



Canadian Food  
Inspection Agency

Agence canadienne  
d'inspection des aliments

# Bacterial Pathogens and Indicators in Ready-to-Eat Fish and Seafood - April 1, 2018 to March 31, 2021

## Food microbiology - Targeted surveys - Final report



## Summary

A 3-year targeted survey<sup>1</sup> analysed 1 165 samples of ready-to-eat (RTE) fish and seafood, and their products for the presence of the pathogens *Listeria monocytogenes* (*L. monocytogenes*), *Salmonella* species (spp.), and *Staphylococcus aureus* (*S. aureus*). All samples were also tested for generic *Escherichia coli* (*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 98.9% of the samples tested were found to be satisfactory. *Salmonella* spp., *S. aureus* (> 10<sup>3</sup> CFU/g) and generic *E. coli* (>10<sup>2</sup> CFU or MPN/g) were not found in any of the samples tested. *L. monocytogenes* was found in 12 of the 1 165 (1.0%) 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 RTE fish and seafood samples sold in Canada are generally safe for consumption, however they can occasionally be contaminated. Consequently, as with all food, and especially 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 provide enhanced oversight of the quality and safety of RTE fish and seafood, and their products sold at retail in Canada. The RTE fish and seafood product types sampled under this survey included fish (smoked, cured, dried), seafood (shrimp, crab), and fish and seafood products (mousse, pâté) which are all commonly consumed by Canadians<sup>2</sup>. Unfortunately, many of these foods have been associated with recalls<sup>3,4</sup>, and foodborne illness outbreaks<sup>5,6</sup> and are considered high-risk foods<sup>7</sup>.

Contamination with bacterial pathogens can occur at any step in the food supply chain such as during production, harvest, post-harvest handling, processing, distribution and/or at retail. When consumed, the presence of 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. Refrigerated products were collected throughout the survey period while frozen products were only collected during the last 2 years of the survey.

## 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 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 1165 pre-packaged RTE fish and seafood samples were collected of which 636 were fish, 310 were imitation crab or lobster, 126 were seafood (other than fish) and 93 were fish and seafood products. 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., *S. aureus* and generic *E. coli*. *L. monocytogenes*, *Salmonella* spp., 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 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>8</sup> that were suitable for the testing of RTE fish and seafood.

## How were samples assessed

The samples were assessed using criteria based on the principles of the CFIA's *Canadian Hazards Guide – Fish and Fish Products*<sup>9</sup>, Health Canada's *Policy on Listeria monocytogenes in Ready-to-Eat Foods*<sup>10</sup> and guidelines developed by international food safety authorities<sup>11, 12</sup>.

**Table 1 - Assessment criteria**

Bacteria	Satisfactory	Investigative	Unsatisfactory
<i>L. monocytogenes</i>	Not detected	Not applicable (Category 1 <sup>a</sup> ) Detected and $\leq 10^2$ CFU/g (Category 2 <sup>a</sup> )	Detected (Category 1 <sup>a</sup> ) > $10^2$ CFU/g (Category 2 <sup>a</sup> )
<i>Salmonella</i> spp.	Not detected	Not applicable	Detected
<i>S. aureus</i>	$\leq 10^3$ CFU/g	> $10^3$ and $\leq 10^4$ CFU/g	> $10^4$ CFU/g
Generic <i>E. coli</i>	$\leq 10^2$ CFU or MPN/g	> $10^2$ and $\leq 10^3$ CFU or MPN/g	> $10^3$ CFU or MPN/g

<sup>a</sup> The storage condition (frozen or refrigerated) and if applicable, pH and water activity of the sample were used to determine the product category.

## What were the survey results

Over 98.9% of the samples tested were found to be satisfactory. *Salmonella* spp., *S. aureus* (>  $10^3$  CFU/g) and generic *E. coli* (>  $10^2$  CFU or MPN/g) were not found in any of the samples tested. *L. monocytogenes* was found in 12 of the 1166 (1.0%) samples at levels of < 5 CFU/g.

