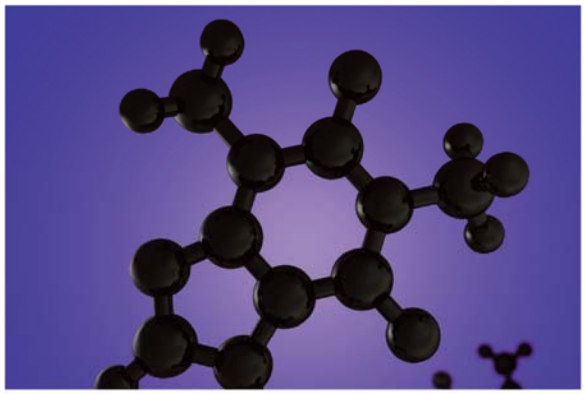
Canadian Food Inspection Agency
Agence canadienne d'inspection des aliments

Food Safety Action Plan

REPORT

2011-2012 Targeted Surveys

Chemistry



Pesticides in Finished Grains and Grain Products

TS-CHEM-11/12

Canada

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Executive Summary

The Food Safety Action Plan (FSAP) aims to modernize and enhance Canada's food safety system. As a part of the FSAP enhanced surveillance initiative, targeted surveys are used to test various foods for specific hazards.

The main objective of this targeted survey was to generate baseline data regarding the presence and levels of pesticide residues in selected finished grains and grain products (specifically corn, oat, rice, wheat, and other grains) available on the Canadian retail market.

A total of 418 domestic and imported samples were collected from Canadian retail stores between June 2011 and March 2012. Samples included 83 corn, 86 oat, 84 rice, 135 wheat, and 30 other grain products. These samples were analyzed for over 430 different pesticide residues consisting mainly of insecticides and fungicides. One hundred eight of the samples were labelled as being organic products. The CFIA monitors food as sold rather than as consumed, therefore samples were not cooked/prepared prior to analysis. As such, the results presented should only be interpreted as foods available as sold and not as they would be consumed.

In total, 99.8% of the samples analyzed in this survey were compliant with existing Canadian Maximum Residue Limits (MRLs) for pesticides. Pesticide residues were not detected in 382 of 418 (91.4%) samples. Thirty-six samples had either one or two pesticide residues; four of these samples were labelled as organic products. Only one sample in this survey (a sample of quinoa) was in violation of the Canadian General MRL of 0.1 parts per million (ppm); however, this was not expected to pose an unacceptable human health concern. Appropriate follow-up actions were initiated that reflected the magnitude of the human health concern. No product recalls were warranted given the lack of a health concern.

1 Introduction

1.1 Food Safety Action Plan

In 2007, the Canadian government launched a five year initiative in response to a growing number of product recalls and concerns about food safety. This initiative, called the Food and Consumer Safety Action Plan (FCSAP), aims to modernize and strengthen Canada's safety system for food, health, and consumer products. The FCSAP initiative unites multiple partners in ensuring safe food for Canadians.

The Canadian Food Inspection Agency's (CFIA) Food Safety Action Plan (FSAP) is one element of the government's broader FCSAP initiative. The goal of FSAP is to identify risks in the food supply, limit the possibility that these risks occur, improve import and domestic food controls and identify food importers and manufacturers.

Within FSAP there are twelve main areas of activity, one of which is risk mapping and baseline surveillance. The main objective of this area is to better identify, assess, and prioritize potential food safety hazards through risk mapping, information gathering, and testing of foods from the Canadian marketplace. Targeted surveys are one tool used to test for the presence and level of a particular hazard in specific foods.

Within the current regulatory framework, some commodities (such as meat products) traded internationally and interprovincially are regulated by specific Acts. These are referred to as federally registered commodities. Under the current regulatory framework, the non-federally registered commodities encompass 70% of domestic and imported foods that are regulated solely under the *Food and Drugs Act* and *Regulations*. Targeted surveys are primarily directed towards non-federally registered commodities.

1.2 Targeted Surveys

Targeted surveys are used to gather information regarding the potential occurrence of chemical residues, contaminants, and/or natural toxins in defined commodities. The surveys are designed to answer specific questions. Therefore, unlike monitoring activities, testing of a particular chemical hazard is targeted to commodity types and/or geographical areas.

Due to the vast number of chemical hazards and food commodity combinations, it is not possible, nor should it be necessary, to use targeted surveys to identify and quantify all chemical hazards in foods. To identify food-hazard combinations of greatest potential health risk, the CFIA uses a combination of scientific literature, media reports, and/or a risk-based model developed by the Food Safety Science Committee, a group of federal, provincial and territorial subject matter experts in the area of food safety.

Pesticide residue testing in raw domestic cereal grains is currently performed by the Canadian Grain Commission (CGC)[1]. The CGC does not test for pesticide residues in

finished grains and grain products found at retail (which consists of both domestic and imported foods), as these types of product are not within the mandate of the CGC. As part of the CFIA's core activities, many agricultural commodities are monitored under the National Chemical Residue Monitoring Program (NCRMP) and Children's Food Project (CFP) for the presence of pesticide residues. However, the NCRMP and CFP do not routinely examine pesticide residues in finished grains and grain products, and residue data in these types of food is limited. This targeted survey establishes baseline data on pesticide residue levels in food products not routinely monitored under these programs, namely selected finished grains and grain products available on the Canadian retail market.

1.3 Acts and Regulations

The *Canadian Food Inspection Agency Act* stipulates that the CFIA is responsible for enforcing Canadian laws and regulations on the production, sale, composition and content of foods and food products as outlined in the *Food and Drugs Act & Regulations*.

