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

Coumarin in Cinnamon, Cinnamon-Containing Foods and Licorice Flavoured Foods - April 1, 2015 to March 31, 2016

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.

Coumarin is a naturally occurring sweet-smelling compound found in many plants, including cinnamon and tonka beans. Its derivatives can be found in plants commonly used as licorice flavour, such as fennel, aniseed and licorice root[1,2,3]. Coumarin was used as a flavouring agent in the food and cosmetic industries for many years, and although its use in the cosmetic industry continues, it has been discontinued in the food industry due to evidence of potential toxic and adverse effects on the liver[4,5]. Low exposure to this compound from natural sources is expected and not anticipated to represent a health risk. The CFIA considered it important to examine coumarin levels in commonly available ground cinnamon, cinnamon-containing products and licorice flavoured products to ensure that these are safe for consumption.

This targeted survey generated further baseline surveillance data on the concentration of coumarin in domestic and imported products on the Canadian retail market. The CFIA sampled and analyzed 747 products, including 200 baked goods, 29 cinnamon samples, 221 spice mixes and 297 tea samples. Coumarin was detected in 90% of the samples, with levels ranging from 0.2 ppm to 5040 ppm. The highest levels were detected in ground cinnamon and spice mixes. The average and maximum concentration in all categories were comparable to previous targeted surveys and a variety of scientific studies.

Health Canada (HC) determined that the levels of coumarin observed in this survey are not expected to pose a concern to human health, therefore there were no follow-up actions resulting from this survey.

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

The main objectives of this targeted survey were to generate further baseline surveillance data on the level of coumarin in ground cinnamon, cinnamon-containing products and licorice flavoured products on the Canadian retail market, and to compare the presence of coumarin in foods targeted in this survey to previous targeted surveys and scientific literature.

Coumarin is a naturally occurring sweet-smelling compound found in many plants, including cinnamon and tonka beans. High coumarin concentrations can be found in Cassia cinnamon (also known as true cinnamon) and Saigon cinnamon, whereas the Ceylon variety typically contains only traces. Ceylon cinnamon is typically more expensive than Cassia cinnamon, and has a milder flavour/spice profile. Due to economics and a preference of the public for a "spicier flavour profile", most of the cinnamon sold today is Cassia cinnamon.

Licorice flavours are often incorporated into foods such as teas and spice mixes due to their unique flavour. Ingredients such as fennel, aniseed and licorice root are also often used to create a licorice flavour in food, and have been shown to contain derivatives of coumarin[1,2,3]. Limited data is available on the presence of this compound in commonly available licorice flavoured products, which is why the CFIA considered it important to include such products in this survey.

In order to achieve a consistent flavour profile in processed foods, the use of flavouring extracts has been a common practice in the food industry. Coumarin, either naturally derived or synthetically produced, was used as a flavouring agent in the past; however, its use in food has been discontinued based on reports of adverse health effects in animal studies[4,5]. The deliberate addition of coumarin to foods is not permitted in Canada; however, plants or herbs that are added to foods as flavours may contain this compound naturally. The main source of

naturally occurring coumarin in the human diet is cinnamon[5,6]. The majority of people can consume these foods daily without adverse effects; however, there is a small number of individuals who are sensitive to coumarin. For this group, consuming higher levels than would normally be found in food can lead to elevation of liver enzymes, and in severe cases to inflammation of the liver[1].

In 2004, the European Food Safety Authority (EFSA) established a Tolerable Daily Intake (TDI) of 0.1 mg for coumarin[7]. In 2006, Germany's Federal Institute of Risk Assessment (BfR) warned against consuming excessive amounts of Cassia cinnamon due to its relatively high content of coumarin[6.] The Norwegian Scientific Committee for Food Safety also conducted a risk assessment and concluded that children and adults who regularly consume even moderate amounts of cinnamon may be at risk of elevated intake of coumarin[8].

Limited data is available on the occurrence of coumarin in foods containing cinnamon and licorice flavouring. Cinnamon is frequently used in baked goods, spice mixes and tea for its unique flavour[9] and licorice flavours are commonly incorporated into teas and spice mixes. It was considered important to examine the coumarin levels in commonly available cinnamon-containing and licorice flavoured products to ensure that the populations consuming these foods are not at risk. All of the survey data was shared with HC.

What did we sample

A variety of domestic and imported baked goods, ground cinnamon, spice mixes and teas were sampled between August 1, 2015 and March 31, 2016. 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. 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 origin[a]	Total number of samples
Ground cinnamon	4	10	15	29
Tea	50	190	57	297
Spice mixes	20	105	96	221
Baked goods	39	36	125	200
Grand Total	**113**	**341**	**293**	**747**

[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 17025 accredited food testing laboratory under contract with the Government of Canada. The results presented represent finished food products as sold and not as they would be consumed, whether the product sampled is considered an ingredient or requires preparation prior to consumption.

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

What were the survey results

Of the 747 samples tested, 90% contained detected levels of coumarin. This was expected as the survey included pure ground cinnamon as well as commodities that contain cinnamon and licorice flavours, which are known to be natural sources of coumarin and its derivatives.

Coumarin concentrations in the survey samples ranged from 0.2 ppm to 5040 ppm (Table 2). The only ground cinnamon sample labelled as Saigon cinnamon had a concentration of 5040 ppm. Given that this type of cinnamon is known to contain high coumarin levels, it is not unexpected that this sample had significantly higher concentration than other samples in this survey.

