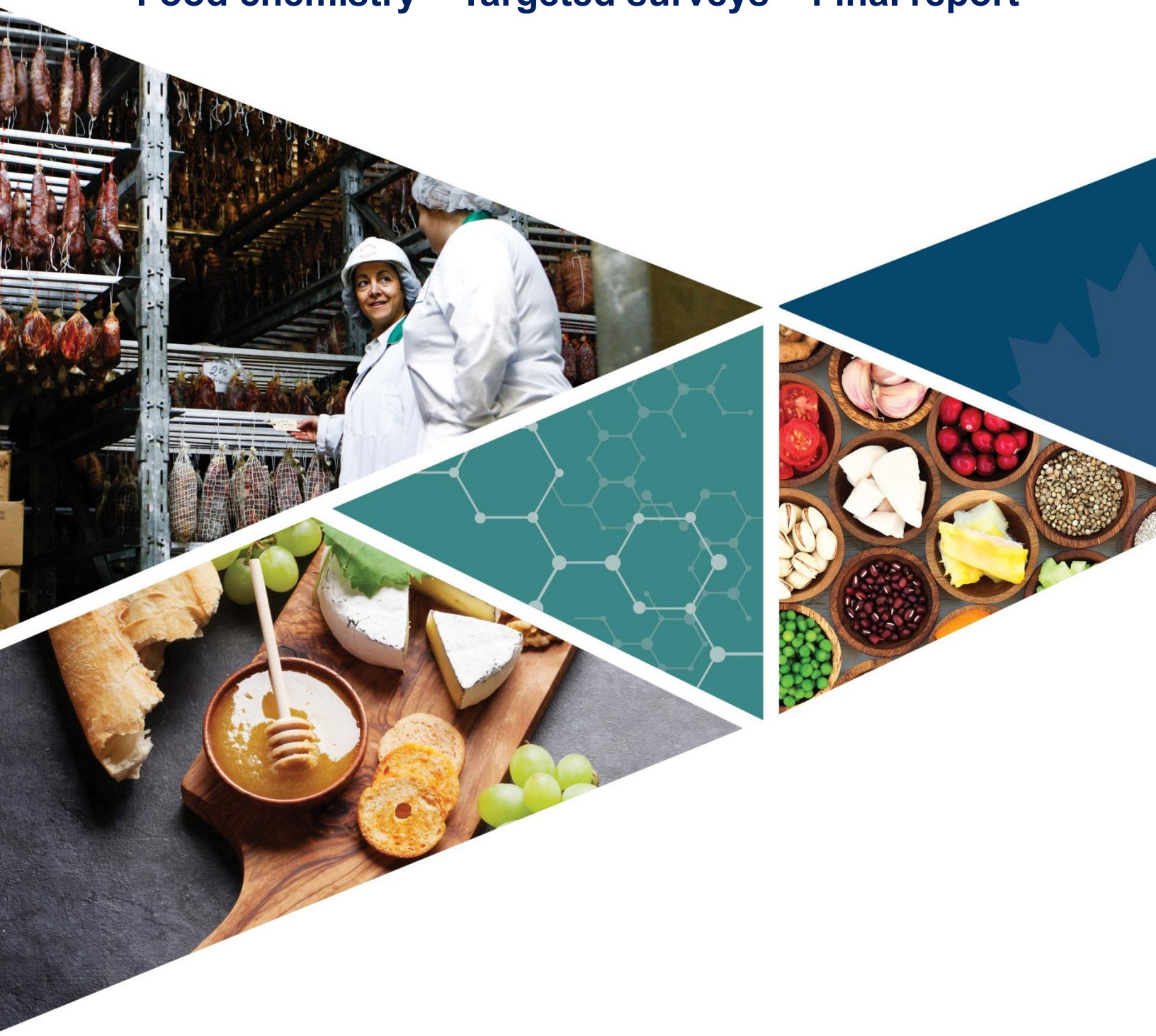
Canadian Food Inspection Agency
Agence canadienne d'inspection des aliments

Pesticides and metals in selected foods – April 1, 2022, to March 31, 2023

Food chemistry – Targeted surveys – Final report



Canada

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Summary

Targeted surveys provide information on potential food hazards and enhance the Canadian Food Inspection Agency's (CFIA's) routine monitoring programs. These surveys provide evidence regarding the safety of the food supply, identify potential emerging hazards, and contribute new information and data to food categories where it may be limited or non-existent. They are often used by the agency to focus surveillance on potential areas of higher risk. Surveys can also help to identify trends and provide information about how industry complies with Canadian regulations.