Health Canada establishes the health-based maximum levels for chemical residues, contaminants, and natural toxins in food sold in Canada. Health Canada's Pest Management Regulatory Agency (PMRA) is responsible for the registration and regulation of pesticides and for specifying maximum residue limits (MRLs) under the *Pest Control Products Act (PCPA)*. The CFIA recognizes the scientific validity of the health risk assessment carried out by Health Canada and PMRA prior to specifying MRLs. Specified MRLs appear in Health Canada's MRL Database[2]. Each MRL is set for a specific pesticide and food commodity combination, and is the maximum amount of residue expected to remain in or on crops (such as vegetables, fruits, grains, and nuts) when a pesticide is used according to label directions. MRLs are set at a level far below the amount of residue that could present a human health concern[3]. The MRLs set by PMRA are generally consistent with those of Canada's major trading partners.

MRLs are set for food commodities sold in Canada, whether imported or produced domestically[4]. An MRL usually applies to the identified raw agricultural food commodity, as well as to processed food products made from that raw commodity. In the absence of a specific MRL for a particular commodity, pesticide residues must comply with the Canadian General MRL of 0.1 parts per million (ppm) as stated in section B.15.002 (a)/(b) of the *Food and Drug Regulations*[5]. Follow-up actions for non-compliant products are initiated in a manner that reflects the magnitude of the health concern. Actions may include further analysis, notification of the producer or importer, follow-up inspections, additional directed sampling, and recall of products.

In Canada, domestic or imported organic products are permitted to carry the "organic" claim when certified according to the Canadian *Organic Product Regulations (OPR)*[6]. Like conventional products, organic products are subject to the pesticide MRLs established under the PCPA. The Organic Products System Permitted Substances List[7] (also referred to as CAN/CGSB 32.311) referenced in the OPR stipulates which substances are permitted for use in or on organic foods. Organic products with detectable

levels of pesticides not permitted for use under the OPR are referred to the appropriate CFIA Program for follow-up.

Similar to the United States and the European Union, follow-up actions on organic products depend on the level of pesticides detected. Organic products with levels of pesticide in violation of the applicable MRL are subject to appropriate follow-up actions based on the health risk. Pesticide levels which fall between 5% of the MRL and the actual MRL are considered to imply the deliberate use of a pesticide. Pesticide levels which are less than 5% of the MRL are not considered to be the result of deliberate use and may be the result of environmental contamination (for example, pesticide use in previous growing seasons, drift from pesticide-treated fields) or transfer during handling, storage or transportation with conventional products. Follow-up activities on non-compliant organic products may include further analysis, investigation of the source of the chemicals (i.e. deliberate use or other sources), and/or suspension/cancellation of the organic certification.

The analytical results from targeted survey samples were compared to applicable MRLs and, where relevant, the Organic Products System Permitted Substances List.

2 Survey Details

2.1 Grains and Grain Products

Grain crops are subject to various pest and disease pressures which impact their production. Pesticides are an important tool used in food production because pests such as insects, bacteria, fungi and other organisms can have devastating effects on the quantity and quality of the grains and their finished products. Different pest pressures and climatic conditions in grain-producing export countries may result in the potential for use of pesticides that are not approved or have been banned for use in Canada. Although pesticides play an important role in agriculture by protecting food and crops from pests, inappropriate use of pesticides may pose a health risk.

In this survey, domestic and imported finished grains and grain products were sampled including barley, buckwheat, millet, spelt, corn, oat, and wheat products. Imported finished rice, quinoa, and rye products were also sampled. In general, the finished grains and grain products sampled in this survey are considered ingredients or require preparation (i.e. cooking).

As noted above, some of the finished grains and grain products consumed by Canadians and analyzed in this survey are not made in Canada nor are they made from domestic grains (e.g. rice). The pesticides used in other countries are not subject to Canadian regulatory oversight for their use; however, any resulting pesticide residues in the imported finished grains and grain products must meet established Canadian MRLs to be legally sold in Canada.

2.2 Rationale

According to Statistics Canada data from 2009[8], more than 82 kg of cereal products per person per year are available for consumption by Canadians. These products include flours (corn, rye, and wheat), rice, barley, oats, cornmeal, and breakfast foods. Wheat flour makes up more than half of the cereal products available for consumption in Canada (more than 43 kg per person per year). In addition, Canadians have increased the amount of rice in their diets, and rice available for consumption has more than doubled in the last two decades[8]. Recent media and health reports suggest that specialty or "ancient" grains (such as quinoa, amaranth, and millet) are becoming more recognizable and popular with consumers[9,10,11], particularly by those with gluten intolerance.

