



Canadian Food
Inspection Agency

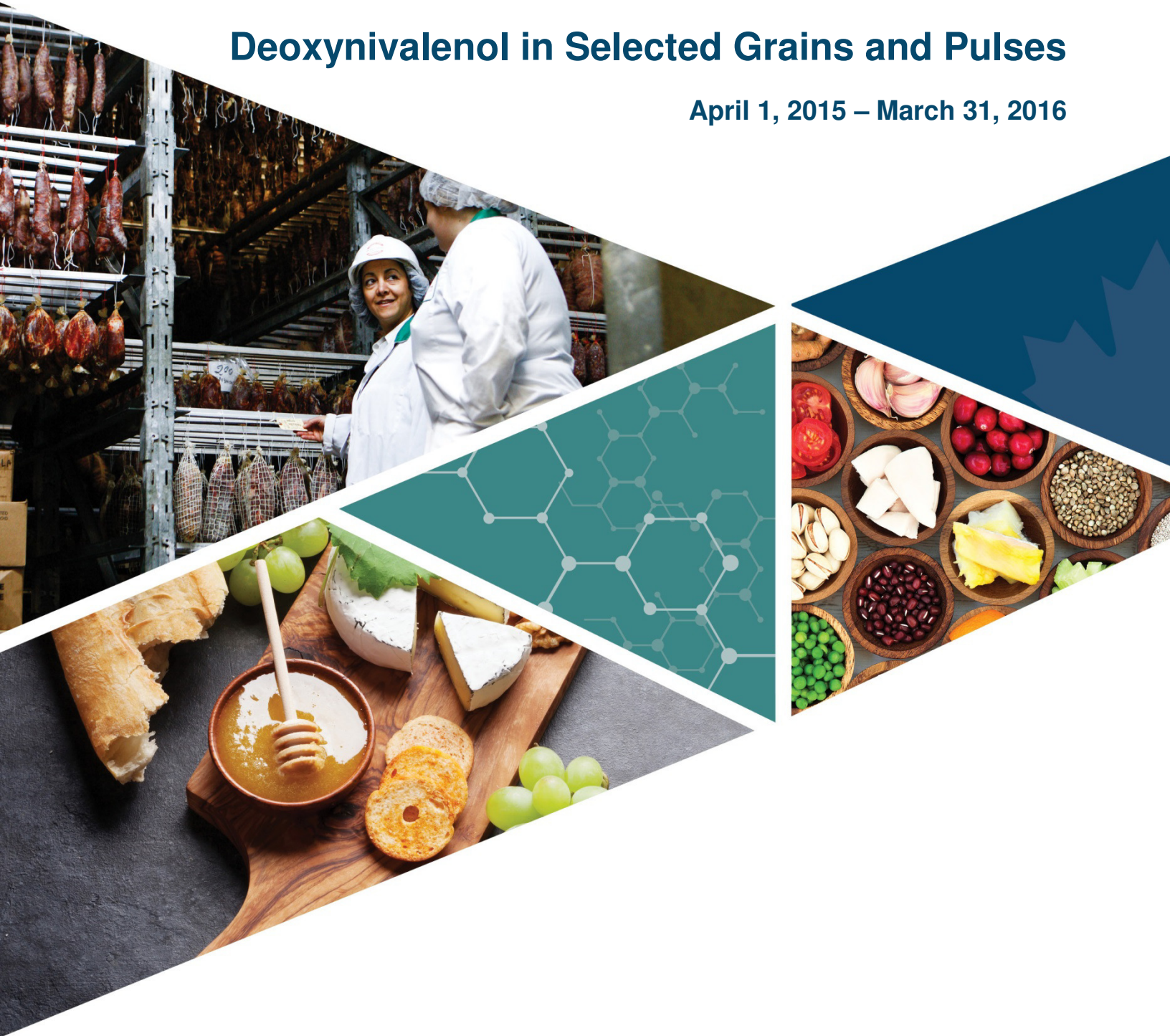
Agence canadienne
d'inspection des aliments

Food Chemistry – Targeted Surveys

FINAL REPORT

Deoxynivalenol in Selected Grains and Pulses

April 1, 2015 – March 31, 2016



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 highest risk. Surveys can also help to identify trends and provide information about how industry complies with Canadian regulations.

