



Canadian Food  
Inspection Agency

Agence canadienne  
d'inspection des aliments

# Bacterial Pathogens and Indicators in Dried Coconut - April 1, 2019 to March 31, 2021

## Food microbiology - Targeted surveys - Final report



## Summary

A 2-year targeted survey<sup>1</sup> analysed 787 samples of dried coconut for the presence of the pathogens *Salmonella* species (spp.), *Staphylococcus aureus* (*S. aureus*), *Bacillus cereus* (*B. cereus*), and *Clostridium perfringens* (*C. perfringens*). 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.

All of the samples tested were found to be satisfactory. *Salmonella* spp., *S. aureus* (>10<sup>4</sup> CFU/g), *B. cereus* (>10<sup>6</sup> CFU/g), *C. perfringens* (>10<sup>6</sup> CFU/g), and generic *E. coli* (>10<sup>2</sup> MPN/g) were not found in any of the samples.

Overall, our survey results indicate that dried coconut sold in Canada is generally safe for consumption. However, as with all foods, and especially with those that are ready for consumption without further preparation or cooking, 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 dried grated coconut sold at retail in Canada.

Dried coconut is a food that is widely available at retail in Canada<sup>2</sup>. It is often eaten directly as a snack or can be used as an ingredient in many prepared foods, such as granola bars, cookies, smoothies or savory dishes. In many cases, dried coconut is added as a topping and consumed without further preparation or cooking.

Various methods are used to make dried coconut, however the process involves the drying of raw coconut meat in a controlled<sup>3</sup> (oven, kiln) or uncontrolled<sup>4</sup> (exposure to the sun, open air) environment. If contamination occurs at any point in the food production chain, pathogens can survive for long periods of time due to the low moisture and high fat content of dried coconut.

Unfortunately, dried coconut has been associated with recalls<sup>5, 6</sup> and outbreaks<sup>7, 8</sup> of foodborne illness as they can become contaminated with pathogens during production, harvest, post-harvest handling, processing, 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 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 787 pre-packaged dried coconut samples were collected. A variety of product types were selected to represent varying degrees of processing (chunks, flaked, shredded, powdered). 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., *S. aureus*, *B. cereus*, *C. perfringens*, and generic *E. coli*. *Salmonella* spp., *S. aureus*, *B. cereus*, and *C. perfringens* 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*<sup>9</sup> that were appropriate for the testing of dried coconut.

## 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*<sup>10</sup>, the *International Commission on Microbiological Specifications for Foods*<sup>11</sup>, the *Food and Drugs Act*<sup>12</sup> (Section 4(1)) and guidelines developed by international food safety authorities<sup>13, 14</sup>.

**Table 1 - Assessment criteria**

Bacteria	Satisfactory	Investigative	Unsatisfactory
<i>Salmonella</i> spp.	Not detected	Not applicable	Detected
<i>S. aureus</i>	$\leq 10^4$ CFU/g	$> 10^4$ CFU/g	Not applicable
<i>B. cereus</i> <sup>a</sup>	$\leq 10^6$ CFU/g	$> 10^6$ CFU/g	Not applicable
<i>C. perfringens</i>	$\leq 10^6$ CFU/g	$> 10^6$ CFU/g	Not applicable
Generic <i>E. coli</i>	$\leq 10^2$ MPN/g	$> 10^2$ MPN/g	Not applicable

<sup>a</sup> The *B. cereus* method used in this survey is unable to discriminate *B. cereus* from other closely related organisms and therefore positive results are considered presumptive for *B. Cereus*.

No assessment guidelines had been established in Canada for the presence of bacterial pathogens or indicator organisms in dried coconut 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*<sup>12</sup> Section 4(1)a.

*B. cereus*, *S. aureus*, and *C. perfringens* 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

All of the samples tested were found to be satisfactory. *Salmonella spp.*, *S. aureus* (>10<sup>4</sup> CFU/g), *B. cereus* (>10<sup>6</sup> CFU/g), *C. perfringens* (>10<sup>6</sup> CFU/g), and generic *E. coli* (>10<sup>2</sup> MPN/g) were not found in any of the 787 samples tested.

**Table 2 - Assessment results**

Bacterial analysis	Number of samples tested	Satisfactory (%)	Investigative	Unsatisfactory
<i>Salmonella spp.</i>	787	787	Not applicable	0
<i>S. aureus</i>			0	Not applicable
<i>B. cereus</i>			0	Not applicable
<i>C. perfringens</i>			0	Not applicable
Generic <i>E. coli</i>			0	Not applicable
<b>Total</b>	<b>787</b>	<b>787 (100.0)</b>	<b>0</b>	<b>0</b>

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
Conventional	536 (68.1)	536
Organic	251 (31.9)	251
<b>Total</b>	<b>787 (100.0)</b>	<b>787</b>

**Table 4 - Assessment results by origin**

Product origin	Number of samples tested (%)	Satisfactory
Import	431 (54.8)	431
Unknown <sup>a</sup>	356 (45.2)	356
<b>Total</b>	<b>787 (100.0)</b>	<b>787</b>

<sup>a</sup> "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
Dried coconut chunks	46 (5.8)	46
Dried coconut flakes	115 (14.6)	115
Dried shredded coconut	557 (70.8)	557
Coconut flour	69 (8.8)	69
<b>Total</b>	<b>787 (100.0)</b>	<b>787</b>

## What do the survey results mean

No previously published studies on the microbiological quality or safety of dried grated coconut were found at the time of writing this report. A previous Canadian<sup>15</sup> study was conducted by the CFIA on the microbial quality and safety of fresh-cut fruits sold at retail including coconut. *E. coli* O157, *Listeria 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 dried coconut sold in Canada is generally safe for consumption. However, as with all foods, and especially with those that are ready for consumption without further preparation or cooking, 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 and support program design and re-design.

## 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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5. Canadian Food Inspection Agency, [Food Recall Warning - Various brands of coconut products recalled due to Salmonella](#). 2018.
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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. Swanson, K., et al., *International Commission on Microbiological Specifications for Foods. Microorganisms in Foods 8: Use of Data for Assessing Process Control and Product Acceptance*. 2011.
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15. 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. 2020. **335**: 108855.