, 2001-2003	5	<0.1	<0.1	0
Seed	Nutmeg	EU, 1998 Guatemala, 2002-2003 India, 2003 Indonesia, 2000-2003 US, 2001	8	<0.1	<0.1	0
SEEDS	TOTAL	1996-2003	359	0.1	2.4	23/ (0.1-2.4)
Fruit or berry	Allspice	EU, 1996-1998 Jamaica, 1999 Mexico, 2002	7	<0.1	<0.1	0
Fruit or berry	Caraway	EU, 1996-1998 US, 2000	18	<0.1	<0.1	0
Fruit or berry	Cardamom	EU, 1996-1998 Guatemala, 2001-2003 India, 2001	14	<0.1	<0.1	0
Fruit or berry	Juniper	EU, 1998	5	<0.1	<0.1	0

Spice		Country/ Year(s)	Residues (mg/kg) [1, 2]			
Group	Name		No.	Median	Max	Detections
Fruit or berry	Pepper, black, white, pink	EU, 1996-1998 Brazil, 2001-2002 Ecuador, 1999 India, 2001-2003 Indonesia, 2001-2003 New Guinea, 1999 Malaysia, 2003 Vietnam, 1999-2003	104	<0.1	3.4	0.1, 3.4
Fruit or berry	Vanilla	EU, 1998	7	<0.1	<0.1	0
FRUITS	TOTAL	1996-2003	155	0.1	3.4	2/ (0.1-3.4)
Roots/ Rhizome	Ginger	China, 2001 EU, 1996-1998 India, 2000-2003	126	<0.1	1.2	0.1, 0.14, 1.2
Roots/ Rhizome	Turmeric	Brazil, 2003 EU, 1996-1998 India, 1999-2003 Vietnam, 2003	139	<0.1	1.7	0.13, 0.14, 0.15, 0.17, 0.24, 0.3, 1.7
ROOTS	TOTAL	1996-2003	265	0.1	1.7	11/ (0.1-1.7)
Buds	Cloves	Madagascar, 1999-2000 Brazil, 2002 India, 2003	5	<0.1	<0.1	0
Bark	Cassia	EU, 1996-1998 Indonesia, 1999 Vietnam, 2001-2003	12	<0.1	0.1	0.1
Bark	Cinnamon	EU, 1996-1998 Vietnam, 2000-2003	15	<0.1	0.1	0.1, 0.1
Aril	Mace	EU, 1996-1998 India, 2001-2003 Indonesia, 2002	10	<0.1	<0.1	0
BARK, BUDS, ARIL	TOTAL, MISC-	1996-2003	42	0.1	0.1	3/ (0.1)

[1] Method as described in Table 2 for organophosphorus screening.
[2] LOQ 0.1 mg/kg for data from ASTA and India; 0.05 mg/kg for data from Egypt and ESA.

Table 25. Summary of monitoring data for permethrin residues in spices.

Spice		Country/ Year(s)	Residues (mg/kg) [1]			
Group	Name		No.	Median	Max	Detections
Seed	Anise	Canada, 1999 EU, 1998 Syria, 2002-2003 Turkey, 1999-2003	16	<0.05	<0.05	0
Seed	Celery seed	EU, 1996-1998 India, 1999-2003	5	<0.05	<0.05	0
Seed	Coriander	Bulgaria, 1999 Canada, 1999	5	<0.05	<0.05	0
Seed	Cumin	EU, 1996-1998 India, 2000-2001 Pakistan, 2000 Syria, 2000-2003 Turkey, 1999-2003	17	<0.05	<0.05	0
Seed	Dill seed	Australia, 1999 Canada, 1999-2001 India, 1999-2003	10	<0.05	<0.05	0
Seed	Fennel seed	EU, 1996-1998 India, 2002-2003	6	<0.05	<0.05	0

Spice		Country/ Year(s)	Residues (mg/kg) [1]			
Group	Name		No.	Median	Max	Detections
Seed	Fenugreek	Canada, 2000 India, 2001-2003	4	<0.05	<0.05	0
Seed	Nutmeg	Guatemala, 2002-2003 Indonesia, 2000-2003 US, 2001	5	<0.05	<0.05	0
SEEDS	TOTAL	1996-2003	68	0.05	0.05	0
Fruit or berry	Allspice	EU, 1998 Jamaica, 1999 Mexico, 2002	14	<0.05	<0.05	0
Fruit or berry	Caraway	EU, 1996-1998 US, 2000	19	<0.05	<0.05	0
Fruit or berry	Cardamom	Guatemala, 2001-2003 India, 2001	14	<0.05	<0.05	0
FRUITS	TOTAL	1996-2003	17	0.05	0.05	0
Roots/ Rhizome	Ginger	China, 2001 EU, 1996-1998 India, 2000-2003	6	<0.05	<0.05	0
Roots/ Rhizome	Turmeric	Brazil, 2003 EU, 1996-1998 India, 1999 Vietnam, 2003	6	<0.05	<0.05	0
ROOTS	TOTAL	1996-2003	12	0.05	0.05	0
Bark	Cassia	EU, 1996-1998 Indonesia, 1999 Vietnam, 2001-2003	11	<0.05	<0.05	0
Bark	Cinnamon	EU, 1996-1998 Vietnam, 2000-2003	7	<0.05	<0.05	0
Buds	Cloves	Madagascar, 1999-2000 Brazil, 2002	4	<0.05	<0.05	0
Aril	Mace	EU, 1996-1998 India, 2001-2003 Indonesia, 2002	5	<0.05	<0.05	0
BARK, BUDS, ARIL	TOTAL, MISC-	1996-2003	27	0.05	0.05	0

[1] LOQ 0.05 mg/kg for data from all sources.