**Table 2 - Assessment results**

Bacteria	Number of samples tested	Satisfactory (%)	Investigative (%)	Unsatisfactory (%)
<i>L. monocytogenes</i>	1165	1153	6 <sup>b</sup>	6 <sup>c</sup>
<i>Salmonella</i> spp.			Not applicable	0
<i>S. aureus</i>			0	0
Generic <i>E. coli</i>			0	0
<b>Total</b>	<b>1165</b>	<b>1153 (99.0)</b>	<b>6 (0.5)</b>	<b>6 (0.5)</b>

<sup>b</sup> <5 CFU/g, frozen smoked salmon, frozen smoked trout, anchovies in oil (category 2)

<sup>c</sup> <5 CFU/g, smoked salmon, herring in oil (category 1)

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

**Table 3 - Assessment results by product origin**

Product origin	Number of samples tested (%)	Satisfactory	Investigative	Unsatisfactory
Domestic	131 (11.2)	129	1	1
Import	512 (44.0)	510	1	1
Unknown <sup>d</sup>	113 (9.7)	111	1	1
Unknown <sup>d</sup> (domestically processed) <sup>e</sup>	409 (35.1)	403	3	3
<b>Total</b>	<b>1165</b>	<b>1153</b>	<b>6</b>	<b>6</b>

<sup>d</sup> “Unknown” refers to those samples for which the country of origin could not be assigned from the product label or available sample information.

<sup>e</sup> “Domestically processed” refers to products which could be assigned as being processed in Canada based on the product label or available sample information.

**Table 4 - Assessment results by RTE product type**

Product type	Number of samples tested (%)	Satisfactory	Investigative	Unsatisfactory
Fish (smoked, salted, dried, fermented)	636 (54.6)	624	6 <sup>f</sup>	6 <sup>g</sup>
Fish and seafood products (caviar, mousse, pâté)	93 (8.0)	93	0	0
Seafood (other than fish) (lobster, shrimp, octopus, crab, mussels)	126 (10.8)	126	0	0
Imitation crab or lobster	310 (26.6)	310	0	0
<b>Total</b>	<b>1165</b>	<b>1153</b>	<b>6</b>	<b>6</b>

<sup>f</sup> *L. monocytogenes* detected in 4 samples of frozen smoked salmon, 1 sample of frozen smoked trout and 1 sample of anchovies in oil (category 2)

<sup>g</sup> *L. monocytogenes* detected in 5 samples of smoked salmon, and 1 sample of herring in oil (category 1)

## What do the survey results mean

Previous Canadian<sup>13</sup> studies on the microbial quality and safety of retail RTE fish and seafood products have shown results approximating those in our study while international<sup>14, 15</sup> studies have shown higher prevalence rates. Differing prevalence rates between studies may be attributable to differences in product types tested, methodology, study design, etc.

Overall, our survey results indicate that RTE fish and seafood sold in Canada are generally safe for consumption, however they can be infrequently contaminated. Consequently, 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
- support program design and re-design

While no illness were related to the investigative and unsatisfactory samples, these results triggered appropriate follow-up actions including:

- 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

1. Canadian Food Inspection Agency, [Food chemistry and microbiology](#).
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6. Food Safety News, [Five dead from Listeria outbreak linked to fish](#). 2019.
7. Ontario Ministry of Health Ministry of Long-Term Care, [Food Safety - Frequently Asked Questions](#). 2021.
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12. Public Health England, *Guidelines for Assessing the Microbiological Safety of Ready-to-Eat Foods Placed on the Market*. 2009.
13. Dodds, K.L., et al., *A Retail Survey of Smoked Ready-to-eat Fish to Determine Their Microbiological Quality*. *Journal of Food Protection*, 1992. **55**(3): p. 208-210.
14. Cabedo, L., et al., *Prevalence of *Listeria monocytogenes* and *Salmonella* in Ready-to-Eat Food in Catalonia, Spain*. *Journal of Food Protection*, 2008. **71**(4): p. 855-859.
15. Gonzalez, D., et al., *Listeria monocytogenes and ready-to-eat seafood in Spain: Study of prevalence and temperatures at retail*. *Food Microbiology*, 2013. **36**(2): p. 374-378.