Canadian Food Inspection Agency
Agence canadienne d'inspection des aliments

Bacterial Pathogens and Indicators in Plant-based Cheese Alternatives - April 1, 2019 to March 31, 2022

Food microbiology - Targeted surveys - Final report

Food microbiology targeted surveys – January 2023

Canada

Summary

A 3-year targeted survey[1] analysed 556 samples of plant-based cheese alternatives for the presence of the pathogens S*almonella* species (spp.), *Listeria monocytogenes* (*L. monocytogenes*), and *Staphylococcus aureus* (*S. aureus*). All samples were also tested for generic *Escherichia coli* (*E. coli*) which is an indicator of the overall hygienic and sanitary conditions of the food supply chain from production to the point of sale.

Over 99.2% of the samples tested were found to be satisfactory. *Salmonella spp.*, *L. monocytogenes*, and *S. aureus* (>10^4 CFU/g) were not found in any of the samples. *E. coli* at elevated levels were found in 4 of the 556 (0.7%) samples. The Canadian Food Inspection Agency (CFIA) conducted appropriate follow-up activities.

Overall, our survey results indicate that plant-based cheese alternatives sold in Canada are generally safe for consumption. However, as with all foods, and especially with those that are ready-to-eat (RTE), 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 plant-based cheese alternatives sold at retail in Canada. Unfortunately, these foods have been associated with recalls[2,3], and foodborne illness outbreaks[4,5,6].

The consumption of plant-based cheese alternatives has a long history in many parts of Asia[7]. However, in recent years they have grown in popularity and a wide variety of products have appeared on the Canadian retail marketplace[8].

Contamination with bacterial pathogens can occur at any step in the food supply chain such as during production, processing, and/or packaging. Consequently, if pathogens are present, there is a potential for foodborne illness as plant-based cheese alternatives are RTE.

When was the survey conducted

The survey was conducted over a 3-year period from April 1, 2019 to March 31, 2022.

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
- Quebec City
- Montreal
- Toronto
- Ottawa
- Vancouver
- Victoria
- 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 556 refrigerated plant-based cheese alternative 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 *Salmonella* spp., *L. monocytogenes, S. aureus* and generic *E. coli*. *Salmonella* spp., *L. monocytogenes*, and *S. aureus* 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*[9] that were appropriate for the testing of plant-based cheese alternatives.

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 Food – An Interpretive* Summary[10], *Policy on Listeria monocytogenes in Ready-to-Eat Foods*[11], the *Food and Drugs Act*[12] (Section 4(1)) and guidelines developed by international food safety authorities[13, 14].

Table 1 - Assessment criteria

Bacteria	Satisfactory	Investigative	Unsatisfactory
Salmonella spp.	Not detected	Not applicable	Detected
L. monocytogenes	Not detected	Not applicable (category 1[a]) Detected and ≤ 10^2 CFU/g (category 2[a])	Detected (category 1[a]) >10^2 CFU/g (category 2[a])
S. aureus	≤ 10^4 CFU/g	> 10^4 CFU/g	Not applicable
Generic *E. coli*	≤ 10^2 CFU or MPN/g	> 10^2 CFU or MPN/g	Not applicable

[a] The pH and water activity of the sample were used to determine the product category

No assessment guidelines had been established in Canada for the presence of *Salmonella* spp., *S. aureus* or indicator organisms in plant-based cheese alternatives at the time of writing this report.

As *Salmonella* spp. is considered pathogenic to humans its presence was assessed as unsatisfactory as it is considered to be a violation of the *Food and Drugs Act*[12] Section 4(1)a.

S. aureus can produce toxins capable of causing foodborne illness and therefore their presence at elevated levels was assessed as investigative, possibly resulting in further follow-up actions.

Unlike bacterial pathogens, most strains of generic *E. coli* are harmless. Generic *E. coli* is considered to be an indicator organism as 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. Their presence at some levels is tolerated, however elevated levels were assessed as investigative, possibly resulting in further follow-up actions.

