



Canadian Food
Inspection Agency

Agence canadienne
d'inspection des aliments

Listeria monocytogenes in Flavoured Milk - April 1, 2017 to March 31, 2020

Food microbiology - 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.

Milk is a nutritious beverage consumed by people of all ages. It is sourced from mammals such as cows, sheep, goats and water buffalo. Flavoured milks (such as chocolate milk) are a popular choice among Canadians as they represent a healthier alternative to soda pops and juices. When compared to unflavoured milk, flavoured milks generally contain additional ingredients such as sugars and flavourings, however they still contain all the nutrients and vitamins found in milk. Consequently, the availability of flavoured milks has increased to meet consumers' demand as Canadians strive to make healthier food choices.

Unfortunately, flavoured milks have been associated with recalls and foodborne illness such as listeriosis outbreaks. In Canada, milk undergoes pasteurization to kill harmful bacteria that may be present in the raw milk. Therefore their presence in the final product may be due a variety of factors such as inadequate pasteurization, or contamination of the milk post-pasteurization. Given that flavoured milks are consumed 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, flavoured milks were 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 1495 samples were collected from retail locations in 11 cities across Canada and tested for the bacterial pathogen *Listeria monocytogenes* (*L. monocytogenes*). All samples were also tested for Aerobic Colony Count (ACC) which is an indicator of microbial quality. An elevated ACC level ($> 5 \times 10^4$ Colony Forming Unit (CFU)/g) detected during the shelf life of the product may contribute to spoilage and be an indicator of poor sanitation conditions throughout the food production chain from the rearing conditions of the mammals through to milk production and inadequate control of storage temperatures during transportation to the point of sale or while on display for sale at retail.

L. monocytogenes was not found in any samples, however ACC at elevated ($5 \times 10^4 < x \leq 10^6$ CFU/mL) and high ($>10^6$ CFU/mL) levels were found in 17 (1.14%) and 16 (1.07%) samples respectively. The CFIA conducted appropriate follow-up activities. For example, in several cases, follow up inspections were conducted at processing facilities leading to the

implementation of corrective actions and in some cases the sampling and testing of additional samples, and in one case a recall was issued. There were no reported illnesses linked to the contaminated products.

Overall, our survey results suggest that the majority of flavoured milks are safe for consumption. Regardless, as this commodity has been linked to 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 (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

Milk is a nutritious beverage consumed by people of all ages¹. It is sourced from mammals such as cows, sheep, goats and water buffalo. Flavoured milks (such as chocolate milk) are a popular choice among Canadians as they represent a healthier alternative to soda pops and juices. Chocolate milk is also consumed by athletes after intense exercise to aid in recovery². When compared to unflavoured milk, flavoured milks generally contain additional ingredients such as sugars and flavourings, however they still contain all the nutrients and vitamins found in milk. Consequently, the availability of flavoured milks has increased³ to meet consumers' demand as Canadians strive to make healthier food choices.

Unfortunately, flavoured milks have been associated with recalls⁴ and foodborne illness such as listeriosis outbreaks⁵⁻⁷. In Canada milk undergoes pasteurization to kill any harmful bacteria that

may be present in the raw milk. Therefore their presence in the final product may be due a variety of factors such as inadequate pasteurization, or contamination of the milk post-pasteurization. Given that flavoured milks are consumed 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, flavoured milks were 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 1495 samples were collected from retail locations in 11 cities across Canada and tested for the bacterial pathogen *L. monocytogenes*. All samples were also tested for ACC which is an indicator of microbial quality. An elevated ACC level ($>5 \times 10^4$ CFU/g) detected during the shelf life of the product may contribute to spoilage and be an indicator of poor sanitation conditions throughout the food production chain from the rearing conditions of the mammals through to milk production and inadequate 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 volume of at least 250 mL. 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 flavoured milks were sampled. Samples included conventional and organic product of domestic or imported origin.

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* ⁸ (table 1). The ACC assessment criteria (table 1) are based on the principles of Health Canada's *Health Products and Food Branch Standards and Guidelines for Microbiological Safety of Foods* ⁹.

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 analyzed

(Category 1, 2A or 2B)¹⁰. Fluid milks are considered to be Category 1 products (foods in which the growth of *L. monocytogenes* can occur).