Products of agricultural commodities may contain pesticide residues introduced from the environment or if the crops were treated with pesticides in the field, during transport and/or during storage to prevent damage from insects, moulds or other pests. These highly consumed products may also contain levels of metals from environmental sources[1,2]. Though metals such as arsenic, cadmium, lead and mercury are not permitted to be added to foods, and manufacturers are responsible for measures aimed at reducing accidental introduction of these elements in foods (e.g., from lead solder in steel equipment), their presence is expected in foods, at very low levels, primarily as a result of their natural presence in the environment. The main objectives of this targeted survey were to generate additional baseline surveillance data on the level of pesticide residues and metal levels in selected food products available on the Canadian market and to compare the detection rates of pesticides in this targeted survey to those recorded in previous surveys.

A total of 1869 samples of botanical powders, fresh herbs, legumes, mushrooms, seed/pseudo-cereal products, and vegetable products were collected and tested for pesticides and metals. Pesticide residues were detected in 553 (30%) of the samples. The overall compliance rate for pesticides in products tested in this survey was 95.8%. Of the 131 non-compliant results, 126 were associated with pesticide residues exceeding the general MRL of 0.1 ppm, while 5 were pesticide levels above the specific established MRL. The average amount of residue detected in the non-compliant samples was 0.463 ppm.

A total of 1968 samples collected were also analyzed for a suite of 20 metals. Only the data for metals of highest concern to human health at low levels of exposure are presented in this report, most notably: arsenic, cadmium, lead, and mercury. Arsenic and mercury had the highest and the lowest overall detection rate, respectively. Botanical powders were found to contain the highest levels of metals, while the maximum levels and the average levels of metals were lowest in legumes.

There are no maximum limits (MLs) set in Canada for metal levels in the products tested. All data generated were forwarded to Health Canada for human risk assessment and determined to pose no concern to human health. All non-compliant pesticide results obtained during the course of this survey were forwarded to the CFIA's Office of Food Safety and Recall (OFSR). The extent of the follow up actions taken by the agency was based on the level of the contamination and the resulting health concern as determined by a health risk assessment.

What targeted surveys are

Targeted surveys are used by the CFIA to focus its surveillance activities on areas of highest health risk. The information gained from these surveys provides support for the allocation and prioritization of the agency's activities to areas of greater concern. Originally started as a project under the Food Safety Action Plan (FSAP), targeted surveys have been embedded in our regular surveillance activities since 2013. Targeted surveys are a valuable tool for generating information on certain hazards in foods, identifying and characterizing new and emerging hazards, informing trend analysis, prompting and refining health risk assessments, highlighting potential contamination issues, as well as assessing and promoting compliance with Canadian regulations.

Food safety is a shared responsibility. We work with federal, provincial, territorial and municipal governments and provide regulatory oversight of the food industry to promote safe handling of foods throughout the food production chain. The food industry and retail sectors in Canada are responsible for the food they produce and sell, while individual consumers are responsible for the safe handling of the food they have in their possession.

Why we conducted this survey

Chemical hazards in foods can come from a variety of sources. Pesticides may be present as contaminants in the environment or they may be deliberately used by farmers to protect food and crops from pests. Different pest pressures and climatic conditions in food export countries may result in the potential use of pesticides that are not approved for use in Canada, or result in pesticide residues in products that do not meet established Canadian MRLs to be legally sold in Canada[3]. Inappropriate use of pesticides may pose a health risk to consumers, with the risk dependant on the type of pesticide, its concentration, the effects on the human body, and the length of exposure to the pesticide by the consumer.

Metals are naturally-occurring elements that may be present in very low amounts in rock, water, soil, or air. Therefore, finding these substances in food products is not unexpected as trace levels generally reflect normal accumulation from the environment[4,5]. They may be present in finished foods due to their presence in the ingredients used to manufacture those foods, and/or may be unintentionally incorporated along the food production chain.

