Canadian Food Inspection Agency
Agence canadienne d'inspection des aliments

Ochratoxin A in Wheat Products, Oat Products, Rice Products and Other Grain Products - April 1, 2018 to March 31, 2019

Canada

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.

Wheat products, oat products, rice products, and other grains (e.g. barley, quinoa) are consumed in varying degrees by some or all populations in Canada. These products can be naturally contaminated with mycotoxins, which are toxic secondary metabolites of fungi. Ochratoxin A (OTA) is a toxin released by mould that can grow on agricultural products as a result of warm, wet climate conditions during storage.

Considering the factors mentioned above and their relevance to Canadians, grains were selected for this targeted survey. The purpose of targeted surveys is to generate a snapshot of the occurrence and levels of chemical hazards in food. Over the course of this study (April 1, 2018 to March 31, 2019), a total of 495 samples were collected from retail locations in 6 cities across Canada and tested for OTA.

OTA was found in 45% of samples tested. Wheat products, oat products, rice products, and kamut products (kamut is a type of wheat) are subject to a maximum level of 3 parts per billion (ppb), which has been proposed by Health Canada (HC).[6] The compliance rate for these products was 99.8% (n=420 samples). There are currently no established limits for OTA in other grains. Levels above historical results (previously submitted to HC and deemed safe) in the specific grains are reviewed by HC to determine if OTA levels are harmful to consumers. Levels in these samples did not pose a health risk to Canadian consumers and there were no product recalls resulting from this survey.

Overall, our survey results suggest that grains are safe for consumption. Regardless, these foods are a known potential source of OTA contamination and as such, safe handling practices are recommended for producers, retailers and consumers.

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 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 did we conduct this survey

Chemical hazards in foods can come from a variety of sources. This report provides the results of a chemistry survey that was carried out to detect a toxin (ochratoxin A) produced by moulds. Various strains of *Aspergillus* and *Penicillium* moulds can infect foods in storage. Wet, warm weather conditions in storage will favour the development of OTA[1]. OTA only forms after harvest and is most commonly found in in cereal grains (wheat, corn, oat, and barley), green coffee, grape juice, beer, wines, cocoa, dried fruits, and nuts[2]. OTA is not easily destroyed by heating so it survives under normal cooking or processing conditions[3,4].

The International Agency for Research on Cancer (IARC) has classified OTA as a possible human carcinogen[5], especially in the kidneys. In animal studies, OTA has also been shown to have negative effects on the kidneys, the developing fetus, and the immune system[5]. HC completed a risk assessment for OTA, and as a result, has proposed maximum levels for OTA in various food commodities[6] as well as an industry guidance value for OTA in unprocessed cereal grains[7].

The main objectives of this targeted survey were: to generate additional baseline surveillance data on the levels of OTA in foods not routinely monitored under other agency programs but available on the Canadian retail market; to assess compliance with proposed Canadian regulations; and to compare the prevalence of OTA in foods in this survey with that of previous targeted surveys, where possible.

What did we sample

A variety of domestic and imported wheat, oat, rice products, and products of other grains were sampled between April1, 2018 and March 31, 2019. Samples 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, Ottawa) and the West (Vancouver, and Calgary). 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 the food on the open market were not considered in this survey.

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

Product type	Sample types	Number of domestic samples	Number of imported samples	Number of samples of unspecified[a] origin	Total number of samples
Wheat	Baked goods, baking mixes, cookies, granola/cereals bars, breakfast/infant cereals, crackers, crispbreads, pasta	23	62	111	196
Oat	Cookies, granola/cereals bars, breakfast cereals, cookies, crackers, bran, grain, oatmeal, oat products	37	38	25	100
Rice	Grain, flavoured rice	8	40	50	98
Buckwheat	Grain, groats, flour	8	10	7	25
Kamut	Breakfast cereals, crackers, grain, flour, pasta	3	7	16	26
Quinoa	Flour, grain, flakes, pasta	5	7	13	25
Rye	Bread, crackers, crispbreads, flour, flakes	9	5	11	25
Grand total	**-**	**93**	**169**	**233**	**495**

[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.

In 2009, HC proposed maximum levels (MLs) for OTA in a variety of foods. These MLs as well as an industry guidance value for OTA in unprocessed cereal grains are still under consideration and remain in "proposed" status[7]. The proposed Canadian standards and guidance value for OTA, and the established international maximum levels for OTA in foods are presented in Appendix 1.

In the absence of established tolerances or standards for OTA in foods, elevated levels of OTA in specific foods may be assessed by HC on a case-by-case basis using the most current scientific data available.

What were the survey results

Of the 495 samples that were tested, 55% were free from contamination by OTA. Of the 45% of samples where OTA was detected, there were various ranges of contamination as seen in Table 2. Average levels of OTA were highest in buckwheat, and lowest in rye products.

