



Canadian Food
Inspection Agency

Agence canadienne
d'inspection des aliments

Alternaria in Selected Foods - April 1, 2014 to March 31, 2018 and April 1, 2019 to March 31, 2022

Food chemistry - Targeted surveys - Final report



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 CFIA 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.

This targeted survey generated baseline surveillance data regarding *Alternaria* mycotoxin levels in selected foods on the Canadian retail market. The most important mycotoxins are alternariol (AOH), alternariol monomethyl ether (AME), altuene (ALT) and L-tenuazonic acid (TeA). TeA is the most acutely toxic while AOH and AME have a lower toxicity¹. However, there are several reports on the mutagenic and genotoxic effects of AME and AOH² as well as a tendency to kill fetuses of rats³.

A total of 2597 samples of fresh bell/hot peppers, grain-based foods, infant foods, fruit juices, nut/seed products, pomegranate products, processed fruits and vegetables, sunflower oil, and grape-based wine were collected from retail locations in 6 cities across Canada and tested for AOH and AME. ALT and TeA were not included in the analytical method because of a lack of commercially available standards. AOH and/or AME were detected in 1554 (60%) of the samples. The levels of AOH and AME were summed so that the total mycotoxin levels are reported in this survey. The levels detected ranged from 0.046 parts per billion (ppb) to 880 ppb.

Currently in Canada, as in the rest of the world, there are no regulated levels for *Alternaria* mycotoxins in foods. Health Canada determined the levels of AOH and AME observed in the current survey are not expected to pose a concern to human health, therefore there were no recalls resulting from this survey. CFIA is conducting appropriate follow up activities which include further testing of similar products in subsequent years.

Other regulatory agencies such as the US Food and Drug Administration, Australia/New Zealand and the European Union are not monitoring their foods for *Alternaria* mycotoxins or are not currently publishing the results. A comparison of the exposure of Canadian consumers to persons in other countries is not possible. All data was shared with Health Canada. This data may be used in future risk assessments and to set standards in Canada and/or internationally.

What are targeted surveys

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 the CFIA's 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. The CFIA works with federal, provincial, territorial and municipal governments and provides 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 did we conduct this survey

The variety of fresh bell/hot peppers, grain-based foods, infant foods, fruit juices, nut/seed products, pomegranate products, processed fruits and vegetables, sunflower oil, and grape-based wine is continuously increasing to meet consumers' demands. These foods and beverages are consumed to some extent by Canadian consumers, including infants and toddlers. Moulds may develop in the field, during transport and/or during storage on the raw ingredients of these foods and beverages. *Alternaria* is a type of mould widely distributed in the soil and occurs in the air. These species are known as plant pathogens and as common allergens in humans.

Alternaria species also produce multiple toxins called mycotoxins. The most important ones are AOH, AME, ALT and TeA. Due to the common presence of *Alternaria*, these mycotoxins are frequently found in a wide variety of commodities. These mycotoxins have been recorded in fruits, such as apples, dark grapes, and citrus fruits, in vegetables like tomatoes, peppers and olives, and in fruit juices and beverages. They have also been found in grains such as wheat and barley, in sunflower seeds, and in wine. *Alternaria* has been reported to be the most frequent fungi infecting tomatoes⁴.

Among the mycotoxins produced by this mould, TeA has the highest acute toxicity. In a study on mice, the oral administration of TeA salts to mice and rats resulted in cardiovascular collapse¹. While the acute toxicity of AOH and AME is low, these mycotoxins have shown genotoxic and mutagenic properties in cell cultures and laboratory animals². These mycotoxins have been

observed to kill rat fetuses³. Inhalation of the mould can lead to asthma, infections and allergies. Dietary exposure has been linked to a variety of adverse health effects. TeA has been associated with human hematological disorders⁴.

The primary source of these mycotoxins in the human diet is fruit⁶. There are no Canadian or international regulations for TeA, ALT, AOH and/or AME levels in foods⁶. The use of fungicide is the most common approach to preventing mould formation.

