Canadian Food Inspection Agency
Agence canadienne d'inspection des aliments

Deoxynivalenol in Infant Cereals - April 1, 2018 to March 31, 2019

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 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.

Deoxynivalenol (DON), also known as vomitoxin, is a toxin released by mould that can grow on agricultural products as a result of warm, wet climate conditions in the field. DON does not cause cancer, but it has been shown to have acute and chronic effects. The last surveys were done in 2013 - 2014. Since then, outbreaks in Asia of acute human illness, involving nausea, vomiting, abdominal pain, headache and dizziness have been attributed to the consumption of grains with very high levels of DON. Further, there have been changes in the marketplace (switch to more organic products, appearance/disappearance of brands) so a new survey to update the information was undertaken.

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, a total of 288 samples were collected from retail locations in 6 cities across Canada and tested for DON.

DON was found in 4.5% of the samples. Health Canada (HC) has not set limits for DON in infant cereals in Canada and positive results associated with infant cereals are reviewed by Health Canada's Bureau of Chemical Safety to determine if the DON levels are harmful to consumers. DON prevalence and levels in infant cereals available in Canada are low and comparable to previous surveys and to other jurisdictions (the US, the European Union and the United Kingdom). HC determined that the levels in these samples did not pose a health risk to Canadian consumers, and there were no product recalls resulting from this survey. Infant cereals will be re-examined for DON in 3-5 years' time.

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

This report provides the results of a chemistry survey that was carried out to look at the levels of a toxin, deoxynivalenol (also known as vomitoxin) produced by moulds. Various strains of Fusarium mould can cause Fusarium head blight (FHB) disease in crops in the field. Wet, warm weather conditions in the field will favour the development of FHB[1]. DON only forms before harvest and is most commonly found in cereal grains (notably wheat, barley and corn) and in grain-based products such as flour, bran, cereals, and beer[2]. DON is not easily destroyed by heating so it survives under normal cooking or processing conditions. This survey provided a snapshot of the levels of DON found in infant cereals that are available in Canada.

DON does not cause cancer, but it has been shown to have acute and chronic effects. Outbreaks in Asia of acute human disease, involving nausea, vomiting, abdominal pain, headache and dizziness, have been attributed to the consumption of grains with very high levels of DON[2]. In animal studies, long-term exposures to low levels of DON are associated with decreased food intake, weight loss, developmental effects and effects on the immune system[1,3].

Infant cereals are often the first foods, other than breast milk or formula, fed to babies. The levels of DON in infant cereals were investigated because infants have been cited as one of the most vulnerable age categories due to the large proportion of infant cereals in their diet.

In addition, since 2013-2014 (the last time a survey in Canada looked at DON levels in infant cereals), there have been changes in the marketplace (switch to more organic products, appearance or disappearance of brands and new combinations of ingredients.

What did we sample

A variety of single-grain and multiple grain infant cereals were sampled between April 1, 2018 and March 31, 2019. 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, 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 infant cereal grain and origin

Product type	Number of domestic samples	Number of imported samples	Number of samples of unspecified[a] origin	Total number of samples
Barley	1	6	0	7
Buckwheat	0	4	0	4
Multigrain	20	17	37	74
Oat	9	63	43	115
Rice	4	10	30	44
Wheat	0	0	44	44
Grand total[b]	**34**	**100**	**154**	**288**

[a] Unspecified refers to those samples for which the country of origin could not be assigned from the product label or available sample information
[b] Samples originated in at least 6 countries

How were samples analyzed and assessed

Samples were analyzed by ISO/IEC 17025 accredited food testing laboratories. The samples obtained from each city were tested as sold, i.e. the product was tested as is and not prepared according to package instructions. The analytical method used for DON was a single-analyte technique using liquid chromatography-tandem mass spectrometry (LC-MS/MS) based on the method used by the CFIA. One laboratory method had a limit of detection (LOD) of 0.2 ppb and the other had an LOD of 20 ppb. To ensure that the two datasets could be combined, a reporting limit for DON of 20 ppb (parts per billion) for all matrices was imposed.

Health Canada (HC) has not set limits for DON There are currently no limits for DON in infant cereals in Canada and positive results associated with infant cereals are reviewed by Health Canada's Bureau of Chemical Safety to determine if the DON levels are harmful to consumers. The results from testing on each food product were assessed on a case-by-case basis. When elevated levels of DON were found, the follow-up actions taken were based on the seriousness of the contamination and the resulting health concern. As no health risk was identified, no immediate action was taken but it was decided to examine infant cereals for DON in the next 3-5 years.

What were the survey results

A total of 288 samples of domestic and imported single-grain and multiple-grain infant cereals were tested for DON in this survey. DON was not detected in 275 (95.5%) samples. In the remaining 13 samples, DON levels ranged from 44.1 ppb to 250 ppb. A summary of the DON results by each product type can be seen in Table 2.

DON was not detected in any of the buckwheat or rice infant cereals and most of the barley cereals. The average DON level was lowest in oat and highest in barley.

