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

Bacterial Pathogens in Chocolate-Based Confectionaries - April 1, 2016 to March 31, 2018

Food microbiology - Targeted surveys - Final report

Canada

Summary

Chocolate-based confectionaries (chocolate bars, chocolate covered nuts, etc.) are commonly consumed by Canadians across all age groups with higher consumption rates among those aged 0 to 19 years. Unfortunately, some chocolate-based confectionaries have been associated with recalls and outbreaks of foodborne illnesses in Canada and worldwide, with the main pathogen of concern being *Salmonella* species (spp.). The primary food safety concern with chocolate-based confectionaries is contamination with bacterial pathogens present in raw ingredients (cocoa beans, nuts, etc.). Once contaminated, bacterial pathogens are able to survive for long periods of time and survive standard thermal treatments due to the low moisture and high fat content of chocolate. Given that these foods do not require further preparation prior to consumption, the presence of bacterial pathogens presents an increased potential risk for foodborne illnesses.

Considering the factors mentioned above and their relevance to Canadians, a variety of chocolate-based confectionaries were selected for targeted surveys. The purpose of the surveys was to generate baseline information on the occurrence of pathogenic bacteria in a variety of these foods. Over the course of this 2 year study (April 1, 2016 to March 31, 2018), a total of 3173 samples were collected from retail locations in 11 cities across Canada. All samples were tested for *Salmonella* spp., coliforms and generic *Escherichia coli* (*E. coli*). Coliforms and generic *E. coli* are indicators of the overall sanitation conditions throughout the food production chain.

Salmonella spp. and generic *E. coli* (> 1.8 Most Probable Number (MPN)/gram (g)) were not found in any samples. Coliforms were detected at elevated ($1.8 < x \leq 10^2$ MPN/g) and high ($>10^2$ MPN/g) levels in 41/3173 (1.3%) and 3/3173 (<0.1%) of the samples respectively.

The Canadian Food Inspection Agency (CFIA) conducted appropriate follow-up activities such as facility inspections and additional sampling. In one case, additional sampling and a root cause analysis conducted by the manufacturing facility led to changes in how products were handled prior to packaging. No reported illnesses were associated with any of the contaminated products.

Overall, our survey results suggest that almost all chocolate-based confectionary samples available for sale at retail in Canada are safe for consumption. Coliforms were found in some of the samples in our survey which may indicate a loss of sanitation controls along the food production chain. Consequently, as with all foods, safe handling practices are recommended for producers, retailers and consumers.

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?

Chocolate-based confectionaries (chocolate bars, chocolate covered nuts, etc.) are commonly consumed by Canadians across all age groups with higher consumption rates among those aged 0 to 19 years[1]. Unfortunately, some chocolate-based confectionaries have been associated with recalls and outbreaks of foodborne illnesses in Canada[2, 3] and worldwide[4-6], with the main pathogen of concern being *Salmonella* spp.. The primary food safety concern with chocolate-based confectionaries is contamination with bacterial pathogens present in raw ingredients (cocoa beans, nuts, etc.). Once contaminated, bacterial pathogens are able to survive for long periods of time and survive standard thermal treatments due to the low moisture and high fat content of chocolate. Given that these foods do not require further preparation prior to consumption, the presence of bacterial pathogens presents an increased potential risk for foodborne illnesses.

Considering the factors mentioned above and their relevance to Canadians, a variety of chocolate-based confectionaries were selected for targeted surveys. The purpose of the surveys was to generate baseline information on the occurrence of pathogenic bacteria in a variety of these foods. Over the course of this 2 year study (April 1, 2016 to March 31, 2018), a total of 3173 samples were collected from retail locations in 11 cities across Canada. Throughout the entire survey period, all samples were tested for the pathogenic bacteria *Salmonella* spp., coliforms and generic *E. coli*. Coliforms and generic *E.coli* are indicators of the overall sanitation conditions throughout the food production chain.

What did we sample?

