



Canadian Food  
Inspection Agency

Agence canadienne  
d'inspection des aliments

# Bacterial Pathogens and Indicators in Ready-to-Eat Powdered Infant Cereal and Children's Breakfast Cereal - April 1, 2018 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.

Ready-to-eat (RTE) powdered infant cereal and children's breakfast cereal are commonly consumed by young Canadians. Unfortunately, breakfast cereals have been associated with recalls and outbreaks which is concerning as the immune systems of infants and children are still developing and therefore they are at an increased risk for foodborne illnesses.

Cereal products are made from grains such as wheat, oats and rice that undergo a heat treatment step during processing. Pathogenic bacteria may occur in cereal products if the heat treatment step did not kill all of the pathogenic bacteria (if present on the grain) or if pathogenic bacteria are introduced after the heat treatment step with the addition of contaminated ingredients, such as sugars, flavourings, dehydrated fruits or nuts. As RTE cereals are intended to be consumed as is, (without any cooking), the presence of pathogenic bacteria in the cereal creates the potential for foodborne illnesses.

Considering the factors mentioned above and their relevance to Canadians, RTE powdered infant cereal and children's breakfast cereals were selected for a targeted survey. The purpose of this survey was to generate baseline information on the occurrence of pathogenic bacteria and indicator organisms of concern in these commodities on the Canadian market.

Over the course of this study (April 1, 2018 to March 31, 2020), 162 samples of powdered infant cereal were tested for Enterobacteriaceae and 199 samples of children's breakfast cereals were tested for *Salmonella* species (spp.), Enterobacteriaceae and Aerobic Colony Count (ACC). Both Enterobacteriaceae and ACC are considered indicator organisms as their presence in food at elevated levels may indicate a loss of sanitation controls, inadequate processing or post-processing contamination.

In this study, 96.9% (157/162) of the powdered infant cereal and 97.5% (194/199) of children's breakfast cereals samples were assessed as satisfactory. Enterobacteriaceae was detected in 3.1% (5/162) of the powdered infant cereal samples at levels <0.3 MPN/g in all 5 samples. *Salmonella* spp. was not detected in any (0/199) of the children's breakfast cereal samples while Enterobacteriaceae (>10<sup>2</sup> CFU/g) and ACC (>10<sup>4</sup> CFU/g) were detected in 2/199 (1.0%) and 3/199 (1.5%) samples respectively with 1 sample containing both Enterobacteriaceae (>10<sup>2</sup> CFU/g) and ACC (>10<sup>4</sup> CFU/g) .

The CFIA conducted appropriate follow-up activities for the investigative samples. For example, in 1 case, the CFIA conducted a review of the implicated facility's production practices but were unable to determine the source of contamination. No product recalls were issued. No reported illnesses were associated with any of the contaminated products.

Overall, the survey results indicate that powdered infant cereal and children's breakfast cereals available for sale at retail in Canada are safe for consumption. Regardless, as cereals have been linked to foodborne illnesses 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. 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

Ready-to-eat (RTE) powdered infant cereal and children's breakfast cereal are commonly consumed by young Canadians. Infants and children are considered a vulnerable population<sup>1</sup> as their immune systems are still developing and therefore they are at an increased risk for foodborne illnesses. Unfortunately, the consumption of breakfast cereals have been previously associated with recalls and *Salmonella* outbreaks.<sup>2,3,4</sup>

Cereal products are made from grains such as wheat, oats, and rice that undergo a heat treatment step during processing. As grains are agricultural products, they may have been exposed to pathogenic bacteria during growth and these may survive the heat treatment step and therefore occur in cereal products. Pathogenic bacteria can also occur in cereal products if introduced after the heat treatment step with the addition of contaminated ingredients such as sugars, flavourings, dehydrated fruits or nuts. As RTE cereals are intended to be consumed as is, (without any cooking), the presence of pathogenic bacteria in the cereal creates the potential for foodborne illnesses.

Considering the factors mentioned above and their relevance to Canadians, RTE powdered infant cereal and children's breakfast cereals were selected for a targeted survey. The purpose of this survey was to generate baseline information on the occurrence of pathogenic bacteria and indicator organisms of concern in these commodities on the Canadian market.