Table 2. Results of DON testing in infant cereals

Product	Total number of samples	Number of positive samples	Minimum (ppb)	Maximum (ppb)	Average (ppb)
Barley	7	6	25	250	102
Buckwheat	4	0	-	-	-
Multigrain	74	4	30	150	81
Oat	115	2	36	64	50
Rice	44	0	-	-	-
Wheat	44	1	-	22	-

What do the survey results mean

Buckwheat infant cereal is a new product so no comparisons could be made.

In comparison to previous survey years[4,5,6], the detection rates for DON in various types of infant cereals were consistent, with the exception of barley (Table 3). In this 2018-2019 survey, 100% of barley infant cereal samples contained a quantifiable amount of DON vs. 50% in the three previous surveys. This is not related to differences in limits of detection (LOD) between sample years.

The average level of DON of this survey was either lower or within the range previously observed, except for barley. The highest observed level of DON (Maximum DON level) in the 2018-2019 surveys per grain type was lower or within the range previously observed.

DON forms in the crop in the field and is thus climate dependent; however, infant cereal producers may source their barley from a variety of countries, regions within the country and different harvest years. As the samples are picked up at retail, it is not possible to determine the source of the DON.

Table 3. Summary of current targeted survey on DON levels in infant cereals

Product	Study	Number of samples	Number (%) of positive samples	Minimum DON levels (ppb)	Maximum DON levels (ppb)	Average DON levels (ppb)
Barley	CFIA survey, 2018 to 2019	7	6 (86)	25	250	102
Barley	CFIA survey, 2012 to 2014	14	7 (50)	1.1	37	8.2
Barley	CFIA survey, 2011 to 2012	4	2 (50)	4.5	67	10.4
Barley	CFIA survey, 2010 to 2011	2	1 (50)	-	128	-
Buckwheat	CFIA survey, 2018 to 2019	4	4 (0)	-	-	-
Multigrain	CFIA survey, 2018 to 2019	74	39 (53)	0.80	110	13
Multigrain	CFIA survey, 2012 to 2014	194	192 (99)	1.4	175	18
Multigrain	CFIA survey, 2011 to 2012	14	14 (100)	4.4	84	17
Multigrain	CFIA survey, 2010 to 2011	22	22 (100)	1.2	56	15
Oat	CFIA survey, 2018 to 2019	115	49 (43)	0.70	64	7.2
Oat	CFIA survey, 2012 to 2014	105	101 (96)	1.4	311	12
Oat	CFIA survey, 2011 to 2012	13	13 (100)	1.4	255	42
Oat	CFIA survey, 2010 to 2011	23	21 (91)	1.1	14	4.4
Rice	CFIA survey, 2018 to 2019	44	7 (16)	0.60	13	4.2
Rice	CFIA survey, 2012 to 2014	21	10 (48)	1.1	14	4.0
Rice	CFIA survey, 2011 to 2012	12	5 (42)	1.3	4.2	2.6
Rice	CFIA survey, 2010 to 2011	34	21 (62)	1.2	64	5.6
Wheat	CFIA survey, 2018 to 2019	44	22 (50)	1.3	22	6.0
Wheat	CFIA survey, 2012 to 2014	64	64 (100)	1.1	59	16
Wheat	CFIA survey, 2011 to 2012	11	11 (100)	2	39	16
Wheat	CFIA survey, 2010 to 2011	10	10 (100)	1.9	50	24

Comparison to Other Jurisdictions. Please consult Appendix A[7,8,9,10] for a listing of the Canadian and international standards for DON. With the exception of Australia, the detection rate and levels of DON are lower than or comparable to those observed in a previous Canadian study, the US, the European Union or the United Kingdom (see Table 4 for more details)[11,12,13,14, 15]. This means that Canadian consumers' exposure to DON from infant cereals is lower than or similar to the exposure of consumers in other jurisdictions.

Table 4. DON testing results in infant cereals from various jurisdictions

Jurisdiction	Survey year	No. of samples	No. (%) of samples with detected DON	Min. (ppb or ng/g)	Max. (ppb or ng/g)	Ave. (ppb or ng/g)
Canada (CFIA)	2018-2019	288	13 (4.5)	25	250	82
Canada- Lombaert , G.A. et al. (2003)	1997–1999	206	132 (64)	20	980	132
USA- Zang et al. (2018)	2016	147	96 (65)	35	258	119
USA - Dombrink-Kurtzman, M.A. et al. (2010)	2007-2009	52	23 (44)	10	224	42
Australia – FSANZ (2011)	2011	4	0 (0)	-	-	-
EU - Pascari, X. et al.(2019)	1999-2015	89	50 (56)	15	314	34

Appendix A

Table A.1 – Canadian and International Standards for DON in Food

Hazard	Commodity	Canada	US	EU	Codex
DON (ppm)	wheat, soft, raw	1-2 *			regulations on hold waiting for info on processing all foods + precursors regulations
	wheat, durum, raw			1.75	
	wheat, other, raw			1.25	
	oats, corn, raw			1.75	
	flour, bran, germ		1	0.75	
	flour, for infant food			-	
	pasta, dry			0.75	
	cereal derived retail food			0.50	
	foods: babies, young children			0.20	

*under review

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