



Canadian Food  
Inspection Agency

Agence canadienne  
d'inspection des aliments

# Bacterial Pathogens and Indicators, Viruses and Parasites in Various Food Commodities - April 1, 2018 to March 31, 2023

## Food microbiology - Targeted surveys - Interim report



Food microbiology targeted surveys – November 2023

Canada 

## Summary

From April 1, 2018 to March 31, 2023, a total of 30,674 food samples were tested in a suite of ongoing targeted surveys<sup>1</sup> to investigate the presence of bacterial pathogens and indicators, viruses and parasites.

Of the samples tested, 99.4% were satisfactory, 0.5% were investigative, and 0.1% were unsatisfactory. The Canadian Food Inspection Agency (CFIA) conducted appropriate follow-up activities including the oversight of industry led voluntary food recalls. There were no reported illnesses related to these products.

Final reports, which will include a detailed analysis of the results, will be published over the next few years as the surveys are completed.

## What is an interim report

An interim report provides preliminary results related to on-going targeted surveys<sup>1</sup> which can vary in duration from several months to several years depending on the objective of each survey.

## Will final reports be published

Yes, upon conclusion of the surveys, [final reports or scientific publications](#) will be published.

## What foods were tested

The presence of bacterial pathogens and indicators, viruses and parasites were investigated in a variety of foods of the following commodities:

- raw dairy milk cheese
- fresh and frozen fruits and vegetables
- seafood
- powdered infant formula and baby food
- tahini
- guacamole
- fresh herb paste
- seaweed salad
- raw shelled nuts
- ready-to-eat (RTE) meat sausages
- kimchi

## Why were these foods tested

The selected foods are all commonly consumed by Canadians of all ages<sup>2</sup>. Unfortunately, most of these commodities have been associated with recalls and outbreaks of foodborne illnesses. Contamination with pathogens can occur at any step in the food supply chain such as during production, processing, packaging, distribution and/or at retail. Given that most of the commodities covered by this report are consumed without further preparation, the presence of pathogens creates the potential for foodborne illness.

## When were the samples collected

The samples were collected from April 1, 2018 to March 31, 2023. This report covers a period of 5 fiscal years (2018-2019, 2019-2020, 2020-2021, 2021-2022 and 2022-2023) with a fiscal year being a 12 month period from April 1 to March 31 of the following year.

## Where were the samples collected from

Samples were collected from national retail chains and local/regional grocery stores located in 11 major cities across Canada:

- Halifax
- Saint John or Moncton
- Quebec City
- Montreal
- Toronto
- Ottawa
- Vancouver
- Kelowna or Victoria
- Calgary
- Saskatoon
- Winnipeg

A sample consisted of a single or multiple consumer-size packages from the same lot weighing at least 250 g. The planned number of samples to be collected from each city was based on the population of the province in which the city was located relative to the total population of Canada.

# What methods were used to test the samples

Samples were analyzed using analytical methods published in Health Canada's *Compendium of Analytical Methods for the Microbiological Analysis of Foods*<sup>3</sup>, CFIA internally-developed methods, methods from other organizations such as ISO or FDA BAM, and methods that detect the presence of deoxyribonucleic acid (DNA) of *Cyclospora* and *Giardia*.

# How were the samples assessed

The samples were assessed using criteria (tables 1, 2, 3) based on the principles of the following Health Canada documents: *Health Products and Food Branch (HPFB) Standards and Guidelines for Microbiological Safety of Food – An Interpretive Summary*<sup>4</sup>, *Policy on Listeria monocytogenes in Ready-to-Eat Foods*<sup>5</sup> and the *Food and Drugs Act* (Section 4 (1))<sup>6</sup>. In the absence of Health Canada standards, policies or guidelines, the assessment criteria are based on guidelines developed by international food safety authorities. Detailed information about the assessment criteria used for each commodity will be provided in the final reports which will be published after the surveys have concluded.