There are a number of metals that may be of concern to human health at certain levels of exposure. Most notably, arsenic, cadmium, lead, and mercury have been shown to have effects on human health, even at low levels of exposure. The results of only these metals of highest concern are presented in this report.

Agricultural commodities may contain pesticide residues introduced from the environment or if the crops were treated with pesticides in the field, during transport, and/or during storage to prevent damage from insects, moulds, or other pests. The objective of this targeted survey was to obtain additional baseline data on the levels of pesticides, arsenic, cadmium, lead and

mercury in these types of products available on the Canadian market, and to compare the detection rate of pesticides in foods with previous targeted surveys.

What we sampled

A variety of domestic and imported botanical powders, fresh herbs, legumes (bean, chickpea, lentil and pea products), mushrooms, seed/pseudo-cereal products (containing quinoa, amaranth, flax, millet, teff, chia, sesame, pumpkin seeds, or sunflower seeds), and vegetable products (prepackaged leafy greens, salad kits, canned/jarred mushrooms) available on the Canadian market were sampled between April 1, 2022, and March 21, 2023. Samples of products were collected from local/regional retail locations located in 11 major cities across Canada. These cities encompassed 4 Canadian geographical areas:

- Atlantic (Halifax and Moncton)
- Quebec (Montreal and Quebec City)
- Ontario (Toronto and Ottawa)
- West (Calgary, Saskatoon, Vancouver, Victoria and Winnipeg)

The number of samples collected from these cities was in proportion to the relative population of the respective areas. The shelf life, storage conditions, and the cost of food on the open market were not considered in this survey.

Table 1. Distribution of samples based on product type and origin

Product type	Number of domestic samples tested for metals /pesticides	Number of imported samples tested for metals /pesticides	Number of samples of unspecified[a] origin tested for metals /pesticides	Total number of samples tested for metals /pesticides
Botanical powders	14 / 14	245 / 214	23 / 22	282 / 250
Herbs	14 / 12	89 / 49	4 / 4	107 / 65
Legumes – Bean products	94 / 93	101 / 101	40 / 40	235 / 235
Legumes – Chickpea products	99 / 98	63 / 63	32 / 32	194 / 193
Legumes – Lentil products	61 / 61	55 / 54	24 / 24	140 / 139
Legumes – Pea products	62 / 62	53 / 52	18 / 18	133 / 132
Mushrooms	25 / 25	90 / 90	1 / 1	116 / 116
Seed/pseudo-cereal products	104 / 102	287 / 284	142 / 140	533 / 526
Vegetable products	10 / 7	202 / 193	16 / 14	228 / 214
Total	**483 / 474**	**1185 / 1100**	**300 / 295**	**1968 / 1869**

Table notes

[a] Unspecified refers to those samples for which the country of origin could not be assigned from the product label or available sample information.

How samples were analyzed and assessed

Of the total 1968 samples collected, 1869 samples were analyzed for pesticides by an ISO/IEC 17025 accredited food testing laboratory under contract with the Government of Canada. See Appendix A for a list of the pesticide residues included in 5 multi-residue pesticide methods. Samples were analyzed using at least 1 and up to 5 of these multi-residue pesticide methods. The number of tests performed for each food category is outlined in Table 2. All samples were also subjected to a multi-metal method that analyzes for 20 metals. The data for metals of highest concern to human health at low levels of exposure, most notably: arsenic, cadmium, lead, and mercury, are presented in this report. The results are based on the food products as sold and not necessarily as they would be consumed.

Results were assessed according to Canadian pesticide MRLs, established by the Pest Management Regulatory Agency (PMRA) of Health Canada and appear in their MRL database[3]. Pesticide MRLs were applied to the specified raw agricultural commodity as well as to any processed food product that contains the commodity unless otherwise specified. According to section B.15.002 (1) of the Food and Drug Regulations (FDR), in the absence of a specific MRL,

residues of a pesticide or other agricultural chemical must not exceed the general MRL of 0.1 ppm.

