



Canadian Food
Inspection Agency

Agence canadienne
d'inspection des aliments

Bacterial Pathogens in Pre-Prepared, Refrigerated Baked Desserts - April 1, 2016 to March 31, 2018

Food microbiology - Targeted surveys - Final report



Summary

Refrigerated baked desserts are considered ready-to-eat (RTE) as they do not require any further preparation before consumption. Store-bought, pre-prepared, refrigerated baked goods are popular across all age groups due to their convenience. Unfortunately, some of these products have been associated with recalls and outbreaks of foodborne illnesses in Canada and worldwide. RTE foods, as with all foods can be contaminated with pathogens during production, handling, packaging and distribution. However, as these products are consumed “as is,” the presence of bacterial pathogens represents an increased potential risk for foodborne illnesses.

Considering the factors mentioned above and their relevance to Canadians, a variety of refrigerated baked desserts were selected for targeted surveys. The primary food safety concern with respect to refrigerated RTE baked desserts is cross-contamination during the addition of pre-prepared glazes, icing, decorations, etc. post-baking. As the products do not undergo further processing (for example, a heat treatment), any pathogens that may be present in the glazes, icing, etc. or transferred from the environment or handler will not be inactivated. Consequently, all samples tested in this survey had either a sugar glaze or dairy spread (filling, icing etc.) added after baking.

The purpose of this survey was to generate baseline information on the occurrence of indicator and pathogenic bacteria in this type of RTE food at retail in Canada. Over the course of this two-year study (April 1, 2016 to March 31, 2018), a total of 2975 samples were collected from retail locations in 11 cities across Canada. All samples were tested for generic *Escherichia coli* (*E.coli*) and various pathogens (*Bacillus cereus* (*B. cereus*), *Clostridium perfringens* (*C. perfringens*), *Staphylococcus aureus* (*S. aureus*), *Listeria monocytogenes* (*L. monocytogenes*), *Salmonella* species (spp.)). Generic *E.coli* is an indicator organism as the levels at which they are found in foods is used to assess the overall sanitation conditions throughout the food production chain.

C. perfringens (>100 Colony Forming Unit (CFU)/gram (g)) and *Salmonella* spp. were not found in any samples. Presumptive *B. cereus* was detected at elevated levels ($10^3 < x \leq 10^4$ CFU/g) in 3/2975 (0.10%) of the samples. *S. aureus* was detected at elevated levels ($10^2 < x \leq 10^4$ CFU/g) in 1/2975 (0.03%) samples and *L. monocytogenes* (<5 CFU/g) was detected in 1/2975 (0.03%) sample. Generic *E.coli* at elevated levels ($1.8 < x \leq 1 \times 10^3$ Most Probable Number (MPN)/g) were detected in 12/2975 (0.4%) samples.

In bakery products, the presence of elevated levels of presumptive *B. cereus* ($10^3 < x \leq 10^4$ CFU/g), *S. aureus* ($10^2 < x \leq 10^4$ CFU/g) and generic *E. coli* ($1.8 < x \leq 1 \times 10^3$ MPN/g) indicate that the food may have been produced under unsanitary conditions. Depending on the product and levels found, samples containing *L. monocytogenes* may have been produced under unsanitary conditions, and may be unfit for human consumption.

The Canadian Food Inspection Agency (CFIA) conducted appropriate follow-up activities such as facility inspections. Corrective and preventive actions were implemented by the manufacturing facilities. No reported illnesses were associated with any of the contaminated products.

Overall, our survey results suggest that almost all RTE refrigerated baked desserts available for purchase at retail in Canada are safe for consumption. They can however be found to be contaminated with pathogens and indicator organisms such as those found in this study: *B. cereus*, *S. aureus*, *L. monocytogenes* and generic *E.coli*. 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?