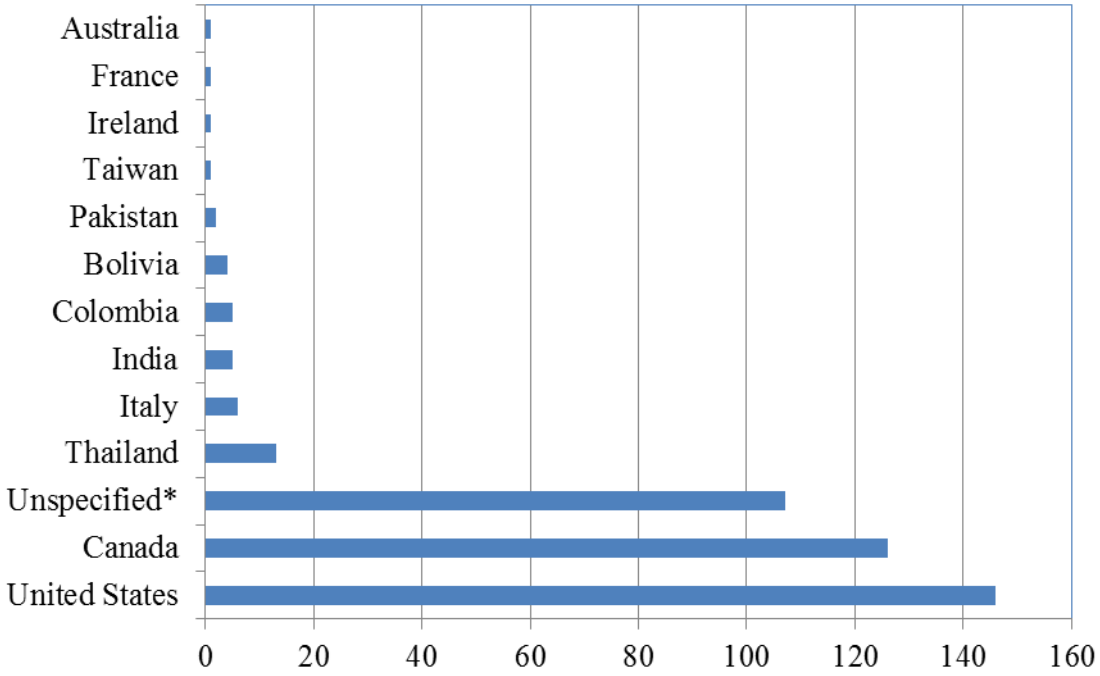
As previously mentioned, the CFIA does not routinely examine pesticide residues in finished grains and grain products, and residue data in these types of food is limited. Given the high consumption of these foods by Canadians, this targeted survey was designed to establish baseline data on pesticide levels in finished grains and grain products available to Canadians. All data may be used by Health Canada in performing health risk assessments.

2.3 Sample Distribution

A total of 418 samples were collected from Canadian retail stores in 9 cities between June 2011 and March 2012. Samples included 83 corn, 86 oat, 84 rice, 135 wheat, and 30 other grain products. One hundred eight of the samples (26%) were labelled as organic products.

The 418 samples collected included 126 domestic products, 207 imported products and 85 products of unspecified origin. In general, an unspecified country of origin refers to those samples for which the origin could not be determined from the product label or sample information. It is important to note that the products sampled often contained the statement "processed in Country X", "imported for Company A in Country Y" or "manufactured for Company B in Country Z", and though the labelling meets the intent of the regulatory standard, it does not identify the true origin of the product ingredients. Only those products labelled with a clear statement of "Product of Country A" were considered as being from a specific country of origin. Some of the samples considered as originating in Canada or imported with unverifiable origin may include, for example, products prepared for a Canadian company without further clarification of the country of origin. Some grains, like rice, are not grown in Canada, thus some of the products listed as domestic were likely manufactured or processed in Canada using imported ingredients. Additionally, Canadian companies may import raw or intermediate materials for use as ingredients, for blending, or for further processing for resale into Canadian and export markets. In some of these cases, products may be considered to be of Canadian origin. Determination of country of origin is further complicated by the fact that ingredients are often sourced from different countries. As a result, no inferences or conclusions were made regarding the data with respect to country of origin. The distribution of samples

collected in this survey with respect to the country of origin (as recorded on the sampling documentation or indicated on the product label) is depicted in Figure 1.



*Unspecified refers to those samples for which the country of origin could not be determined from the product label or sample information.

Figure 1. Distribution of finished grain and grain product samples by country of origin (arranged by increasing number of samples)

2.4 Method Details

Samples in the Pesticides in Finished Grains and Grain Products targeted survey were analyzed by an accredited laboratory under contract with the Government of Canada. Finished grain and grain product samples were analyzed using multi-residue pesticide methods.

Sufficient quantities were collected to allow for two different analytical methodologies to be conducted on each sample. Combined, the two multi-residue methods can analyze for over 400 different pesticide residues. These pesticides are targeted for various reasons, including whether the pesticides are permitted/registered for use in Canada or in other countries, if they are banned for use domestically or globally, or if they are considered a health risk. The gas chromatography–mass spectrometry (GC-MS) method used monitors for 298 pesticide residues (Appendix A). The GC-MS method used in this survey had limits of detection with an analytical range of 0.001 ppm to 0.17 ppm, depending on the pesticide. The liquid chromatography–mass spectrometry (LC-MS) method used monitors for 144 pesticide residues (Appendix B). The LC-MS method used in this survey had limits of detection with an analytical range of 0.005 ppm to 0.1 ppm,

depending on the pesticide. Please refer to Appendices A and B for lists of pesticide residues analyzed by the two multi-residue methods. Approximately 80% of the pesticides listed in Appendices A and B are not included in the CGC scope of testing for raw domestic grains, while the CGC methods include about 70 pesticides not tested herein.

2.5 Limitations

This survey was designed to provide a snapshot of the levels of pesticide residues in finished grains and grain products for sale in Canada and had the potential to highlight commodities that warrant further investigation. The limited sample sizes analyzed represent a small fraction of the products available to consumers. In addition, while samples were analyzed for many different pesticide residues (mainly insecticides and fungicides), the spectrum of herbicides included in the analysis was limited. Therefore, care must be taken when interpreting and extrapolating these results.