Contaminants and other adulterating substances in foods have regulatory maximum levels that are established by Health Canada. In the absence of a specific maximum level, they assess the levels of arsenic, cadmium, mercury and lead on a case-by-case basis using the most current scientific data available.

Results of the survey

Pesticides

A total of 1869 samples of domestic and imported botanical powders, fresh herbs, legumes, mushrooms, seed/pseudo-cereal products and vegetable products were tested for up to 531 pesticide residues in this targeted survey. Refer to Appendix A for a list of the pesticide residues included in the multi-residue pesticide methods.

Pesticide residues were not detected in 1316 (70%) samples. Of the samples with detectable pesticide residues, 91.9% contained from 1 to 3 pesticide residues per sample. The greatest number of individual pesticides found in a single sample was 23 in a sample of imported relish made from mustard greens. A summary of the results by product type can be seen in Table 2.

Table 2. Results of pesticide testing in selected foods

Product type	Number of samples	Number of multi-residue pesticide methods performed[b]	Number (percentage) of samples with detected pesticide residue(s)	Number (percentage) of non-compliant samples
Botanical powders	250	673	83 (33 %)	31 (12 %)
Herbs	65	152	36 (55 %)	14 (22 %)
Legumes – Bean products	234	908	35 (15 %)	0
Legumes – Chickpea products	193	708	72 (37 %)	1 (0.5 %)
Legumes – Lentil products	139	460	36 (26 %)	1 (0.7 %)
Legumes – Pea products	132	467	37 (28 %)	0
Mushrooms	116	325	47 (41 %)	0
Seed/pseudo-cereal products	526	1775	105 (20 %)	8 (1.5 %)
Vegetable products	214	593	102 (48 %)	23 (11 %)
Total	**1869**	**6061**	**553 (30 %)**	**78 (4.2 %)**

Table notes

[b] Methods used are outlined in Appendix A and contain between 11 and 284 pesticides per method. A total of 1838 (98%) samples were tested using at least 2 major methods for a minimum of 488 pesticide residues.

When evaluated by commodity, the percentage of samples with pesticide residues detected ranged from 20% in seed/pseudo-cereal products to 55% in herbs. Glyphosate was the pesticide with the highest overall detection rate, all results reported for glyphosate were compliant. Chlorpyrifos was the second most frequently detected pesticide. The overall compliance rate for pesticides in the products tested was 95.8%. Compliance was assessed against the MRLs which were in place when the survey was carried out. There were 131 non-compliant results associated with 78 samples. Of the 131 non-compliant results, 126 were associated with pesticide residues exceeding the general MRL of 0.1 ppm, while 5 were pesticide levels above the specific established MRL for that product type. The average amount of residue detected in the non-compliant samples was 0.463 ppm.

Of the 1869 products tested, 1390 samples were conventionally-grown and 479 products were labelled as “organic” (note that identification of samples as organic is based solely on the information on the product label). The detection rate of pesticide residues was 32% and 23% respectively, for conventionally grown and organic products. The average amount of pesticide residues detected in the conventional and organic samples was 0.149 ppm and 0.098 ppm, respectively. Of the 78 non-compliant samples, 18 were organic samples.

All non-compliant results obtained during the course of this survey were forwarded to the CFIA's Office of Food Safety and Recall (OFSR) and to the CFIA Organic Office for follow-up. The extent of the follow up actions taken by the agency was based on the level of the contamination and the resulting health concern as determined by a health risk assessment.

Metals

All 1968 samples collected were subjected to a multi-metal laboratory method that analyzes for 20 metals. Only the results of the metals of highest human health concern (arsenic, cadmium, lead and mercury) are presented in this report. Table 3 illustrates the level of these metals found in the products tested.