For this survey, a sample consisted of a single or multiple unit(s) (individual consumer-size package(s)) from a single lot with a total weight of at least 250g. All samples were collected from national retail chains and local/regional grocery stores located in 11 major cities across Canada. These cities encompassed 4 geographical areas:

- Atlantic (Halifax and Saint John)
- Quebec (Quebec City, Montreal)
- Ontario (Toronto, Ottawa)
- West (Vancouver, Kelowna, Calgary, Saskatoon and Winnipeg)

The number of samples collected from these cities was in proportion to the relative population of the respective areas. Samples were collected between April 1, 2016 and March 31, 2018. A variety of domestic, imported, conventional and organic products were sampled. Sample collection was evenly distributed throughout the year.

What analytical methods were used and how were samples assessed?

Samples were analyzed using methods published in Health Canada's *Compendium of Analytical Methods for the Microbiological Analysis of Foods* [7] (table 1). The assessment criteria used in this survey (table 1) are based on the principles of Health Canada's *Health Products and Food Branch Standards and Guidelines for Microbiological Safety of Foods* [8].

Table 1 - Analytical methods and assessment criteria for chocolate-based confectionary samples

Bacterial analysis	Method identification number [a]	Satisfactory	Investigative	Unsatisfactory
Salmonella spp.	MFHPB-20	Absent in 25g	Not Applicable (N/A)	Present in 25g
Coliforms	MFHPB-19	≤ 1.8 MPN/g	$1.8 < x \leq 10^2$ MPN/g	$> 10^2$ MPN/g
Generic *E. coli*	MFHPB-19	≤ 1.8 MPN/g	$1.8 < x \leq 10^2$ MPN/g	$> 10^2$ MPN/g

[a] The methods used were the published versions at the time of analysis

At the time of writing this report, no assessment guidelines had been established in Canada for the presence of indicator or pathogenic bacteria in confectionaries. Health Canada's guidelines and standards for indicator organisms and *Salmonella* in chocolate[8] were applied in the

assessment of chocolate-based confectionaries' (table 1). As *Salmonella* spp. is considered pathogenic to humans their presence was considered to be a violation of the *Food and Drugs Act* (FDA) Section 4(1)a[9] and was therefore assessed by the CFIA as unsatisfactory.

Unlike harmful bacterial pathogens such as *Salmonella* spp., coliforms and generic *E. coli* are commonly found in the intestines of humans and most strains are harmless. They are considered to be indicator organisms and their levels in a food product are used to assess the overall sanitation conditions throughout the food chain from production to the point of sale. An investigative assessment is associated with elevated levels of these organisms ($1.8 < x \leq 10^2$ MPN/g) which may result in further follow-up actions. As results are based on the analysis of one unit (n=1), further sampling may be required to verify the levels of these organisms in the lot. An unsatisfactory assessment is associated with high levels of these organisms ($> 10^2$ MPN/g) as it may indicate a breakdown in good manufacturing practices, and therefore possibly warranting the initiation of follow-up activities to determine the source of the contamination and improve sanitation conditions along the food chain.

What were the survey results?

Over the course of this 2 year study (April 1, 2016 to March 31, 2018), a total of 3173 samples were collected from retail locations in 11 cities across Canada. Throughout the entire survey period, all samples were tested for the pathogenic bacteria *Salmonella* spp., coliforms and generic *E. coli*. Coliforms and generic *E. coli* are indicators of the overall sanitation conditions throughout the food production chain.

Salmonella spp., and generic *E. coli* (> 1.8 MPN/g) were not found in any samples. Coliforms were detected at elevated ($1.8 < x \leq 10^2$ MPN/g) and high ($>10^2$ MPN/g) levels in 41/3173 (1.3%) and 3/3173 (<0.1%) of the samples respectively. Sample assessment results can be found in table 2.

Table 2 - Assessment results of chocolate-based confectionary samples

Bacterial analysis	Number of samples tested	Satisfactory	Investigative	Unsatisfactory
Salmonella spp.	3173	3129	0	0
Coliforms			41	3
Generic *E.coli*			0	0
Total	**3173**	**3129**	**41**	**3**

Of the 3173 samples tested, 446 (14%) were domestic, 2091 (66%) were imported and 636 (20%) were of unknown origin (table 3).

