



Canadian Food
Inspection Agency

Agence canadienne
d'inspection des aliments

Bacterial Pathogens and Indicators in Fresh Baby Leafy Vegetables - April 1, 2018 to March 31, 2021

Food microbiology - Targeted surveys - Final report



Summary

A 3-year [targeted survey](#) analysed 3172 samples of baby leafy vegetables for the presence of the pathogens *Listeria monocytogenes* (*L. monocytogenes*), *Salmonella* species (spp.), and *Escherichia coli* (*E. coli*) O157. All samples were also tested for generic *E. coli* which is an indicator of the hygienic and sanitary conditions of the food supply chain from production to the point of sale.

Over 99.5% of the samples tested were found to be satisfactory. *Salmonella* spp. and *E. coli* O157 were not found in any samples. *L. monocytogenes* was found in 12/3172 (0.38%) samples. Generic *E. coli* at elevated levels were found in 3/3172 (0.09%) samples. The Canadian Food Inspection Agency (CFIA) conducted appropriate follow-up activities. There were no reported illnesses related to these products.

Overall, our survey results indicate that baby leafy vegetables sold in Canada are generally safe for consumption, however they can occasionally be contaminated. Consequently, as with all foods, and especially with those that are consumed raw, good hygienic practices are recommended for producers, retailers and consumers.

Why was this survey conducted

The survey was conducted to generate baseline information on the quality and safety of fresh baby leafy vegetables sold at retail in Canada.

Baby leafy vegetables are younger versions of typical leafy greens such as spinach, and kale. They have become increasingly popular¹ as they are highly nutritious, tender, and flavourful². Also, they are often sold pre-washed and ready-to-eat.

Unfortunately, leafy baby vegetables have been associated with recalls^{3, 4} and outbreaks⁵ of foodborne illnesses as they can become contaminated with pathogens during production, harvest, post-harvest handling, packaging, distribution, and/or at retail. When consumed, the presence of bacterial pathogens creates the potential for foodborne illness.

When was the survey conducted

The survey was conducted over a 3-year period from April 1, 2018 to March 31, 2021.

Where were the samples collected from

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

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

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.

How many and what kind of samples were collected

A total of 3172 pre-packaged baby leafy vegetable samples were collected. A sample consisted of a single or multiple consumer sized packages of the same lot weighing at least 250g.

What were the samples tested for

All samples were tested for *L. monocytogenes*, *Salmonella* spp., *E.coli* O157 and generic *E.coli*. *L. monocytogenes*, *Salmonella* spp. and *E.coli* O157 are pathogenic bacteria while generic *E.coli* is an indicator of the overall hygienic and sanitary conditions under which the samples have been produced, processed, stored and transported.

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*⁶ that were suitable for the testing of baby leafy vegetables.

How were the samples assessed

The samples were assessed using criteria based on the principles of Health Canada's *Health Products and Food Branch Standards and Guidelines for Microbiological Safety of Foods – An Interpretive Summary*⁷ and the *Food and Drugs Act*⁸ (Section 4(1)).

Table 1 - Assessment criteria

| Bacteria | Satisfactory | Investigative | Unsatisfactory |
|-------------------------|-------------------------|---|------------------------|
| <i>Salmonella</i> spp. | Not detected | Not applicable | Detected |
| <i>L. monocytogenes</i> | Not detected | Detected | Not applicable |
| <i>E. coli</i> O157 | Not detected | Not applicable | Detected |
| Generic <i>E. coli</i> | ≤ 10 ² MPN/g | 10 ² < x ≤ 10 ³ MPN/g | >10 ³ MPN/g |

No assessment guidelines had been established in Canada for the presence of *Salmonella* spp. or *L. monocytogenes* in fresh baby leafy vegetables at the time of writing this report. While both bacteria are pathogenic to humans, each have unique characteristics (for example, growth potential, infectious dose) which result in different levels of risk when present in baby leafy vegetables. Consequently, the presence of *L. monocytogenes* was assessed as investigative as it could be a violation of the *Food and Drugs Act* Section 4(1)a⁸ whereas the presence of *Salmonella* spp. was assessed as unsatisfactory as it is considered a violation of the *Food and Drugs Act* Section 4(1)a⁸.

What were the survey results

Over 99.5% of the samples tested were found to be satisfactory. *Salmonella* spp., and *E. coli* O157 were not found in any of the 3172 samples tested. *L. monocytogenes* was found in 12/3172 (0.38%) samples at levels ranging from <5 to 360 CFU/g. Generic *E. coli* at elevated levels (10² < x ≤ 10³ MPN/g) were found in 3/3172 (0.09%) samples.

Table 2 - Assessment results

| Bacterial analysis | Number of samples tested | Satisfactory (%) | Investigative (%) | Unsatisfactory |
|-------------------------|--------------------------|--------------------|-------------------|----------------|
| <i>Salmonella</i> spp. | 3172 | 3157 | Not applicable | 0 |
| <i>E. coli</i> O157 | | | Not applicable | 0 |
| <i>L. monocytogenes</i> | | | 12 (0.38) | Not applicable |
| Generic <i>E. coli</i> | | | 3 (0.09) | 0 |
| Total | 3172 | 3157 (99.5) | 15 (0.47) | 0 |

Survey results are also presented by production practice (table 3), origin (table 4) and product type (table 5).

Table 3 - Assessment results by production practice

| Production practice | Number of samples tested (%) | Satisfactory | Investigative |
|---------------------|------------------------------|--------------|---------------|
| Conventional | 2259 (71.2) | 2244 | 15 |
| Organic | 913 (28.8) | 913 | 0 |
| Total | 3172 | 3157 | 15 |

Table 4 - Assessment results by product origin

| Product origin | Number of samples tested (%) | Satisfactory | Investigative |
|----------------------|------------------------------|--------------|---------------|
| Domestic | 473 (14.9) | 469 | 4 |
| Import | 2513 (79.2) | 2506 | 7 |
| Domestic and import | 179 (5.6) | 176 | 3 |
| Unknown ^a | 7 (0.2) | 6 | 1 |
| Total | 3172 | 3157 | 15 |

^a Unknown refers to those samples for which the country of origin could not be assigned from the product label or available sample information.

Table 5 - Assessment results by product type

| Product type | Number of samples tested (%) | Satisfactory | Investigative |
|-------------------|------------------------------|--------------|---------------|
| Mixed baby greens | 1343 (42.3) | 1339 | 4 |
| Baby spinach | 1186 (37.4) | 1179 | 7 |
| Baby arugula | 499 (15.7) | 496 | 3 |
| Baby kale | 143 (4.5) | 142 | 1 |
| Baby bok choy | 1 (0.03) | 1 | 0 |
| Total | 3172 | 3157 | 15 |

What do the survey results mean

Previous Canadian and international studies^{9, 10, 11, 12} on the microbial quality and safety of retail fresh baby leafy vegetables have shown results approximating those in our study. Differing prevalence rates between studies may be attributable to differences in product types tested, methodology, study design, etc.

Overall, our survey results indicate that baby leafy vegetables sold in Canada are generally safe for consumption, however they can occasionally be contaminated. Consequently, as with all foods, and especially with those that are consumed raw, good hygienic practices are recommended for producers, retailers and consumers.

What is done with the survey results

All results are used to:

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

While no illness were related to the investigative and unsatisfactory samples, these results triggered appropriate follow-up actions. Follow-up actions may have included:

- facility inspections
- additional sampling and testing
- removal of affected products from the marketplace

Can I access the survey data

Yes. The data will be accessible on the [Open Government Portal](#).

References

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