Table 3. Detected levels of metals in selected foods

Product type	Number of samples	% positive for arsenic	Average level (range) of arsenic (ppm)	% positive for cadmium	Average level (range) of cadmium (ppm)	% positive for lead	Average level (range) of lead (ppm)	% positive for mercury	Average level (range) of mercury (ppm)
Botanical powders	282	97	0.272 (<LOD-32.5)	94	0.094 (<LOD-0.770)	97	0.711 (<LOD-67.5)	34	0.0130 (<LOD-0.0408)
Herbs	107	83	0.066 (<LOD-0.659)	58	0.062 (<LOD-1.05)	87	0.045 (<LOD-0.261)	21	0.0075 (<LOD-0.0515)
Legumes – Bean products	235	41	0.038 (<LOD-1.43)	28	0.011 (<LOD-0.054)	27	0.017 (<LOD-0.237)	1	0.0058 (<LOD-0.0081)
Legumes – Chickpea products	194	61	0.020 (<LOD-0.190)	44	0.015 (<LOD-0.133)	41	0.012 (<LOD-0.058)	4	0.0069 (<LOD-0.0154)
Legumes – Lentil products	140	66	0.014 (<LOD-0.155)	20	0.014 (<LOD-0.166)	54	0.014 (<LOD-0.051)	4	0.0057 (<LOD-0.0061)
Legumes – Pea products	133	47	0.027 (<LOD-0.148)	71	0.020 (<LOD-0.116)	32	0.010 (<LOD-0.025)	5	0.0065 (<LOD-0.0121)
Mushrooms	116	69	0.011 (<LOD-0.031)	19	0.022 (<LOD-0.155)	27	0.021 (<LOD-0.079)	48	0.0053 (<LOD-0.0254)
Seed/pseudo-cereal products	533	84	0.037 (<LOD-0.670)	86	0.084 (<LOD-0.786)	69	0.018 (<LOD-0.384)	6	0.0066 (<LOD-0.0142)
Vegetable products	228	52	0.026 (<LOD-0.303)	81	0.055 (<LOD- 0.294)	54	0.069 (<LOD-1.19)	19	0.0032 (<LOD-0.0116)

Table notes

<LOD = Below the limit of detection (0.0005 - 0.01 ppm, depending on the laboratory and the analyte).
Note: Average values were calculated using only results for samples with quantifiable metal levels.

Mercury and arsenic had the lowest and the highest overall detection rate at 14% and 70%, respectively. Although, most (87%) of survey samples contained at least 1 of the toxic metals, the detection rate was slightly lower in legumes (68%). The maximum levels and the average levels of metals were also lowest in legumes compared to other products tested in this survey. All botanical powder samples were positive for at least one toxic metal and the average levels of all toxic metals were also the highest for this category. Two different samples of botanical powders substantially exceeded the average arsenic and lead levels sound at 32.5 ppm and 67.5 ppm, respectively. All 4 toxic metals were detected in 8% of all the survey samples, of

which 55% were botanical powders. There are no regulations in Canada for the levels of these metals in the products tested. Health Canada received these survey results and determined that none of the products posed a health risk to consumers.

What the survey results mean

Table 4 compares this survey's results with past survey data for pesticides[6,7,8,9]. The detection rate for this survey is lower when compared to the rate observed for the 4 most recent survey years, but the overall non-compliance rate is higher. However, the percentages of non-compliant samples observed in previous surveys in the same product types are comparable or lower. For example, the non-compliance rate was 8.4% for vegetable products in 2020, 3.3% in legume products in 2019, and 6.1% in botanical powders in 2018 survey[7,8,9]. Some differences observed are due to the specific type of product selected more likely to contain pesticide residues. Highest non-compliance of 78% was observed for fresh herbs, which is consistent with findings of the National Chemical Residue Monitoring Program (NCRMP) [10,11]. In 2022, NCRMP compliance rate for herbs was 94.7% for domestic samples and 83.0% for imported products (47 samples collected in total). In 2021, NCRMP compliance rate was 62.5% and 59.5% for domestic and imported fresh herbs, respectively (37 samples)[10]. Similarly, a small difference between the compliance for domestic and imported fresh herbs was observed in this survey (77.6% and 75%, respectively)[11]. Out of the 29 of non-compliant results in 14 samples of fresh herbs, only 2 results were pesticide levels above the specific established MRL. Therefore, it is important to note that non-compliance rate is often closely related to absence of specific MRLs for product types tested. It should also be re-iterated that product types were selected due to their high likelihood of containing pesticide residues, and that the observed prevalence is not necessarily representative of the prevalence of pesticide residues in all foodstuffs available at retail. In general, the same types of non-compliant results found in the current survey were found in previous surveys in similar product types.

