Canadian Food Inspection Agency | Agence canadienne d'inspection des aliments

Bacterial pathogens and indicators in bulb onions - April 1, 2021, to March 31, 2024

Food microbiology - Targeted surveys - Final report

Food microbiology targeted surveys – June 2025

Canada

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Summary

A targeted survey[1] analyzed 2649 samples of bulb onions over a 3-year period from April 1, 2021, to March 31, 2024, for the presence of the pathogens S*almonella* spp. and *E. coli* O157. All samples were also tested for generic *E. coli*, which is used as an indicator of the overall hygienic and sanitary conditions of the food supply chain from production to the point of sale.

All (100%) of the 2649 samples tested were found to be satisfactory. *Salmonella* spp. and *E. coli* O157 were not found in any of the samples. Generic *E. coli* at elevated levels (>10^2 most probable number (MPN)/g) were not found in any of the samples.

Overall, our survey results indicate that bulb onions sold in Canada are generally safe for consumption. However, as with all foods, and especially those that may be consumed raw, good hygienic practices are recommended for producers, retailers, and consumers.

Why the survey was conducted

This survey was conducted to generate baseline information on the quality and safety of bulb onions sold at retail in Canada. Similar surveys on green onions were conducted by the Canadian Food Inspection Agency (CFIA) from 2010 to 2014[2,3,4].

Bulb onions are a popular ingredient in Canadian cuisine and are widely used for their flavour and nutritional benefits. Many varieties of domestic and imported bulb onions are available on the Canadian retail marketplace. They are commonly consumed cooked in a wide variety of dishes; however, many bulb onions are also often eaten raw.

Unfortunately, bulb onions have been associated with recalls[5] and recent foodborne illness outbreaks[6,7,8]. The 2020 Canadian[6,8] and US[7,8] *Salmonella* outbreaks were likely associated with red onions grown in California, US. Subsequent outbreaks linked to onions have occurred in 2021[9] and 2024[10] in the US. The 2021 US *Salmonella* outbreak was likely linked to onions grown in Mexico, while the 2024 *E. coli* O157 outbreak was likely linked to onions grown in California, US. Investigations into the 2020 outbreaks indicated that contaminated irrigation water was the most likely cause[7,11]. This survey was designed in response to the 2020 and 2021 outbreaks.

Contamination with bacterial pathogens can occur at any step in the food supply chain such as during primary production, harvest, processing, packaging, distribution, at retail and/or during

preparation for consumption. Consequently, if pathogens are present, there is a potential for foodborne illness as bulb onions may be consumed raw.

When the survey was conducted

The survey was conducted over a 3-year period from April 1, 2021, to March 31, 2024.

Where the samples were 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
- Quebec City
- Montreal
- Ottawa
- Toronto
- Winnipeg
- Saskatoon
- Calgary
- Vancouver
- Victoria

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.

Total number and description of samples collected

A total of 2649 bulb onion samples were collected. During the first year of the study (April 1, 2021, to March 31, 2022) only red onions were collected. During years 2 and 3 (April 1, 2022, to March 31, 2024) the scope of the study was expanded to include all types of fresh whole onions. A sample consisted of a single or multiple consumer sized packages of the same lot weighing at least 250 g.

What the samples were tested for

All samples were tested for *Salmonella* spp., *E. coli* O157, and generic *E. coli*. *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.

Methods 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*[12] that were appropriate for the testing of bulb onions.

How the samples were 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 Food – An Interpretive* Summary[13], and the *Food and Drugs* Act[14] (Section 4(1)).

Table 1 - Assessment criteria

Bacteria	Satisfactory	Investigative	Unsatisfactory
Salmonella spp.	Not detected/25 g	Not applicable	Detected/25 g
E. coli O157	Not detected/25 g	Not applicable	Detected/25 g
Generic *E. coli*	≤ 10^2 MPN/g	>10^2 and ≤10^3 MPN/g	>10^3 MPN/g

No assessment guidelines had been established in Canada for the presence of *Salmonella* spp. in bulb onions at the time of writing this report.

As *Salmonella* spp. are considered pathogenic to humans, their presence might be considered a violation of the *Food and Drugs Act*[14] Section 4(1)a and therefore assessed as unsatisfactory.

Survey results

All 100% of the samples tested were found to be satisfactory. *Salmonella* spp. and *E. coli* O157 were not found in any of the samples. Generic *E. coli* at elevated levels (>10^2 MPN/g) was not found in any of the samples.

Table 2 - Analysis assessment results

Bacterial analysis	Number of samples tested	Satisfactory	Investigative	Unsatisfactory
Salmonella spp.	2649	2649	Not applicable	0
E. coli O157	2649	2649	Not applicable	0
Generic *E. coli*	2649	2649	0	0

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

Table 3 - Assessment results by production practice

Production practice	Number of samples tested (%)	Satisfactory
Conventional	2250 (84.9)	2250
Organic	399 (15.1)	399
Total	**2649 (100)**	**2649**

Table 4 - Assessment results by country of origin

Country of origin	Number of samples tested (%)	Satisfactory
Canada	693 (26.2)	693
Chile	1 (0.04)	1
China	22 (0.8)	22
Egypt	5 (0.2)	5
France	11 (0.4)	11
Mexico	56 (2.1)	56
Netherlands	25 (0.9)	25
Peru	130 (4.9)	130
Spain	1 (0.04)	1
United States	1689 (63.8)	1689
Unknown[a]	16 (0.6)	16
Total	**2649 (100)**	**2649**

Table 5 - Assessment results by product type

Product type	Number of samples tested (%)	Satisfactory
Cipollini	7 (0.3)	7
Pearl onion	155 (5.9)	155
Pink onion	2 (0.1)	2
Red onion	1306 (49.3)	1306
Shallots	99 (3.7)	99
Sweet onion	427 (16.1)	427
White onion	227 (8.6)	227
Yellow onion	426 (16.1)	426
Total	**2649 (100)**	**2649**

What the survey results mean

Previously published Canadian studies[2,3,4] on the microbiological quality (generic *E. coli*) and safety (*Salmonella* spp., *E. coli* O157, *Shigella*) of retail green onions on the Canadian marketplace have shown higher prevalence rates of *Salmonella* spp. and generic *E. coli*. All (100%) of the onion samples in the current study were found to be satisfactory. Differing

[a] Country of origin could not be assigned from the product label or available sample information.

prevalence rates between studies may be attributable to differences between the onion types tested.

Overall, our survey results indicate that bulb onions sold in Canada are generally safe for consumption. However, as with all foods, and especially with those that may be 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

Where to access the survey data

The data will be accessible on the Open Government Portal.

References

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