As noted above, some of the finished grains and grain products consumed by Canadians and analyzed in this survey are not made in Canada, nor are they made from domestic grains (e.g. rice). Distribution of samples by country of origin (as recorded by the sampler or indicated on the label) is presented to provide a general sense of the origin of finished grains and grain product samples. Regional differences, impact of product shelf-life, packaging and storage conditions, or cost of the commodity on the open market were also not examined in this survey.

A number of products in the survey have been identified as organic; this designation is based solely on the accompanying sample information and/or the product label. Organic products are certified to the *Organic Product Regulations* by a certification body recognized by the CFIA.

Analysis was completed on finished grains and grain products as available on the Canadian retail market. In general, the products sampled in this survey are considered ingredients or require preparation prior to consumption (i.e. cooking). The CFIA monitors food as sold rather than as consumed, and as such the results should only be interpreted as finished grain and grain products available as sold and not as they would be consumed. Estimation of the level of a pesticide that may occur in the food as it would be consumed based on the levels detected in the unprepared finished grains or grain products available at retail (i.e. the level of transfer of a pesticide) will not be considered herein.

3 Results and Discussion

3.1 Overview of Pesticide Results

In total, 418 samples were collected that consisted primarily of corn, oat, rice, and wheat products, but also buckwheat, barley, millet, quinoa, rye, and spelt products to a lesser

extent. One hundred eight of the samples were labelled as being organic products. The overall compliance rate for samples in this targeted survey was 99.8%, with no detectable pesticide residues in 382 of 418 (91.4%) samples. Only one sample (organic quinoa) in this survey was in violation of the Canadian General MRL of 0.1 parts per million (ppm); however, this was not expected to pose an unacceptable human health concern. Appropriate follow-up actions were initiated that reflected the magnitude of the human health concern. No product recalls were warranted given the lack of a health concern.

Table 1 presents the number of samples per product type, the number and percentage of samples found negative for pesticides, and those with a detectable level of pesticide. Twenty-five samples had a single pesticide residue, and eleven samples had two pesticide residues. None of the samples tested had more than two residues. Samples with compliant residues were those with a detectable level of pesticide (or pesticides) at or below the applicable MRL. The compliance rate was 100% for all commodity types except quinoa.

Table 1. Summary of pesticide results by commodity type in order of decreasing compliance rate

Commodity	Number of Samples	Number of Samples with No Detected Pesticide Residue(s) (Percentage)	Number of Samples with Compliant Residue(s) (Percentage)	Number of Samples with Residue(s) in Violation (Percentage)
Corn Products	83	82 (98.8)	1 (1.2)	0 (0)
Oat Products	86	85 (98.8)	1 (1.2)	0 (0)
Rice Products	84	74 (88.1)	10 (11.9)	0 (0)
Wheat Products	135	114 (84.4)	21 (15.6)	0 (0)
Other Grain Products*	30	27 (90.0)	2 (6.7)	1 (3.3)

* Includes buckwheat, barley, millet, quinoa, rye, and spelt products

A total of 14 different pesticides were detected in finished grain and grain product samples analyzed in this targeted survey. For a summary of the pesticide residues and the range of levels detected, please refer to Appendix C. Exposure to the levels of pesticides detected in samples in this survey is not expected to pose a human health concern to Canadian consumers and thus, no product recalls were warranted.

Samples in this survey were categorized as organic if the sample was clearly labelled/recorded as being organic. Four of the 108 organic samples contained one or two detectable pesticide residues (one sample each of brown basmati rice, wheat flour, spelt flour, and quinoa). Three of these four organic samples were compliant with applicable pesticide MRLs. However, the residue(s) detected are not permitted as per the Organic Production Systems Permitted Substances Lists, and thus may not meet the organic certification requirements. The only violative sample in this survey, an imported organic quinoa product, had a single residue for a pesticide not registered in Canada for use on cereals, grain products, or quinoa, the level of which exceeded the General MRL. These

four samples were forwarded to the appropriate Program(s) for follow-up. Depending on the nature of the non-compliance, follow-up activities may include further analysis, notification of the producer or importer, inspections, additional directed sampling, investigation of the source of the chemicals (i.e. deliberate addition or other sources), cancellation of the organic certification, and/or recall of products.

3.2 Pesticide Results by Product Type

The following sections present the results for pesticide residues in each of the grain types. For a summary of the pesticide residues and the range of levels detected by product type, please refer to Appendix C. In these sections, the results of this targeted survey are compared to CFIA Children's Food Project (CFP) data (2010-2012; unpublished) and Canadian Grain Commission (CGC) data (2005-2009; unpublished) for pesticide residues in similar products, where available and appropriate.

3.2.1 Pesticides in Corn Products

A total of 83 domestic and imported corn product samples were analyzed in this targeted survey. These samples included corn bran, corn starch, cornmeal (also grits and semolina/polenta), and corn flour. Of these 83 samples, 82 (98.8%) did not have detectable pesticide residues. Twelve of the corn product samples were labelled as organic, none of which had a detectable level of pesticide. The compliance rate for corn products sampled in this targeted survey was 100%, thus no follow-up action was required.

A single sample of corn flour imported from the United States was found positive for a pesticide residue (malathion; see Appendix C for further details). This pesticide is permitted for use on cereal crops (raw cereals, including corn) in Canada, and on corn crops in the United States, so finding a low level of residue is not unexpected. Similar malathion residue levels were found by the CGC in raw Canadian corn.