Table 26. Summary of monitoring data for phenthoate residues in spices.

Spice		Country/ Year(s)	Residues (mg/kg) [1]			
Group	Name		No.	Median	Max	Detections
Seed	Anise	Egypt 2000-2001	415	<0.05	5.2	0.05, 0.19, 0.49, 1.1, 1.1, 1.3, 1.4, 1.4, 5, 5.2
SEEDS	TOTAL	1996-2003	415	<0.05	5.2	10/(0.05-5.2)

[1] LOQ 0.05 mg/kg for data from all sources.

Table 27. Summary of monitoring data for phorate residues in spices.

Spice		Country/ Year(s)	Residues (mg/kg) [1, 2]			
Group	Name		No.	Median	Max	Detections
Seed	Anise	Canada, 1999 Syria, 2002-2003 Turkey, 1999-2003	15	<0.1	<0.1	0
Seed	Celery seed	EU, 1996-1998 India, 1999-2003	9	<0.1	<0.1	0

Spice		Country/ Year(s)	Residues (mg/kg) [1, 2]			
Group	Name		No.	Median	Max	Detections
Seed	Coriander	Bulgaria, 1999 Canada, 1999 India, 2000-2003 EU, 1996-1998	30	<0.1	<0.1	0
Seed	Cumin	EU, 1996-1998 India, 2000-2001 Pakistan, 2000 Syria, 2000-2003 Turkey, 1999-2003	32	<0.1	0.3	0.12, 0.3
Seed	Dill seed	Australia, 1999 Canada, 1999-2001 India, 1999-2003	11	<0.1	<0.1	0
Seed	Fennel seed	EU, 1996-1998 India, 2002-2003	4	<0.1	<0.1	0
Seed	Fenugreek	Canada, 2000 India, 2001-2003	5	<0.1	<0.1	0
Seed	Nutmeg	EU, 1998 Guatemala, 2002-2003 India, 2003 Indonesia, 2000-2003 US, 2001	8	<0.1	<0.1	0
SEEDS	TOTAL	1996-2003	115	0.1	0.3	2/ (0.12– 0.3)
Fruit or berry	Allspice	EU, 1996-1998 Jamaica, 1999 Mexico, 2002	4	<0.075	<0.1	0
Fruit or berry	Caraway	EU, 1996-1998 US, 2000	12	<0.05	<0.1	0
Fruit or berry	Cardamom	EU, 1996-1998 Guatemala, 2001-2003 India, 2001	12	<0.075	<0.1	0
Fruit or berry	Juniper	EU, 1998	2	<0.05	<0.05	0
Fruit or berry	Pepper, black, white, pink	EU, 1996-1998 Brazil, 2001-2002 Ecuador, 1999 India, 2001-2003 Indonesia, 2001-2003 New Guinea, 1999 Malaysia, 2003 Vietnam, 1999-2003	86	<0.1	<0.1	0
Fruit or berry	Vanilla	EU, 1998	1	<0.05	<0.05	0
FRUITS	TOTAL	1996-2003	117	0.1	0.1	0
Roots/ Rhizome	Ginger	China, 2001 EU, 1996-1998 India, 2000-2003	35	<0.05	<0.1	0
Roots/ Rhizome	Turmeric	Brazil, 2003 EU, 1996-1998 India, 1999-2003 Vietnam, 2003	40	<0.1	<0.1	0
ROOTS	TOTAL	1996-2003	75	0.1	0.1	0
Bark	Cassia	EU, 1996-1998 Indonesia, 1999 Vietnam, 2001-2003	5	<0.1	<0.1	0
Bark	Cinnamon	EU, 1996-1998 Vietnam, 2000-2003 India, 2003	10	<0.05	<0.1	0
Buds	Cloves	Madagascar, 1999-2000 Brazil, 2002 India, 2003	5	<0.1	<0.1	0
Aril	Mace	EU, 1996-1998 India, 2001-2003 Indonesia, 2002	9	<0.05	<0.1	0

Spice		Country/ Year(s)	Residues (mg/kg) [1, 2]			
Group	Name		No.	Median	Max	Detections
BARK, BUDS, ARIL	TOTAL, MISC-	1996-2003	29	0.1	0.1	0

[1] Method as described in Table 2 for organophosphorus screening.
[2] LOQ 0.1 mg/kg for data from ASTA and India; 0.05 mg/kg for data from EU.

Table 28. Summary of monitoring data for phosalone residues in spices. Origin of meat samples was not reported.

Spice		Country/ Year(s)	Residues (mg/kg) [1,2]			Detections
Group	Name		No.	Median	Max	
Seeds	Anise	Egypt 2001	171		0.05	0.1
Seeds	Celery seed		49		0.05	0.95
Seeds	Coriander seed		22		0.05	0
Seeds	Cumin	Turkey 1999-2003.	18		0.05	0.25
Seeds	Dill seed		8		0.05	0
Seeds	Fennel seed		6		0.05	0
Seeds	Nutmeg	Indonesia 2000-2003.	2		0.05	0
SEEDS		TOTAL	276	0.05	0.95	1(0.1-0.95)
Fruits	Allspice		5		0.05	0
Fruits	Caraway		13		0.05	0
Fruits	Cardamom		8		0.05	0
Fruits	Juniper berries		4		0.05	0
Fruits	Pepper		43		0.05	0.05, 0.85, 0.89
Fruits	Vanilla pod		6		0.05	0
Fruits	Vanilla pod		1		0.05	0
FRUITS		TOTAL	80	0.05	0.89	3(0.05-0.89)
Roots	Ginger		118		0.05	0.05, 0.14, 0.22, 0.4, 0.5
Roots	Turmeric		108		1.49	0.27, 0.31, 0.49, 1.49
ROOTS		TOTAL	226	0.05	1.49	4(0.27-1.49)
Bark	Cassia		9		0.05	0.05
Bark	Cinnamon		10		0.05	0.05, 0.05
Aril	Mace		6		0.05	0
BARK, BUDS, ARIL		TOTAL	25	0.05	0.05	3(0.05)

[1] Method as described in Table 2 for organophosphorus screening.
[2] LOQ 0.05 mg/kg from all sources.

