



Canadian Food
Inspection Agency

Agence canadienne
d'inspection des aliments

Food Microbiology – Targeted Surveys

FINAL REPORT

Bacterial Pathogens in Fresh-Cut Ready-To-Eat Fruits

April 1, 2014 – March 31, 2016



Summary

In recent years, the availability of pre-packaged, fresh-cut, ready-to-eat (RTE) fruits has increased to meet consumers' demand for convenient and healthy foods. Unfortunately, fresh fruits, including fresh-cut fruits, have been associated with numerous recalls and several outbreaks of foodborne illnesses worldwide.

Fresh fruits can become contaminated with pathogens during production, harvest, post-harvest handling, processing, packaging and distribution. The additional processing steps that fresh-cut fruits undergo such as cutting, slicing, peeling and shredding remove or damage their protective surfaces, provide a favourable environment (i.e., increased availability of nutrients, higher water activity) for any micro-organisms that may be present on the surface to multiply. Since pre-packaged, fresh-cut RTE fruits are expected to be consumed raw without further preparation, the presence of bacterial pathogens creates a potential risk for foodborne illnesses.

Considering the factors mentioned above and their relevance to Canadians, pre-packaged, fresh-cut, RTE fruits were selected for targeted surveys. The purpose of targeted surveys is to generate baseline information on the occurrence and distribution of pathogenic bacteria in food. Over the course of this study (April 1, 2014 to March 31, 2016), a total of 2621 samples were collected from retail locations in 11 cities across Canada and tested for bacterial pathogens of concern (*Listeria monocytogenes*, *Salmonella*, *Shigella*, and *Escherichia coli* O157:H7 (*E.coli* O157:H7)) as well as generic *E. coli*. Generic *E. coli* is an indicator of the overall sanitation conditions throughout the food production chain.

Salmonella, *Shigella*, *E.coli* O157:H7 and high levels of generic *E.coli* (>1000 Most Probable Number (MPN)/g) were not found in any samples. *Listeria monocytogenes* was found in 14 (0.53%) samples and an elevated level of generic *E.coli* (350 MPN/g) was found in one sample (0.04%).

The Canadian Food Inspection Agency (CFIA) conducted appropriate follow-up activities such as facility inspections and additional sampling. One *Listeria monocytogenes* positive fresh-cut apple sample resulted in a recall due to a possible link to a human illness case and also because it had been distributed to a high risk population group¹ (e.g., immunocompromised, elderly, pregnant, etc.). In all other cases, due to the perishable nature of the products the implicated products were no longer available on the market when the pathogen was detected, and consequently no direct product action was possible. In most cases, however, corrective actions were implemented by the processing facilities.

Overall, our survey results suggest that almost all pre-packaged, fresh-cut, RTE fruits are safe for consumption. Regardless, pre-packaged, fresh-cut, RTE fruits are a known potential source of foodborne illness and as such, safe handling practices are recommended for producers, retailers and consumers.

What Are Targeted Surveys?

Targeted surveys are used by the Canadian Food Inspection Agency (CFIA) to focus its surveillance activities on areas of highest health risk. The information gained from these surveys provides support for the allocation and prioritization of the Agency's activities to areas of greater concern. Originally started as a project under the Food Safety Action Plan (FSAP), targeted surveys have been embedded in the CFIA's regular surveillance activities since 2013. Targeted surveys are a valuable tool for generating information on certain hazards in foods, identifying and characterizing new and emerging hazards, informing trend analysis, prompting and refining health risk assessments, highlighting potential contamination issues, as well as assessing and promoting compliance with Canadian regulations.

Food safety is a shared responsibility. The Canadian Food Inspection Agency works with federal, provincial, territorial and municipal governments and provides regulatory oversight of the food industry to promote safe handling of foods throughout the food production chain. The food industry and retail sectors in Canada are responsible for the food they produce and sell, while individual consumers are responsible for the safe handling of the food they have in their possession.

Why Did We Conduct This Survey?

In recent years, the availability of pre-packaged, fresh-cut, ready-to-eat (RTE) fruits has increased to meet consumers' demand for convenient and healthy foods. Unfortunately, fresh fruits, including fresh-cut fruits have been associated with numerous recalls and several outbreaks of foodborne illnesses worldwide.

Fresh fruits can become contaminated with pathogens during production, harvest, post-harvest handling, processing, packaging and distribution. The additional processing steps that fresh-cut fruits undergo such as cutting, slicing, peeling and shredding remove or damage their protective surfaces, providing a favourable environment (i.e. increased availability of nutrients, higher water activity) for any micro-organisms that may be present on the surface to multiply². Since pre-packaged, fresh-cut RTE fruits are expected to be consumed raw without further preparation, the presence of bacterial pathogens creates a potential risk for foodborne illnesses.

