



Canadian Food
Inspection Agency

Agence canadienne
d'inspection des aliments

Bacterial Pathogens and Indicators in Fresh Whole Stone Fruits - April 1, 2016 to March 31, 2020

Food Microbiology - Targeted Surveys - Final report



Summary

Targeted surveys provide information on potential food hazards and enhance the Canadian Food Inspection Agency's (CFIA's) routine monitoring programs. These surveys provide evidence regarding the safety of the food supply, identify potential emerging hazards, and contribute new information and data to food categories where it may be limited or non-existent. They are often used by the agency to focus surveillance on potential areas of higher risk. Surveys can also help to identify trends and provide information about how industry complies with Canadian regulations.

Stone fruits are fruits with a large stone/pit containing the seed and some examples are nectarines, peaches, plums and apricots. Stone fruits are soft and highly perishable fruits of agricultural origin and contamination can occur during pre-harvest, harvest, sorting and packing, as well as during transport, distribution and retail storage and display. A 2014 listeriosis outbreak in the US, and recalls associated with stone fruits raised food safety concerns about this commodity. Additionally, as fresh fruits are commonly eaten raw (without further processing or cooking) the presence of bacterial pathogens creates the potential for foodborne illness.

Considering the factors mentioned above and their relevance to Canadians, fresh whole stone fruits were selected for a 3-year targeted survey (April 1, 2016 to March 31, 2017 and April 1, 2018 to March 31, 2020) to generate baseline information on the occurrence of pathogenic bacteria of concern in stone fruits. A total of 2947 stone fruit samples were tested for *Escherichia coli* (*E. coli*) O157:H7, *Salmonella* species (spp.), *Listeria monocytogenes* (*L. monocytogenes*), and generic *E. coli* which is an indicator of the overall sanitation conditions throughout the food production chain. Of the 2947 samples, 1001 samples were also tested for *Shigella*.

Overall, 98.8% of the stone fruit samples were assessed as satisfactory. *Salmonella* spp., *E. coli* O157:H7, *Shigella*, and generic *E. coli* (>1000 MPN/g) were not identified in any of the samples tested. *L. monocytogenes* was present in 1.15% (34/2947) of the samples and generic *E. coli* (100 < x ≤ 1000 MPN/g) was found in 0.07% (2/2947) of the samples. The CFIA conducted follow-up activities such as facility inspections and additional sampling and testing and in some cases, enhanced sanitation procedures were implemented by packing facilities. As there are currently no established Canadian guidelines or policies on the presence of *L. monocytogenes* in fresh whole stone fruits and as there were no known stone fruit associated human listeriosis cases or outbreaks at the time the food safety investigations were being conducted, no product recalls were undertaken.

Overall, the results of this survey suggest that most of the stone fruit samples have been produced under good hygienic practices, however they can be infrequently contaminated with

L. monocytogenes. Consequently, as with all foods, and especially with fruits that are consumed raw, good hygienic 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. 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

Stone fruits are fruits with a large stone/pit containing the seed and some examples are nectarines, peaches, plums, and apricots. Stone fruits are soft and highly perishable fruits of agricultural origin and contamination with bacterial pathogens such as *L. monocytogenes* can occur during pre-harvest, harvest, sorting, and packing, as well as during transport, distribution and retail storage and display.

A listeriosis outbreak linked to the consumption of stone fruits occurred in 2014 in the US¹. Several types of stone fruits were recalled (nectarines, peaches, plums and pluots) and among those, nectarines and peaches were the fruit types implicated in the outbreak. Therefore, it was concluded that whole stone fruits can serve as a vehicle for listeriosis^{1,2}. Experimental studies suggest that *L. monocytogenes* can survive on the surface of stone fruits under cold storage conditions (4 °C, 26 days) and the levels present could be a food safety concern^{3,4}. As stone fruits are commonly eaten raw and not subject to further processing or cooking that would eliminate bacterial pathogens, the presence of *L. monocytogenes* creates the potential for foodborne illness.

Considering the factors mentioned above and their relevance to Canadians, a 3-year targeted survey on fresh whole stone fruits was initiated in 2016. The purpose of the survey was to generate baseline information on the occurrence of pathogenic bacteria of concern (*E. coli*

O157:H7, *Salmonella* spp., *L. monocytogenes*, and *Shigella*), as well as generic *E. coli* which is an indicator of the overall sanitation conditions throughout the food production chain, in stone fruits on the Canadian retail market.

What did we sample

For this survey, the following stone fruit types were collected: nectarines, peaches, plums and apricots. Hybrid varieties of apricot and plum (plumcots, pluots, apriums, apriplums) were also collected. Other stone fruits such as cherries, mangoes, lychees, coconuts, dates and raspberries were not included in this study. A sample consisted of a single or multiple unit(s) (individual consumer-sized packages or multiple single fruits from bulk) from a single lot with a total weight of at least 250 g.

Samples were collected over a 3 year period from April 1, 2016 to March 31, 2017 and April 1, 2018 to March 31, 2020. Imported and domestic samples were collected at a ratio of 60%:40% throughout the survey period. Both imported and domestic samples were mainly collected between June and October during each survey year, and imported samples were also collected from November to February of the third survey year as imported stone fruits were available on the Canadian market during this time period. All samples were randomly collected from national retail chains and local/regional grocery stores located in 11 major cities across Canada. The percentage of samples collected from each city was approximately proportional to the population of the province in which they were located in relation to the total population of Canada. These cities encompassed 4 geographical areas:

- Atlantic (Halifax and Saint John or Moncton)
- Quebec (Quebec City and Montreal)
- Ontario (Toronto and Ottawa)
- West (Vancouver, Kelowna or Victoria, Calgary, Saskatoon and Winnipeg).