The main objectives of this targeted survey were to generate baseline surveillance data on the levels of mycotoxins in foods that are known or suspected to be contaminated by the mould. In addition, the prevalence and levels of AOH and/or AME in this survey were compared with those reported in found other studies in the scientific literature. Most mycotoxins are not routinely monitored under other CFIA programs.

What did we sample

A variety of domestic and imported products from the following categories were sampled including: fresh bell/hot peppers, grain-based foods, infant foods, fruit juices, nut/seed products, pomegranate products, processed fruits and vegetables, sunflower oil, and grape-based wine. Products were sampled from April 1, 2014 to March 31, 2018 and from April 1, 2019 to March 31, 2022. Samples of products were collected from local/regional retail locations located in 6 major cities across Canada. These cities encompassed 4 Canadian geographical areas:

- Atlantic (Halifax)
- Quebec (Montreal)
- Ontario (Toronto and Ottawa)
- West (Vancouver and Calgary)

The number of samples collected from these cities was in proportion to the relative population of the respective areas. The samples originated in 44 countries.

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

Product type	Number of domestic samples	Number of imported samples	Number of samples of unspecified^a origin	Total number of samples
Fresh pepper	20	53	6	79
Grain-based foods	258	225	272	755
Infant foods	34	160	64	258
Juices	123	64	30	217
Nut/seed products	22	78	47	147
Pomegranate products	156	250	176	582
Processed fruits and vegetables	24	135	84	243
Sunflower oil	4	16	21	41
Wine	73	200	2	275
Total	714	1181	702	2597

^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 were samples analyzed and assessed

Samples were analyzed by an ISO/IEC 17025 accredited food testing laboratory under contract with the Government of Canada. The results are based on the food products as sold and not necessarily as they would be consumed.

There are no regulations in Canada or elsewhere in the world for *Alternaria* mycotoxins in foods⁵. In the absence of a specific maximum level, the levels of *Alternaria* mycotoxins are assessed by Health Canada on a case-by-case basis using the most current scientific data available.

What were the survey results

A total of 2597 samples of domestic and imported fresh peppers, grain-based foods, infant foods, juices, nut/seed products, pomegranate products, processed fruits and vegetables, sunflower oil, and wine were tested for the AOH and AME. ALT and TeA were not included in the analytical method because of a lack of commercially available standards. AOH and/or AME were detected in 1554 (60%) of the samples. The levels of AOH and AME were summed so that the total mycotoxin levels are reported in this survey. The total levels ranged from 0.046 ppb to 880 ppb. A summary of the testing results by each product type can be seen in Table 2.

The percentage of samples with mycotoxin levels detected ranged from 0% in fresh peppers to 81% in grain-based foods. The average level ranged from 1.9 ppb in wine to 165 ppb in pomegranate products. See [Appendix A](#) for a more detailed breakdown of the results by type of commodity (for example, by type of juice).

Table 2. Levels of *Alternaria* toxins in fresh peppers, grain-based foods, infant foods, juices, nut/seed products, pomegranate products, processed fruits and vegetables, sunflower oil, and wine

Product type	Total number of samples	Number (%) of positive samples	Min (ppb)	Max (ppb)	Average level (ppb) of positive results
Fresh pepper	79	0 (0)	0	0	0
Grain-based foods	755	610 (81)	0.090	240	4.2
Infant foods	258	197 (76)	0.10	26	5.2
Juices	217	82 (38)	0.050	340	6.0
Nut/seed products	147	96 (65)	0.046	20	2.8
Pomegranate products	243	179 (74)	0.060	870	165
Processed fruits and vegetables	582	192 (33)	0.050	880	8.7
Sunflower oil	41	31 (76)	0.10	62	5.9
Wine	275	167 (61)	0.092	21	1.9
Total	2597	1554 (60)	0.046	871	23

What do the survey results mean

The detection rates for *Alternaria* mycotoxins in imported fresh peppers, grain-based foods, infant foods, juices, nut/seed products, pomegranate products, processed fruits and vegetables, sunflower oil, and wine in this survey were comparable to or lower than those reported in other survey years⁷ and/or other cited scientific literature^{8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30}. The average and highest observed levels in this survey were comparable to or lower than those reported in previous years. Also consistent with other surveys, the level of these mycotoxins was observed to be lower in commonly consumed juices such as apple, orange and grape juices, and higher in juices containing pomegranate as a main ingredient.