Table 29. Summary of monitoring data for pirimicarb residues in spices.

Spice		Country/ Year(s)	Residues (mg/kg) [1]			
Group	Name		No.	Median	Max	Detections
Seed	Anise	Egypt, 1996-2001	484	0.05	1.4	0.05 (8), 0.06 (13), 0.07 (8), 0.08 (5), 0.09 (10), 0.1 (9), 0.12 (3), 0.13 (5), 0.14 (7), 0.15 (4), 0.16 (6), 0.17, 0.17, 0.18, 0.18, 0.19, 0.19, 0.2, 0.2, 0.22, 0.22 (3), 0.23, 0.27, 0.27, 0.28 (3), 0.29, 0.29, 0.33 (3), 0.34, 0.34, 0.37, 0.39, 0.41, 0.42, 0.42, 0.43, 0.44, 0.45, 0.47, 0.47, 0.53, 0.53, 0.58, 0.58, 0.59, 0.6, 0.6, 0.64, 0.67, 0.69, 0.7, 0.8, 0.84, 0.93, 1.2, 1.4

Spice		Country/ Year(s)	Residues (mg/kg) [1]			
Group	Name		No.	Median	Max	Detections
Seed	Fennel seed	Egypt, 1996-2001	824	0.05	3	0.05 (3), 0.06 (9), 0.07, 0.08 (4), 0.09 (4), 0.1, 0.1, 0.12 (3), 0.13, 0.13, 0.14, 0.15 (3), 0.17, 0.17, 0.18, 0.2, 0.21, 0.22,0.24 0.26, 0.27, 0.28, 0.31, 0.35, 0.37, 0.38, 0.54, 0.54, 0.59, 0.7, 0.94, 1.4, 1.5, 3
SEEDS	TOTAL	1996-2001	1308	<0.1	3	183/ (0.05-3)

[1] LOQ 0.05 mg/kg

Table 30. Summary of monitoring data for pirimiphos-methyl residues in spices.

Spice		Country/ Year(s)	Residues (mg/kg) [1, 2]			
Group	Name		No.	Median	Max	Detections
Seed	Anise	Canada, 1999 EU, 1998 Syria, 2002-2003 Turkey, 1999-2003	16	<0.1	<0.1	0
		Egypt, 1996-2001	492	<0.05		0.05, 0.06, 0.07, 0.08, 0.12, 0.17, 0.18, 0.19, 0.27, 0.32, 0.47, 0.58, 0.6, 0.61, 0.63, 1.8
Seed	Celery seed	EU, 1996-1998 India, 1999-2003	8	<0.1	<0.1	0
Seed	Coriander	Bulgaria, 1999 Canada, 1999 EU, 1996-1998	14	<0.05	<0.1	0
Seed	Cumin	EU, 1996-1998 India, 2000-2001 Pakistan, 2000 Syria, 2000-2003 Turkey, 1999-2003	23	<0.1	<0.1	0
Seed	Dill seed	Australia, 1999 Canada, 1999-2001 India, 1999-2003	10	<0.1	<0.1	0
Seed	Fennel seed	EU, 1996-1998 India, 2002-2003	7	<0.05	<0.1	0
		Egypt, 1996-2001	556	<0.05		0.05, 0.07, 0.08, 0.1, 0.11
Seed	Fenugreek	Canada, 2000 India, 2001-2003	4	<0.1	<0.1	0
Seed	Nutmeg	EU, 1998 Guatemala, 2002-2003 Indonesia, 2000-2003 US, 2001	7	<0.1	0.1	0.1
SEEDS	TOTAL	1996-2003	1137	0.1	1.8	22/ (0.05-1.8)
Fruit or berry	Allspice	EU, 1996-1998 Jamaica, 1999 Mexico, 2002	6	<0.05	<0.1	0
Fruit or berry	Caraway	EU, 1996-1998 US, 2000	15	<0.05	<0.1	0
Fruit or berry	Cardamom	EU, 1996-1998 Guatemala, 2001-2003 India, 2001	10	<0.075	0.18	0.18
Fruit or berry	Juniper	EU, 1998	3	<0.05	<0.05	0
Fruit or berry	Pepper, black, white, pink	Europe, 1996-1998 Brazil, 2001-2002 Ecuador, 1999 India, 2001-2003 Indonesia, 2001-2003 New Guinea, 1999 Malaysia, 2003 Vietnam, 1999-2003	59	<0.1	0.1	0.1, 0.1

