



Canadian Food
Inspection Agency

Agence canadienne
d'inspection des aliments

Aflatoxins in Selected Corn Products, Nuts, Nut Products, Raisins, Cocoa Powder, Chili Powder and Paprika - April 1, 2012 to March 31, 2013

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

Aflatoxins are a family of mycotoxins (naturally-occurring and toxic secondary metabolites) produced by *Aspergillus* fungi. Hot, humid conditions and pest damage during plant growth or storage can favour the growth of aflatoxin-producing fungi, leading to the presence of aflatoxins in foods. Aflatoxins are known to occur in nuts and nut products, dried foods, grains, spices and cocoa beans. This survey targeted corn products, nuts and nut products, raisins, cocoa powder, paprika and chili powder.

To look at the levels of aflatoxins present in foods in the Canadian market, the CFIA carried out a retail survey of foods likely to contain aflatoxins. In this survey, 904 products were sampled. Aflatoxins were found in 17% of samples tested. There are currently no limits for aflatoxin in corn products, raisins, cocoa powder, paprika or chili powder in Canada but there is a limit of 15 ppb of total aflatoxin in nuts and nut products. Results from samples of nuts and nut products were compared to the 15 ppb limit and 99.8% were below this limit. Any high results of aflatoxin are reviewed by Health Canada's Bureau of Chemical Safety to determine if aflatoxin 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 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?

Aflatoxins are naturally occurring mycotoxins produced by *Aspergillus* fungi¹. The 4 main aflatoxins are AFB₁, AFG₁, AFB₂ and AFG₂. The B₁ form is the predominant and most toxic form of aflatoxin². Short term exposure to high levels of aflatoxins can cause vomiting, abdominal pain and death². Long term exposure to higher levels of aflatoxins, specifically AFB₁, has been linked to liver cancer and liver disease as well as preventing proper growth in children². It is important to note that exposure to high levels of aflatoxins is very rare in developed countries.

Aflatoxins can be present in foods such as nuts and nut products, spices, rice, dried foods, grains and cocoa beans¹. During growth and harvest phases of food, moulds can be produced as a result of hot and humid conditions and pest damage, resulting in aflatoxin contamination¹. The major route of human exposure to aflatoxins is through the consumption of contaminated foods directly or as ingredients². 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 corn products, nuts and nut products, raisins, cocoa powder, paprika and chili powder were sampled between April 1, 2012 to March 31, 2013. Samples of products were collected from local/regional retail locations located in 11 cities across Canada. These cities encompassed four Canadian geographical areas: Atlantic (Halifax, Saint John), Quebec (Montreal, Quebec City), Ontario (Toronto and Ottawa) and the West (Vancouver, Kelowna, Calgary, Saskatoon, Winnipeg). The number of samples collected from these cities was in proportion to the relative population of the respective areas. Refer to Table 1 for the product types collected in this survey.

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
Corn products	38	165	92	295
Nuts	53	136	94	283
Nut butter	103	27	24	154
Cocoa powder	0	24	1	25
Raisins	0	79	19	98
Chili powder	0	21	4	25
Paprika	0	18	6	24
Grand total	194	470	240	904

^aUnspecified 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, which means that the product was tested as is and not prepared according to package instructions.

Currently, there are no limits set for aflatoxins in Canada for corn products, cocoa powder, raisins or spices, but there is a limit of 15 ppb for total aflatoxins in nuts and nut butters. All high results of aflatoxin are reviewed by Health Canada's Bureau of Chemical Safety to determine if the levels are harmful to consumers. Levels in this survey were considered safe for consumption by Canadians and no product recalls were required.

What were the survey results?

Of the 904 samples tested, 750 (83%) did not have detected levels of aflatoxin. Of the samples where aflatoxins were detected, a range of concentrations was observed and is presented in Table 2. Average levels of aflatoxins were highest in chili powder and lowest in cocoa powder and raisins.

Corn products

Aflatoxins were not detected in 86% of corn product samples with the highest average detected concentrations found in tortillas/corn chips (0.8 ppb). There were no detected levels in popcorn.

Nuts

Aflatoxins were not detected in 93% of nut samples. Peanuts had the highest average detected level of aflatoxin at 3.8 ppb. Almonds and pistachios had no detected levels of aflatoxins. With

the exception of one peanut sample at 28 ppb, all samples were compliant with the Canadian Food and Drug Regulations limit of 15 ppb total aflatoxins in nuts and nut products.

Nut butter

Aflatoxins were not detected in 61% of nut butter samples. Peanut butter had the highest detected average at 1.9 ppb. Walnut, cashew, macadamia nut and blended nut butters had no detected levels. All nut butter samples were below the 15 ppb total aflatoxins limit for nuts and nut products.

Table 2. Levels of aflatoxin in corn products, nuts and nut butters, raisins, cocoa powder, paprika and chili powder.

Product type	Total number of samples	Number of samples with detectable levels (%)	Minimum (ppb)	Maximum (ppb)	Average ^b (ppb)
Corn products	295	40 (14)	0.1	20	0.5
Nuts	283	19 (7)	0.1	28	3.0
Nut butter	154	60 (39)	0.2	8.5	1.5
Raisins	98	1 (1)	0	0.2	0.2
Cocoa powder	25	0 (0)	0	0	0
Paprika	24	7 (29)	0.4	13	1.6
Chili powder	25	8 (32)	0.2	44	6.4

^bOnly positive results were used to calculate average aflatoxins levels

What do the survey results mean?

