Canadian Food Inspection Agency
Agence canadienne d'inspection des aliments

Bacterial Pathogens and Indicators in Frozen Raw Coconut Meat - April 1, 2019 to March 31, 2021

Food microbiology - Targeted surveys - Final report

Canada

Summary

A 2-year targeted survey[1] analysed 584 samples of frozen raw coconut meat for the presence of the pathogens *Listeria monocytogenes* (*L. monocytogenes*), S*almonella* species (spp.), and *Escherichia coli* O157 (*E. coli* O157). All samples were also tested for generic *E. coli* and Aerobic Colony Count (ACC) which are indicators of the overall hygienic and sanitary conditions of the food supply chain from production to the point of sale.

Almost all (99.8%) of the samples tested were found to be free of pathogenic bacteria. *L. monocytogenes*, and *E. coli* O157 were not found in any of the samples. *Salmonella* spp. and ACC at elevated levels were found in 1 of the 584 (0.2%) samples. ACC at elevated levels were found in 213 of the 584 (36.5%) samples. Both ACC and generic *E. coli* at elevated levels were found in 31 of the 584 (5.3%) samples. The Canadian Food Inspection Agency (CFIA) conducted appropriate follow-up activities and a food recall was issued by industry. There were no reported illnesses related to these products.

Overall, our survey results indicate that frozen raw coconut meat sold in Canada are generally safe for consumption, however they can occasionally be contaminated. Also, given that >40% of the samples in our survey contained elevated levels of indicator organisms which may be indicative of poor processing controls, focus should be placed on good hygienic practices for producers, retailers and consumers for all foods, and especially those that are consumed raw.

Why was this survey conducted

The survey was conducted to generate baseline information on the quality and safety of frozen raw coconut meat sold at retail in Canada.

Frozen coconut is a food that has become increasingly available at retail in Canada in recent years. It can be eaten frozen or thawed as a snack or can be used as an ingredient in many prepared foods such as smoothies, baked goods, or soups. In many cases, frozen coconut is added to dishes during the final stages of preparation and consumed without further cooking.

Unfortunately, frozen raw coconut meat has been associated with recalls[2, 3] and outbreaks[4, 5] of foodborne illness as it can become contaminated during production, harvest, post-harvest handling, processing, packaging, distribution, and/or at retail. When consumed, a product containing bacterial pathogens creates the potential for foodborne illness. Additionally, studies[6] have shown that raw coconut meat can support the growth of foodborne pathogens.

When was the survey conducted

The survey was conducted over a 2-year period from April 1, 2019 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
- 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 584 pre-packaged frozen raw coconut meat samples were collected. A variety of product types were selected to represent varying degrees of processing (chunks, sliced, shredded, pureed). 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*, S*almonella* spp., *E. coli* O157, generic *E. coli*, and ACC. *L. monocytogenes*, S*almonella* spp., and *E. coli* O157 are pathogenic bacteria while generic *E. coli*, and ACC are indicators 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*[7] that were appropriate for the testing of frozen raw coconut meat.

How were the samples assessed

The samples were assessed using criteria based on the principles of the following documents: *Health Products and Food Branch Standards and Guidelines for Microbiological Safety of Foods – An Interpretive Summary*[8], *Policy on Listeria monocytogenes in Ready-to-Eat Foods*[9], the *Food and Drugs Act*[10] (Section 4(1)), and the *International Commission on Microbiological Specifications for Foods*[11].

Table 1 - Assessment criteria

Bacteria	Satisfactory	Investigative	Unsatisfactory
Salmonella spp.	Not detected	Not applicable	Detected
L. monocytogenes	Not detected	$\leq 10^2$ CFU/g	$>10^2$ CFU/g
E. coli O157	Not detected	Not applicable	Detected
ACC	$\leq 10^4$ CFU/g	$>10^4$ CFU/g	Not applicable
Generic *E. coli*	$\leq 10^2$ MPN/g	$>10^2$ MPN/g	Not applicable

No assessment guidelines had been established in Canada for the presence of indicator organisms and most bacterial pathogens in frozen raw coconut meat at the time of writing this report.

As *Salmonella* spp. and *E. coli* O157 are considered pathogenic to humans their presence is considered to be a violation of the *Food and Drugs Act*[10] Section 4(1)a and therefore assessed as unsatisfactory.

Unlike bacterial pathogens, most strains of generic *E. coli* are harmless. Similarly, ACC is the total number of generally harmless bacteria that are able to grow in an oxygenated (aerobic) environment. Both generic *E. coli* and ACC are considered to be indicators of the microbial quality of food. Generic *E. coli* is an indicator of fecal contamination while ACC is an indicator of the conditions under which a food is produced, processed, packaged, and stored. Their levels 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

Almost all (99.8%) of the samples tested were found to be free of pathogenic bacteria. *L. monocytogenes* and *E. coli* O157 were not found in any of the 584 samples tested. *Salmonella* spp. and ACC at elevated levels (>10^4 CFU/g) were found in 1 of the 584 (0.2%) samples.