Spice		Country/ Year(s)	Residues (mg/kg) [1, 2]			
Group	Name		No.	Median	Max	Detections
Fruit or berry	Vanilla	EU, 1998	1	<0.05	<0.05	0
FRUITS	TOTAL	1996-2003	94	0.05	0.18	3/ (0.1-0.18)
Roots/ Rhizome	Ginger	China, 2001 EU, 1996-1998 India, 2000-2003	31	<0.05	0.1	0.1
Roots/ Rhizome	Turmeric	Brazil, 2003 EU, 1996-1998 India, 1999-2003 Vietnam, 2003	16	<0.05	<0.1	0
ROOTS	TOTAL	1996-2003	47	<0.05	0.1	1/(0.1)
Bark	Cassia	EU, 1996-1998 Indonesia, 1999 Vietnam, 2001-2003	12	<0.1	0.1	0.1
Bark	Cinnamon	EU, 1996-1998 Vietnam, 2000-2003	10	<0.1	0.1	0.1, 0.1
Buds	Cloves	Madagascar, 1999-2000 Brazil, 2002	4	<0.1	0.1	0
Aril	Mace	EU, 1996-1998 India, 2001-2003 Indonesia, 2002	10	<0.1	<0.1	0
BARK, BUDS, ARIL	TOTAL, MISC-	1996-2003	36	0.1	0.1	3/ (0.1)

[1] Method as described in Table 2 for organophosphorus screening.
[2] LOQ 0.1 mg/kg for data from ASTA and India; 0.05 mg/kg for data from EU

Table 31. Summary of monitoring data for quintozene residues in spices.

Spice		Country/ Year(s)	Residues (mg/kg) [1]			
Group	Name		No.	Median	Max	Detections
Seed	Anise	Canada, 1999 EU, 1998 Syria, 2002-2003 Turkey, 1999-2003	18	<0.01	<0.01	0
Seed	Celery seed	EU, 1996-1998 India, 1999-2003	53	<0.01	<0.01	0
Seed	Coriander	Bulgaria, 1999 Canada, 1999 EU, 1996-1998	29	<0.01	0.05	0.05
Seed	Cumin	EU, 1996-1998 India, 2000-2001 Pakistan, 2000 Syria, 2000-2003 Turkey, 1999-2003	27	<0.01	0.024	0.013, 0.014, 0.024
Seed	Dill seed	Australia, 1999 Canada, 1999-2001 EU, 1996-1998 India, 1999-2003	18	<0.01	<0.01	0
Seed	Fennel seed	EU, 1996-1998 India, 2002-2003	9	<0.01	0.022	0.022
Seed	Fenugreek	Canada, 2000 India, 2001-2003	4	<0.01	<0.01	0
Seed	Nutmeg	Guatemala, 2002-2003 Indonesia, 2000-2003 US, 2001	5	<0.01	<0.01	0

Spice		Country/ Year(s)	Residues (mg/kg) [1]			
Group	Name		No.	Median	Max	Detections
SEEDS	TOTAL	1996-2003	163	0.01	0.05	5/ (0.01-0.05)
Fruit or berry	Allspice	Jamaica, 1999 Mexico, 2002	2	<0.01	<0.01	0
Fruit or berry	Caraway	EU, 1996-1998 US, 2000	18	<0.01	<0.01	0
Fruit or berry	Cardamom	EU, 1996-1998 Guatemala, 2001-2003 India, 2001	13	<0.01	<0.01	0
Fruit or berry	Juniper	EU, 1996-1998	5	<0.01	<0.01	0
Fruit or berry	Pepper, black, white, pink	EU, 1996-1998 Brazil, 2001-2002 Ecuador, 1999 India, 2001-2003 Indonesia, 2001-2003 New Guinea, 1999 Malaysia, 2003 Vietnam, 1999-2003	66	<0.01	0.01	0.01
Fruit or berry	Vanilla	EU, 1996-1998	7	<0.01	<0.01	0.01
FRUITS	TOTAL	1996-2003	111	0.01	0.01	1/ (0.01)
Roots/ Rhizome	Ginger	China, 2001 EU, 1996-1998 India, 2000-2003	121	<0.01	0.082	0.01, 0.082
Roots/ Rhizome	Turmeric	Brazil, 2003 EU, 1996-1998 India, 1999-2003 Vietnam, 2003	115	<0.01	1.25	0.04, 0.05, 0.05, 1.2
ROOTS	TOTAL	1996-2003	236	<0.01	1.25	6/ (0.01-1.2)
Bark	Cassia	EU, 1996-1998 Indonesia, 1999 Vietnam, 2001-2003	12	<0.01	0.01	0.01
Bark	Cinnamon	EU, 1996-1998 Vietnam, 2000-2003	14	<0.01	0.01	0.01, 0.01
Buds	Cloves	Madagascar, 1999-2000 Brazil, 2002	4	<0.01	<0.01	0.01
Aril	Mace	EU, 1996-1998 India, 2001-2003 Indonesia, 2002	10	<0.01	<0.01	0
BARK, BUDS, ARIL	TOTAL, MISC-	1996-2003	40	0.01	0.01	3 (0.01)

[1] LOQ 0.01 mg/kg for data from all sources.

Table 32. Summary of monitoring data for vinclozolin residues in spices.

Spice		Country/ Year(s)	Residues (mg/kg) [1]			Detections
Group	Name		No.	Median	Max	
S	Anise	EU	3		0.05	0
S	Celery seed	EU	49		0.05	0
S	Coriander seed	EU	22		0.05	0
S	Cumin	Turkey 0999.-20003.. EU	18			0
S	Dill seed	EU	8		0.05	0
S	Fennel seed	EU	6		0.05	0
S	Nutmeg	Indonesia 2000.-2003.. EU	4		0.05	0
	SEEDS	TOTAL	110	0.05	0.05	0

Spice		Country/ Year(s)	Residues (mg/kg) [1]			Detections
Group	Name		No.	Median	Max	
F	Allspice	EU	5		0.05	0
F	Caraway	EU	13		0.05	0
F	Cardamom	EU	8		0.05	0
F	Junniper berries	EU	4		0.05	0
F	Pepper	EU	43		0.05	0
F	Vanilla pod	EU	7		0.05	0
FRUITS		TOTAL	80	0.05	0.05	0
R	Ginger	EU	117		0.05	0
R	Turmeric	EU	110		0.05	0
ROOTS		TOTAL	227	0.05	0.05	0
B	Cassia	EU	9		0.05	0
B	Cinnamon	EU	10		0.05	0
A	Mace	EU	6		0.05	0
BARK. BUDS. ARIL		TOTAL	25	0.05	0.05	0

[1] LOQ 0.01 mg/kg for data from all sources.