**Table 1. Assessment criteria for indicator organisms**

Analysis	Product(s)	Satisfactory assessment	Investigative assessment	Unsatisfactory assessment
Generic <i>Escherichia coli</i> ( <i>E. coli</i> )	Fresh fruits and vegetables Frozen cut fruits Guacamole Herb paste	$\leq 10^2$ CFU/g or MPN/g	$>10^2$ and $\leq 10^3$ CFU/g or MPN/g	$>10^3$ CFU/g or MPN/g
Generic <i>E. coli</i>	Seaweed salad Raw shelled nuts RTE meat sausages	$\leq 10^2$ MPN/g	$> 10^2$ MPN/g	N/A
Generic <i>E. coli</i>	Raw dairy milk cheese	$\leq 5 \times 10^2$ CFU or MPN/g	$> 5 \times 10^2$ and $\leq 2 \times 10^3$ CFU or MPN/g	$> 2 \times 10^3$ CFU or MPN/g

**Table 2. Assessment criteria for pathogenic bacteria**

Analysis	Product(s)	Satisfactory assessment	Investigative assessment	Unsatisfactory assessment
<i>E. coli</i> O157	All products tested for <i>E. coli</i> O157	Not detected/25 g	N/A	Detected/25 g
Non-O157 Shiga-toxigenic <i>E. coli</i> (STEC)	All products tested for non-O157 STEC	Not detected/25 g	Detected/25 g	N/A
<i>Listeria monocytogenes</i> ( <i>L. monocytogenes</i> )	Category 1 products <sup>a</sup>	Not detected/25 g	N/A	Detected/25 g
<i>L. monocytogenes</i>	Category 2A and 2B products <sup>a</sup>	Not detected/25 g	≤10 <sup>2</sup> CFU/ g	>10 <sup>2</sup> CFU/g
<i>L. monocytogenes</i>	Microgreens Whole mushrooms Whole fruits	Not detected/25 g	Detected/25 g (enumeration is required)	N/A
<i>Salmonella</i> species (spp.)	All products tested for <i>Salmonella</i> spp. (except for specified products)	Not detected/25 g	N/A	Detected/25 g
<i>Salmonella</i> spp.	RTE meat sausages	Not detected/65 g	N/A	Detected/65 g
<i>Salmonella</i> spp.	Powdered infant formula	Not detected/125 g	N/A	Detected/125 g
<i>Staphylococcus aureus</i> ( <i>S. aureus</i> )	Raw dairy milk cheese	≤10 <sup>3</sup> CFU/g	>10 <sup>3</sup> and ≤10 <sup>4</sup> CFU/g	>10 <sup>4</sup> CFU/g
<i>S. aureus</i>	RTE meat sausages	≤250 CFU/g	>250 and ≤10 <sup>4</sup> CFU/g	>10 <sup>4</sup> CFU/g
<i>Enterobacteriaceae</i>	Powdered infant formula	Not detected/10 g	Detected/10 g (enumeration is required)	N/A
<i>Cronobacter</i> spp.	Powdered infant formula	Not detected/125 g	N/A	Detected/125 g
Commercial sterility	Baby foods in retort pouches	Pass	N/A	Fail

**Table 3. Assessment criteria for viruses and parasites**

Analysis	Product(s)	Satisfactory assessment	Investigative assessment	Unsatisfactory assessment
<i>Cyclospora</i> <sup>b</sup> <i>Giardia</i> <sup>b</sup> Hepatitis A Virus (HAV) <sup>b</sup> Norovirus Genotype (I and II) (NoV (GI and GII)) <sup>b</sup>	All products tested for parasites or viruses	Not detected	Detected	N/A

<sup>a</sup> Information such as storage condition (frozen or refrigerated), shelf life, and if applicable, pH and water activity were used to determine the product category.

<sup>b</sup> The detection methods used cannot discriminate between potentially infectious and non-infectious viruses or parasites.

# What were the survey preliminary results

Details about each targeted survey and test results (as of March 31, 2023) can be found in table 4.