Table 4. Pesticide testing results from various survey years

Survey year[c]	Number of samples	Number (percentage) of samples with detected pesticide residue(s)	Number (percentage) of non-compliant samples
2022[d]	**1869**	**553 (30%)**	**78 (4.2%)**
2021	2048	1275 (62%)	13 (0.6%)
2020	1486	892 (60%)	31 (2.1%)
2019	2849	1446 (51%)	73 (2.9%)
2018	3348	1327 (40%)	22 (0.7%)

Table notes

[c] Note: In survey years 2018 to 2021, samples were tested for 483 pesticide residues.
[d] Note: In this survey year, 2 polar pesticide methods included a number of pesticide residues not tested for in previous years.

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Appendix A

Table A-1: List of analytes (284) included in the PESTICIDE-GC multi-residue pesticide method used by the accredited laboratory in this survey

Acephate	Cyprodinil	Fluorodifen	Penconazole
Acibenzolar-s-methyl	Deltamethrin	Fluridone	Pendimethalin
Aclonifen	Demeton-O	Fluroxypyr	Pentachloroaniline
Acrinathrin	Demeton-S	Flusilazole	Permethrin-cis
Alachlor	Demeton-S-methyl	Fluvalinate	Permethrin-trans
Aldrin	Desmetryn	Folpet	Phenthoate
Allethrin (Total)	Diallate	Fonofos	Phorate
Allidochlor	Diazinon	HCH-alpha	Phorate sulfone
Ametryn	Diazinon o analogue	HCH-beta	Phosalone
Aramite	Dichlobenil	HCH-delta (delta-lindane)	Phosmet
Aspon	Dichlofenthion	HCH-gamma (Lindane)	Phosphamidon
Atrazine	Dichlofluanid	Heptachlor	Piperonyl butoxide
Atrazine-desethyl	Dichlormid	Heptachlor epoxide endo	Pirimicarb
Azinphos-ethyl	Dichlorvos	Heptenophos	Pirimiphos-ethyl
Azinphos-methyl	Diclobutrazole	Hexachlorobenzene	Pirimiphos-methyl
Azoxystrobin	Diclofop-methyl	Hexaconazole	Prochloraz
Benalaxyl	Dicloran	Hexazinone	Procymidone
Benfluralin	Dicofol	Imazalil	Profenofos
Benodanil	Dicrotophos	Iodofenphos	Profluralin
Benzoylprop-ethyl	Dieldrin	Iprobenfos	Prometon
Bifenazate	Diethatyl-ethyl	Iprodione	Prometryne
Bifenox	Dimethachlor	Isazophos	Pronamide
Bifenthrin	Dimethenamid	Isofenphos	Propachlor
Biphenyl	Dimethoate	Isopropalin	Propanil
Bromacil	Dinitramine	Isoprothiolane	Propargite
Bromophos	Dioxathion	Isoproturon	Propazine
Bromophos-ethyl	Diphenamid	Kresoxim-methyl	Propetamphos
Bromopropylate	Diphenylamine	Leptophos	Propham
Bupirimate	Disulfoton	Linuron	Propiconazole
Buprofezin	Disulfoton sulfone	Malaoxon	Propyzamide
Butachlor	Edifenphos	Malathion	Prothiophos
Butralin	Endosulfan sulfate	Mecarbam	Pyracarbolid
Butylate	Endosulfan-alpha	Metalaxyl	Pyrazophos
Captafol	Endosulfan-beta	Metazachlor	Pyridaben
Captan	Endrin	Metconazole	Quinalphos
Carbofenthion	EPN	Methamidophos	Quinomethionate
Carboxin	EPTC	Methoprotryne	Quintozene
Chlorbenside	Erbon	Methoxychlor	Resmethrin
Chlorbufam	Esfenvalerate	Methyl Pentachlorophenyl sulphide	Secbumeton