Estimation of maximum residue levels for pesticides in or on dry chili peppers

As a general practice, chili peppers are traded according to colour. They are not normally harvested at maturity. Harvest practices differ from country to country and even farmer to farmer, but usually chilies are harvested when the colour is at its optimum on the industry scale which is almost always much later than peak ripeness. It is now common practice for farmers to leave the fruit on the plant to be dried in the sun, thus saving dehydration costs.

In establishing the existing Codex MRLs for fresh peppers, it was assumed, on the basis of GAP, that samples were taken when the fruits were mature. This is not the harvest point for the peppers that are dried and consumed as spices. Estimating dehydration factors based on the Fruit at harvest does not reflect the common cultural practices described, and would not give a lower factor than one based on the mature fruit.

In a study in Spain on the nutrient content of fresh peppers (*Capsicum annum L.)*, results showed the water content to be 91 g/100 g of fruit (Lopez-Hernandez *et.al.*, 1996). The United States Department of Agriculture Nutrient Database gives a water content for several varieties of peppers as ranging from 87.7 g to 93.9 g per 100 g fresh fruit. The corresponding concentration factors are shown in Table 33.

Table 33. Dehydration/concentration factors for dried chili peppers.

Pepper variety	Water content (g/100 g edible portion)[1]	Concentration factor[2, 3]
Fresh		
Pepper, sweet, green, raw	93.89	16.4
Peppers, sweet, red, raw	92.21	12.8
Pepper, hot chili, green, raw	87.74	8.1
Peppers, hot chili, red, raw	88.02	8.3
Pepper, Hungarian, raw	91.51	11.8
Peppers, jalapeno, raw	91.69	12.0

Average		**11.6**
Dried		
Peppers, hot chili, sun-dried	7.15	13.9
Peppers, pasilla, dried	14.84	6.7
Spices, peppers, red or cayenne	8.05	12.4
Spices, paprika	9.54	10.5
Spice, chili powder	7.79	12.8
Average		**11.3**

[1] USDA nutrient Database (http://www.nal.usda.gov/fnic/foodcomp/search)
[2] From fresh peppers: concentration factor = 1/(1-g water/g edible)
[3] From dried peppers: concentration factor = 1/(g water/g edible)

The average concentration factor is about 11.6 based on the worst-case assumption that all water is removed from the fresh peppers during drying. Depending on the variety, in reality about 5-10% water is retained. Using the same USDA Nutrient Database, the water content of dried peppers and spices is about 7 to 15 g/100 g of the dried commodity (average concentration factor 11.3). ASTA routinely monitors the moisture content of dried chili peppers (capsicums). The results of the latest inter-comparison study based on results from 27 laboratories indicated an average water content of 7.06% with a reproducibility coefficient of variation of 14.7%. The highest moisture content was 9.79%. The data support the rounded figure of 10 for the dehydration/concentration factor currently applied by the spice industry.

Table 34 shows existing CXLs for pesticide residues in peppers as well as for draft MRLs at Step 6 and above of the Codex procedure.

Table 34. MRLs for peppers being at or above step 6 in Codex procedure

Pesticide and commodity	MRL for fresh produce (mg/kg)	Status	Comments
PEPPERS (VO 0051)			
Acephate	5	Step 6	Proposed by 2003 JMPR
Carbendazim	0.1	Step 6	
Chlorpyrifos-methyl	0.5	CXL	
Cypermethrin	0.5	CXL	
Cyromazine	1	CXL	
Dichlofluanid	2	CXL	
Dicofol	1	CXL	
Dimethoate	1	CXL	Withdrawal recommended by 1998 & 2003 JMPR (replacement)
Dinocap	0.2	CXL	
Ethephon	5	CXL	
Ethoprophos	0.02 (*)	CXL	2004 JMPR withdrew its previous recommendation for peppers and recommended 0.05 mg/kg for sweet peppers
Imidacloprid	1 (dry basis)	CXL	
Malathion	0.1	CXL	
Metalaxyl	1	CXL	
Methamidophos	2	Step 6	To replace CXLs
Methomyl	1	CXL	Withdrawal recommended by 2001 JMPR
Methoxyfenozide	2	Step 6	Proposed by 2003 JMPR
Monocrotophos	0.2	CXL	
Oxamyl	5	Step 6	Proposed by 2002 JMPR
Permethrin	1	CXL	
Phosphamidon	0.2	CXL	
Pirimicarb	2	CXL	
Pirimiphos-methyl	1	CXL	Withdrawal recommended by 2003 JMPR
Piperonyl butoxide	2	CXL	
Procymidone	5	CXL	