Over the course of this study (April 1, 2018 to March 31, 2020), 162 samples of powdered infant cereal and 199 samples of children's breakfast cereals were collected from retail locations in 11 cities across Canada. All 361 samples were tested for Enterobacteriaceae. Additionally, all 199 children's breakfast cereal samples were tested for *Salmonella* spp. and Aerobic Colony Count (ACC). Both Enterobacteriaceae and ACC are considered indicator organisms as their presence in food at elevated levels may indicate a loss of sanitation controls, inadequate processing or post-processing contamination.

## What did we sample

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 250 g. All samples were collected from national retail chains and local/regional grocery stores located in 11 major cities across Canada. The number of samples collected from these cities was in proportion to the relative population of the respective areas. These cities encompassed 4 geographical areas:

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

Samples of infant powdered cereals were collected between April 1, 2018 and March 31, 2019 while samples of children's breakfast cereals were collected between April 1, 2019 and March 31, 2020. A variety of domestic, imported, organic and conventional infant and children's cereals brands were collected.

## 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 Food*<sup>5</sup> and methods published by the International Organization for Standardization<sup>6</sup>. The assessment criteria for ACC and *Salmonella* in children's breakfast cereals are based on the principles of Health Canada's *Health Products and Food Branch (HPFB) Standards and Guidelines for Microbiological Safety of Food – An Interpretive Summary*<sup>7</sup>. At the time of writing this report, no guidelines or assessment criteria had been established in Canada for the presence of Enterobacteriaceae in

powdered infant cereals or children’s breakfast cereals and are therefore based on *International Commission on Microbiological Specifications for Foods*<sup>8</sup> (tables 1 and 2).

**Table 1 - Analytical methods and assessment criteria for Enterobacteriaceae in powdered infant cereal**

Bacterial analysis	Method number <sup>a</sup>	Satisfactory	Investigative	Unsatisfactory
Enterobacteriaceae	ISO21528	Not detected/10g	Detected/10g <sup>b</sup>	Not applicable (N/A)

<sup>a</sup> The methods used were the published versions at the time of analysis.

<sup>b</sup> Enumeration is required.

**Table 2 - Analytical methods and assessment criteria for bacteria in children’s breakfast cereal**

Bacterial analysis	Method number <sup>c</sup>	Satisfactory	Investigative	Unsatisfactory
Enterobacteriaceae	ISO21528	≤10 <sup>2</sup> CFU/g	>10 <sup>2</sup> CFU/g	N/A
ACC	MFHPB-33	≤10 <sup>4</sup> CFU/g	>10 <sup>4</sup> CFU/g	N/A
<i>Salmonella</i> spp.	MFLP-29	Not detected/25g	N/A	Detected/25g

<sup>c</sup> The methods used were the published versions at the time of analysis.

As *Salmonella* spp. is considered pathogenic to humans its presence would have been considered a violation of the *Food and Drugs Act* Section 4(1)a<sup>9</sup> and would therefore have been assessed as unsatisfactory (table 2).

Enterobacteriaceae are a large family of gram-negative bacteria commonly found in the intestines of animals and humans. ACC is the total number of generally harmless bacteria that are able to grow in an oxygenated (aerobic) environment. ACC is a normal component of the environment and can be found in soil and natural water sources. Both Enterobacteriaceae and ACC are considered to be an indicator organism 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. An investigative assessment which may result in further follow-up actions is associated with the detection of Enterobacteriaceae in powdered infant cereal (table 1) and elevated levels (>10<sup>2</sup> CFU/g) in children’s breakfast cereals (table 2). An investigative assessment which may result in further follow-up actions is associated with the detection of ACC at elevated levels (>10<sup>4</sup> CFU/g) in children’s breakfast cereals (table 2). As all results are based on the analysis of 1 unit (n=1), further sampling may be required to verify their levels in the lot.

## What were the survey results

In this study, 96.9% (157/162) of the powdered infant cereal and 97.5% (194/199) of children's breakfast cereals samples were assessed as satisfactory. Enterobacteriaceae was detected in 3.1% (5/162) samples of powdered infant cereal at levels <0.3 MPN/g in all 5 samples.

*Salmonella* spp. was not detected in any (0/199) of the children's breakfast cereal samples while Enterobacteriaceae (>10<sup>2</sup> CFU/g) and ACC (>10<sup>4</sup> CFU/g) were detected in 2/199 (1.0%) and 3/199 (1.5%) samples respectively with 1 sample containing both Enterobacteriaceae (>10<sup>2</sup> CFU/g) and ACC (>10<sup>4</sup> CFU/g) .