Refrigerated baked desserts are considered to be RTE foods as they do not require any further preparation before consumption. Store-bought, pre-prepared refrigerated baked goods are popular across all age groups due to their convenience. Unfortunately, some of these products have been associated with recalls and outbreaks of foodborne illnesses in Canada^{1,2} and worldwide³⁻⁵. RTE foods, as with all foods can be contaminated with pathogens during production, handling, packaging and distribution. However, as these products are consumed "as is," the presence of bacterial pathogens represents an increased potential risk for foodborne illnesses.

Considering the factors mentioned above and their relevance to Canadians, a variety of refrigerated RTE baked desserts were selected for targeted surveys over a two year period from April 1, 2016 to March 31, 2018. The primary food safety concern with respect to refrigerated RTE baked desserts is cross-contamination during the addition of pre-prepared glazes, icing, decorations, etc. post-baking. As the products do not undergo further processing (for example, a heat treatment), any pathogens that may be present in the glazes, icing, etc. or transferred from the environment or handler will not be inactivated. While less likely, there is also a concern that pathogens if present prior to baking may survive the baking process and multiply if the product is not cooled down fast enough after baking. Consequently, all samples tested in this survey had either a sugar glaze or dairy spread (filling, icing, etc.) added after baking. This survey was implemented to gain further information on the occurrence of generic *E.coli* and various pathogens (*B. cereus*, *C. perfringens*, *Salmonella* spp., *S. aureus*, *L. monocytogenes*) in this product type at retail in Canada. Generic *E. coli* is an indicator organism as the levels at which they are found in foods is used to assess the overall sanitation conditions throughout the food production chain.

What did we sample?

For this survey, a sample consisted of one 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 four 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.

A variety of domestic and imported refrigerated RTE baked goods (cake, pastries, breads, tarts, etc.) with a sugar glaze or dairy spread (filling, icing etc.) added after baking were sampled. Sample collection was evenly distributed throughout the survey period (April 1, 2016 to March 31, 2018).

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*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 or in the absence of Health Canada's Guidelines, on other international food safety authorities' microbiological guidelines⁸⁻¹¹.

Table 1 - Analytical methods and assessment criteria for pre-prepared refrigerated baked dessert samples

Bacterial analysis	Method identification number ^a	Satisfactory	Investigative	Unsatisfactory
<i>Salmonella</i> spp.	MFHPB-20	Absent in 25g	Not Applicable (N/A)	Present in 25g
<i>S. aureus</i>	MFHPB-21	$\leq 10^2$ CFU/g	$10^2 < x \leq 10^4$ CFU/g	$> 10^4$ CFU/g
<i>B. cereus</i>	MFLP-42	$\leq 10^3$ CFU/g	$10^3 < x \leq 10^4$ CFU/g	$> 10^4$ CFU/g
<i>C. perfringens</i>	MFHPB-23	$\leq 10^2$ CFU/g	$10^2 < x \leq 10^3$ CFU/g	$> 10^3$ CFU/g
<i>L. monocytogenes</i>	MFHPB-30	Absent in 25g	N/A (category 1 ^b)	Present in 25g (category 1 ^b)
	MFLP-28 MFLP-74		Present and $\leq 10^2$ CFU/g (category 2 ^b)	$> 10^2$ CFU/g (category 2 ^b)
Generic <i>E. coli</i>	MFHPB-19	≤ 1.8 MPN/g	$1.8 < x \leq 1 \times 10^3$ MPN/g	$> 1 \times 10^3$ MPN/g

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

^b The pH and water activity of the sample were used to determine the product category

At the time of writing of this report, no assessment guidelines had been established in Canada for the presence of *B. cereus*, *C. perfringens* or *L. monocytogenes* in bakery products. The assessment guidelines for *L. monocytogenes* are based on Health Canada's Policy on *Listeria monocytogenes* in RTE foods¹² and are dependent upon the sample type analysed (category 1, 2A or 2B).