Pesticide and commodity	MRL for fresh produce (mg/kg)	Status	Comments
Profenofos	5	CXL	
Pyrethrins	0.05 (*)	CXL	
Spinosad	0.3	CXL	
Tebufenozide	1	CXL	
PEPPERS, SWEET (VO 0445)			
Abamectin	0.02	CXL	
Azinphos-methyl	1	CXL	
Benalaxyl	0.05	CXL	
Bromide ion	20	CXL	
Carbaryl	5	CXL	
Chlorothalonil	7	CXL	
Chlorpyrifos	2	CXL	
Cyfluthrin	0.2	CXL	
Cyhexatin	0.5	CXL	
Cyprodinil	0.5	Step 6	Proposed by 2003 JMPR
Diazinon	0.05	CXL	
Dimethoate	5	Step 6	Proposed by 2003 JMPR
Dithiocarbamates	1	CXL	
Fenarimol	0.5	CXL	
Fenpropathrin	1	CXL	
Fenvalerate	0.5	CXL	
Methamidophos	1	CXL	Withdrawal recommended by 2003 JMPR (replacement)
Oxamyl	0.1	CXL	To be replaced by MRL for peppers
Pirimicarb	1	CXL	
Profenofos	0.5	CXL	
Propamocarb	1	CXL	
Quintozene	0.01	CXL	
Tebuconazole	0.5	CXL	
Triadimefon	0.1	CXL	
Triadimenol	0.1	CXL	
Tolylfluanid	2	CXL	
Vinclozolin	3	CXL	
PEPPERS, CHILI (VO 0 444)			
Carbendazim	2	Step 6	Proposed by 2003 JMPR
Methamidophos	2	CXL	Withdrawal recommended by 2003 JMPR (replacement)
Pirimicarb	2	CXL	
Profenofos	5	CXL	

In a substantial proportion of random samples residues were undetectable indicating that the sampled lots were probably not treated with the prescribed pesticide. Median residues were therefore derived from detected residues. The long-term intake from the residue data which gave the largest contribution to the intake and the percentage of samples contained detectable residues of that particular crop–pesticide combination. Where no samples contained detectable residues the intake was calculated from highest and median LOQs, and the proportion of commodities "treated" could not be taken into account. The values on which intake calculations are shown in Table 35.

Table 35. Percentage of samples containing detectable residues of pesticides, and the highest contributing residues to short-term and chronic intakes.

Pesticide	Commodity	No. of samples	Samples with detectable residues, %	High residue, mg/kg	Median mg/kg
Acephate	All spices	225	0	0.2	0.2
Azinphos-methyl	All spices	260	0	0.5	0.1
Chlorpyrifos	Anise	762	10	3.6	0.09

Pesticide	Commodity	No. of samples	Samples with detectable residues, %	High residue, mg/kg	Median mg/kg
Chlorpyrifos-methyl	Ginger	22	100	2.9	0.077
Cypermethrin	Pepper	57	1.7	0.12	0.11
Diazinon	Anise seed	685	10	3.6	0.19
Dichlorvos	All spices	277	0	0.1	0.1
Dicofol	Root/rhizomes	112	3	0.05	0.05
Dimethoate	Anise	744	8	3	0.17
Disulfoton	All spices	223	0	0.05	0.05
Endosulfan	Pepper	143	5	3.2	0.12
Ethion	Pepper	104	2	3.1	1.7
Fenitrothion	Anise	756	3	5.4	0.4
Iprodione	Ginger	92	1	0.05	0.05
Malathion	Celery	53	6	0.86	0.48
Metalaxyl	Anise	411	1.5		0.43
	Fennel	895		3.2	
Methamidophos	All spices	260	0	0.1	0.01
Mevinphos	Celery	53	1.9	2.9	0.05
Parathion	Pepper	114	0	0.1	0.1
Parathion-methyl	Cumin	40	25	3.4	0.43
Permethrin	All spices	160	0	0.05	0.05
Phenthoate	Anise	415	2.4	5.2	1.2
Phorate	Cumin	32	6.2	0.3	0.21
Phosalone	Pepper	43	7	1.5	0.85
Pirimicarb	Anise	484	27		0.14
	Fennel	824		3	
Pirimiphos-methyl	Anise	508	3.1	1.8	0.23
Quintozene	Turmeric	115	3.5	1.2	0.05
Vinclozolin	All spices	442	0	0.05	0.05

The Meeting noted that the sampled commodities were probably already blended or mixed from a number of lots. A composite sample from such a mixed lot represents its average residue, which provides similar information to the median residue from supervised trials. Therefore the highest residues observed in composite samples were used in the short-term intake calculations.

Dried chili pepper consumption

The Gems/Food Regional Diets break down the consumption of peppers into chili peppers and sweet peppers (including pimientos), in most cases mainly as fresh vegetables. The proportion of both, when dried, consumed as spices (i.e. sprinkled on or cooked in foods, etc) is estimated by the spice industry to be about 10% of the total consumption.

Therefore for the assessment of long and short-term intakes 10% of the sum of the Gems/Food dietary consumption of sweet and chili peppers was used. Instead of the IEDI only TMDI calculations were possible, since the only residue values available were derived by extrapolation from the MRLs for fresh peppers. Similarly the estimated maximum residue levels for dried chili peppers were used for the IESTI calculations.

DIETARY RISK ASSESSMENT

Taking into account the specific nature of monitoring data and the lack of detailed information on spice consumptions, the following assumptions and approximations had to be made for the calculations:

- Since the sub-groups of spices used by the GEMS/Food Diet did not coincide with those drawn up by the 36th session of the CCPR (2004 report 2.6), the consumption for the entire spices group was used for long-term and short-term intake calculations.
- The ratio of samples containing detectable residues to all samples taken from a given commodity-pesticide combination was used to reflect the proportion of the commodity which was treated with or exposed to the pesticide. The factor derived was used in the IEDI calculations.
- The IEDI was calculated only from detected residues in that particular pesticide spice commodity combination which gave the highest contribution to the intake from any of the sub-groups.
- The IESTI was calculated where ARfD values were available.
- The consumption of "dried chili peppers" was estimated to be about 10% of the combined consumption of fresh sweet and chili peppers (VO 0445 and VO 0444).
- For dried chili peppers, only TMDI calculations were possible, since the only residue values available were the ones derived by extrapolation from MRLs for fresh peppers. The IESTI was also calculated from the estimated maximum residue levels.
- A composite sample taken from a spice shipment containing several lots represents the average residue in the mixed commodity. This residue value provides similar information to the median residue from supervised trials. Therefore the highest residues observed in composite samples were used in the short-term intake calculations instead of the median values which would have been used in case of results deriving from supervised trials.
- The estimations were made for spices and chili peppers independently.