Table 2 - Assessment results for pathogenic bacteria

Bacterial analysis	Number of samples tested	Satisfactory (%)	Investigative (%)	Unsatisfactory (%)
Salmonella spp.	584	583 (99.8)	Not applicable	1[b]
L. monocytogenes			0	0
E. coli O157			Not applicable	0
Total	**584**	**583 (99.8)**	**0 (0.0)**	**1 (0.2)**

[a] ACC at elevated (>10^4 CFU/g) levels was also detected

ACC at elevated levels (>10^4 CFU/g) was found in 213 of the 584 (36.5%) samples. ACC at elevated levels (>10^4 CFU/g) and generic *E. coli* at elevated levels (>10^2 MPN/g) were found in 31 out of 584 (5.3%) samples.

Table 3 - Assessment results for indicator organisms

Bacterial analysis	Number of samples tested	Satisfactory (%)	Investigative (%)
ACC	584	340 (58.2)	213 (36.5)
ACC and generic *E. coli*			31(5.3)
Total	**584**	**340 (58.2)**	**244 (41.8)**

Survey results are also presented by production practice (table 4), origin (table 5), and product type (table 6).

Table 4 - Assessment results by production practice

Production practice	Number of samples tested (%)	Satisfactory	Investigative	Unsatisfactory
Conventional	566 (96.9)	325	241	0
Organic	18 (3.1)	14	3	1
Total	**584**	**339**	**244**	**1**

Table 5 - Assessment results by origin

Product origin	Number of samples tested (%)	Satisfactory	Investigative	Unsatisfactory
Import	509 (87.2)	267	241	1
Unknown[b] (domestically packaged)[c]	75 (12.8)	72	3	0
Total	**584**	**339**	**244**	**1**

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

Table 6 - Assessment results by product type

Product type	Number of samples tested (%)	Satisfactory	Investigative	Unsatisfactory
Frozen raw coconut chunks	310 (53.1)	279	30	1
Frozen pureed raw coconut	6 (1.0)	6	0	0
Frozen grated raw coconut	61 (10.4)	5	56	0
Frozen shredded raw coconut	195 (33.4)	44	151	0
Frozen sliced raw coconut	12 (2.1)	5	7	0
Total	**584**	**339**	**244**	**1**

What do the survey results mean

No previously published studies on the microbiological quality and safety of frozen raw coconut meat were found at the time of writing this report. A previous Canadian[12] study was conducted by the CFIA on the microbial quality and safety of fresh-cut fruits sold at retail including coconut. *E. coli* O157, *L. monocytogenes*, *Salmonella* spp., *Shigella*, and generic *E. coli* (> 100 CFU/g) were not found in any of the 20 fresh-cut coconut samples tested.

Overall, our survey results indicate that frozen raw coconut meat sold in Canada is generally safe for consumption, however they can be infrequently contaminated. Also, given that >40% of the samples in our survey contained elevated levels of indicator organisms (ACC $>10^4$ CFU/g) which may be indicative of poor processing controls, focus should be placed on good hygienic practices for producers, retailers and consumers for all foods, and especially those that are consumed raw.

What is done with the survey results

All results are used to:

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

No illnesses were associated with the investigative and unsatisfactory samples, however appropriate follow-up activities were initiated including food safety investigations and recalls[3].

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.*

2. Canadian Food Inspection Agency, *Health Hazard Alert - Diwa brand frozen grated coconut from the Philippines may contain Salmonella bacteria*. 2013.

3. Canadian Food Inspection Agency, *Updated Food Recall Warning - Feeding Change brand Young Thai Coconut Meat recalled due to Salmonella*. 2019.

4. Public Health Agency of Canada, *Outbreak of Salmonella Chailey infections linked to precut coconut pieces — United States and Canada*. 2017.

5. Centers for Disease Control and Prevention, *Multistate Outbreak of Salmonella Infections Linked to Coconut Tree Brand Frozen Shredded Coconut (Final Update).* 2018.

6. Strawn, L., et al., *Microbial Safety of Tropical Fruits. Critical Reviews in Food Science and Nutrition.* **51**: p.132-45. 2011.

7. Health Canada, *Compendium of Analytical Methods.* 2011.

8. Health Canada, *Health Products and Food Branch (HPFB) Standards and Guidelines for Microbiological Safety of Food - An Interpretive Summary*. 2008.

9. Health Canada, *Policy on Listeria monocytogenes in Ready-to-Eat Foods.* 2011.

10. Department of Justice Canada, *Food and Drugs Act.* 2014.

11. Swanson, K., et al., *Microorganisms in Foods 8: Use of Data for Assessing Process Control and Product Acceptance*. 2011.

12. Zhang, H., et al., *Microbiological safety of ready-to-eat fresh-cut fruits and vegetables sold on the Canadian retail market.* International Journal of Food Microbiology. **335**: 108855. 2020.