Table 3. Levels of AOH and/or AME in fresh sweet and hot peppers in the CFIA survey and scientific literature

Product type	Jurisdiction/author	Survey year	Number of samples - toxins included in the survey	Number (%) of positive samples	Min (ppb)	Max (ppb)	Average level (ppb) of positive results
Fresh pepper	CFIA	2020	79	0 (0)	0	0	0
Fresh pepper	Italy - Gambacorta et al.	2018	7 - AME	6 (86)	<0.16	270.7	111.1
Fresh pepper	Italy – Gambacorta et al.	2018	7 - AOH	4 (57)	<0.99	17.8	10.0
Fresh pepper	Argentina - Da Cruz Cabral et al.	2016	10 - AME	2 (21)	3	98	29
Fresh pepper	Argentina - Da Cruz Cabral et al.	2016	14 - AOH	4 (29)	7	262	56

Table 4. Levels of AOH and/or AME in grain-based foods in CFIA and from scientific literature

Product type	Jurisdiction/author	Survey year	Number of samples - toxins included in the survey	Number (%) of positive samples	Min (ppb)	Max (ppb)	Average level (ppb) of positive results
Barley-based foods	CFIA	2021	123	78 (63)	0.093	240	5.7
Barley-based foods	Russia - Orina et al.	2021	49 - AOH	5 (10)	2	8	Not specified
Barley-based foods	Russia – Orina et al.	2021	49 - AME	1 (2)	Not specified	3	Not specified
Barley-based foods	Argentina - Castañares et al.	2019	60 - AME	37 (62)	368	1689	700
Barley-based foods	Argentina – Castañares et al.	2019	60 - AOH	5 (8)	384	6812	2201
Barley-based foods	EU – EFSA	2016	106 - AOH	2 (1)	0.1	6.1	3.1

Product type	Jurisdiction/author	Survey year	Number of samples - toxins included in the survey	Number (%) of positive samples	Min (ppb)	Max (ppb)	Average level (ppb) of positive results
Barley-based foods	EU – EFSA.	2016	106 - AME	5 (5)	0.2	1.3	0.7
Barley-based foods	Sweden – Häggblom et al.	2007	14 - AME	Not specified	Not specified	Not specified	142
Barley-based foods	Sweden – Häggblom et al.	2007	14 - AOH	Not specified	Not specified	Not specified	25
Corn-based foods	CFIA	2020	52	37 (71)	0.20	6.7	2.0
Corn-based foods	EU – EFSA	2016	145 - AOH	2 (1)	0.1	6.1	3.1
Corn-based foods	EU – EFSA.	2016	243 - AME	2 (1)	0.1	3.0	1.5
Rice-based foods	CFIA	2020	53	37 (70)	0.10	2.3	0.80
Rice-based foods	EU – Patriarca et al.	2016	31	6 (19)	1.83	2.97	Not specified
Rice-based foods	EU - EFSA	2016	145 - AOH	2 (1)	0.1	6.1	3.1
Rice-based foods	EU - EFSA	2016	243 - AME	2 (1)	0.1	3.0	1.5
Sorghum-based foods	Ethiopia – Chala et al.	2014	70 - AOH	41 (58.6)	Not specified	104	18
Sorghum-based foods	Ethiopia – Chala et al.	2014	70 - AME	61 (87.1)	Not specified	171	16.6
Sorghum-based foods	India – Ansari et al.	1990	20	7 (35)	0.60	1.8	1.0
Wheat-based foods	CFIA	2021	122	99 (81)	0.10	29	2.2