Considering the factors mentioned above and their relevance to Canadians, pre-packaged, fresh-cut RTE fruits were selected for targeted surveys over a four fiscal year period starting in 2012. The purpose was to gather baseline information on the occurrence and distribution of *Listeria monocytogenes*, *Salmonella*, *Shigella*, *Escherichia coli* O157:H7 (*E. coli* O157:H7) and generic *E. coli* in this commodity at retail in Canada. Generic *E. coli* is an indicator of the overall

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sanitation conditions throughout the food production chain. This report details results of the last two fiscal years of the survey period (April 1, 2014 to March 31, 2016). Results of the first two fiscal years of the survey (April 1, 2012 to March 31, 2014) are very similar to those reported here and are detailed in a [separate report](#).

What Did We Sample?

For this survey, a sample consisted of a single unit (e.g., individual consumer-size package(s) from a single lot) with a total weight of at least 250 g. All samples were collected from national retail chains and local/regional grocery stores located in 11 major cities across Canada. These cities encompassed four geographical areas: Atlantic (Halifax and Saint John), Quebec (Quebec City, Montreal), Ontario (Toronto, Ottawa), and the West (Vancouver, Kelowna, Calgary, Saskatoon and Winnipeg). The number of samples collected from these cities was in proportion to the relative population of the respective areas. Samples were collected between April 1, 2014 and March 31, 2016. A variety of pre-packaged, fresh-cut, RTE fruits were sampled.

What Analytical Methods Were Used and How Were Samples Assessed?

Samples were analyzed using methods published in Health Canada's *Compendium of Analytical Methods for the Microbiological Analysis of Foods*³ (Table 1). The assessment criteria used in this survey (Table 1) are based on the principles of Health Canada's *Health Products and Food Branch Standards and Guidelines for Microbiological Safety of Foods*⁴.

Table 1 - Analytical Methods and Assessment Criteria for Bacteria in Fresh-cut Fruits

Bacterial Analysis	Method Identification Number*	Assessment Criteria		
		Satisfactory	Investigative	Unsatisfactory
<i>Listeria monocytogenes</i>	MFLP-28 MFHPB-30 MFLP-74	Absent in 25g	Not Applicable (N/A) (Category 1) ≤100 CFU/g (Category 2)	Present in 25g (Category 1) or >100 CFU/g (Category 2)
<i>Salmonella</i>	MFHPB-20	Absent in 25g	N/A	Present in 25g
<i>Shigella</i>	MFLP-25	Absent in 25g	N/A	Present in 25g
<i>E. coli</i> O157:H7	MFLP-30, MFHPB-10	Absent in 25g	N/A	Present in 25g
Generic <i>E. coli</i>	MFHPB-19 MFHPB-27	≤ 100 MPN/g or CFU/g	100 < x ≤ 1000 MPN/g of CFU/g	> 1000 MPN/g or CFU/g

* The methods used were the published versions at the time of analysis

No assessment guidelines had been established in Canada for the presence of *Salmonella* or *Shigella* in fresh-cut fruits at the time of writing this report. However, these microorganisms are considered pathogenic to humans and as such in the absence of assessment guidelines, their presence in pre-packaged, fresh-cut RTE fruits is considered to be a violation of the *Food and Drugs Act* (FDA) Section 4(1) and is therefore assessed by the CFIA as unsatisfactory.

The assessment guidelines for *Listeria monocytogenes* are based on Health Canada's Policy on *Listeria monocytogenes* in RTE foods and is dependent upon the sample type analysed (i.e. Category 1, 2A or 2B) ¹.

Unlike harmful bacterial pathogens (e.g. *Salmonella*, *E. coli* O157:H7), generic *E. coli* is commonly found in the intestines of humans and most strains are harmless. It is considered to be an indicator organism and levels of generic *E. coli* found in a food product are used to assess the overall sanitation conditions throughout the food chain from production to the point of sale. Its presence at some levels is tolerated on agricultural products. An investigative assessment which may result in further follow-up actions is associated with elevated levels of generic *E. coli* (100 < x ≤ 1000 MPN/g). As the results are based on the analysis of one unit (n=1), further sampling is required to verify the levels of generic *E. coli* of the lot. An unsatisfactory assessment is associated with high levels of generic *E. coli* (> 1000 MPN/g) as it may indicate a breakdown in Good Agricultural Practices, or Good Manufacturing Practices (sanitation practices), and therefore possibly warranting the initiation of follow-up activities to, for example, improve sanitation conditions along the food chain.

What Were The Survey Results?

Over the course of this study (April 1, 2014 to March 31, 2016), a total of 2621 samples were tested for bacterial pathogens of concern (*Listeria monocytogenes*, *Salmonella*, *Shigella*, *E. coli* O157:H7) as well as generic *E. coli*. Generic *E. coli* is an indicator of the overall sanitation conditions throughout the food production chain. Sample assessment results can be found in Table 2.

