



Canadian Food  
Inspection Agency

Agence canadienne  
d'inspection des aliments

# Bacterial Pathogens and Indicators in Seaweed Salad - April 1, 2021, to March 31, 2024

## Food microbiology - Targeted surveys - Final report



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# Summary

A targeted survey<sup>1</sup> analysed 858 samples of seaweed salad over a 3-year period from April 1, 2021, to March 31, 2024, for the presence of the pathogens *Listeria monocytogenes* (*L. monocytogenes*), *Salmonella* species (spp.), and *E. coli* O157:H7. All samples were also tested for generic *E. coli* which is an indicator of the hygienic and sanitary conditions of the food supply chain from production to the point of sale.

A majority (98.1%) of the samples tested were found to be satisfactory. *Salmonella* spp., *E. coli* O157, and generic *E. coli* at elevated levels were not detected in any of the samples. *L. monocytogenes* was found in 16 of the 858 (1.9%) samples, however these 16 samples (which were all frozen) represented only 5 unique lot codes of products. The frozen products sampled under this survey had shelf lives of up to 2-years and consequently some lots were sampled multiple times throughout the survey period. 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 seaweed salad sold in Canada is generally safe for consumption. However, as with all food, and especially those that are ready-to-eat (RTE) good hygienic practices are recommended for producers, retailers, and consumers.

## Why the survey was conducted

The survey was conducted to generate baseline information on the quality and safety of seaweed salad sold at retail in Canada.

The consumption of seaweed has a long history in many parts of Europe and Asia<sup>2</sup>. However, in recent years it has grown in popularity in Western countries including Canada as people continue to embrace foods and flavours of cuisines from different parts of the world. Seaweed salad is generally made using wakame seaweed combined with a dressing consisting of a base of sesame seed oil, soy sauce, and vinegar. Unfortunately, seaweed has been associated with foodborne illness outbreaks<sup>3,4,5,6</sup>.

Contamination with bacterial pathogens can occur at any step in the food supply chain such as during production, processing, packaging, distribution, at retail, and/or during preparation for consumption. Consequently, if pathogens are present, there is a potential for foodborne illness as seaweed salads are RTE.

## 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
- 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.

## Total number and description of samples collected

A total of 858 fresh and frozen seaweed salad samples were collected. A sample consisted of a single or multiple consumer sized packages of the same lot weighing at least 250g.

## What the samples were tested for

All samples were tested for *L. monocytogenes*, *Salmonella* spp., *E. coli* O157, and generic *E. coli*. *L. monocytogenes*, *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 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*<sup>7</sup> that were suitable for the testing of seaweed salad.

# How were samples assessed

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

**Table 1 - Assessment criteria**

Bacteria	Satisfactory	Investigative	Unsatisfactory
<i>L. monocytogenes</i>	Not detected	Not applicable (category 1 <sup>a</sup> ) Detected and ≤10 <sup>2</sup> Colony Forming Unit (CFU)/g (category 2 <sup>a</sup> )	Detected (category 1 <sup>a</sup> ) >10 <sup>2</sup> CFU/g (category 2 <sup>a</sup> )
<i>Salmonella</i> spp.	Not detected	Not applicable	Detected
<i>E. coli</i> O157	Not detected	Not applicable	Detected
Generic <i>E. coli</i>	≤ 10 <sup>2</sup> Most Probable Number (MPN)/g	>10 <sup>2</sup> MPN/g	Not applicable

No assessment guidelines had been established in Canada for the presence of *Salmonella* spp., *E. coli* O157, or generic *E. coli* in seaweed salad at the time of writing this report.

As *Salmonella* spp. and *E. coli* O157 are considered pathogenic to humans the presence of either organism might be considered a violation of the *Food and Drugs Act* 10<sup>10</sup> Section 4(1)a and therefore assessed as unsatisfactory.

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.

## Survey results

A majority (98.1%) of the samples tested were found to be satisfactory. *Salmonella* spp., *E. coli* O157, and generic *E. coli* (>10<sup>2</sup> CFU/g) were not detected in any of the samples. *L. monocytogenes* at <5 CFU/g were found in 16 of the 858 (1.9%) samples, however these 16 samples (which were all frozen) represented only 5 unique lot codes of products. The frozen

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

products sampled under this survey had shelf lives of up to 2-years and consequently some lots were sampled multiple times throughout the survey period.

**Table 2 – Analysis assessment results**

Bacteria	Number of samples tested	Satisfactory	Investigative	Unsatisfactory
<i>L. monocytogenes</i>	858	842	16 <sup>b,c</sup>	0
<i>Salmonella</i> spp.	858	858	Not applicable	0
<i>E. coli</i> O157	858	858	Not applicable	0
Generic <i>E. coli</i>	858	858	0	Not applicable

Survey results are also presented by country of origin (table 3), and whether the product was frozen or refrigerated at the time of purchase (table 4).

**Table 3 - Assessment results by country of origin**

Product origin	Number of samples tested (%)	Satisfactory	Investigative	Unsatisfactory
China	347 (40.4)	331	16 <sup>b,c</sup>	0
Korea, Republic of	22 (2.6)	22	0	0
Taiwan	2 (0.2)	2	0	0
Unknown <sup>d</sup> (prepared in Canada)	45 (5.2)	45	0	0
Unknown <sup>d</sup>	442 (51.5)	442	0	0
<b>Total</b>	<b>858</b>	<b>842</b>	<b>16</b>	<b>0</b>

**Table 4 - Assessment results by product state**

Product type	Number of samples tested (%)	Satisfactory	Investigative	Unsatisfactory
Fresh	475 (55.4)	475	0	0
Frozen	383 (44.6)	367	16 <sup>b,c</sup>	0
<b>Total</b>	<b>858</b>	<b>842</b>	<b>16</b>	<b>0</b>

## What the survey results mean

A previous international<sup>11</sup> study investigated the presence of a variety of indicator and pathogenic bacteria in brown microalgae. Different from our study, *Listeria monocytogenes* was not detected in any of the samples. Differing prevalence rates between studies may be attributable to differences in product types tested, methodology, study design, etc.

<sup>b</sup> *L. monocytogenes* <5 CFU/g, frozen, imported from China (category 2B product)

<sup>c</sup> The 16 samples represented only 5 unique lot codes of products.

<sup>d</sup> The product origin could not be assigned from the product label, or available sample information.

Overall, our survey results indicate that seaweed salads sold in Canada are generally safe for consumption. However, as with all food, and especially 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

While no illnesses were related to the investigative samples, these results triggered appropriate follow-up actions which may have included:

- follow-up with the importer
- review of manufacturer production, sanitation, and distribution practices
- review of records, including product receiving procedures, and previous laboratory test results

## Where to access the survey data

The data will be accessible on the [Open Government Portal](#).

# References

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