Sample assessment results can be found in tables 3 and 4.

**Table 3 - Assessment results of powdered infant cereal tested**

Bacterial analysis	Number of samples tested	Satisfactory	Investigative
Enterobacteriaceae	162	157	5 <sup>d</sup>
<b>Total (%)</b>	<b>162</b>	<b>157 (96.9)</b>	<b>5 (3.1)</b>

<sup>d</sup> Positive samples were enumerated and contained <0.3 MPN/g.

**Table 4 - Assessment results of children's breakfast cereals tested**

Bacterial analysis	Number of samples tested	Satisfactory	Investigative	Unsatisfactory
Enterobacteriaceae	199	197	2 <sup>e</sup>	N/A
ACC		195	4 <sup>e</sup>	N/A
<i>Salmonella</i> spp.		199	N/A	0
<b>Total (%)</b>	<b>199</b>	<b>194 (97.5)</b>	<b>5 (2.5)<sup>e</sup></b>	<b>0 (0)</b>

<sup>e</sup> 1 sample contained both Enterobacteriaceae (>10<sup>2</sup> CFU/g) and ACC(>10<sup>4</sup> CFU/g).

Samples collected were from both domestic and imported origins (tables 5 and 6) and included both organic and conventional types (tables 7 and 8) of powdered infant cereal and children's breakfast cereals.

**Table 5 - Assessment results by product origin of powdered infant cereal**

Product origin	Satisfactory	Investigative	Total
Canada	5	0	5
Imported	131	5	136
Unknown	21	0	21
<b>Total (%)</b>	<b>157 (96.9)</b>	<b>5 (3.1)</b>	<b>162 (100)</b>

**Table 6 - Assessment results by product origin for children's breakfast cereals**

Product origin	Satisfactory	Investigative	Total
Imported	159	5	164
Unknown	35	0	35
<b>Total (%)</b>	<b>194 (97.5)</b>	<b>5 (2.5)</b>	<b>199 (100)</b>

**Table 7- Assessment results by production practice for powdered infant cereal**

Production practice	Satisfactory	Investigative	Total
Conventional	114	1	115
Organic	43	4	47
<b>Total (%)</b>	<b>157 (96.9)</b>	<b>5 (3.1)</b>	<b>162 (100)</b>

**Table 8- Assessment results by production practice for breakfast cereals for children**

Production practice	Satisfactory	Investigative	Total
Conventional	181	5	186
Organic	13	0	13
<b>Total (%)</b>	<b>194 (97.5)</b>	<b>5 (2.5)</b>	<b>199 (100)</b>

## What do the survey results mean

Our study has shown that powdered infant and children's breakfast cereals are generally safe for consumption as 96.9% (157/162) of the powdered infant cereal and 97.5% (194/199) of children's breakfast cereals samples were assessed as satisfactory. Enterobacteriaceae was detected in 3.1% (5/162) samples of powdered infant cereal at levels <0.3 MPN/g in all 5 samples. *Salmonella* spp. was not detected in any (0/199) of the children's breakfast cereal samples while Enterobacteriaceae (>10<sup>2</sup> CFU/g) and ACC (>10<sup>4</sup> CFU/g) were detected in 2/199 (1.0%) and 3/199 (1.5%) samples respectively with 1 sample containing both Enterobacteriaceae (>10<sup>2</sup> CFU/g) and ACC (>10<sup>4</sup> CFU/g).

A Polish study<sup>10</sup> which was conducted in 2003 investigated the microbiological safety and quality of muesli samples (n=40) purchased at retail. Similar to our study, the Polish study did not detect *Salmonella* in any of the samples tested. Additionally, similar to our survey, low levels (≤10<sup>3</sup> CFU/g) of mesophilic aerobic bacteria were detected in the majority of samples at levels not exceeding suitability.

No trends were observed in our study when comparing country of origin (tables 5 and 6) or method of production (tables 7 and 8).

The CFIA conducted appropriate follow-up activities for the investigative samples. For example, in 1 case, the CFIA conducted a review of the implicated facility's production practices but were unable to determine the source of contamination. No product recalls were issued. No reported illnesses were associated with any of the contaminated products.

Overall, the survey results indicate that powdered infant cereal and children's breakfast cereals available for sale at retail in Canada are safe for consumption. Regardless, as cereals have been linked to foodborne illnesses and as with all foods, safe handling practices are recommended for producers, retailers and consumers.

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