**Table 4. Survey results as of March 31, 2023**

Fiscal year(s)	Product (sample plan ID)	Microorganisms tested	Number of samples tested	Satisfactory (S)	Investigative (I)	Unsatisfactory (U)	Comments
2020/2021 2021/2022 2022/2023	Imported raw dairy milk cheese (SB3015)	<i>L. monocytogenes</i> <i>Salmonella</i> spp. <i>E. coli</i> O157 <i>S. aureus</i> Generic <i>E. coli</i>	1079	1079	0	0	All satisfactory
2021/2022 2022/2023	Domestic raw dairy milk cheese (SB3098)	<i>L. monocytogenes</i> <i>Salmonella</i> spp. <i>E. coli</i> O157 <i>S. aureus</i> Generic <i>E. coli</i>	595	594	0	1	U= <i>L. monocytogenes</i>
2021/2022 2022/2023	Non-cow raw milk cheese (SB3097)	<i>L. monocytogenes</i> <i>Salmonella</i> spp. <i>S. aureus</i> Generic <i>E. coli</i>	580	578	1	1	I= <i>L. monocytogenes</i> U=Generic <i>E. coli</i>
2019/2020 2020/2021 2021/2022 2022/2023	Fresh seed sprouts (SB3082)	<i>Salmonella</i> spp. (2021-2023 only) <i>E. coli</i> O157 STEC Generic <i>E. coli</i>	983	979	3	1	I=STEC (2) I=Generic <i>E. coli</i> (1) U=Generic <i>E. coli</i>
2019/2020	Fresh microgreens (SB3083)	<i>L. monocytogenes</i> <i>Salmonella</i> spp. <i>E. coli</i> O157 STEC Generic <i>E. coli</i>	75	73	2	0	I= <i>L. monocytogenes</i> I=Generic <i>E. coli</i>
2021/2022 2022/2023	Fresh whole mushrooms (enoki, beech, oyster, king oyster) (SB3114 & SB3226)	<i>L. monocytogenes</i> <i>Salmonella</i> spp. <i>E. coli</i> O157 Generic <i>E. coli</i>	956	936	20	0	I= <i>L. monocytogenes</i> (20)
2021/2022 2022/2023	Red onions (SB3115, SB3120, SB3121, SB3122)	<i>Salmonella</i> spp. <i>E. coli</i> O157 Generic <i>E. coli</i>	1466	1466	0	0	All satisfactory

Fiscal year(s)	Product (sample plan ID)	Microorganisms tested	Number of samples tested	Satisfactory (S)	Investigative (I)	Unsatisfactory (U)	Comments
2021/2022 2022/2023	Imported green onions (SB3223)	HAV NoV (GI, GII)	375	375	0	0	All satisfactory
2021/2022 2022/2023	Domestic green onions (SB3224)	HAV NoV (GI, GII)	128	128	0	0	All satisfactory
2020/2021 2021/2022 2022/2023	Domestic whole leafy vegetables (SB3092)	<i>Salmonella</i> spp. (2021-2023 only) <i>E. coli</i> O157 STEC Generic <i>E. coli</i>	418	415	3	0	I=STEC (1) I=Generic <i>E. coli</i> (2)
2021/2022 2022/2023	Domestic whole leafy vegetables (SB3102)	<i>Salmonella</i> spp. <i>E. coli</i> O157 Generic <i>E. coli</i>	385	382	3	0	I=Generic <i>E. coli</i> (3)
2021/2022 2022/2023	Domestic fresh whole vegetables (SB3106)	<i>Salmonella</i> spp. <i>E. coli</i> O157 Generic <i>E. coli</i>	495	495	0	0	All satisfactory
2020/2021 2021/2022 2022/2023	Imported whole leafy vegetables (SB3093)	<i>Salmonella</i> spp. (2021-2023 only) <i>E. coli</i> O157 STEC Generic <i>E. coli</i>	478	476	2	0	I=STEC (2)
2021/2022 2022/2023	Imported whole leafy vegetables (SB3101)	<i>Salmonella</i> spp. <i>E. coli</i> O157 Generic <i>E. coli</i>	872	871	1	0	I=Generic <i>E. coli</i>
2021/2022 2022/2023	Imported fresh whole vegetables (SB3105)	<i>Salmonella</i> spp. <i>E. coli</i> O157 Generic <i>E. coli</i>	1087	1086	1	0	I=Generic <i>E. coli</i>
2019/2020 2020/2021 2021/2022 2022/2023	Imported romaine lettuce (SB3085)	<i>Salmonella</i> spp. (2021-2023 only) <i>E. coli</i> O157 Generic <i>E. coli</i>	984	984	0	0	All satisfactory
2019/2020 2020/2021 2021/2022 2022/2023	Imported romaine lettuce hearts (SB3086)	<i>Salmonella</i> spp. (2021-2023 only) <i>E. coli</i> O157 Generic <i>E. coli</i>	1440	1439	1	0	I=Generic <i>E. coli</i>