Table 1 - Analytical methods and assessment criteria for flavoured milk samples

Bacterial analysis	Method identification number ^a	Satisfactory	Investigative	Unsatisfactory
<i>L. monocytogenes</i>	MFLP-28 MFHPB-30 MFLP-77	Absent in 25mL	Not applicable (N/A)	Detected in 25mL
ACC	MFHPB-18	$\leq 5 \times 10^4$ CFU/mL	$5 \times 10^4 < x \leq 10^6$ CFU/mL	$> 10^6$ CFU/mL

^aThe 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 1495 samples were tested for *L. monocytogenes* and ACC. *L. monocytogenes* was not found in any samples. ACC at elevated ($5 \times 10^4 < x \leq 10^6$ CFU/mL) and high ($> 10^6$ CFU/mL) levels were found in 17/1495 (1.14%) and 16/1495 (1.07%) samples respectively.

Sample assessment results can be found in table 2.

Table 2 - Assessment results of flavoured milk samples

Bacterial analysis	Number of samples tested	Satisfactory	Investigative	Unsatisfactory
<i>L. monocytogenes</i>	1495	1462	N/A	0
ACC			17	16
Total (%)	1495 (100)	1462 (97.79)	17 (1.14)	16 (1.07)

A variety of flavours of flavoured milks were analyzed. The flavours most frequently sampled were chocolate (60.4%), strawberry (15.7%) and vanilla (9.0%). Sample assessment results by flavour can be found in table 3.

Table 3 - Assessment results by milk flavour

Milk flavour	Number of samples analyzed (% total)	Satisfactory	Investigative ACC $5 \times 10^4 < x \leq 10^6$ CFU/mL	Unsatisfactory ACC $> 10^6$ CFU/mL
Chocolate	903 (60.4)	873	17	13
Strawberry	234 (15.7)	233	0	1
Vanilla	135 (9.0)	135	0	0
Banana	74 (4.9)	74	0	0
Caramel, chocolate	45 (3.0)	45	0	0
Coffee	35 (2.3)	35	0	0
Cookies and cream	32 (2.1)	32	0	0
Strawberry, banana	18 (1.2)	17	0	1
Caramel latte	9 (0.6)	9	0	0
Maple	5 (0.3)	5	0	0
Orange cream	2 (0.1)	1	0	1
Chai tea latte	1 (<0.1)	1	0	0
Chocolate, banana	1 (<0.1)	1	0	0
Pumpkin spice	1 (<0.1)	1	0	0
Total	1495 (100)	1462	17	16

Almost all of the samples tested were domestically produced (98.9%), sourced from cows (99.9%) and conventionally produced (98.9%). Sample assessment results by country of origin, animal source and production practice can be found in tables 4, 5 and 6 respectively.

Table 4 - Assessment results by country of origin

Country of origin	Satisfactory	Investigative ACC $5 \times 10^4 < x \leq 10^6$ CFU/mL	Unsatisfactory ACC $> 10^6$ CFU/mL	Total (%)
Canada	1445	17	16	1478 (98.86)
United States	17	0	0	17 (1.14)
Total	1462	17	16	1495 (100)

Table 5 - Assessment results by animal source

Animal source	Satisfactory	Investigative ACC $5 \times 10^4 < x \leq 10^6$ CFU/mL	Unsatisfactory ACC $> 10^6$ CFU/mL	Total (%)
Cow	1461	16	16	1493 (99.9)
Sheep	1	0	0	1 (<0.1)
Water buffalo	0	1	0	1 (<0.1)
Total	1462	17	17	1495 (100)

Table 6 - Assessment results by production practice

Production practice	Satisfactory	Investigative ACC $5 \times 10^4 < x \leq 10^6$ CFU/mL	Unsatisfactory ACC $> 10^6$ CFU/mL	Total (%)
Conventional	1380	10	14	1404 (93.9)
Organic	82	7	2	91 (6.1)
Total	1462	17	16	1495 (100)

Details about each investigative sample are provided in table 7.