The Meeting evaluated residues of 28 pesticides based on monitoring data, and estimated maximum reside levels for 47 pesticides for dried chili peppers based on MRLs established for fresh sweet and chili peppers. The intakes from spices and chili only were compared to the existing ADI and acute RfD values; intakes arising from uses of compounds on other commodities were not considered.

Table 38 summarises the available ADIs and ARfDs used for the dietary risk assessments.

Table 38. ADIs and ARfDs used in the intake assessments for pesticide residues in spices and dried chili peppers.

Pesticide	ADI mg/kg bw/day	ARfD mg/kg bw/day	Assessment
Abamectin	0.002		Dried chili
Acephate	0.01	0.05	Spices/dried chili
Azinphos-methyl	0.005		Spices/dried chili
Benalaxyl	0.05		Dried chili
Carbaryl	0.008	0.2	Dried chili
Carbendazim	0.03		Dried chili
Chlorothalonil	0.03		Dried chili
Chlorpyrifos	0.01	0.1	Spices/ dried chili
Chlorpyrifos-methyl	0.01		Dried chili
Cyfluthrin	0.02		Dried chili
Cyhexatin	0.007		Dried chili
Cypermethrin	0.05		Spices/ dried chili
Cyromazine	0.02		Dried chili
Diazinon	0.002	0.03	Spices/ dried chili
Dichlofluanid	0.3		Dried chili

Pesticide	ADI mg/kg bw/day	ARfD mg/kg bw/day	Assessment
Dichlorvos	0.004		Spices
Dicofol	0.002		Dried chili
Dimethoate	0.002	0.02	Spices/ dried chili
Dinocap	0.008		Dried chili
Disulfoton	0.0003	0.003	Spices
Dithiocarbamates (c,n)	0.03		Dried chili
Endosulfan	0.006	0.02	Spices
Ethephon	0.05	0.05	Dried chili
Ethion	0.002		Spices
Ethoprophos	0.0004	0.05	Dried chili
Fenarimol	0.01		Dried chili
Fenitrothion	0.005	0.04	Spices
Fenpropathrin	0.03		Dried chili
Fenvalerate	0.02		Dried chili
Imidacloprid	0.06	0.4	Dried chili
Iprodione	0.06		Spice
Malathion	0.3	2	Spices/ dried chili
Metalaxyl	0.08		Dried chili
Methamidophos	0.004	0.01	Spices
Methomyl	0.02	0.02	Dried chili
Methoxyfenozide	0.1	0.9	Dried chili
Mevinphos	0.0008	0.003	Spices
Monocrotophos	0.0006	0.002	Dried chili
Oxamyl	0.009	0.009	Dried chili
Parathion	0.004	0.01	Spices
Parathion-methyl	0.003	0.03	Spices
Permethrin	0.05	1.5	Spices/ dried chili
Phenthoate	0.003		Spices
Phorate	0.0007	0.003	Spices
Phosalone	0.02	0.3	Spices
Phosphamidon	0.0005		Dried chili
Piperonyl butoxide	0.2		Dried chili
Pirimicarb	0.02	0.1	Dried chili
Pirimiphos-methyl	0.03		Spices/ dried chili
Procymidone	0.1		Dried chili
Profenofos	0.01		Dried chili
Propamocarb	0.1		Dried chili
Pyrethrins	0.04	0.2	Dried chili
Quintozene	0.01		Spices/ dried chili
Spinosad	0.02		Dried chili
Tebuconazole	0.03		Dried chili
Tebufenozide	0.02	0.9	Dried chili
Tolylfluanid	0.08	0.5	Dried chili
Triadimefon	0.03	0.08	Dried chili
Triadimenol	0.03	0.08	Dried chili
Vinclozolin	0.01		Dried chili

Long-term intake

The results of intake calculations show that the IEDI for spices was below 1% of the ADI in all diets. The Meeting concluded that spice consumption would not change the risk assessment based on all other uses of the compounds. The results are given in Table 39.

The calculated TMDIs for dried chili peppers did not exceed 5% of the ADI in any GEMS/Food diet for abamectin, benalaxyl, cyfluthrin, cypermethrin, diazinon, dichlofulanid, dinocap, dithiocarbamates, fenpropathrin, fenvalerate, imidacoprid, metalaxyl, methoxyfenozide, permethrin, piperonyl butoxide, propamocarb, pyrethrins, quintozene, spinosad, tebuconazole, tolylfluanid,

triadimefon and triadimenol. The Meeting concluded that dried chili pepper consumption would not change the risk assessment based on all other uses of these compounds.

The residues of acephate, azinphos-methyl, carbaryl, carbendazim, chlorothalonil, chlorpyrifos, chlorpyrifos-methyl, cyhexatin, cyromazine, dicofol, dimethoate, ethephon, ethoprophos, fenarimol, methamidophos, methomyl, monocrotophos, oxamyl, phosphamidon, procymidone, profenofos, tebufenozide and vinclozolin in dried chili pepper contribute more than 5% of the ADI in at least one diet. The Meeting concluded that a complete long-term intake assessment for these compounds should be carried out taking into account their residues in all other commodities.