Product type	Jurisdiction/author	Survey year	Number of samples - toxins included in the survey	Number (%) of positive samples	Min (ppb)	Max (ppb)	Average level (ppb) of positive results
Wheat-based foods	CFIA	2020	1	1 (100)	N/A	3.5	N/A
Wheat-based foods	CFIA	2017	283	247 (87)	0.090	37	2.2
Wheat-based foods	Russia – Orina et al.	2021	116 - AOH	36 (31)	2	44	Not specified
Wheat-based foods	Russia – Orina et al.	2021	116 - AME	17 (14)	3	56	Not specified
Wheat-based foods	EU - EFSA	2016	99 - AOH	3 (2)	0.3	8.1	4.2
Wheat-based foods	EU - EFSA	2016	99 - AOH	1 (1)	0.03	3.	1.6
Wheat-based foods	Sweden – Häggblom et al.	2007	14 - AME	Not specified	Not specified	Not specified	22
Wheat-based foods	Sweden – Häggblom et al.	2007	14 - AOH	Not specified	Not specified	Not specified	24
Wheat-based foods	Czech Republic – Skarkova et al.	2005	129 - AOH	60 (46.5)	6.3	44.4	7.7
Wheat-based foods	Czech Republic – Skarkova et al.	2005	129 - AME	0 (0)	0	0	0

N/A = not applicable

Table 5. Levels of AOH and/or AME in infant foods in CFIA surveys and from scientific literature

Product type	Jurisdiction/ author	Survey year	Number of samples - toxins included in the survey	Number (%) of positive samples	Min (ppb)	Max (ppb)	Average level (ppb) of positive results
Infant food - puree	CFIA	2019	108	94 (87)	0.52	26	7.9
Infant food - puree	CFIA	2016	58	42 (72)	0.20	37	4.4
Meal - toddler/baby	CFIA	2019	90	60 (67)	0.10	12	1.1
Meal - toddler/baby	CFIA	2016	2	1 (50)	N/A	1.2	N/A
Fruit Puree	China – Xing et al.	2021	80	8 (10)	2.28	16.98	8.23

N/A = not applicable

Table 6. Levels of AOH and/or AME in juices in CFIA surveys and from scientific literature

Product type	Jurisdiction/ author	Survey year	Number of samples - toxins included in the survey	Number (%) of positive samples	Min (ppb)	Max (ppb)	Average level (ppb) of positive results
Juices	CFIA	2015	147	72 (49)	0.050	340	6.6
Juices	CFIA	2014	75	15 (20)	0.20	200	28
Juices	CFIA.	2018	174	125 (72)	0.050	570	17
Juices	EU - Patriarca et al.	2016	95	41 (43)	0.13	20.19	Not specified
Juices	China - Fan	2016	15	9 (60)	0.13	8.68	2.56
Juices	Italy – Prella et al.	2012	10	0 (0)	0	0	0
Juices	Canada – Lau et al.	2003	19	15 (79)	0.62	40.6	6.16
Juices	Canada – Scott et al.	1997	8	3 (38)	0.8	5.0	2.7
Juices	Spain – Delgado et al.	1993 to 1994	32	16 (50)	1.35	5.42	Not specified

Table 7. Levels of AOH and/or AME in nut/seed products in CFIA surveys and from scientific literature

Product type	Jurisdiction/ author	Survey year	Number of samples - toxins included in the survey	Number (%) of positive samples	Min (ppb)	Max (ppb)	Average level (ppb) of positive results
Nut/seed products	CFIA	2020	113	65 (58)	0.046	6.2	1.4
Nut/seed products	CFIA	2017	34	31 (91)	0.20	20	5.6
Nut/seed products	CFIA	2018 to 2019	50	36 (72)	0.054	55	6.0
Nut/seed products	EU – Patriarca et al.	2016	11	7 (64)	16.64	60	Not specified
Nut/seed products	EU - EFSA	2016	587 - AOH	42 (7)	1.0	44.5	15.5
Nut/seed products	EU - EFSA	2016	585 - AME	53 (9)	0.5	17.5	9.3
Nut/seed products	Argentina - Chulze et al.	1995	150	134 (89)	30	1512	286
Nut/seed products	Argentina – Torres et al.	1993	50	38 (76)	90	1026	415

