



Canadian Food
Inspection Agency

Agence canadienne
d'inspection des aliments

Bacterial Pathogens in Dairy Ice Cream - April 1, 2017 to March 31, 2020

Food microbiology - Targeted surveys - Final report



Food microbiology targeted surveys – October 2020

Canada 

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.

Ice cream is a popular dessert made from dairy milk, cream or other milk products and consumed by people of all ages. Unfortunately, ice cream has been associated with recalls and foodborne illness outbreaks. In Canada, the production of commercially sold ice cream involves pasteurization of the ice cream mix to kill any harmful bacteria. Therefore their presence in the final product may be due a variety of factors such as inadequate pasteurization or contamination of the ice cream post-pasteurization. Given that ice cream is consumed more frequently by children and young adults (≤ 19 years of age) and without further preparation, the possible presence of bacterial pathogens creates the potential for foodborne illness.

Considering the factors mentioned above and their relevance to Canadians, dairy ice cream was selected for targeted surveys. The purpose of targeted surveys is to generate baseline information on the occurrence and distribution of pathogenic bacteria in food. Over the course of this study (April 1, 2017 to March 31, 2020), a total of 1186 samples were collected from retail locations in 11 cities across Canada. All samples were tested for *Listeria monocytogenes* (*L. monocytogenes*) and Aerobic Colony Count (ACC) and 387 samples were tested for *Salmonella* species (*Salmonella* spp.) and total coliforms. Total coliforms and ACC are both indicators of the overall sanitation conditions from the rearing of the cows through to ice cream production and control of storage temperatures during transportation to the point of sale or while on display for sale at retail.

L. monocytogenes and *Salmonella* spp. were not found in any samples. Total coliforms at elevated ($10 < x \leq 10^3$ CFU/g) and high ($> 10^3$ CFU/g) levels were found in 10/387 (2.58%) and 1/387 (0.26%) samples respectively. ACC at elevated ($10^5 < x \leq 10^6$ CFU/g) and high ($> 10^6$ CFU/g) levels were found in 4/1186 (0.34%) and 2/1186 (0.17%) samples respectively. The CFIA conducted appropriate follow-up activities. For example, in one case, the CFIA contacted the processing facility and referred a follow up inspection to the relevant provincial food safety authority. There were no reported illnesses linked to these products.

Overall, our survey results suggest that while ice cream sold in Canada is generally safe for consumption, as this commodity is a known potential source of foodborne illness and 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, 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

Ice cream is a popular dessert made from dairy milk, cream or other milk products and consumed by people of all ages¹. Unfortunately, ice cream has been associated with recalls² and foodborne illness outbreaks^{3,4}. In Canada, the production of commercially sold ice cream involves pasteurization of the ice cream mix⁵ to kill any harmful bacteria. Therefore their presence in the final product may be due a variety of factors such as inadequate pasteurization or contamination of the ice cream post-pasteurization. Given that ice cream is consumed more frequently by children and young adults (≤ 19 years of age)¹ and without further preparation, the possible presence of bacterial pathogens creates the potential for foodborne illness.

Considering the factors mentioned above and their relevance to Canadians dairy ice cream was selected for targeted surveys. The purpose of targeted surveys is to generate baseline information on the occurrence and distribution of pathogenic bacteria in food. Over the course of this study (April 1, 2017 to March 31, 2020), a total of 1186 samples were collected from retail locations in 11 cities across Canada. All samples were tested for *L. monocytogenes* and ACC and 387 samples were tested for Salmonella spp. and total coliforms. Total coliforms and ACC are both indicators of the overall sanitation conditions from the rearing of the cows through to ice cream production and control of storage temperatures during transportation to the point of sale or while on display for sale at retail.

What did we sample

For this survey, a sample consisted of a single unit (individual consumer-size package(s) from a single lot) with a total weight of at least 250 g. 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 or Moncton), Quebec (Quebec City and Montreal), Ontario (Toronto and Ottawa), and the West (Vancouver, Kelowna or Victoria, 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, 2017 and March 31, 2020. A variety of dairy ice cream samples made from cow's milk or cream sold in multi-serve cartons or plastic containers were collected with no restrictions placed on country of origin or production practice. Ice cream in single serve formats (such as ice cream bars, sandwiches, cones) were not sampled.

What analytical methods were used and how were samples assessed

Samples were analyzed using analytical methods published in Health Canada's *Compendium of Analytical Methods for the Microbiological Analysis of Foods*⁶ (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*⁷.