Grain products, pseudo-cereals, such as quinoa, and pulses (chickpeas, lentils, beans, etc.) are staple foods consumed in Canada. Mould can grow on agricultural products as a result of insect damage and/or warm, wet weather conditions during growth and harvest. Deoxynivalenol (DON) is a natural toxin that can be released by these moulds

To look at the levels of DON present in foods in the Canadian market, the CFIA carried out a retail survey of foods likely to contain DON. In this survey, 997 products were sampled. Detectable levels of DON were found in 46% of samples tested. There are currently no limits for DON in finished grain products in Canada but there is a limit of 2000 ppb for DON in uncleaned soft wheat in non-staple foods. Any high results of DON are reviewed by Health Canada's Bureau of Chemical Safety to determine if DON levels are harmful to consumers. Levels found in this survey were considered safe for consumption by Canadians and no product recalls were required.

What Are Targeted Surveys?

Targeted surveys are used by the Canadian Food Inspection Agency (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 Canadian Food Inspection Agency 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 consumption of pulses (beans, chickpeas, lentils, peas and soy products), specialty grains and pseudo-cereals (like quinoa) have increased in the Canadian marketplace due to changing demographics and to meet consumers' demands for healthy, alternative food sources. During the growth and harvest phases of cereal grains (notably wheat, barley and corn) ¹ and pulses, moulds can be produced as a result of insect damage and/or warm, wet weather conditions. Various strains of *Fusarium* mould can cause a disease known as Fusarium head blight (FHB) in field crops ². These moulds can result in the release of a natural toxin known as vomitoxin or deoxynivalenol (DON).

DON only forms before harvest and is most commonly found in cereal grains and in grain-based products such as flour, bran, cereals, and beer². Studies have shown that 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 DON¹. In animal studies, long-term exposures to low levels are associated with decreased food intake, weight loss, developmental effects and effects on the immune system^{2,3}. DON is not easily destroyed by heating so it survives under normal cooking or processing conditions. This survey provided a snapshot of the levels found in food products that are available in Canada.

What Did We Sample?

A variety of domestic and imported pulses (beans, chickpeas, lentils, peas and soy products), specialty grains and pseudo-cereals (like quinoa) were sampled between April 1, 2015 to March 31, 2016. Samples of products were collected from local/regional retail locations located in 6 major cities across Canada. These cities encompassed four geographical areas: Atlantic (Halifax), Quebec (Montreal), Ontario (Toronto, Ottawa) and the West (Vancouver, Calgary). The number of samples collected from these cities was in proportion to the relative population of the respective areas.

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 Origin*	Total Number of Samples
Other Grain Products	181	343	278	802
Bean Products	31	24	12	67
Pea Products	9	5	10	24
Chickpea Products	8	10	7	25
Lentil Products	8	12	4	24
Soy Products	17	31	7	55
Total Samples	254	425	318	997

*Unspecified refers to those samples for which a 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 17025 accredited food testing laboratory under contract with the Government of Canada. The samples were tested as sold, i.e. the product was tested as is and not prepared according to package instructions.

Currently, there are no limits set for DON in Canada for finished grain products (e.g. flour, pasta, baked goods), but there is a limit of 2000 ppb for DON in uncleaned soft wheat in non-staple foods. Canadian DON limits are currently under review by Health Canada. Any high results of DON are reviewed by Health Canada's Bureau of Chemical Safety to determine if the levels are harmful to consumers. Levels found in this survey were considered safe for consumption by Canadians and no product recalls were required.

What Were the Survey Results?

Of the 997 samples tested, 54% did not contain detectable DON levels. Of the 46% of samples where the toxin was detected, the range of levels found is presented in Table 2. Average levels of DON were highest in other grain products and lowest in chickpea products.

Other Grain Products

No DON was detected in arrowroot samples. Three of the 60 (5%) amaranth samples were contaminated. Eight percent (8%) of quinoa samples, 35% of buckwheat samples, 43% of teff samples, 46% of millet samples, 80% of rye samples, 87% of barley samples, 88% of grain blends, 89% of kamut samples, and 89% of spelt samples had detectable levels of DON. Overall, 51% of other grain products had detectable levels of DON.

Bean Products

Overall, 15% of bean product samples had detectable levels of DON. In samples where DON was detected, the levels ranged from 0.8 ppb to 33.8 ppb. Kidney beans and pinto beans had the highest total levels of DON. No DON was detected in canned beans in sauce or black bean samples.