Table 8. Levels of AOH and/or AME in pomegranate products in CFIA surveys and from scientific literature

Product type	Jurisdiction/ author	Survey year	Number of samples - toxins included in the survey	Number (%) of positive samples	Min (ppb)	Max (ppb)	Average level (ppb) of positive results
Pomegranate products	CFIA	2019	187	124 (66)	0.060	870	160
Pomegranate products	CFIA	2015	51	50 (98)	2.6	620	180
Pomegranate products - Fruit	Middle East – Elhariry et al.	2016	110 - AOH	56 (51)	0.71	19.2	Not specified
Pomegranate products	Middle East – Elhariry et al.	2016	110 - AME	75 (68)	0.9	32.02	Not specified
Pomegranate products - Juice	Middle East – Elhariry et al.	2016	8 - AOH	4 (50)	3.14	4.85	3.91
Pomegranate products - Juice	Middle East – Elhariry et al.	2016	8 - AME	4 (50)	4.49	6.07	5.26

Table 9. Levels of AOH and/or AME in processed fruits and vegetables in CFIA and from scientific literature

Product type	Jurisdiction/ author	Survey year	Number of samples - toxins included in the survey	Number (%) of positive samples	Min (ppb)	Max (ppb)	Average level (ppb) of positive results
PFV (fruit-based)	CFIA	2016	333	109 (33)	0.050	150	3.4
PFV (fruit-based)	EU - EFSA	2016	229 - AOH	11 (5)	1.0	8.8	6.1
PFV (fruit-based)	EU - EFSA	2016	217 - AME	9 (4)	0.03	8.7	3.6
PFV (tomato-based)	CFIA	2016	100	41 (41)	0.060	350	9.4
PFV (tomato-based)	CFIA	2015	101	36 (36)	0.080	880	25
PFV (tomato-based)	EU - EFSA	2016	99 - AOH	3 (3)	2.5	17.1	10.2
PFV (tomato-based)	EU - EFSA	2016	118 - AME	14 (12)	0.6	3.6	2.2
PFV (tomato-based)	EU - Patriarca et al.	2016	70 - AOH	52 (74)	<1.4	41.6	Not specified
PFV (tomato-based)	EU - Patriarca et al.	2016	70 - AME	53 (76)	<0.8	7.8	Not specified
PFV (tomato-based)	Argentina - Terminiello et al.	2006	80 - AOH	5 (6)	187	8756	Not specified
PFV (tomato-based)	Argentina – Terminiello et al.	2006	80 - AME	21 (26)	84	1734	Not specified

Table 10. Levels of AOH and/or AME in sunflower oils in CFIA surveys and from scientific literature

Product type	Jurisdiction/ author	Survey year	Number of samples - toxins included in the survey	Number (%) of positive samples	Min (ppb)	Max (ppb)	Average level (ppb) of positive results
Sunflower Oil	CFIA	2017	41	31 (76)	0.10	62	5.9
Oils	CFIA	2018	90	50 (56)	0.10	57	7.1
Sunflower oil	EU - EFSA	2016	35 - AOH	4 (11)	1.2	3.3	2.2
Sunflower oil	EU - EFSA	2016	35 - AME	11 (31)	2.9	3.9	3.4
Sunflower oil	EU - Patriarca et al.	2016	19	16 (84)	2.8	14	Not specified
Sunflower oil	Hungary - Tölgyesi et al.	2020	16	0 (0)	0	0	0

Table 11. Levels of AOH and/or AME in grape wine in CFIA surveys and from scientific literature