3.2.2 Pesticides in Oat Products

Eighty-six domestic and imported oat product samples were analyzed. These products included oat bran, oat flour, minute oats, quick oats, rolled oats, oat flakes, steel cut oats, and plain/flavoured instant oatmeal. Of these 86 samples, 85 (98.8%) did not have detectable pesticide residues. Twenty-eight of the oat product samples were labelled as organic, none of which were positive for pesticide residues. The compliance rate for oat products sampled in this targeted survey was 100%, thus no follow-up action was required.

One sample of quick-cooking oats of unspecified origin was found positive for a pesticide residue (piperonyl butoxide; see Appendix C for further details). While residues of piperonyl butoxide were not found by the CGC in raw Canadian oats or by the CFIA CFP in several samples of instant oatmeal, this pesticide is permitted for use on cereal crops (raw cereals, including oats) in Canada. Similarly, it is permitted for use on cereal grains/oats in both the United States and the European Union, so finding a low level of residue is not unexpected.

3.2.3 Pesticides in Rice Products

A total of 84 domestic and imported rice product samples were analyzed in this targeted survey. These samples included rice bran, rice flour, and grain rice. Grain rice consisted of white basmati, brown basmati, jasmine, white glutinous, sushi, parboiled, short, long, and extra long grain rice. 74 (88.1%) of the 84 samples did not have detectable pesticide residues. None of the rice flour samples were found positive for pesticides. The compliance rate for rice products sampled in this targeted survey was 100%, thus no follow-up action was required.

Eight different pesticides were detected in the ten positive rice product samples (five of the samples each had two different residues; see Appendix C for more details). Four samples of rice bran (three imported from the United States and one of unspecified origin) had low levels of dichlorvos, diphenylamine, and/or piperonyl butoxide. Six samples of grain rice, all basmati rice and most imported from India, were positive for isoprothiolane, malathion, orthophenyl-phenol (also known as 2-phenylphenol or sodium orthophenyl phenate), and/or tricyclazole. While most of these pesticides are not permitted for use in either Canada or the United States for rice or rice products, they are acceptable for use in other countries, including those that export rice[12]. Some samples had a low level of imidacloprid, a residue for which Health Canada has established an MRL in rice. The CFIA CFP found similar concentrations of tricyclazole and imidacloprid in several grain rice samples.

Sixteen of the rice product samples were labelled as organic. One of which, an organic brown basmati rice imported from India (noted above), had two different pesticide residues (isoprothiolane and tricyclazole). While compliant with the Canadian General pesticide MRL, these residues are not permitted substances as per the Organic Production Systems Permitted Substances Lists, and thus may not meet the organic certification requirements. The organic brown basmati rice sample was forwarded to the appropriate Program for follow-up.

3.2.4 Pesticides in Wheat Products

One hundred and thirty-five domestic and imported wheat product samples were analyzed. These products included wheat bran, wheat flour, couscous, bulgur, and wheat germ. Of these 135 samples, 114 (84.4%) did not have detectable pesticide residues. None of the bulgur samples were found positive for pesticides. The compliance rate for wheat products sampled in this targeted survey was 100%, thus no follow-up action was required.

Nine different pesticides were detected in the 21 positive wheat product samples (six of the samples each had two different residues; see Appendix C for more details). Dichlorvos, malathion, chlorpyrifos-methyl, and/or piperonyl butoxide were detected in samples of domestic and imported wheat bran, wheat germ, and wheat flour. These pesticides are registered for use on raw cereals and/or whole meal/flour from wheat in Canada, and on wheat grain in both the United States and the European Union, so finding low levels of these residues is not unexpected. Similar malathion residue levels were found by the CGC in raw Canadian wheat. Orthophenyl-phenol, pirimiphos-methyl, and/or tepraloxydim residues were found at low levels in several couscous, wheat bran and germ samples. While these pesticides are not registered for use in Canada for wheat or wheat products, either MRLs exist for other crops domestically (e.g. fresh fruits and vegetables, oilseeds) or they are acceptable for use in other countries. Two pesticides were found at very low levels in several samples of couscous (diniconazole and propoxur). While these pesticides are not permitted for use in Canada, the United States, or the European Union for cereal grains, wheat, or wheat products, these residues have been detected occasionally by the EU in cereals and other food commodities (e.g. fruit, vegetables, and nuts)[13], and may indicate inappropriate pesticide use.

Thirty-seven of the wheat product samples were labelled as organic. One of these samples, a domestic organic whole wheat pastry flour (noted above), had a single pesticide residue (dichlorvos). While compliant with the applicable pesticide MRL, this residue is not a permitted substance as per the Organic Production Systems Permitted Substances Lists, and thus may not meet the organic certification requirements. The organic whole wheat pastry flour sample was forwarded to the appropriate Program for follow-up.

3.2.5 Pesticides in Other Grain Products

Thirty domestic and imported samples of other grain products were analyzed, which included barley, quinoa, and rye finished grains, buckwheat and spelt flours, and millet (flour and grits). Of these 30 samples, 27 (90.0%) did not have detectable pesticide residues. None of the rye, buckwheat or millet samples were found positive for pesticides. The compliance rate for other grain products sampled in this targeted survey was 96.7%. One sample (organic quinoa) was violative, having a single pesticide residue at a level above the Canadian General MRL of 0.1 ppm; however, this pesticide was not expected to pose an unacceptable human health concern. Appropriate follow-up actions were initiated that reflected the magnitude of the human health concern.