Fiscal year(s)	Product (sample plan ID)	Microorganisms tested	Number of samples tested	Satisfactory (S)	Investigative (I)	Unsatisfactory (U)	Comments
2021/2022 2022/2023	Imported fresh whole leafy vegetables (SB3221)	<i>Cyclospora</i> <i>Giardia</i>	362	360	2	N/A	I= <i>Cyclospora</i> (2)
2021/2022 2022/2023	Imported fresh leafy herbs (SB3103)	<i>Salmonella</i> spp. <i>E. coli</i> O157 Generic <i>E. coli</i>	784	773	6	5	I=Generic <i>E. coli</i> (6) U=Generic <i>E. coli</i> (5)
2021/2022 2022/2023	Domestic fresh leafy herbs (SB3104)	<i>Salmonella</i> spp. <i>E. coli</i> O157 Generic <i>E. coli</i>	380	375	4	1	I=Generic <i>E. coli</i> (4) U=Generic <i>E. coli</i> (1)
2020/2021	Domestic whole fresh vegetables and herbs (F258R)	<i>Salmonella</i> spp. <i>E. coli</i> O157 Generic <i>E. coli</i>	91	91	0	0	All satisfactory
2020/2021	Imported whole fresh vegetables and herbs (F259R)	<i>Salmonella</i> spp. <i>E. coli</i> O157 Generic <i>E. coli</i>	196	196	0	0	All satisfactory
2020/2021	Domestic fresh-cut RTE prepackaged vegetable salads (F242R)	<i>L. monocytogenes</i> <i>Salmonella</i> spp. <i>E. coli</i> O157 Generic <i>E. coli</i>	15	15	0	0	All satisfactory
2020/2021	Imported fresh-cut RTE prepackaged vegetable salads (F247R)	<i>L. monocytogenes</i> <i>Salmonella</i> spp. <i>E. coli</i> O157 Generic <i>E. coli</i>	193	193	0	0	All satisfactory
2021/2022 2022/2023	Fresh-cut RTE prepackaged leafy vegetable-based salads with dressing kids (SB3209)	<i>L. monocytogenes</i> <i>Salmonella</i> spp. <i>E. coli</i> O157 Generic <i>E. coli</i>	858	855	0	3	U= <i>L. monocytogenes</i> (2) U= <i>Salmonella</i> spp. (1)