Table 2. Summary of targeted survey results on coumarin in cinnamon and cinnamon-containing foods

Product type	Number of samples	Number of samples (%) with detected levels	Minimum (ppm)	Maximum (ppm)	Average[b] (ppm)
Ground Cinnamon	29	29 (100)	6.8	5040	2839
Tea	297	245 (82)	0.2	2230	442
Spice mixes	221	209 (95)	0.2	3040	328
Baked goods	200	187 (94)	0.2	130	18
Grand total	**747**	**670 (90)**	**0.2**	**5040**	**392**

[b] Only positive results were used to calculate the average (hazard) levels

The majority of sampled baked goods, spice mixes and teas contained cinnamon among other ingredients. As expected, these product types had lower coumarin concentrations than ground cinnamon.

Coumarin was detected in 82% of tea samples, with levels ranging from 0.2 ppm to 2230 ppm. Teas containing cinnamon but not licorice flavour had higher concentrations than teas containing licorice flavour but not cinnamon. Coumarin levels in teas containing cinnamon and licorice flavour were similar to those found in teas containing cinnamon but not licorice flavour.

Of the spice mixes, cinnamon mixed with sugar as well as mulling and pumpkin spices had higher than average coumarin levels: 730 ppm, 984 ppm and 1141 ppm, respectively. The average concentration of all sampled spice mixes was 328 ppm.

The average coumarin concentration in baked goods was 18 ppm, which is proportional to the cinnamon content in these foods when compared to coumarin levels in pure cinnamon.

What do the survey results mean

The average and maximum coumarin concentration found in baked goods, ground cinnamon, spice mixes and tea were comparable to previous targeted surveys[10,11,12,13] and a variety of scientific studies[9,14,15,16,17,18]. The wide range of levels found in these commodities is due to natural variation, degree of processing, the amount and the type of cinnamon used in these commodities.

The highest coumarin concentration reported in this survey was 5040 ppm in ground Saigon cinnamon, which is within the range reported in literature of up to 6970 ppm[14]. Most of the ground cinnamon products did not identify the specific type of cinnamon utilized; however, concentrations found in all samples are within the range reported in literature of up to 9900 ppm in pure Cassia cinnamon[15]. The only sample of pure Ceylon cinnamon tested had a coumarin level of 6.8 ppm, which is within the range reported in literature of up to 90 ppm[14].

The percentages of tea and spice mix samples with detected levels of coumarin in this survey were 82% and 95%. These numbers are comparable to the results of the 2014 to 2015 survey of 85% and 86%. The average and maximum concentrations in these commodities are also in agreement with the literature values (Table 3).

The average and maximum coumarin levels in baked goods in this survey were 18 ppm and 130 ppm. These numbers are in close agreement with the results of the 2014 to 2015 survey of 16 ppm and 83 ppm.

A total of 175 samples in this survey contained licorice flavouring, of which 121 contained detected levels of coumarin. Due to the fact that most of these commodities also contained other coumarin-containing ingredients, such as cinnamon and chamomile, no conclusion can be drawn concerning the effect of licorice flavouring on coumarin level.

HC's Bureau of Chemical Safety determined the levels of coumarin in food observed in this survey are not expected to pose a concern to human health; therefore no follow-up actions were required.

Table 3. Minimum, maximum and average concentration of coumarin-containing foods across various studies

Product type	Study[c]	Number of samples	Minimum (ppm)	Maximum (ppm)	Average (ppm)
Ground cinnamon	CFIA survey, 2015 to 2016	28	6.8	5040	2939[e]
Ground cinnamon	CFIA survey, 2011 to 2012	87	16.2	7816	3594[e]
Saigon cinnamon	Wang et al., 2013[f]	2	1060	6970	4015
Ceylon cinnamon	Wang et al., 2013[f]	17	5	90	18.8
Ground cinnamon	Blahová et al., 2012[g]	60	2571	7057	3856
Cinnamon powder and sticks	Krüger et al., 2018[h]	28	8	5017	1449
Cassia cinnamon powder and sticks	Woehrlin et al., 2010[i]	69	<LOD[d]	9900	3697
Cinnamon powder	Lungarini et al., 2008[j]	20	5	3094	1456
Tea	CFIA survey, 2015 to 2016	297	0.2	2230	442[e]
Tea	CFIA survey, 2014 to 2015	508	0.2	1920	302[e]
Tea	CFIA survey, 2013 to 2014	115	0.3	2430	500[e]
Tea	CFIA survey, 2011 to 2012	11	<0.29	1040	380[e]
Tea	Krüger et al., 2018[h]	8	20	137	62
Tea	Lungarini et al., 2008[j]	5	30	192	81
Spice mix	CFIA survey, 2015 to 2016	222	0.2	3040	327[e]
Spice mix	CFIA survey, 2014 to 2015	324	0.2	2170	329[e]
Spice mix	CFIA survey, 2013 to 2014	103	0.2	2510	390[e]
Spice mix	CFIA survey, 2012 to 2013	53	30	3078	568[e]
Spice mix	CFIA survey, 2011 to 2012	24	<0.29	2014	352[e]
Spice mix	Raters et al., 2008[k]	172	<0.03	4309	174
Baked goods	CFIA survey, 2015 to 2016	200	0.2	130	18[e]
Baked goods	CFIA survey, 2013 to 2014	139	0.1	83	16[e]
Baked goods	Raters et al., 2008[k]	307	<0.03	103	7.87

[c] When no sample year is present, year of publication and sample year are the same
[d] Limit of detection
[e] Only positive results were used to calculate the average coumarin levels
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