Three different pesticides were detected in the three positive other grain products (see Appendix C for more details). A low level of tepraloxydim was found in a domestic pot barley sample, and carbendazim was found at a low level in a domestic spelt flour sample. These pesticides are not registered for use in Canada for barley or spelt products; however, they are permitted for use on other crops domestically. Orthophenyl-phenol was found in a sample of imported quinoa. This pesticide is not registered for use in Canada (nor internationally) for quinoa, however, either MRLs exist for other crops domestically (e.g. fresh fruits and vegetables) or it is acceptable for use in other countries. As noted above, this quinoa sample was violative, having a residue level above the Canadian General MRL.

Fifteen of the other grain samples were labelled as organic. Two of these organic samples, the domestic spelt flour and imported quinoa noted above, were each positive for a single pesticide residue. Whether compliant with the applicable pesticide MRL or not, these residues are not permitted substances as per the Organic Production Systems Permitted Substances Lists, and thus may not meet the organic certification requirements. The organic spelt flour and quinoa samples were forwarded to the appropriate Program for follow-up.

4 Conclusions

The 2011-2012 Pesticides in Finished Grains and Grain Products targeted survey generated baseline data regarding the presence and levels of pesticide residues in selected corn, oat, rice, wheat, and other grain products available on the Canadian retail market.

The overall compliance rate for pesticide residues in this targeted survey was 99.8%. In total, there were 36 samples containing one or two pesticide residues. None of the samples tested had more than two residues. The only violative sample in this survey, an imported organic quinoa product, had a single residue for a pesticide not permitted in Canada for use on quinoa, the level of which exceeded the General MRL; however, this was not expected to pose an unacceptable human health concern. Appropriate follow-up actions were initiated that reflected the magnitude of the human health concern. No product recalls were warranted given the lack of a health concern.

Four of the 108 samples categorized as organic (clearly labelled/recorded as such) contained one or two detectable pesticide residues (one sample each of brown basmati rice, wheat flour, spelt flour, and quinoa). Three of these four organic samples were compliant with applicable pesticide MRLs. However, the residue(s) detected are not permitted substances as per the Organic Production Systems Permitted Substances Lists, and thus may not meet the organic certification requirements. These samples were forwarded to the appropriate Program(s) for follow-up. Depending on the nature of the non-compliance, follow-up activities may include further analysis, notification of the producer or importer, inspections, additional directed sampling, investigation of the source of the chemicals (i.e. deliberate addition or other sources), cancellation of the organic certification, and/or recall of products.

5 Appendix A

List of analytes (298) typically included in the GC-MS multi-residue pesticide method used by the accredited laboratory in this survey

Note: Pesticides highlighted in **bold** are included in both the GC-MS and LC-MS methods

3-hydroxy Carbofuran	Cypermethrin	Flumetralin	Penconazole
Acephate	Cyprazine	Fluorochloridone	Pendimethalin
Acibenzolar-s-methyl	Cyproconazole	Fluorodifen	Pentachloroaniline
Alachlor	Cyprodinil	Flusilazole	Permethrin cis
Aldicarb	Cyromazine	Folpet	Permethrin trans
Aldicarb Sulfone	Dacthal (chlorthal-dimethyl)	Fonofos	Phenthoate
Aldicarb sulfoxide	delta-HCH (delta-lindane)	Heptachlor	Phorate
Aldrin	Deltamethrin	Heptachlor epoxide endo	Phorate sulfone
Allidochlor	delta-trans-allethrin	Heptachlor epoxide exo	Phosalone
Ametryn	Demeton-O	Heptenophos	Phosmet
Aminocarb	Demeton-S	Hexachlorobenzene	Phosphamidon
Aramite	Demeton-S-methyl	Hexaconazole	Piperonyl butoxide
Aspon	Des-ethyl Atrazine	Hexazinone	Pirimicarb
Atrazine	Desmetryn	Imazalil	Pirimiphos-ethyl
Azinphos-ethyl	Di-allate	Iodofenphos	Pirimiphos-methyl
Azinphos-methyl	Dialofos	Iprobenfos	Procarbolid
Azoxystrobin	Diazinon	Iprodione	Prochloraz
Benalaxyl	Diazinon o analogue	Isazophos	Procymidone
Bendiocarb	Dichlobenil	Isofenphos	Profenofos
Benfluralin	Dichlofenthion	Isopropalin	Profluralin
Benodanil	Dichlofluanid	Isoprothiolane	Promecarb
Benzoylprop-ethyl	Dichloran	Kresoxim-methyl	Prometon
BHC Alpha	Dichlormid	Leptophos	Prometryn
BHC beta	Dichlorvos	Lindane (gamma-BHC)	Pronamide
Bifenox	Diclobutrazole	Linuron	Propachlor
Bifenthrin	Diclofop-methyl	Malaoxon	Propanil
Biphenyl	Dicofol	Malathion	Propargite
Bromacil	Dicrotophos	Mecarbam	Propazine
Bromophos	Dieldrin	Metalaxyl	Propetamphos
Bromophos-ethyl	Diethatyl-ethyl	Metazachlor	Propham
Bromopropylate	Dimethachlor	Methamidophos	Propiconazole
Bufencarb	Dimethoate	**Methidathion**	**Propoxur**
Bupirimate	Dinitramine	**Methiocarb**	Prothiophos
Buprofezin	**Dioxacarb**	**Methiocarb Sulfoxide**	Pyrazophos
Butachlor	Dioxathion	**Methomyl**	Pyridaben
Butralin	Diphenamid	Methoprotryne	Quinalphos
Butylate	Diphenylamine	Methoxychlor	Quinomethionate

