Canadian Food Inspection Agency | Agence canadienne d'inspection des aliments

Tropane Alkaloids in Canola-Based Condiments, Fats and Oils - 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.

Tropane alkaloids (TAs) are natural toxins produced by numerous plant families. Exposure to TAs can cause increased heart rate, changes in blood pressure, blurred vision, and affect functions of the central nervous system. Human exposure to TAs may occur through mistaken identity of edible plants or contamination of crops with parts of the TA-containing plant. Reports indicate that seeds from Jimsonweed (*Datura stramonium*) are most often the source[1]. Jimsonweed is primarily found in southeastern Canada, however in recent years, the species started to appear as a weed in Alberta canola fields[2]. Jimsonweed seeds are similar in size to canola therefore it is hard to separate them out during processing. Since canola is mainly used for oil production, the need for monitoring TAs in canola oil has arisen to prevent accidental human exposure and to protect the quality of this important for Canadian agriculture industry plant crop[2].

A total of 300 samples of canola-based condiments, fats and oils were collected from retail locations in 6 cities across Canada and tested for atropine and scopolamine in this targeted survey. Atropine was not detected in any of the products tested. Only 6 (2%) samples had detected levels of scopolamine. The highest level (55.8 ppb) of scopolamine was detected in 1 sample of pure canola oil. Of the 6 positive samples, 2 samples were samples of expeller pressed pure canola oil from the same brand, 2 samples were seasoned oil from the same brand with the same 'best before' date, and 2 samples were samples of the same stir-fry oil with a different lot number. The results suggested homogeneous distribution of TA levels in products produced from the same batch of the raw material.

The range of the scopolamine levels observed was comparable to that found in scientific literature (Table 4). The detection rate was lower than reported in literature for other types of grain products, suggesting a lower on average degree of cross-contamination of the canola crop and/or that denaturation of the alkaloids is more pronounced during the heating process in canola oil processing.

Health Canada (HC) determined the levels of TAs in canola-based oils observed in this survey are not expected to pose a concern to human health, therefore there were no recalls resulting from this survey. CFIA conducted appropriate follow up activities which includes further testing of similar products in subsequent years.

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

Tropane alkaloids are natural toxins produced by numerous plant families. Human exposure to TAs may occur through mistaken identity of edible plant or contamination of crops with TA-containing plants. Reports indicate that seeds from *Datura stramonium* (Jimsonweed) are most often the source. Jimsonweed is primarily found in southeastern Canada, however in recent years, the species started to appear as a weed in Alberta canola fields[2]. All parts of the plant are toxic, although the highest concentration occurs in the seeds with approximately 0.4-0.6% tropane content[1]. Jimsonweed seeds are similar in size to canola seeds therefore it is hard to separate them out during processing. Removal prior to harvest is recommended. Since most of the canola is used for oil production, a need for monitoring TAs in canola oil arose to prevent accidental human exposure and to protect the quality of this important for Canadian agriculture industry plant crop.

Tropane alkaloids prevent binding of a major neurotransmitter to its receptor and, as a result they can cause increased heart rate, blood pressure, blurred vision and affect functions of the central nervous system. Atropine and scopolamine are the best known representatives of this class of metabolites. The principal TAs found in Jimsonweed are atropine, scopolamine and hyocyamine. The European Food Safety Authority (EFSA) studied the toxicity and the TA levels in food and feed and established an Acute Reference Dose (ARfD) of 0.016 µg/kg body weight for 2 (hyoscyamine and scopolamine) TAs for which occurrence and toxicity data were available[3].

The main objectives of this targeted survey were to generate baseline surveillance data on the level of TAs in canola-based products available on the Canadian retail market, and to compare, the prevalence of TAs in this survey with that reported in scientific literature.

What did we sample

A variety of domestic and imported canola-based condiments, fats and oils 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 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
Canola oil	85	44	49	178
Margarine/shortening	12	1	63	76
Dipping oil/infused/stir-fry oil	6	0	40	46
Grand total	**103**	**45**	**152**	**300**

[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

Survey samples were analyzed by a CFIA laboratory which is ISO/IEC 17025 accredited for food testing. The laboratory used a method that quantifies atropine and scopolamine. The results are based on the food products as sold and not necessarily as they would be consumed.

In the absence of a specific maximum level, the levels of TAs detected were assessed by HC on a case-by-case basis using the most current scientific data available.

What were the survey results

A total of 300 samples of domestic and imported canola-based condiments, fats and oils were tested for atropine and scopolamine in this targeted survey. Atropine was not detected in any of the products tested. Only 6 (2%) samples had detected levels of scopolamine. A summary of positive TA results can be seen in Table 2. Of the 6 positive samples, 2 samples were samples of expeller pressed pure canola oil from the same brand, 2 samples were seasoned oil from the same brand with the same "best before" date, and 2 samples were samples of the same stir-fry oil with a different lot number. The highest level (55.8 ppb) of scopolamine was detected in 1 sample of pure canola oil.

Table 2. Level of tropane alkaloids in canola-based foods and oils

Product type	Level of tropane alkaloids (scopolamine) (ppb)
Canola oil	55.8[b]
	2.8[b]
Dipping oil/infused/stir-fry oil	24.6[c]
	16.3[c]
	6[d]
	4.9[d]
Grand total	**18.4**

[b] Same brand, same products
[c] Same brand, different products
[d] Same products with different lot numbers

What do the survey results mean

This is the first year tropane alkaloids were tested by the CFIA and there was limited literature available for comparison. The levels of TAs found in this targeted survey were compared to those reported in literature in similar grain-based products where cross-contamination of the raw ingredient is possible[4,5,6]. The range of the scopolamine levels observed was comparable to that found in scientific literature (Table 4). The detection rate was lower than reported in literature for other types of grain products, suggesting a lower on average degree of cross-contamination of the canola crop. It may also be possible that denaturation of the alkaloids is more pronounced during the heating process in canola oil processing[7].

Table 4. TA testing results in canola-based foods from various survey years

Commodity	Study	Number of samples	Number (percentage) of positive samples	Levels of scopolamine (ppb)	Levels of atropine (ppb)
Canola-based condiments, fats and oils	CFIA survey, 2018 to 2019	300	6 (2%)	2.8 - 55.8[e]	
Organic buckwheat products	Cirlini et al. (2015)	26	3 (12%)	5.7 - 10.4	13.9 - 83.9
Grain-based infants and children products	Mulder et al. (2015)	113	21 (15%)		Average[f]: 1.5; Maximum: 65.6
	Mulder et al. (2015)	113	18 (13%)		Average[f]: 0.44; Maximum: 15.2
Grain-based products	Mulder et al. (2016)	1106	0 - 21.3% (different subcategories)	Maximum: 97.82	Maximum: 149.0

[e] Only positive results were used to calculate the TA levels
[f] Negative results were included in calculating the average TA levels

The highest level (55.8 ppb) of scopolamine was detected in a sample of expeller pressed canola oil which may be caused by a lower degree of heat processing which would cause a lower degree of TA denaturation. Scopolamine was also detected in another expeller pressed canola oil sample from this brand, however it was not detected in other types of canola oil samples tested.

As seen in Table 3, 2 samples of seasoned oil samples from the same brand with the same “best before” date and 2 samples of the same stir-fry oil with a different lot numbers had comparable levels of scopolamine. Other types of canola oil from these brands tested did not have detected levels of TAs. These observations suggest homogeneous distribution of TA levels in products produced from the same batch of the raw material.

HC determined the levels of TAs in canola-based oils 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 conducted appropriate follow up activities which includes further testing of similar products in subsequent years.

References

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