Chlordane	Etaconazole	Metobromuron	Simazine
Chlordane-cis	Ethalfluralin	Metolachlor	Simetryn
Chlordane-trans	Ethion	Metribuzin	Sulfallate
Chlordimeform	Ethofumesate	Mevinphos (Total)	Sulfotep
Chlorfenson	Ethoprophos	Mirex	Sulprophos
Chlorfenvinphos (e+z)	Ethylan	Monolinuron	TCMTB
Chlorflurenol-methyl	Etridiazole	Myclobutanil	Tebuconazole
Chlormephos	Etrimfos	Naled	Tecnazene
Chlorobenzilate	Famoxadone	Nitralin	Tefluthrin
Chloroneb	Fenamiphos	Nitrapyrin	Terbacil
Chloropropylate	Fenamiphos sulfone	Nitrofen	Terbufos
Chlorothalonil	Fenamiphos sulfoxide	Nitrothal-isopropyl	Terbumeton
Chlorpropham	Fenarimol	Nonachlor-trans	Terbuthylazine
Chlorpyrifos-ethyl	Fenbuconazole	Norflurazon	Terbutryne
Chlorpyrifos-methyl	Fenchlorphos (Ronnel)	Nuarimol	Tetrachlorvinphos
Chlorthal-dimethyl (Dacthal)	Fenfuram	o,p'-DDD (o,p'-TDE)	Tetradifon
Chlorthiamid	Fenitrothion	o,p'-DDE	Tetraiodoethylene
Chlorthion	Fenoxaprop-ethyl	o,p'-DDT	Tetramethrin
Chlorthiophos	Fenpropathrin	Octhilinone	Tetrasul
Chlozolinate	Fenson	Omethoate	Thiobencarb
Clomazone	Fensulfothion	Ortho-phenylphenol	Tolclofos-methyl
Coumaphos	Fenthion	Oxadiazon	Tolyfluanid
Crotoxyphos	Fenvalerate	Oxamyl-oxime	Triadimefon
Crufomate	Fipronil	Oxychlordane	Triadimenol
Cyanazine	Flamprop-isopropyl	Oxyfluorfen	Triallate
Cyanophos	Flamprop-methyl	p,p'-DDD (p,p'-TDE)	Triazophos
Cycloate	Fluchloralin	p,p'-DDE	Tribufos
Cyfluthrin (I,II,III,IV)	Flucythrinate	p,p'-DDT	Trifloxystrobin
Cyhalothrin-lambda	Fludioxonil	Paraoxon	Triflumizole
Cypermethrin	Flufenacet	Parathion-ethyl	Trifluralin
Cyprazine	Flumetralin	Parathion-methyl	Vernolate
Cyproconazole	Fluorochloridone	Pebulate	Vinclozolin

Table A-2: List of analytes (204) included in the PESTICIDE-LC multi-residue pesticide method used by the accredited laboratory in this survey

3-hydroxyCarbofuran	Diethofencarb	Imazethapyr	Promecarb
Abamectin	Difenoconazole	Imidacloprid	Propamocarb
Acephate	Dimethametryn	Indoxacarb	Propoxur
Acetamiprid	Dimethoate	Ipconazole	Pymetrozine
Acetochlor	Dimethomorph	Iprovalicarb	Pyraclostrobin
Aclonifen	Dimetilan	Isocarbamide	Pyraflufen-ethyl
Aldicarb	Dimoxystrobin	Isoprocarb	Pyridalyl
Aldicarb Sulfone	Diniconazole	Isoproturon	Pyridaphenthion
Aldicarb sulfoxide	Dinotefuran	Isoxadifen-ethyl	Pyridate