Captafol	Disulfoton	Methyl - trithion	Quintozene
Captan	Disulfoton sulfone	Methyl Pentachlorophenyl sulphide	Schradan
Carbaryl	Edifenphos	Metobromuron	Secbumeton
Carbetamide	Endosulfan alpha	Metolachlor	Simazine
Carbofenthion	Endosulfan beta	Metribuzin	Simetryn
Carbofuran	Endosulfan sulfate	Mevinphos-cis	Sulfallate
Carboxin	Endrin	Mevinphos-trans	Sulfotep
Chlorbenside	EPN	**Mexacarbate**	Sulprophos
Chlorbromuron	EPTC	Mirex	tau-Fluvalinate
Chlorbufam	Erbon	**Monocrotophos**	TCMTB
Chlordane cis	Esfenvalerate	Monolinuron	Tebuconazole
Chlordane trans	Etaconazole	Myclobutanil	Tecnazene
Chlordimeform	Ethalfluralin	Naled	Terbacil
Chlorfenson	Ethion	Nitralin	Terbufos
Chlorfenvinphos (e+z)	Ethofumesate	Nitrapyrin	Terbumeton
Chlorflurenol-methyl	Ethoprophos	Nitrofen	Terbutryne
Chloridazon	Ethylan	Nitrothal-isopropyl	Terbutylazine
Chlormephos	Etridiazole	Norflurazon	Tetrachlorvinphos
Chlorobenzilate	Etrimfos	Nuarimol	Tetradifon
Chloroneb	Fenamiphos	o,p'-DDD (o,p'-TDE)	Tetraiodoethylene
Chloropropylate	Fenamiphos sulfone	o,p'-DDE	Tetramethrin
Chlorothalonil	Fenamiphos sulfoxide	o,p'-DDT	Tetrasul
Chlorpropham	Fenarimol	Octhilinone	Thiobencarb
Chlorpyrifos	Fenbuconazole	Omethoate	Tolclofos-methyl
Chlorpyrifos-methyl	Fenchlorphos (Ronnel)	Orthophenyl-phenol	Tolyfluanid
Chlorthiamid	Fenfuram	Oxadiazon	Triadimefon
Chlorthion	Fenitrothion	**Oxadixyl**	Triadimenol
Chlorthiophos	Fenpropathrin	**Oxamyl**	Tri-allate
Chlozolinate	**Fenpropimorph**	**Oxycarboxin**	Triazophos
Clomazone	Fenson	Oxychlordane	Tribufos
Coumaphos	Fensulfothion	Oxyfluorfen	**Tricyclazole**
Crotoxyphos	Fenthion	p,p'-DDD (p,p'-TDE)	Trifloxystrobin
Crufomate	Fenvalerate	p,p'-DDE	Triflumizole
Cyanazine	Flamprop-isopropyl	p,p'-DDT	Trifluralin
Cyanophos	Flamprop-methyl	Paraoxon	Vernolate
Cycloate	Fluchloralin	Parathion	Vinclozolin
Cyfluthrin (I,II,III,IV)	Flucythrinate	Parathion-methyl	
Cyhalothrin-lambda	Fludioxonil	Pebulate	

Note: The GC-MS method used in this survey had limits of detection with an analytical range of 0.001 ppm to 0.17 ppm, depending on the pesticide.

6 Appendix B

List of analytes (144) typically included in the LC-MS multi-residue pesticide method used by the accredited laboratory in this survey

Note: Pesticides highlighted in **bold** are included in both the GC-MS and LC-MS methods

3-hydroxy Carbofuran	Dimethomorph	Isocarbamide	Pyraclostrobin
Acetochlor	Diniconazole	Isoprocarb	Pyraflufen-ethyl
Aclonifen	**Dioxacarb**	Isoxathion	Pyridalyl
Aldicarb	Dipropetryn	Mepanipyrim	Pyridaphenthion
Aldicarb Sulfone	Diuron	Mephosfolan	Pyridate
Aldicarb sulfoxide	Dodemorph	Methabenzthiazuron	Pyrifenox
Azaconazole	Emamectin	**Methidathion**	Pyrimethanil
Benomyl	Epoxiconazole	**Methiocarb**	Pyriproxyfen
Benoxacor	Ethiofencarb	Methiocarb sulfone	Quinoxyfen
Bitertanol	Ethiofencarb sulfoxide	**Methiocarb Sulfoxide**	Quizalofop
Bromuconazole	Ethirimol	**Methomyl**	Spinosyn A
Butafenacil	Ethoprop	Methoxyfenozide	Spirodiclofen
Butocarboxim sulfoxide	Etofenprox	Metolcarb	Spiromesifen
Cadusafos	Etoxazole	Metoxuron	Spiroxamine
Carbaryl	Fenamidone	**Mexacarbate**	Sulfentrazone
Carbendazim	Fenazaquin	Molinate	Tebufenpyrad
Carbofuran	Fenhexamid	**Monocrotophos**	Tebupirimfos
Carbosulfan	Fenoxanil	Napropamide	Tepraloxydim
Carfentrazone-ethyl	Fenpropidin	Naptalam	Tetraconazole
Chloridazon	**Fenpropimorph**	Neburon	Thiabendazole
Chlorimuron-ethyl	Fenpyroximate	Ofurace	Thiacloprid
Chloroxuron	Fentrazamide	**Oxadixyl**	Thiamethoxam
Chlortoluron	Fluazifop-butyl	**Oxamyl**	Thiazopyr
Clodinafop-propargyl	Flucarbazone-sodium	Oxamyl-oxime	Thiodicarb
Cloquintocet-mexyl	Flutolanil	**Oxycarboxin**	Thiofanox
Clothianidin	Flutriafol	Paclobutrazol	Thiofanox sulfone
Cyanofenphos	Forchlorfenuron	Pencycuron	Thiofanox sulfoxide
Cycloxydim	Formetanate	Penoxsulam	Thiophanate-methyl
Cycluron	Fosthiazate	Picolinafen	Tralkoxydim
Demeton-s-methyl sulfone	Fuberidazole	Picoxystrobin	Trichlorfon
Demeton-s-methyl sulfoxide	Furathiocarb	Piperophos	**Tricyclazole**
Desmedipham	Haloxyfop	Pretilachlor	Trietazine
Diclocymet	Imazamethabenz-methyl	Primisulfuron-methyl	Trifloxysulfuron