C. perfringens and *B. cereus* are commonly found in the environment and are bacteria that can produce protein toxins when present in high levels in foods or in the intestines of infected humans, which can cause foodborne illness. An investigative assessment which may result in further follow-up actions is associated with elevated levels (table 1). As the results are based on the analysis of one unit (n=1), further sampling may be required to verify their levels in the lot. The presence of high levels of these organisms (table 1) is indicative of the potential to

cause foodborne illnesses. Therefore, samples with high levels of *C. perfringens* or *B. cereus* are assessed as unsatisfactory indicating that follow-up activities are warranted. The *B. cereus* method used in this survey is unable to discriminate *B. cereus* from other closely related organisms and therefore results are considered presumptive for *B. cereus*.

Unlike harmful bacterial pathogens such as *Salmonella*, generic *E. coli* is commonly found in the intestines of humans and most strains are harmless. It is considered to be an indicator organism and levels of generic *E. coli* found in foods are used to assess the overall sanitation conditions throughout the food chain from production to the point of sale. For bakery products, an investigative assessment is associated with elevated levels of generic *E. coli* ($1.8 < x \leq 1000$ MPN/g), which may result in further follow-up actions. As the results are based on the analysis of one unit (n=1), further sampling may be required to verify the levels of generic *E. coli* of the lot. An unsatisfactory assessment is associated with high levels of generic *E. coli* (> 1000 MPN/g) as it may indicate a breakdown in good manufacturing practices (sanitation practices), and therefore possibly warranting the initiation of follow-up activities to determine the source of contamination and improve sanitation conditions along the food chain.

What were the survey results?

Over the course of this two-year study (April 1, 2016 to March 31, 2018), a total of 2975 samples were collected from retail locations in 11 cities across Canada. All samples were tested for *B. cereus*, *C. perfringens*, *S. aureus*, *L. monocytogenes*, *Salmonella* spp., and generic *E. coli*.

C. perfringens (>100 CFU/g) and *Salmonella* spp. were not found in any samples. Presumptive *B. cereus* was detected at elevated levels ($10^3 < x \leq 10^4$ CFU/g) in 3/2975 (0.10%) of the samples. *S. aureus* was detected at elevated levels ($10^2 < x \leq 10^4$ CFU/g) in 1/2975 (0.03%) samples and *L. monocytogenes* was detected ($<10^2$ CFU/g) in 1/2975 (0.03%) sample. Elevated levels of generic *E. coli* ($1.8 < x \leq 1 \times 10^3$ MPN/g) were detected in 12/2975 (0.4%) samples (table 2).

Table 2 - Assessment results of bacterial analyses in pre-prepared refrigerated baked dessert samples

Bacterial analysis	Number of samples tested	Satisfactory	Investigative	Unsatisfactory
<i>Salmonella</i> spp.	2975	2958	N/A	0
<i>S. aureus</i>			1	0
<i>L. monocytogenes</i>			1	0
<i>B. cereus</i>			3	0
<i>C. perfringens</i>			0	0
Generic <i>E.coli</i>			12	0
Total	2975	2958	17	0

Of the 2975 samples tested, 1206 (41%) were domestic and 57 (2%) were imported (table 4). The country where the desserts were produced could not be determined (unknown origin) for 1712 (58%) samples.

Table 3 – Assessment results of pre-prepared refrigerated baked dessert samples by product origin

Product origin	Number of samples tested (% of total samples)	Satisfactory	Investigative Generic <i>E.coli</i> ($1.8 < x \leq 10^3$ MPN/g)	Investigative <i>B.cereus</i> ($10^3 < x \leq 10^4$ CFU/g)	Investigative <i>L. monocytogenes</i> (Present and $< 10^2$ CFU/g - Category 2)	Investigative <i>S. aureus</i> ($10^2 < x \leq 10^4$ CFU/g)
Domestic	1206 (41%)	1199	5	0	1	1
Import	57 (2%)	57	0	0	0	0
Unknown	1712 (58%)	1702	7	3	0	0
Total	2975	2958	12	3	1	1

A variety of RTE product types were analysed (table 4).