Table 2. Levels of OTA in wheat products, oat products, rice products, and other grains

Product	Total number of samples	Number of positive samples	Number of samples with non-compliant/ elevated levels	Min (ppb)	Max (ppb)	Average level (ppb) of positive results
Buckwheat	25	11	0	0.060	7.6	2.4
Kamut	26	10	0	0.050	1.2	0.48
Oat	100	55	0	0.050	1.6	0.26
Quinoa	25	8	0	0.054	5.8	1.3
Rice	98	13	1	0.049	11	1.1
Rye	25	15	0	0.050	1.9	0.24
Wheat	196	107	0	0.042	2.2	0.27

Only 1 (0.2%) sample had non-compliant/elevated levels of OTA. A sample of brown rice had a level of 11 ppb. The proposed maximum limit for rice is 3 ppb.

The results for the elevated sample, along with the entire dataset, were forwarded to HC for a safety assessment. Adverse health effects are associated with long-term exposure to OTA. Periodic, short-term exposures to elevated OTA levels in a limited number of foods would not be considered to pose a safety concern. HC is of the opinion that the levels of OTA in the products analyzed in this survey were unlikely to pose a health risk. No product recalls were warranted given the low risk to human health.

What do the survey results mean

In this survey, 55% of samples of selected foods analyzed were free of detectable levels of OTA. Tables 3-6 present a comparison of the maximum, minimum and average OTA levels in specific food categories observed in this study vs. previous agency surveys[8,9,10,11,12]. Please note that only the detectable values of OTA were included in the calculation of the minimum, maximum and average OTA levels for agency surveys.

Table 3. Summary of current and previous targeted survey data on OTA concentrations in wheat products

Food	Year	Number of samples	Number (%) of positive samples	Minimum OTA levels (ppb)	Maximum OTA levels (ppb)	Average OTA levels (ppb)
Baked goods	***2018-2019***	1	1 (100)	-	0.073	-
	2016-2017	100	64 (64)	0.040	65	1.2
	2012-2014	48	48 (100)	0.39	5.3	2.0
	2011-2012	19	13 (68)	0.043	0.35	0.13
Baking mixes	***2018-2019***	***28***	***9 (32)***	***0.051***	***0.46***	***0.16***
	2012-2014	247	163 (66)	0.042	6.1	0.28
Granola/ cereal bars	***2018-2019***	9	6 (67)	0.080	1.3	0.36
Breakfast cereal (wheat)	***2018-2019***	***31***	***13 (42)***	***0.050***	***2.0***	***0.32***
	2012-2014	361	208 (58)	0.042	7.0	0.38
	2011-2012	80	59 (74)	0.041	1.8	0.37
	2010-2011	56	26 (46)	0.040	2.8	0.56
Infant cereal (wheat)	***2018-2019***	***28***	***5 (18)***	***0.050***	***0.17***	***0.077***
	2012-2014	259	111 (43)	0.041	2.2	0.57
	2011-2012	25	9 (36)	0.041	0.76	0.30
	2010-2011	10	1 (10)	-	0.22	-
	2009-2010	75	19 (25)	0.30	4.1	0.82
Cookies	***2018-2019***	***31***	***22 (71)***	***0.042***	***1.0***	***0.23***
	2016-2017	198	136 (69)	0.042	2.6	0.24
	2012-2014	102	86 (84)	0.041	4.4	0.23
	2010-2011	30	20 (67)	0.049	3.8	0.50
Crackers/ Crispbreads	***2018-2019***	***40***	***30 (75)***	***0.047***	***2.2***	***0.41***
	2016-2017	100	73 (73)	0.048	1.7	0.28
	2012-2014	147	121 (82)	0.045	2.8	0.32
	2011-2012	10	10 (100)	0.044	3.2	0.94
Pasta	***2018-2019***	***28***	***21 (75)***	***0.049***	***0.34***	***0.18***
	2016-2017	262	132 (50)	0.040	1.9	0.32
	2012-2014	159	96 (60)	0.041	2.8	0.26

Table 4. Summary of current and previous targeted survey data on OTA concentrations in oat products

Year	Number of samples	Number (%) of positive samples	Minimum OTA levels (ppb)	Maximum OTA levels (ppb)	Average OTA levels (ppb)
2018-2019	***100***	***55 (55)***	***0.050***	***1.6***	***2.6***
2012-2014	314	141 (45)	0.040	21	0.9
2011-2012	31	22 (71)	0.042	1.2	0.32
2010-2011	17	13 (76)	0.042	0.74	0.23

Table 5. Summary of current and previous targeted survey data on OTA concentrations in rice products

Year	Number of samples	Number (%) of positive samples	Minimum OTA levels (ppb)	Maximum OTA levels (ppb)	Average OTA levels (ppb)
2018-2019	***98***	***14 (14)***	***0.049***	***11***	***1.1***
2011-2012	1	1 (14)	-	0.25	-

Table 6. Summary of current and previous targeted survey data on OTA concentrations in other grains