Product type	Jurisdiction/ author	Survey year	Number of samples - toxins included in the survey	Number (%) of positive samples	Min (ppb)	Max (ppb)	Average level (ppb) of positive results
Wine	CFIA	2015	200	141 (70)	0.092	21	1.8
Wine	CFIA	2014	75	26 (35)	0.50	11	2.6
Wine	Germany - Zwickel	2016	14 - AME	13 (93)	0.80	1.45	1.19
Wine	Germany - Zwickel	2016	25 - AOH	17/25 (68)	0.65	7.65	2.75
Wine	Netherlands - López	2016	5	1 (20)	<2.0	11	Not specified

Other regulatory agencies such as the US Food and Drug Administration, Australia/New Zealand and the European Union are not currently publishing the testing results for Alternaria mycotoxins. A comparison of the exposure of Canadian consumers to these mycotoxins with persons in other countries is not possible.

Health Canada determined the levels of AOH and AME observed in the current survey are not expected to pose a concern to human health, therefore there were no recalls resulting from this

survey. CFIA is conducting appropriate follow up activities which include further testing of similar products in subsequent years.

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Appendix A

Table A1. More detailed distribution of levels of AOH and/or AME in juices, pomegranate-containing foods, infant foods, nut/seed products, and processed fruits and vegetables

Product type	Product type/principal ingredient	Total number of samples	Number of samples with detected levels	Min (ppb)	Max (ppb)	Average level (ppb) of positive results
Juices	Apple juice	17	4 (24)	0.41	2.2	1.3
Juices	Apricot nectar/juice	2	1 (50)	N/A	4.2	N/A
Juices	Blends	38	11 (29)	0.050	2.4	0.48
Juices	Blueberry juice	3	2 (67)	0.170	340	170
Juices	Cherry juice	2	2 (100)	7.6	8.7	16
Juices	Cranberry juice	1	0 (0)	0	0	0
Juices	Grape juice	11	5 (45)	0.22	6.8	1.6
Juices	Grape-based wine	275	167 (61)	0.092	21	1.9
Juices	Guava juice/nectar	2	0 (0)	0	0	0
Juices	Lemon juice	3	0 (0)	0	0	0
Juices	Lemonade	6	1 (17)	N/A	0.090	N/A
Juices	Mango nectar/juice	16	2 (12)	0.25	2.0	1.1
Juices	Orange juice	20	8 (40)	0.11	0.79	0.39
Juices	Papaya juice	1	1 (100)	N/A	0.92	N/A
Juices	Peach juice	4	2 (50)	0.41	0.60	0.50
Juices	Pear juice	2	2 (100)	1.9	4.4	3.1
Juices	Pineapple juice	9	5 (56)	0.16	2.1	0.82
Juices	Prune nectar	1	1 (100)	N/A	0.090	N/A
Juices	Smoothies	77	35 (45)	0.14	38	2.8
Juices	Wildberry juice	2	0 (0)	0	0	0
Pomegranate foods	Arils	40	19 (48)	0.060	67	4.2
Pomegranate foods	Juice blends containing pomegranate	46	45 (98)	0.70	590	150
Pomegranate foods	Pomegranate drinks	4	4 (100)	140	340	190
Pomegranate foods	Fresh pomegranate	51	13 (25)	0.060	7.4	1.2
Pomegranate foods	Pomegranate juice	99	98 (99)	1.9	870	220
Pomegranate foods	Pomegranate seeds	3	0 (0)	0	0	0