Table 2 - Assessment Results of Fresh-cut Fruit Samples

Bacterial Analysis	Assessment Results		
	Satisfactory (% of total samples)	Investigative (% of total samples)	Unsatisfactory (% of total samples)
<i>Listeria monocytogenes</i>	2606 (99.4%)	13 (0.5%)	1 (<0.1%)
<i>Salmonella</i>		N/A	0
<i>Shigella</i>		N/A	0
<i>E. coli</i> O157:H7		N/A	0
Generic <i>E. coli</i>		1 (<0.1%)	0
Total	2606 (99.4%)	14 (0.5%)	1 (<0.1%)

Salmonella, *Shigella*, *E.coli* O157 and high levels of generic *E. coli* (>1000 MPN/g) were not found in any samples. *Listeria monocytogenes* was found in 14 (0.5%) samples and an elevated level of generic *E.coli* (350 MPN/g) was found in 1 sample (<0.1%). *Listeria monocytogenes* was detected in a sample of cantaloupe, which was considered to be a Category 1 product according to Health Canada's Policy on *Listeria monocytogenes* in RTE foods¹. This sample was assessed as Unsatisfactory and it contained levels of *Listeria monocytogenes* of 230 CFU/g. The remaining *Listeria monocytogenes* positive samples were found to be Category 2A or 2B products as per Health Canada's Policy on *Listeria monocytogenes* in RTE foods¹ with counts between <5-15 CFU/g and were therefore assessed as Investigative.

A variety of pre-packaged, fresh-cut, RTE fruit product types were analysed and are detailed in Table 3.

Table 3 - Sample Distribution by Fresh-Cut Fruit Product Types

Product type	Number of Samples Analysed (% of total)	<i>Listeria monocytogenes</i>	<i>E.coli</i> (100 < x ≤ 1000 MPN/g)
Watermelon	416 (15.9%)	1	-
Cantaloupe	336 (12.8%)	3 (2 investigative, 1 unsatisfactory)	-
Honeydew	206 (7.9%)	-	-
Mixed Melons	226 (8.6%)	2	1
Mixed Fruits & Melons	312 (11.9%)	3	-
Mixed Fruits	256 (9.8%)	1	-
Pineapple	518 (19.8%)	-	-
Mango	132 (5.0%)	-	-
Apple	111 (4.2%)	3	-
Papaya	28 (1.1%)	1	-
Strawberry	45 (1.7%)	-	-
Coconut	12 (0.5%)	-	-
Orange	10 (0.4%)	-	-
Grapefruit	8 (0.3%)	-	-
Kiwi	4 (0.2%)	-	-
Pear	1 (<0.1%)	-	-
Total	2621	14	1

What Do The Survey Results Mean?

In this survey, over 99% of the pre-packaged, fresh-cut RTE fruit samples analyzed were free of pathogenic bacteria tested for. *Salmonella*, *Shigella*, *E.coli* O157:H7 and high levels of generic *E.coli* (>1000 Most Probable Number (MPN)/g) were not found in any samples. *Listeria monocytogenes* was found in 14 (0.5%) samples and an elevated level of generic *E.coli* (350 MPN/g) was found in 1 sample (<0.1%).

The prevalence of *Listeria monocytogenes* (0.5%) and elevated levels of generic *E.coli* (350MPN/g) (<0.1%) in our survey were higher than a 2005-2006 Spanish study⁵ and lower than a 2012 UK study⁶. Both the Spanish and UK studies investigated the microbiological quality of minimally processed fruits in several retail establishments. The UK study also sampled from catering premises. The Spanish study tested 21 single ingredient pre-cut fruit samples and found no *E.coli*, or *Listeria monocytogenes* contamination. The UK study tested both single and mixed fruit samples and showed a *Listeria monocytogenes* prevalence of 4.5% (53/1188) and generic *E.coli* (>100 MPN/g) prevalence of 0.3% (3/1188). Similar to our study, the Spanish and UK study also found no samples to be contaminated with *Salmonella* and the UK study

found no samples to be contaminated with generic *E.coli* (>1000 MPN/g). The differences in contamination rates may be due to various reasons such as differences in sanitation practices, package types (the Spanish study included samples from vending machines and the UK study included both pre-packaged and unpackaged samples), product types tested, methodology, study design, number of samples tested, etc.

The Canadian Food Inspection Agency (CFIA) conducted appropriate follow-up activities such as facility inspections and additional sampling. One *Listeria monocytogenes* positive fresh-cut apple sample resulted in a recall due to a possible link to a human illness case and also because it had been distributed to a high risk population group¹ (e.g., immunocompromised, elderly, pregnant, etc.). In all other cases, due to the perishable nature of the products the implicated products were no longer available on the market when the pathogen was detected, and consequently no direct product action was possible. In most cases, however, corrective actions were implemented by the processing facilities.

Overall, our survey results suggest that almost all pre-packaged, fresh-cut, RTE fruits are safe for consumption however they can sporadically become contaminated with *Listeria monocytogenes*. Consequently, safe handling practices are recommended for producers, retailers and consumers.

References

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