Grain	Year	Number of samples	Number (%) of positive samples	Minimum OTA levels (ppb)	Maximum OTA levels (ppb)	Average OTA levels (ppb)
Buck-wheat	***2018-2019***	***25***	***11 (44)***	***0.060***	***7.6***	***2.4***
	2017-2018	17	9 (53)	0.050	3.3	0.70
	2012-2014	37	17 (46)	0.052	5.3	0.88
	2011-2012	12	7 (58)	0.11	29	5.3
Kamut	***2018-2019***	***26***	***10 (38)***	***0.050***	***1.2***	***0.48***
	2017-2018	1	0 (0)	-	-	-
	2012-2014	33	8 (24)	0.14	13	3.3
	2011-2012	15	7 (47)	0.047	2.3	1.0
Quinoa	***2018-2019***	***25***	***8 (32)***	***0.054***	***5.8***	***1.3***
	2017-2018	22	10 (45)	0.043	1.3	0.52
	2012-2014	32	13 (41)	0.12	12	2.6
	2011-2012	24	9 (38)	0.045	0.70	0.25
Rye	***2018-2019***	***25***	***15 (60)***	***0.050***	***1.9***	***0.24***
	2017-2018	3	1 (33)	-	0.36	-
	2012-2014	26	12 (46)	0.045	6.7	1.6
	2011-2012	4	4 (100)	0.068	2.4	0.98

When examining the baseline data collected from 2009 to 2017, rice typically had very low prevalence and low levels of OTA. Wheat, oat and other grain products had relatively high OTA prevalence, and the levels were variable.

In general, the OTA prevalence and average levels in the current targeted survey data were comparable or lower than those recorded in previous targeted surveys, except for oat products, rice products and buckwheat products. The scientific studies purchased local products while the CFIA studies included samples from at least 28 countries. This may account for some of the differences.

The OTA levels in all samples were assessed by HC, who concluded that the levels of OTA found in the products analyzed in this survey did not pose a health concern. No product recalls were warranted given the lack of a health concern.

Appendix 1

Proposed Canadian and established international OTA maximum levels/levels/guidelines in foods

Commodity	Canada† (proposed) – see ref 7	United States	European Union	Codex
Raw/unprocessed cereal grains	5	Not specified to date	5	Not specified to date
Grains for direct consumption	3		3	
Derived cereal products (e.g. flour, bread, breakfast cereal)	3		3	
Wheat bran	7		3	
Cereal-based foods for infants and young children	0.5		0.5	
Wheat gluten not sold directly to the consumer			8.0	

†Proposed maximum level by HC

Levels reflect latest regulations in the USA[13], European Union (EU) [14] and Codex[15]

References

[1] Birzele, B., et al. (2000).Deoxynivalenol and ochratoxin A in German wheat and changes of level in relation to storage parameters. Food Additives & Contaminants: Part A17 (12), pp. 1027 -1035.

[2] Murphy, P.A., Hendrich, S., Landgren, C., Bryant, C. (2006) Food Mycotoxins: An Update. Journal of Food Science. 71 (5), pp. R51-R65.

[3] Bakker, M., and Pieters, M.N. (2002). Risk Assessment of Ochratoxin A in the Netherlands. RIVM report 388802025/2002.

[4] Kushiro, M. (2008). Effects of Milling and Cooking Processes on the Deoxynivalenol Content in Wheat. International Journal of Molecular Sciences. 9 (11), pp. 21217-2145

[5]Ochratoxin A. (1991). International Agency for Research on Cancer. IARC Monographs on the Evaluation of Carcinogenic Risks to Humans. IARC Scientific Publications. 56, pp. 489–521

[6] Kuiper-Goodman, T.; et al. (2010). Health risk assessment of ochratoxin A for all age-sex strata in a market economy. Food Additives & Contaminants: Part A. 27, pp. 212-240.

[7] Summary of Comments Received as part of Health Canada's 2010 Call for Data on Ochratoxin (2012). Health Canada's Bureau of Chemical Safety.

[8] 2016 – 2017 Ochratoxin A in Finished Grain Products and Pulses. Canadian Food Inspection Agency. Unpublished data.

[9] 2012 – 2014 Ochratoxin A in Selected Foods. Canadian Food Inspection Agency. Unpublished data

[10] 2011-2012 Ochratoxin A in Selected Foods. Modified August 2018. Canadian Food Inspection Agency.

[11] 2010 – 2011 Ochratoxin A in Selected Foods. Modified August 2018. Canadian Food Inspection Agency.

[12] 2009 – 2010 Ochratoxin A and Deoxynivalenol in Selected Foods. Modified August 2018. Canadian Food Inspection Agency.

[13] Mycotoxins Legislation Worldwide. Updated February 2012. European Mycotoxins Awareness Network.

[14] Commission Regulation (EC) No 1881/2006 of 19 December 2006 setting maximum levels for certain contaminants in foodstuffs. Published December 2006. European Union.

[15] Working Document for Information and Use in Discussions Related to Contaminants and Toxins in the GSCTFF. Published March 2011. Joint FAO/WHO Food Standards Programme Codex Committee on Contaminants in Foods, Fifth session.