No assessment guidelines had been established in Canada for the presence of *Salmonella* spp. in ice cream at the time of writing this report. However, these microorganisms are considered pathogenic to humans and as such in the absence of assessment guidelines, their presence in ice cream is considered to be a violation of the *Food and Drugs Act* (FDA) Section 4(1) and is therefore assessed by the CFIA as unsatisfactory.

The assessment guidelines for *L. monocytogenes* are based on Health Canada's Policy on *Listeria monocytogenes* in RTE foods and is dependent upon the sample type analysed (i.e., Category 1, 2A or 2B)⁸. Ice cream is considered to be a Category 2B product (i.e. foods in which the growth of *L. monocytogenes* cannot occur throughout the stated shelf life). However, ice cream in multi-serve formats might undergo repeated cycles of freezing and thawing throughout its shelf life and may support the growth of *L. monocytogenes* due to the elevated temperatures (>0°C) required for thawing.

Unlike harmful bacterial pathogens (such as *Salmonella* spp.), total coliforms are a group of bacteria commonly found in the soil, water and intestines of animals and humans and most strains are harmless. Similarly, ACC is the total number of generally harmless bacteria that are

able to grow in an oxygenated (aerobic) environment. ACC are normal components of the environment and can be found in soil and natural water sources. Both total coliforms and ACC are considered to be indicator organisms and their levels present in a food product are used to assess the overall sanitation conditions throughout the food chain from production to the point of sale. Their presence at some levels is tolerated. An investigative assessment which may result in further follow-up actions is associated with elevated levels of total coliforms ($10 < x \leq 10^3$ CFU/g) and ACC ($10^5 < x \leq 10^6$ CFU/g) (table 1). An unsatisfactory assessment is associated with high levels of total coliforms ($> 10^3$ CFU/g) and ACC ($> 10^6$ CFU/g) as it may indicate a breakdown in Good Manufacturing Practices (sanitation practices), and therefore possibly warranting the initiation of follow-up activities to, for example, improve sanitation conditions along the food chain. As the results are based on the analysis of 1 unit (n=1), further sampling may be required to verify the levels of total coliforms or ACC of the lot.

Table 1 - Analytical methods and assessment criteria for bacteria in ice cream

Bacterial analysis	Method identification number ^a	Satisfactory	Investigative	Unsatisfactory
<i>L. monocytogenes</i>	MFLP-28 MFLP-77 MFHPB-30	Absent in 25g	≤ 100 CFU/g	> 100 CFU/g
<i>Salmonella</i> spp.	MFLP-49	Absent in 25g	Not applicable (N/A)	Present in 25g
Total coliforms	MFHPB-34	≤ 10 CFU/g	$10 < x \leq 10^3$ CFU/g	$> 10^3$ CFU/g
ACC	MFHPB-18	$\leq 10^5$ CFU/g	$10^5 < x \leq 10^6$ CFU/g	$> 10^6$ CFU/g

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

What were the survey results

Over the course of this study (April 1, 2017 to March 31, 2020), a total of 1186 samples were collected. All samples were tested for *L. monocytogenes* and ACC and 387 were tested for *Salmonella* spp. and total coliforms. Sample assessment results can be found in table 2.

Table 2 - Assessment results of ice cream samples

Bacterial analysis	Number of samples tested	Satisfactory (%)	Investigative (%)	Unsatisfactory (%)
<i>L. monocytogenes</i>	1186	1169 (98.6)	0	0
ACC			4 (0.3)	2 (0.2)
<i>Salmonella</i> spp. ^b			N/A	0
Total coliforms ^b			10/387 (2.6)	1/387 (0.3)
Total	1186	1169	14	3

^b tested in 387 samples

L. monocytogenes and *Salmonella* spp. were not found in any samples. Total coliforms at elevated ($10 < x \leq 10^3$ CFU/g) and high ($>10^3$ CFU/g) levels were found in 10/387 (2.6%) and 1/387 (0.3%) samples respectively. ACC at elevated ($10^5 < x \leq 10^6$ CFU/g) and high ($>10^6$ CFU/g) levels were found in 4/1186 (0.3%) and 2/1186 (0.2%) samples respectively.

A variety of ice cream flavours were analysed and are detailed in table 3.