Table 4 – Assessment results of pre-prepared refrigerated baked dessert samples by product type

Product type	Number of samples tested	Satisfactory	Investigative Generic <i>E.coli</i> ($1.8 < x \leq 10^3$ MPN/g)	Investigative <i>B.cereus</i> ($10^3 < x \leq 10^4$ CFU/g)	Investigative <i>L. monocytogenes</i> (Present and $<10^2$ CFU/g-Category 2)	Investigative <i>S. aureus</i> ($10^2 < x \leq 10^4$ CFU/g)
Bread with sugar/dairy topping	2	2	0	0	0	0
Cake with sugar/dairy topping	2697	2682	11	2	1	1
Cookie with sugar/dairy topping	7	7	0	0	0	0
Mousse with sugar/dairy topping	8	8	0	0	0	0
Pastry with sugar/dairy topping	261	259	1	1	0	0
Total	2975	2958	12	3	1	1

Further details about each investigative sample are provided in table 5.

Table 5 – Product and analytical information about investigative pre-prepared refrigerated baked dessert samples

Generic <i>E.coli</i> (n=12) ($1.8 < x \leq 10^3$ MPN/g)	<i>B. cereus</i> (n=3) ($10^3 < x \leq 10^4$ CFU/g)
Cake (n=11) Pie (n=1) Domestic (n=5) Unknown Country of Origin (n=7)	Tarts (n=2) Cake (n=1) Unknown Country of Origin (n=3)
<i>L. monocytogenes</i> (n=1) (Present and $<10^2$ CFU/g - Category 2)	<i>S. aureus</i> (n=1) ($10^2 < x \leq 10^4$ CFU/g)
Brownie Domestic	Cake Domestic

What do the survey results mean?

In this survey, all (100%) of the RTE bakery product samples tested were free of *C. perfringens* (>100 CFU/g) and *Salmonella* spp. Presumptive *B. cereus* was detected at elevated levels ($10^3 < x \leq 10^4$ CFU/g) in 3/2975 (0.10%) of the samples tested. *S. aureus* was detected at elevated levels ($10^2 < x \leq 10^4$ CFU/g) in 1/2975 (0.03%) samples tested. *L. monocytogenes* was detected ($<10^2$ CFU/g) in 1/2975 (0.03%) samples. Elevated levels of generic *E.coli* ($1.8 < x \leq 1 \times 10^3$ MPN/g) were detected in 12/2975 (0.4%) samples tested (table 2).

Studies similar to ours were conducted in India¹³ and Denmark¹⁴. The study conducted in India investigated the presence of *S. aureus* in various bakery products from five local bakeries and

found the presence of *S. aureus* in a variety of products (such as plain cakes, puffs, cake with sugar and cream layer) ranging in counts from <10 to 6.5×10^4 CFU/g. The study did not find any *S. aureus* in bread or buns. The Danish study published in 2005 investigated the presence of *B. cereus* (and *B. thuringiensis*) in various RTE foods including desserts. The study found the presence of *B. cereus*-like organisms at levels of $10^3 < x \leq 10^4$ CFU/g in 1.5% of cream-cakes (n=4948) tested. The study found *B. cereus*-like organisms at levels of $> 10^4$ CFU/g in 0.8% of cream-cakes (n=4948) tested. The prevalence rates reported in the Danish study are higher than those reported in our study.

No trends were observed in our study with respect to product origin (table 3) or product type (table 4).

The CFIA conducted appropriate follow-up activities such as facility inspections. Corrective and preventive actions were implemented by the manufacturing facilities. No reported illnesses were associated with any of the contaminated products.

Overall, our survey results suggest that almost all RTE refrigerated baked desserts available for purchase at retail in Canada are safe for consumption. They can however be found to be contaminated with pathogens and indicator organisms such as those found in this study: *B. cereus*, *S. aureus*, *L. monocytogenes* and generic *E.coli*. Consequently, as with all foods, safe handling practices are recommended for producers, retailers and consumers.

References

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