Aminocarb	Dioxacarb	Isoxathion	Pyrifenox
Anilofos	Dipropetryn	Linuron	Pyrimethanil
Azaconazole	Diuron	Malaoxon	Pyriproxyfen
Bendiocarb	Dodemorph	Malathion	Pyroquilon
Benomyl	Emamectin (Total)	Mandipropamid	Pyroxsulam
Benoxacor	Epoxiconazole	Mepanipyrim	Quinoxyfen
Bitertanol	Ethiofencarb	Mephosfolan	Quizalofop
Boscalid	Ethiofencarb sulfone	Methabenzthiazuron	Quizalofop-ethyl
Bromuconazole	Ethiofencarb sulfoxide	Methamidophos	Schradan
Butafenacil	Ethiprole	Methidathion	Simeconazole
Butocarboxim	Ethirimol	Methiocarb	Spinosyn A
Butocarboxim sulfoxide	Ethoprop	Methiocarb sulfone	Spinosyn D
Cadusafos	Etofenprox	Methiocarb Sulfoxide	Spirodiclofen
Carbaryl	Etoxazole	Methomyl	Spiromesifen
Carbendazim	Famoxadone	Methoxyfenozide	Spirotetramat
Carbetamide	Fenamidone	Metolcarb	Spiroxamine
Carbofuran	Fenamiphos sulfone	Metosulam	Sulfentrazone
Carbosulfan	Fenamiphos sulfoxide	Metoxuron	Tebufenozide
Carfentrazone-ethyl	Fenazaquin	Mexacarbate	Tebufenpyrad
Chlorantraniliprole	Fenhexamid	Molinate	Tebupirimfos
Chlorbromuron	Fenoxanil	Monocrotophos	Tepraloxydim
Chloridazon	Fenoxycarb	Napropamide	Tetraconazole
Chlorimuron-ethyl	Fenpropidin	Naptalam	Thiabendazole
Chloroxuron	Fenpropimorph	Neburon	Thiacloprid
Chlortoluron	Fenpyroximate	Nicotine	Thiamethoxam
Clodinafop-propargyl	Fentrazamide	Nitenpyram	Thiazopyr
Clofentezine	Fluazifop-butyl	Novaluron	Thiodicarb
Cloquintocet-mexyl	Flucarbazone-sodium	Ofurace	Thiofanox
Clothianidin	Fluoxastrobin	Omethoate	Thiofanox sulfone
Cyanofenphos	Fluroxypyr	Oxadixyl	Thiofanox sulfoxide
Cyazofamid	Flutolanil	Oxamyl	Thiophanate-methyl
Cycloxydim	Flutriafol	Oxamyl-oxime	Tolfenpyrad
Cycluron	Forchlorfenuron	Oxycarboxin	Tolyfluanid
Cyromazine	Formetanate	Paclobutrazol	Tralkoxydim
Demeton-O	Fosthiazate	Pencycuron	Trichlorfon
Demeton-S	Fuberidazole	Penoxsulam	Tricyclazole
Demeton-S-methyl	Furathiocarb	Picolinafen	Trietazine
Demeton-s-methyl sulfone	Griseofulvin	Picoxystrobin	Trifloxysulfuron
Demeton-s-methyl sulfoxide	Haloxyfop	Piperophos	Triforine
Desmedipham	Hexythiazox	Pretilachlor	Trimethacarb
Dialofos	Imazalil	Primisulfuron-methyl	Zinophos
Diclocymet	Imazamethabenz-methyl	Prochloraz	Zoxamide

Table A-3: List of analytes (17) included in the PHENOXY HERBICIDES multi-residue pesticide method used by the accredited laboratory in this survey

2,4,5-T	Chloramben	MCPA
2,4-D	Clopyralid	MCPB
2,4-DB	Dicamba	Mecoprop
Acifluorfen	Dichlorprop	Picloram
Bentazon	Dinoseb	Triclopyr
Bromoxynil	Fenoprop	

Table A-4: List of analytes (11) included in the POLAR-A multi-residue pesticide method used by the accredited laboratory in this survey

AminomethylPhosphonic Acid	Glufosinate	N-AcetylAminomethylPhosphonic Acid
Cyanuric Acid	Glyphosate	N-Acetylglufosinate
Ethephon ((2-Chloroethyl) Phosphonic Acid)	Maleic hydrazide	N-Acetylglyphosate
Fosetyl-Al	MPPA (3-Methylphosphinicopropionic Acid)	

Table A-5: List of analytes (15) included in the POLAR-B multi-residue pesticide method used by the accredited laboratory in this survey

Aminocyclopyrachlor	Ethylene Thiourea	Propamocarb
Amitrole (Aminotriazole)	Melamine	Propamocarb-N-desmethyl
Chloridazon desphenyl	Mepiquat	Propamocarb-N-oxide
Chlormequat	Mepiquat-4-hydroxy	PTU (N,N'-(1,2-Propylene) thiourea)
Difenzoquat	Morpholine	Trimesium (Trimethylsulfonium)