Residues resulting from the use of dimethoate on peppers exceed the ADI (430% in the European diet) on chili pepper alone. The Meeting could not conclude that its use would not present a health public concern. The detailed results are given in Table 40.

Short-term intake

The IESTI values for spices ranged from <1% to 170% (mevinphos) of the acute RfD.

For chili peppers intake values at or above the acute RfD were calculated for dimethoate (120%), methamidophos (100%) and oxamyl (270%).

The intakes expressed in mg/kg bw/day were similar for children and for the general population for both spices and chili peppers.

The Meeting concluded that short-term intake of pesticide residues, other than those listed above, from spice and dried chili consumption is unlikely to present a public health concern.

Table 39. Summary of results of IEDI and IE STI calculations for spices

Compound	Long-term intake, % of ADI[1]					Short-term intake, % of acute RfD[1]	
	Mid-East	Far-East	African	Latin American	European	Adult	Children
Diet (g/kg bw/day)	0.043	0.055	0.030	0.008	0.008	1.75	1.67
Acephate	0	0	0	0	0	0	0
Azinphos-methyl	0	0	0	0	0		
Chlorpyrifos	0	0	0	0	0	5	5
Chlorpyrifos-methyl	0	0	0	0	0		
Cypermethrin	0	0	0	0	0		
Diazinon	0	0	0	0	0	20	20
Dichlorvos	0	0	0	0	0		
Dicofol	0	0	0	0	0		
Dimethoate	0	0	0	0	0	25	25
Disulfoton	0	0	0	0	0	5	5
Endosulfan	0	0	0	0	0	30	25
Ethion	0	0	0	0	0		
Fenitrothion	0	0	0	0	0	25	25
Iprodione	0	0	0	0	0		
Malathion	0	0	0	0	0	0	0
Metalaxyl	0	0	0	0	0		
Methamidophos	0	0	0	0	0	0	0
Mevinphos	0	0	0	0	0	170	160
Parathion	0	0	0	0	0		
Parathion-methyl	0	0	0	0	0	20	20
Permethrin	0	0	0	0	0		
Phenthoate	0	0	0	0	0		

Compound	Long-term intake, % of ADI[1]					Short-term intake, % of acute RfD[1]	
	Mid-East	Far-East	African	Latin American	European	Adult	Children
Diet (g/kg bw/day)	0.043	0.055	0.030	0.008	0.008	1.75	1.67
Phorate	0	0	0	0	0		
Phosalone	0	0	0	0	0	0	0
Pirimicarb	0	0	0	0	0		
Pirimiphos-methyl	0	0	0	0	0		
Quintozene	0	0	0	0	0		
Vinclozolin	0	0	0	0	0		

[1] Rounded figures

Table 40. Summary of results of TMDI (% ADI) and IESTI (% of acute RfD) calculations based on MRLs proposed for dried chili peppers.

Compound	Long-term intake, % of ADI[1]					Short-term intake, % of acute RfD[1]	
	Mid-East	Far-East	African	Latin American	European	Adults	Children
Diet (g/kg bw/day)	0.057	0.038	0.090	0.040	0.173	0.472	0.477
Abamectin	1	0	1	0	2		
Acephate	30	20	45	20	90	50	50
Azinphos-methyl	10	10	20	10	35		
Benalaxyl	0	0	0	0	0		
Carbaryl	35	20	60	25	110	10	10
Carbendazim	5	5	5	5	10		
Chlorothalonil	10	10	20	10	40		
Chlorpyrifos	10	10	20	10	35	10	10
Chlorpyrifos-methyl	5	0	5	0	10		
Cyfluthrin	0	0	0	0	0		
Cyhexatin	0	5	5	5	10		
Cypermethrin	0	0	0	0	0		
Cyromazine	5	0	5	0	10		
Diazinon	0	0	0	0	0	0	0
Dichlofluanid	0	0	0	0	1		
Dicofol	30	20	45	20	90		
Dimethoate	140	90	230	100	430	120	120
Dinocap	0	0	0	0	0		
Dithiocarbamates	0	0	5	0	5		
Ethephon	5	5	10	5	20	50	50
Ethoprophos	5	0	5	0	10	0	0
Fenarimol	5	0	5	0	10		
Fenpropathrin	5	0	5	0	5		
Fenvalerate	0	0	0	0	5		
Imidacloprid	0	0	0	0	0	0	0
Metalaxyl	0	0	0	0	0		
Methamidophos	30	20	50	20	90	90	100
Methomyl	5	0	5	0	10	20	20
Methoxyfenozide	0	0	0	5	0	0	0
Monocrotophos	20	10	30	10	60		
Oxamyl	30	20	50	20	100	260	270
Permethrin	0	0	0	0	5		
Phosphamidon	20	20	40	20	70		
Piperonyl butoxide	0	0	0	0	0		
Pirimicarb	?????						
Procymidone	0	0	5	0	10		

Compound	Long-term intake, % of ADI[1]					Short-term intake, % of acute RfD[1]	
	Mid-East	Far-East	African	Latin American	European	Adults	Children
Diet (g/kg bw/day)	0.057	0.038	0.090	0.040	0.173	0.472	0.477
Profenofos	30	20	50	20	90		
Propamocarb	0	0	0	0	2		
Pyrethrins	0	0	0	0	0	0	0
Quintozene	0	0	0	0	0		
Spinosad	0	0	0	0	5		
Tebuconazole	0	0	0	0	5		
Tebufenozide	5	0	5	0	10		
Tolylfluanid	0	0	0	0	5	0	0
Triadimefon	0	0	0	0	0		
Triadimenol	0	0	0	0	0		
Vinclozolin	20	10	30	10	50		

[1] Rounded figures

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