Table 7 - Detailed information about investigative samples

Milk flavour	ACC level (CFU/mL)	Number of days tested prior to best before date	Milk fat (%)	Country of origin	Source animal	Production practice
Chocolate	8.6×10^5	3	3.5	Canada	Cow	Organic
Chocolate	3.3×10^5	6	1	Canada	Cow	Conventional
Chocolate	9.6×10^5	8	3.8	Canada	Cow	Organic
Chocolate	2.1×10^5	12	8	Canada	Water buffalo	Conventional
Chocolate	$\sim 1.3 \times 10^5$	7	2	Canada	Cow	Organic
Chocolate	$\sim 5.5 \times 10^4$	4	3.25	Canada	Cow	Conventional
Chocolate	8.4×10^5	3	3.8	Canada	Cow	Organic
Chocolate ^b	2.1×10^5	1	1	Canada	Cow	Conventional
Chocolate	3.0×10^5	4	1	Canada	Cow	Conventional
Chocolate	$\sim 1.1 \times 10^5$	0	3.25	Canada	Cow	Conventional
Chocolate	4.2×10^5	6	3.25	Canada	Cow	Conventional
Chocolate	6.8×10^5	-2 ^c	2	Canada	Cow	Conventional
Chocolate	$\sim 7.5 \times 10^4$	1	2	Canada	Cow	Conventional
Chocolate	$\sim 8.0 \times 10^4$	7	3.8	Canada	Cow	Organic
Chocolate	$\sim 5.5 \times 10^4$	7	3.8	Canada	Cow	Organic
Chocolate	2.2×10^5	5	1	Canada	Cow	Conventional
Chocolate	2.9×10^5	7	3.8	Canada	Cow	Organic

^bUltra-high-temperature (UHT) pasteurized

^csample tested 2 days after the best before date

Details about each unsatisfactory sample are provided in table 8.

Table 8 - Detailed information about unsatisfactory samples

Ice cream flavour	ACC level (CFU/mL)	Number of days tested prior to best before date	Milk fat (%)	Country of origin	Source animal	Production practice
Chocolate	2.3×10^7	0	1	Canada	Cow	Conventional
Orange Cream ^d	$\sim 4.1 \times 10^8$	20	1	Canada	Cow	Conventional
Chocolate	6.0×10^6	7	1	Canada	Cow	Conventional
Chocolate	1.9×10^6	10	1	Canada	Cow	Conventional
Strawberry	3.9×10^7	2	1	Canada	Cow	Conventional
Chocolate	$\sim 3.2 \times 10^8$	27	3.6	Canada	Cow	Conventional
Chocolate	4.3×10^7	5	3.5	Canada	Cow	Organic
Chocolate	1.6×10^6	3	2	Canada	Cow	Conventional
Chocolate	4.2×10^6	5	3.6	Canada	Cow	Conventional
Chocolate	1.5×10^6	9	2	Canada	Cow	Conventional
Chocolate	1.9×10^6	9	2	Canada	Cow	Conventional
Strawberry ^d	5.4×10^6	78	Skim (0-0.5)	Canada	Cow	Conventional
Chocolate	3.7×10^6	5	3.5	Canada	Cow	Organic
Chocolate	3.7×10^6	6	2	Canada	Cow	Conventional
Chocolate	2.6×10^6	4	1	Canada	Cow	Conventional
Chocolate	2.7×10^7	4	2	Canada	Cow	Conventional

^dUHT pasteurized

What do the survey results mean

In this survey, 97.79% of the flavoured milk samples analyzed were assessed as satisfactory. *L. monocytogenes* was not found in any samples. ACC at elevated ($5 \times 10^4 < x \leq 10^6$ CFU/mL) and high ($> 10^6$ CFU/mL) levels were found in 17 (1.14%) and 16 (1.07%) samples respectively.

L. monocytogenes was not found in any of the flavoured milk samples (0/1495) in our survey. Similar results were found in a US study¹¹ conducted in 2000 that investigated the presence of *L. monocytogenes* in 1669 pasteurized chocolate milk samples collected from a variety of retail stores near their sell-by date. *L. monocytogenes* was not detected in any of these US produced chocolate milk samples (0/1669).

The levels of ACC found in the samples tested in our survey are similar to those previously reported in a US study¹² conducted during 1996 and 1997 which tested the standard plate counts (SPC) of both unflavoured and chocolate milk samples from four production plants at various time points throughout their shelf life. On the day of production, the SPC counts of all samples (unflavoured and chocolate) were not significantly different ($P > 0.001$) with SPCs

<1000 CFU/mL. By day 14 post production, the SPC of chocolate milk samples were significantly higher ($P < 0.001$) than the SPC of unflavoured milk samples with 53.7% and 26.1% of the samples $>10^6$ CFU/g, respectively.

The CFIA conducted appropriate follow-up activities. In several cases, follow up inspections were conducted at processing facilities leading to the implementation of corrective actions and in some cases additional samples were tested, and in one case a [recall](#) was issued. There were no reported illnesses linked to the contaminated products.

Overall, our survey results suggest that the majority of flavoured milks are safe for consumption. Regardless, as this commodity has been linked to foodborne illness and as with all foods, safe handling practices are recommended for producers, retailers and consumers.

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