Table 3 – Assessment results of chocolate-based confectionary samples by product origin

Product origin	Number of samples tested	Satisfactory	Investigative (coliforms $1.8 < x \leq 10^2$ MPN/g)	Unsatisfactory (coliforms $> 10^2$ MPN/g)
Domestic	446	440	4	2
Import	2091	2067	23	1
Australia	5	5	0	0
Austria	4	4	0	0
Belgium	93	91	2	0
Colombia	2	2	0	0
Croatia	8	7	1	0
Czech Republic	2	2	0	0
European Union	6	6	0	0
France	269	268	1	0
Germany	122	122	0	0
Greece	5	5	0	0
Ireland	1	1	0	0
Israel	9	8	1	0
Italy	52	52	0	0
Japan	19	19	0	0
Korea	1	1	0	0
Latvia	1	1	0	0
New Zealand	10	10	0	0
Peru	1	1	0	0
Poland	123	118	5	0
Portugal	1	1	0	0
Romania	5	5	0	0
Scotland	4	4	0	0
Serbia	4	4	0	0
Slovenia	2	1	1	0
Spain	32	32	0	0
Sweden	1	1	0	0
Switzerland	677	675	2	0
Thailand	1	1	0	0
Turkey	5	4	1	0
Ukraine	1	0	1	0
United Arab Emirates	1	1	0	0
United Kingdom	71	71	0	0
United States	143	139	4	0
Unknown	410	405	4	1
Unknown	636	622	14	0
Total	**3173**	**3129**	**41**	**3**

A variety of ready-to-eat (RTE) product types were analysed (table 4).

Table 4 – Assessment results by product type

Product type	Number of samples tested	Satisfactory	Investigative (coliforms $1.8 < x \leq 10^2$ MPN/g)	Unsatisfactory (coliforms $> 10^2$ MPN/g)
Cereal bars covered with chocolate	168	156	11	1
Chocolate blocks/bars	1100	1096	4	0
Chocolate candies	551	542	9	0
Chocolate bars containing grains, nuts, seeds and/or fruits	1016	1008	6	2
Cookies or crackers covered with chocolate	338	327	11	0
Total	**3173**	**3129**	**41**	**3**

What do the survey results mean?

In this survey, all (100%) of the samples were free of *Salmonella* spp. and generic *E.coli* (> 1.8 MPN/g). Coliforms were detected at elevated ($1.8 < x \leq 10^2$ MPN/g) and high ($>10^2$ MPN/g) levels in 41/3173 (1.3%) and 3/3173 (<0.1%) of the samples respectively.

Results similar to ours were found in other studies. A Canadian study[10] (published in 1981) investigated the microbiological quality and safety of 431 lots of domestic and imported finished chocolate products and liquid chocolate base. The results of this study formed the basis of the current microbiological guidelines found in Health Canada's *Health Products and Food Branch Standards and Guidelines for Microbiological Safety of Foods*[8]. *Salmonella* was not detected in any of the samples and coliform counts ranged from <1.8 /g to 50-100 /g.

A Korean study[11] conducted between 2006 and 2007 investigated the microbiological quality of 1008 inexpensive convenience foods (candy, ice cream, chocolate, etc.) frequently consumed by primary schoolchildren. Of the 100 chocolate samples analysed, coliforms (10^2 - 10^3 CFU/g) were detected in 2 samples (2%). *Salmonella* spp. and generic *E.coli* were not detected in any samples.

A Slovakian study[12] (published in 2011) investigated the microbiological quality of confectionery products (n=18). *Salmonella* spp. was not detected and coliforms were detected at levels ranging from $<1x10^1$ to $4x10^2$ CFU/g.

No trends were observed in our study when comparing domestic vs. imported product (table 3). It is interesting to note however that a larger proportion of cereal bars coated with chocolate and cookies/crackers coated with chocolate were assessed as investigative or unsatisfactory (table

4). This result is not surprising as these 2 product types are multi-ingredient foods that undergo a complex food production process.

The CFIA conducted appropriate follow-up activities such as facility inspections and additional sampling. In one case, additional sampling and a root cause analysis conducted by the manufacturing facility led to changes in how products were handled prior to packaging. No reported illnesses were associated with any of the contaminated products.

Overall, our survey results suggest that almost all chocolate-based confectionary samples available for sale at retail in Canada are safe for consumption. Some of the samples in our survey were found to be contaminated with coliforms which may indicate a loss of sanitation controls along the food production chain. Consequently, as with all foods, safe handling practices are recommended for producers, retailers and consumers.

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