Fiscal year(s)	Product (sample plan ID)	Microorganisms tested	Number of samples tested	Satisfactory (S)	Investigative (I)	Unsatisfactory (U)	Comments
2021/2022 2022/2023	Fresh-cut RTE prepackaged leafy vegetable-based salads without dressing kits (SB3210)	<i>L. monocytogenes</i> <i>Salmonella</i> spp. <i>E. coli</i> O157 Generic <i>E. coli</i>	777	774	0	3	U= <i>L. monocytogenes</i> (3)
2021/2022 2022/2023	Imported fresh-cut leafy vegetable-based salads (SB3217)	HAV NoV (GI, GII)	569	569	0	N/A	All satisfactory
2021/2022 2022/2023	Domestic fresh-cut leafy vegetable-based salads (SB3218)	HAV NoV (GI, GII)	193	193	0	N/A	All satisfactory
2019/2020 2020/2021 2021/2022 2022/2023	Imported fresh-cut romaine lettuce (SB3087)	<i>Salmonella</i> spp. (2021-2023 only) <i>E. coli</i> O157 Generic <i>E. coli</i>	1080	1080	0	0	All satisfactory
2020/2021 2021/2022 2022/2023	Imported fresh-cut leafy vegetable-based salads (F263R & SB3222)	<i>Cyclospora</i> <i>Giardia</i>	882	878	4	N/A	I= <i>Cyclospora</i> (2) I= <i>Giardia</i> (2)
2020/2021	Domestic fresh whole fruits (F260R)	<i>Salmonella</i> spp. <i>E. coli</i> O157 Generic <i>E. coli</i>	81	81	0	0	All satisfactory
2020/2021	Imported fresh whole fruits (F261R)	<i>Salmonella</i> spp. <i>E. coli</i> O157 Generic <i>E. coli</i>	194	194	0	0	All satisfactory
2021/2022 2022/2023	Imported fresh whole fruits (SB3107)	<i>L. monocytogenes</i> <i>Salmonella</i> spp. <i>E. coli</i> O157 Generic <i>E. coli</i>	790	779	11	0	I= <i>L. monocytogenes</i> (11)
2021/2022 2022/2023	Domestic fresh whole fruits (SB3108)	<i>L. monocytogenes</i> <i>Salmonella</i> spp. <i>E. coli</i> O157 Generic <i>E. coli</i>	392	385	7	0	I= <i>L. monocytogenes</i> (7)

Fiscal year(s)	Product (sample plan ID)	Microorganisms tested	Number of samples tested	Satisfactory (S)	Investigative (I)	Unsatisfactory (U)	Comments
2021/2022 2022/2023	Imported fresh berries (SB345)	HAV NoV (GI, GII)	591	591	0	N/A	All satisfactory
2021/2022 2022/2023	Domestic fresh berries (SB346)	HAV NoV (GI, GII)	248	248	0	N/A	All satisfactory
2021/2022 2022/2023	Fresh-cut fruits (SB3211)	<i>L. monocytogenes</i> <i>Salmonella</i> spp. <i>E. coli</i> O157 Generic <i>E. coli</i>	809	808	0	1	U= <i>L. monocytogenes</i>
2021/2022 2022/2023	Frozen berries (SB3215 & SB3225)	HAV NoV (GI, GII)	689	687	2	N/A	I=Norovirus (2)
2021/2022 2022/2023	Frozen cut fruits (SB3112)	<i>L. monocytogenes</i> <i>Salmonella</i> spp. <i>E. coli</i> O157 Generic <i>E. coli</i>	589	589	0	0	All satisfactory
2021/2022 2022/2023	Frozen cut fruits (bulk packaged) (SB3212)	<i>L. monocytogenes</i> <i>Salmonella</i> spp. <i>E. coli</i> O157 Generic <i>E. coli</i>	274	274	0	0	All satisfactory
2018/2019 2019/2020	Imported frozen-cut fruits (SB3063)	HAV NoV (GI, GII)	484	484	0	N/A	All satisfactory
2021/2022 2022/2023	Frozen-cut fruits (SB3216, SB3088)	HAV NoV (GI, GII)	1130	1130	0	N/A	All satisfactory
2020/2021 2021/2022 2022/2023	Imported tahini (FS358R & SB3099)	<i>Salmonella</i> spp.	346	343	N/A	3	U= <i>Salmonella</i> spp. (3)
2021/2022 2022/2023	Guacamole (SB3113)	<i>L. monocytogenes</i> <i>Salmonella</i> spp. <i>E. coli</i> O157 Generic <i>E. coli</i>	592	592	0	0	All satisfactory
2021/2022 2022/2023	Herb paste (SB3116)	<i>L. monocytogenes</i> <i>Salmonella</i> spp. <i>E. coli</i> O157 Generic <i>E. coli</i>	87	87	0	0	All satisfactory
2021/2022 2022/2023	Seaweed salad (SB3117)	<i>L. monocytogenes</i> <i>Salmonella</i> spp. <i>E. coli</i> O157 Generic <i>E. coli</i>	572	562	10	0	I= <i>L. monocytogenes</i> (10)
2021/2022 2022/2023	Domestic oysters (SB3219)	HAV NoV (GI, GII)	276	261	15	N/A	I=NoV (GI) (1) I=Nov (GII) (10)