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

Product type	Study	Year	Total number of samples	Number of positive samples (%)	Minimum (ppb)	Maximum (ppb)	Average (ppb) ^c
Corn products	CFIA Survey (current)	2012-2013	295	40 (14)	0	20	0.5
	CFIA Survey ³	2011-2012	304	20 (7)	0.1	1.5	0.4
	CFIA Survey ⁴	2010-2011	285	23 (8)	0	1.2	0.4
Nuts	CFIA Survey (current)	2012-2013	283	19 (7)	0.1	28	3.0

	CFIA Survey ³	2011-2012	295	21 (7)	0.1	7.6	0.9
	CFIA Survey ⁴	2010-2011	234	12 (5)	0	1.9	0.57
Nut butter	CFIA Survey (current)	2012-2013	154	60 (39)	0.2	8.5	1.5
	CFIA Survey ³	2011-2012	104	34 (33)	0.1	12.5	1.8
	CFIA Survey ⁴	2010-2011	19	9 (47)	0	0.5	0.2
Raisins	CFIA Survey (current)	2012-2013	98	1 (1)	0	0.2	0.2
	Feizy et al. ⁵	2009-2011	22	1 (4)	0	0.6	0.6
Cocoa powder	CFIA Survey (current)	2012-2013	25	0 (0)	0	0	0
	Health Canada ⁶ Cocoa Powder	2011-2012	15	14 (93)	<LOD	3.5	1.15
	Health Canada ⁶ Alkalized Cocoa Powder	2011-2012	21	20 (95)	<LOD	0.97	0.43
Paprika	CFIA Survey (current)	2012-2013	24	7 (29)	0.4	13	1.6
	Codex ⁷	2009-2013	692	692 (100)	0.1	221	n/a
Chili powder	CFIA Survey (current)	2012-2013	25	8 (32)	0.2	44	6.4
	Codex ⁷	2009-2013	29	29 (100)	0.0169	120	n/a

^cOnly positive results were used to calculate the average aflatoxin levels for CFIA surveys

In comparison to previous survey years, the percentage of samples with detected levels of aflatoxin was consistent. Corn product samples had similar average concentrations throughout CFIA survey years. Nuts had a similar percent of samples that contain detected levels, however the average concentration was slightly higher in the current survey compared to previous years. This could have been due to the increase in peanut samples in the current survey year in comparison to previous years since peanuts are known to contain aflatoxins⁸.

The percentage of positive nut butter samples and average concentration was comparable to previous survey years with no levels above the 15 ppb total aflatoxin limit. Aflatoxin levels in raisins were consistent with a survey in Iran. Both surveys had similar average concentrations of 0.2 ppb and 0.6 ppb and only one sample from each survey was positive for aflatoxins.

Cocoa powder samples did not have detected levels of aflatoxins. Levels have decreased in comparison to a survey of cocoa powder from Health Canada in 2011 to 2012 in which 93 to 95% of samples had detected levels of aflatoxins.

Paprika and chili powder concentrations were compared to an international Codex study on aflatoxins in spices. Maximum levels and the prevalence of aflatoxins in paprika and chili powder samples were lower in the current study than the Codex survey. Since there are presently no Canadian maximum levels for aflatoxins in corn products, raisins, cocoa powder, paprika and chili powder, all positives were assessed on a case by case basis by Health Canada.

The peanut sample exceeding 15 ppb was followed up by testing additional samples of peanuts from the same brand. No detectable levels of aflatoxin were found in any of these follow up samples. Health Canada reviewed the sample and determined that the high aflatoxin level did not represent typical levels found in peanuts. They concluded that long term exposure to high levels would be unlikely and short term exposure to this level of aflatoxin would not represent a health risk.

The CFIA survey results show that corn products, nuts, nut butters, raisins, cocoa powder, paprika and chili powder are safe for consumption. There were no follow-up actions resulting from this survey. Future targeted surveys will focus on corn products, nuts and nut butters, dried fruit, spices, cocoa powder, breads and breakfast/infant cereals as these are known to have detected levels of aflatoxins.

References

1. [Aflatoxins in Food](#). (2018) European Union. European Food Safety Authority.
2. Kumar, P., Mahato, D.K., Kamle, M., Mohanta, T.K., Kand, S.G. (2016). Aflatoxins: A Global Concern for Food Safety, Human Health and Their Management. *Front Microbiol.*, 7 (2170).
3. [Canadian Food Inspection Agency 2011-2012 Aflatoxins in Corn Products, Nuts and Nut Butters](#) (2015). Canada. Government of Canada.
4. [Canadian Food Inspection Agency 2010-2011 in Dried Fruits, Nuts and Nut Products, and Corn Products](#) (2014). Canada. Government of Canada.
5. Feizy, J., Beheshti, H.R., Asadi, M. (2012) [Ochratoxin A and aflatoxins in dried vine fruits from the Iranian market](#). *Mycotoxin Research*, 28 (4), pp. 237-242.
6. Turcotte, A.M. Scott, P.M., Tague. B. (2013). [Analysis of cocoa products for ochratoxin A and aflatoxins](#). *Mycotoxin Research*, 29 (3), pp. 193–201.
7. [Discussion Paper on Mycotoxin Contamination in Spices](#). (2015) India. Codex Alimentarius Commission.
8. Marin, S., Ramos. A. J. (2016). *Food Hygiene and Toxicology in Ready-to-Eat Foods*. 1st edition. Lleida, Spain. Elsevier Inc. pp. 295-312.