What were the survey results

Over 99.2% of the samples tested were found to be satisfactory. *Salmonella* spp., *L. monocytogenes*, and *S. aureus* (> 10^4 CFU/g) were not found in any of the samples. Generic *E. coli* at elevated levels (>10^2 CFU or MPN/g) were found in 4 of the 556 (0.7%) samples.

Table 2 - Assessment results

Bacterial analysis	Number of samples tested	Satisfactory (%)	Investigative (%)	Unsatisfactory
Salmonella spp.	556	552	Not applicable	0
L. monocytogenes			0	0
S. aureus			0	Not applicable
Generic *E. coli*			4	Not applicable
Total	**556**	**552 (99.3)**	**4 (0.7)**	**0**

Survey results are also presented by the product's production practice (table 3), origin (table 4), main ingredient(s) (table 5), and format (table 6).

Table 3 - Assessment results by production practice

Production practice	Number of samples tested (%)	Satisfactory	Investigative
Conventional	511 (91.9)	507	4
Organic	45 (8.1)	45	0
Total	**556**	**552**	**4**

Table 4 - Assessment results by product origin

Origin	Number of samples tested (%)	Satisfactory	Investigative
Domestic	3 (0.5)	0	0
Import	282 (50.7)	282	0
Unknown[b]	16 (2.9)	16	0
Unknown[b] (domestically processed)[c]	255 (45.9)	251	4
Total	**556**	**552**	**4**

[b] "Unknown" refers to those samples for which the country of origin could not be assigned from the product label or available sample information.

[c] "Domestically processed" refers to products which could be assigned as being processed in Canada based on the product label or available sample information.

Table 5 - Assessment results by product main ingredient(s)

Main ingredient(s)	Number of samples tested (%)	Satisfactory	Investigative
Almond	6	6	0
Butter bean, oat	3	3	0
Cashew	28	24	4
Cashew, chickpea	4	4	0
Cashew, chickpea, coconut oil or cream	8	8	0
Cashew, cocoa butter, coconut oil	2	2	0
Cashew, coconut oil	57	57	0
Cashew, coconut oil, almond	7	7	0
Coconut oil	384	384	0
Coconut oil, soybean	6	6	0
Oat flour, coconut oil	2	2	0
Palm oil	17	17	0
Palm oil, soybean oil	11	11	0
Soybean oil and milk	5	5	0
Soybean milk, coconut oil	1	1	0
Soy, corn or palm oil	3	3	0
Soy, palm and olive oils	11	11	0
Sunflower seed, navy bean, coconut oil	1	1	0
Total	**556**	**552**	**4**

Table 6 - Assessment results by product format

Format	Number of samples tested (%)	Satisfactory	Investigative
Block	213	209	4
Curd	3	3	0
Grated	60	60	0
Shredded	4	4	0
Sliced	211	211	0
Stick	5	5	0
Spread	60	60	0
Total	**556**	**552**	**4**

What do the survey results mean

No previously published studies on the microbiological quality or safety of plant-based cheese alternatives were found at the time of writing this report.

Overall, our survey results indicate that plant-based cheese alternatives sold in Canada is generally safe for consumption. However, as with all foods, and especially with those that are RTE, 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

The investigative samples triggered appropriate follow-up activities which may have included:

- on-site visit of the manufacturer
- review of manufacturer production and sanitation practices
- review of records and inspection of equipment and establishment conditions

Can I access the survey data

Yes. The data will be accessible on the Open Government Portal.

References

1. Canadian Food Inspection Agency, *Food chemistry and microbiology*.
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10. Health Canada, *Health Products and Food Branch (HPFB) Standards and Guidelines for Microbiological Safety of Food - An Interpretive Summary*. 2008.
11. Health Canada, *Policy on Listeria monocytogenes in Ready-to-Eat Foods*. 2011.
12. Department of Justice Canada, *Food and Drugs Act*. 2014.
13. UK Health Protection Agency, *Guidelines for Assessing the Microbiological Safety of Ready-to-Eat Foods Placed on the Market*. 2009.
14. Hong Kong Centre for Food Safety, *Microbiological Guidelines for Food (for Ready-to-Eat in General and Specific Food Items)*. 2014.