Fiscal year(s)	Product (sample plan ID)	Microorganisms tested	Number of samples tested	Satisfactory (S)	Investigative (I)	Unsatisfactory (U)	Comments
							I=NoV (GI and GII) (4)
2021/2022 2022/2023	Imported oysters (SB3220)	HAV NoV (GI, GII)	87	41	46	N/A	I=NoV (GI) (11) I=NoV (GII) (10) I=NoV (GI and GII) (25)
2021/2022 2022/2023	RTE meat sausages (SB3213)	<i>L. monocytogenes</i> <i>Salmonella</i> spp. <i>S. aureus</i> Generic <i>E. coli</i>	571	570	1	0	I=Generic <i>E. coli</i>
2021/2022 2022/2023	Raw shelled nuts (SB3119)	<i>Salmonella</i> spp. <i>E. coli</i> O157 Generic <i>E. coli</i>	983	983	0	0	All satisfactory
2020/2021 2021/2022 2022/2023	Powdered infant formula (FS360R & SB3100)	<i>Salmonella</i> spp. (2021-2023 only) <i>Cronobacter</i> spp. <i>Enterobacteriaceae</i>	409	408	1	0	I= <i>Enterobacteriaceae</i>
2021/2022 2022/2023	Baby food in retort pouches (SB3214)	Commercial sterility	378	378	0	0	All satisfactory
2022/2023	Imported fresh leafy herbs (seasonal focus on cilantro) (SB3081)	<i>Cyclospora</i>	353	351	2	0	I= <i>Cyclospora</i>
2022/2023	Fresh whole hot peppers (SB3123)	<i>Salmonella</i> spp. <i>E. coli</i> O157 Generic <i>E. coli</i>	298	294	2	2	I=Generic <i>E. coli</i> (2) U=Generic <i>E. coli</i> (2)
2022/2023	Refrigerated kimchi (SB3125)	<i>L. monocytogenes</i> <i>Salmonella</i> spp. <i>E. coli</i> O157	297	297	0	0	All satisfactory
2022/2023	Imported fresh berries (SB341)	<i>Cyclospora</i>	376	375	1	0	I= <i>Cyclospora</i>
<b>Total (%)</b>	-	-	<b>30,672</b>	<b>30,500 (99.4)</b>	<b>151 (0.5)</b>	<b>21 (0.07)</b>	-

## What is done with the survey results

All results are used to:

- inform risk management decisions
- support program design and re-design

All investigative and unsatisfactory results triggered appropriate follow-up actions such as:

- on site visit of the manufacturer
- follow-up with the importer
- review of hygiene and sanitation procedures
- review of production and distribution records
- review of previous laboratory test results
- additional sampling and testing
- food recalls

## Can I access the survey data

All of the results reported herein are considered preliminary, as the targeted surveys are still ongoing. Therefore, the data will only be accessible to the public on the [Open Government portal](#) following the publication of the [final report or scientific publication](#).

# References

1. Canadian Food Inspection Agency, [\*Food chemistry and microbiology\*](#).
2. Public Health Agency of Canada, [\*Foodbook Report\*](#). 2015.
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4. Health Canada, [\*Health Products and Food Branch \(HPFB\) Standards and Guidelines for Microbiological Safety of Food - An Interpretive Summary\*](#). 2008.
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6. Department of Justice, [\*Food and Drugs Act\*](#). 2014.