Product type	Product type/principal ingredient	Total number of samples	Number of samples with detected levels	Min (ppb)	Max (ppb)	Average level (ppb) of positive results
Infant food - puree	Fruit	145	119 (82)	0.20	37	6.6
Infant food - puree	Fruit/vegetable	18	17 (94)	0.75	19	7.8
Infant food - puree	Vegetable	3	0 (0)	0	0	0
Nut/seed products	Almond	34	24 (70)	0.046	3.8	1.0
Nut/seed products	Cashew	2	1 (50)	N/A	3.5	N/A
Nut/seed products	Hazelnut	2	2 (100)	1.2	1.3	1.2
Nut/seed products	Mixed nuts	18	4 (22)	1.7	2.6	2.2
Nut/seed products	Mixed seeds	12	11 (92)	0.10	3.4	1.5
Nut/seed products	Mixed seeds & nuts	1	0 (0)	0	0	0
Nut/seed products	Peanut	32	13 (41)	0.10	2.7	0.76
Nut/seed products	Pecan	3	2 (67)	1.4	3.4	2.4
Nut/seed products	Pistachio	1	0 (0)	0	0	0
Nut/seed products	Sesame	6	6 (100)	1.0	4.0	1.9
Nut/seed products	Sunflower seeds	36	33 (92)	0.20	20	5.5
Processed fruits and vegetables	Apple	1	0 (0)	0	0	0
Processed fruits and vegetables	Apricot	15	5 (33)	0.51	9.0	4.0
Processed fruits and	Banana	1	0 (0)	0	0	0

Product type	Product type/principal ingredient	Total number of samples	Number of samples with detected levels	Min (ppb)	Max (ppb)	Average level (ppb) of positive results
vegetables						
Processed fruits and vegetables	Blackberry	4	4 (100)	0.48	6.3	2.9
Processed fruits and vegetables	Blueberry	11	6 (54)	0.26	9.2	3.7
Processed fruits and vegetables	Cherry	8	6 (75)	0.093	8.2	1.7
Processed fruits and vegetables	Cranberry	37	15 (40)	0.10	1.5	0.68
Processed fruits and vegetables	Currant	4	3 (75)	0.10	0.30	0.23
Processed fruits and vegetables	Date	25	1 (4)	N/A	0.060	N/A
Processed fruits and vegetables	Fig	26	11 (42)	0.14	150	22
Processed fruits and vegetables	Goji berries	1	0 (0)	0	0	0
Processed fruits and vegetables	Mango	11	0 (0)	0	0	0
Processed fruits and	Mixed berries	31	13 (42)	0.13	5.0	1.1

Product type	Product type/principal ingredient	Total number of samples	Number of samples with detected levels	Min (ppb)	Max (ppb)	Average level (ppb) of positive results
vegetables						
Processed fruits and vegetables	Mixed Fruit	51	13 (25)	0.097	6.2	1.3
Processed fruits and vegetables	Papaya	1	0 (0)	0	0	0
Processed fruits and vegetables	Peach	5	0 (0)	0	0	0
Processed fruits and vegetables	Pear	1	0 (0)	0	0	0
Processed fruits and vegetables	Pepper	27	1 (4)	N/A	0.82	N/A
Processed fruits and vegetables	Pepper - Hot	21	5 (24)	0.099	2.4	1.1
Processed fruits and vegetables	Pineapple	2	1 (50)	N/A	0.97	N/A
Processed fruits and vegetables	Prune	27	10 (37)	0.11	3.3	0.70
Processed fruits and vegetables	Raisin	25	8 (32)	0.050	2.2	0.99
Processed fruits and	Raspberry	13	5 (38)	0.12	1.7	0.77

Product type	Product type/principal ingredient	Total number of samples	Number of samples with detected levels	Min (ppb)	Max (ppb)	Average level (ppb) of positive results
vegetables						
Processed fruits and vegetables	Saskatoon berry	1	0 (0)	0	0	0
Processed fruits and vegetables	Strawberry	32	8 (25)	0.093	3.2	0.65
Processed fruits and vegetables	Tomato - crushed	16	10 (62)	0.090	5.2	0.99
Processed fruits and vegetables	Tomato - diced	85	28 (33)	0.070	350	13
Processed fruits and vegetables	Tomato - paste	1	1 (100)	N/A	0.50	N/A
Processed fruits and vegetables	Tomato - sauce	45	28 (62)	0.060	3.9	0.81
Processed fruits and vegetables	Tomato - stewed	6	0 (0)	0	0	0
Processed fruits and vegetables	Tomato - strained	1	0 (0)	0	0	0
Processed fruits and vegetables	Tomato - whole	47	10 (21)	0.080	880	88

N/A = not applicable