Table 3 - Assessment results by ice cream flavour

Ice cream flavour	Number of samples analysed	Satisfactory	Investigative Total coliforms $10 < x \leq 10^3$ CFU/g	Investigative ACC $10^5 < x \leq 10^6$ CFU/g	Unsatisfactory Total coliforms $>10^3$ CFU/g	Unsatisfactory ACC $>10^6$ CFU/g
Vanilla	281	280	1	0	0	0
Chocolate	222	221	0	1	0	0
Strawberry	72	72	0	0	0	0
Caramel	68	68	0	0	0	0
Coffee	51	50	1	0	0	0
Cherry	49	49	0	0	0	0
Chocolate, Vanilla	47	46	0	1	0	0
Chocolate, Peanut butter	36	36	0	0	0	0
Mint	35	34	1	0	0	0
Pistachio	24	21	3	0	0	0
Maple	23	21	0	0	1	1
Pineapple	21	21	0	0	0	0
Mango	19	18	1	0	0	0
Dulce de leche	16	16	0	0	0	0
Peanut butter	16	16	0	0	0	0
Caramel, Chocolate	15	15	0	0	0	0
Coconut	15	13	0	2	0	0
Pecan	12	12	0	0	0	0
Butterscotch	11	11	0	0	0	0
Green tea	11	11	0	0	0	0
Raspberry	10	10	0	0	0	0
Other flavours (<10 samples per flavour)	132	128	3	0	0	1
Total	1186	1169	10	4	1	2

Sample assessment results by product origin can be found in table 4.

Of the 1186 samples tested, 95.9% (1137/1186) were domestic, 4.0% (47/1186) were imported and 0.2% (2/1186) were of unknown origin (table 4).

Table 4 - Assessment results by product origin

Product origin	Satisfactory	Investigative	Unsatisfactory	Total (%)
Domestic	1121	13	3	1137 (95.9)
Import	46	1	0	47 (4.0)
Unknown	2	0	0	2 (0.2)
Total (%)	1169 (98.6)	14 (1.2)	3 (0.3)	1186 (100)

Details about each unsatisfactory sample are provided in table 5.

Table 5 - Detailed information about unsatisfactory samples

Ice cream flavour	Bacteria & Level (CFU/g)	Country of origin	Production practice
Maple	ACC - 4.3×10^6	Canada	Conventional
Blueberry	ACC - 5.0×10^6	Canada	Conventional
Maple	Total coliforms - 3.2×10^3	Canada	Conventional

What do the survey results mean

In this survey, 98.6% of the dairy ice cream samples analyzed were assessed as satisfactory. *L. monocytogenes* and *Salmonella* spp. were not found in any samples. Total coliforms at elevated ($10 < x \leq 10^3$ CFU/g) and high ($>10^3$ CFU/g) levels were found in 10/387 (2.6%) and 1/387 (0.3%) samples respectively. ACC at elevated ($10^5 < x \leq 10^6$ CFU/g) and high ($>10^6$ CFU/g) levels were found in 4/1186 (0.3%) and 2/1186 (0.2%) samples respectively. The CFIA conducted appropriate follow-up activities for investigative and unsatisfactory samples. For example, in one case, the CFIA contacted the processing facility and referred a follow up inspection to the relevant provincial food safety authority. There were no reported illnesses linked to these products.

Previous studies on *L. monocytogenes* and *Salmonella* spp. in ice cream have shown similar and higher rates of prevalence as compared to our survey. A similar prevalence (0.25%) was observed in a Canadian study⁹ published in 1989 that detected *L. monocytogenes* in 1 of 394 ice cream samples collected from 114 domestic manufacturing facilities. Another survey conducted in Greece¹⁰ between 2010 and 2013 investigated the occurrence of *L. monocytogenes* and *Salmonella* spp. in 127 samples of retail ice cream. This study found 33/127 (26.0%) to be positive for *L. monocytogenes* and none (0.0%) were positive for *Salmonella* spp. The levels of ACC and total coliforms found in the samples tested in our survey are lower and similar respectively to those previously reported in a study conducted in Libya¹¹ during 2001 and 2002 which looked at the bacteriological quality of packed ice cream manufactured and sold in Tripoli city. Of the 49 samples tested, mean total bacterial count was 5.5×10^7 CFU/mL and the mean coliform count was 7 MPN. Differing rates of contamination in

our study as compared to those found in other studies may be due to various reasons such as differences in product types tested, methodology, study design etc.

Overall, our survey results suggest that while ice cream sold in Canada is generally safe for consumption, as this commodity is a known potential source of foodborne illness and as with all foods, safe handling practices are recommended for producers, retailers and consumers.

References

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