Soy Products

DON was detected in 22% of the soy product samples. Soy bean and tofu samples did not contain any levels of DON and levels of DON were highest in other soy products and meat alternative samples.

Pea Products

DON was detected in 8% of pea samples. Only 2 out of the 24 samples had detectable levels of DON at 1.1 ppb and 5.8 ppb.

Lentil Products

DON was detected in 29% of lentil samples.

Chickpea Products

DON was detected in only one of the chickpea samples tested. The sample with a detectable level of DON had a level of 0.8 ppb.

Table 2. Levels of DON in selected foods

Product Type	Number of Samples	Number of Samples (%) with Detectable Levels	Minimum (ppb)	Maximum (ppb)	Average* (ppb)
Other Grain Products	802	424 (53)	0.5	5720	113
Bean Products	67	10 (15)	0.8	33.8	7.8
Pea Products	24	2 (8)	1.1	5.8	3.4
Chickpea Products	25	1 (4)	0.8	0.8	0.8
Lentil Products	24	7 (29)	0.6	15.5	3.8
Soy Products	55	12 (22)	0.6	22	8.6

* Only positive results were used to calculate the average (hazard) levels

What Do the Survey Results Mean?

In this survey, 46% of samples of specialty grains and pulses analyzed contained detectable levels of DON. The levels and frequency at which DON was detected in the food products covered in this survey were similar to those found in previous surveys.

Table 3 presents the comparison of levels of DON in grain products for three CFIA surveys from 2011-2016. In 2011-2012 and 2012-2014 surveys, milled specialty grain products were sampled, whereas the 2015-2016 survey included a variety of specialty grain products and pseudo-cereals.

Table 3. Minimum, maximum and average concentration of DON across various studies

Product Type	Study	Year	Number of Samples	Number of Samples (%) with Detectable Levels	Minimum (ppb)	Maximum (ppb)	Average* (ppb)
Grains	CFIA Survey (current)	2015-2016	802	409 (51%)	0.5	5720	113.2

	CFIA Survey ⁴	2012-2014	273	145 (53%)	1.0	1700	61.2
	CFIA Survey ⁵	2011-2012	128	62 (48%)	1.2	484	60.6
Soy Products	CFIA Survey (current)	2015-2016	55	12 (22%)	0.6	22	8.6
	CFIA Survey ⁴	2012-2014	288	39 (14%)	1.0	26.7	7.7
	CFIA Survey ⁵	2011-2012	198	32 (16%)	1.1	18.2	8.0

*Only positive results were used to calculate the average DON levels

In comparison to previous survey years, the percentage of samples with a detectable level of DON was consistent for grain and soy as seen in Table 3. The percentage of positive grain samples was 51% for this survey year, 53% in 2012-2014 CFIA surveys and 48% in 2011-2012 CFIA surveys. The highest levels of DON found increased with each survey year to up to 10 times the level from 2011-2012 (for surveys) and average DON levels almost doubled in the current survey year compared to previous years. While it appears that DON concentrations are increasing over time, the grain varieties tested differs with each study. Therefore, a comparison of levels per year as a trend is not possible.

Soy products were tested in previous CFIA surveys in 2011-2012 and 2012-2014 and these results were consistent with the current survey. Maximum levels of DON found in soy product samples were similar across the CFIA surveys, ranging from 18.2 ppb to 26.7 ppb.

This is the first year that bean, chickpea, lentil and pea products were tested for DON by the CFIA and there was limited literature available for comparison. Since there are presently no Canadian maximum levels for DON in these products, all positives were assessed on a case by case basis by Health Canada. It was ultimately determined by Health Canada that all positive samples reported did not represent a risk to Canadian consumers

The CFIA survey results show that specialty grain products, pseudo-cereals and pulses are safe for consumption. There were no follow-up actions resulting from this survey. Future targeted surveys will focus on processed grains and grain products such as breads, crackers, cookies, pasta, rice and rice products as these are known to have detectable levels of DON.

References

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2. Pestka; J.J., Smolinski, A.T. (2005). Deoxynivalenol: Toxicology and potential effects on humans. *Journal of Toxicology and Environmental Health, Part B: Critical Reviews*, 1, pp. 39 – 69.
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