Diethofencarb	Imidacloprid	Prodiamine	Triforine
Difenoconazole	Indoxacarb	**Propoxur**	Trimethacarb
Dimethametryn	Iprovalicarb	Pymetrozine	Zinophos

Note: The LC-MS method used in this survey had limits of detection with an analytical range of 0.005 ppm to 0.1 ppm, depending on the pesticide.

7 Appendix C

Summary of pesticide residues found in finished grain and grain products

Product Type	Pesticide Residue	Number of Samples Positive for Residue	Number of Non-compliant Samples	Range of Detected Amount (ppm)	Applicable Canadian Maximum Residue Limit(s) (MRL/EMRL)
Corn Flour	Malathion	1	0	0.063	MRL - Raw cereals* - 8 ppm; Food and Drug Regulations - B.15.002 (a)/(b) - 0.1 ppm
Oats	Piperonyl butoxide	1	0	0.163	MRL - Raw cereals* - 20 ppm
Rice Bran†	Dichlorvos	1	0	0.019	MRL - Non-perishable packaged foods of low fat content (under 6%) - 0.5 ppm
	Diphenylamine	2	0	0.012 - 0.012	Food and Drug Regulations - B.15.002 (a)/(b) - 0.1 ppm
	Piperonyl butoxide	2	0	0.049 - 0.077	MRL - Raw cereals* - 20 ppm; Food and Drug Regulations - B.15.002 (a)/(b) - 0.1 ppm
Rice	Imidacloprid	2	0	0.0057 - 0.009	EMRL - Rice - 0.05 ppm
	Isoprothiolane	1	0	0.053	Food and Drug Regulations - B.15.002 (a)/(b) - 0.1 ppm
	Malathion	1	0	0.051	MRL - Raw cereals* - 8 ppm
	Orthophenyl-phenol	1	0	0.067	Food and Drug Regulations - B.15.002 (a)/(b) - 0.1 ppm
	Tricyclazole	5	0	0.0136 - 0.0354	Food and Drug Regulations - B.15.002 (a)/(b) - 0.1 ppm
Wheat Bran†	Chlorpyrifos-methyl	4	0	0.013 - 0.043	Food and Drug Regulations - B.15.002 (a)/(b) - 0.1 ppm
	Malathion	3	0	0.017 - 0.029	MRLs - Whole meal and flour from wheat - 2 ppm; Raw cereals* - 8 ppm
	Orthophenyl-phenol	2	0	0.023 - 0.075	Food and Drug Regulations - B.15.002 (a)/(b) - 0.1 ppm
	Tepraloxydim	1	0	0.0098	Food and Drug Regulations - B.15.002 (a)/(b) - 0.1 ppm
Couscous	Diniconazole	1	0	0.0717	Food and Drug Regulations - B.15.002 (a)/(b) - 0.1 ppm
	Pirimiphos-methyl	1	0	0.046	Food and Drug Regulations - B.15.002 (a)/(b) - 0.1 ppm
	Propoxur	4	0	0.0066 - 0.029	Food and Drug Regulations - B.15.002 (a)/(b) - 0.1 ppm
Wheat Flour	Dichlorvos	2	0	0.01 - 0.017	MRL - Non-perishable packaged foods of low fat content (under 6%) - 0.5 ppm
	Malathion	1	0	0.033	MRL - Whole meal and flour from wheat - 2 ppm
	Piperonyl butoxide	1	0	0.031	MRL - Raw cereals* - 20 ppm; Food and Drug Regulations - B.15.002 (a)/(b) - 0.1 ppm
	Pirimiphos-methyl	3	0	0.016 - 0.06	Food and Drug Regulations - B.15.002 (a)/(b) - 0.1 ppm
Wheat Germ†	Chlorpyrifos-methyl	1	0	0.014	Food and Drug Regulations - B.15.002 (a)/(b) - 0.1 ppm
	Malathion	3	0	0.015 - 0.191	MRLs - Whole meal and flour from wheat - 2 ppm; Raw cereals* - 8 ppm
Barley	Tepraloxydim	1	0	0.0251	Food and Drug Regulations - B.15.002 (a)/(b) - 0.1 ppm
Quinoa	Orthophenyl-phenol	1	1	0.136	Food and Drug Regulations - B.15.002 (a)/(b) - 0.1 ppm
Spelt Flour	Carbendazim	1	0	0.0124	Food and Drug Regulations - B.15.002 (a)/(b) - 0.1 ppm

* The Cereal Grains Crop Group includes corn, oat, rice, wheat, and barley[14]
† Germ/bran falls in between raw cereal and whole meal/flour in terms of processing[15]

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