What analytical methods were used and how were samples assessed

Samples were analyzed for the bacterial pathogens *Salmonella* spp., *E. coli* O157:H7, *Shigella*, *L. monocytogenes* and the indicator organism generic *E. coli* using methods published in Health Canada's *Compendium of Analytical Methods for the Microbiological Analysis of Foods*⁵. See table 1 for the specific methods used and associated assessment criteria.

At the time of writing this report no Canadian microbiological guidelines or policies had been established for the presence of *Salmonella* spp., *Shigella* and *L. monocytogenes* in fresh whole stone fruits. However, as these bacteria are considered pathogenic to humans their presence or levels in foods may be considered to be a violation of the *Food and Drugs Act* (FDA) Section

4(1)a. Consequently, samples were assessed as unsatisfactory for the presence of *Salmonella* spp. and *Shigella*, and assessed as investigative for the presence of *L. monocytogenes* and if detected, their presence resulted in follow-up actions such as facility inspections and additional sampling and testing.

Unlike bacterial pathogens such as *Salmonella* spp., generic *E. coli* is commonly found in the intestines of humans and animals with most strains being 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* ($100 < x \leq 1000$ MPN/g). As the results are based on the analysis of 1 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, and therefore possibly warranting the initiation of follow-up activities to determine the source of the contamination and improve sanitation conditions along the food chain.

Table 1 - Analytical methods and assessment criteria for bacteria in stone fruits

Bacterial analysis	Method number ^a	Satisfactory	Investigative	Unsatisfactory
<i>Salmonella</i> spp.	MFLP-29 MFLP-49 MFHPB-20	Not detected in 25g	Not applicable (N/A)	Detected in 25g
<i>E. coli</i> O157:H7	MFLP-30 MFHPB-10	Not detected in 25g	N/A	Detected in 25g
<i>Shigella</i>	MFLP-25	Not detected in 25g	N/A	Detected in 25g
<i>L. monocytogenes</i>	MFLP-28 MFHPB-30 MFLP-74	Not detected in 25g	Detected in 25g	N/A
Generic <i>E. coli</i>	MFHPB-19	≤ 100 MPN/g	$100 < x \leq 1000$ MPN/g	> 1000 MPN/g

^a The compendium methods used were the published versions at the time of analysis ⁵.

What were the survey results

Over the course of this study (April 1, 2016 to March 31, 2107, and April 1, 2018 to March 31, 2020), a total of 2947 fresh whole stone fruit samples were collected. All samples were tested for bacterial pathogens *Salmonella* spp., *E. coli* O157:H7, and *L. monocytogenes* and the indicator organism generic *E. coli*. In the first year of the survey, all samples (1001) were also tested for *Shigella*. Overall, 98.8% of the stone fruit samples were assessed as satisfactory. *Salmonella* spp., *E. coli* O157:H7, and *Shigella* were not identified in any of the samples tested. *L. monocytogenes* was present in a total of 34 samples (1.15%, 34/2947) and generic *E. coli* (>100 MPN/g and ≤1000 MPN/g) were found in 2 samples (0.07%, 2/2947). Sample assessment results can be found in table 2.

Table 2 - Assessment results of fresh whole stone fruit samples

Bacterial analysis	Number of samples tested	Satisfactory (% of total)	Investigative (% of total)	Unsatisfactory (% of total)
<i>Salmonella</i> spp.	2947	2911	N/A	0
<i>E. coli</i> O157:H7			N/A	0
<i>Shigella</i> ^b			N/A	0
<i>L. monocytogenes</i>			34	N/A
Generic <i>E. coli</i>			2	0
Total	2947	2911 (98.8)	36 (1.2)	0 (0)

^b Tested in 1001 samples only

Of the 2947 samples tested, 39.8 % were domestic and 60.0% were imported from over 8 countries including the US (54.5% of total), and 0.1% were of unknown country of origin (table 3).

Table 3 - Assessment results by origin of fresh whole stone fruit samples

Origin	Number of samples tested (% of total)	Satisfactory	Investigative	Unsatisfactory
Domestic	1174 (39.8)	1164	10	0
Imported	1769 (60.0)	1743	26	0
Unknown	4 (0.1)	4	0	0
Total	2947 (100)	2911	36	0

A variety of fresh whole stone fruit samples were collected including plums (34.5%), peaches (32%), nectarines (25.9%), apricots (5.2%) and apricot/plum hybrids (2.3%). These fruit samples were either conventionally produced (91.3%) or organically produced (8.7%) (table 4).

Table 4 - Product types and production practices of fresh whole stone fruit samples

Product type	Number of samples tested (% of total)	Organic (% of total)	Conventional (% of total)
Apricot	154 (5.2)	25	129
Apriplum	5 (0.2)	0	5
Aprium	6 (0.2)	0	6
Nectarine	764 (25.9)	63	701
Peach	944 (32.0)	105	839
Plum	1018 (34.5)	62	956
Plumcot	36 (1.2)	1	35
Pluot	20 (0.7)	1	19
Total	2947 (100)	257 (8.7)	2690 (91.3)

The 34 *L. monocytogenes* positive samples consisted of peaches (18/944, 1.9%), nectarines (15/764, 2.0%) and plums (1/1018, 0.1%). Levels of *L. monocytogenes* ranged from <5 to 260 CFU/g, and the levels at <5, 5 to 100, and >100 CFU/g were found in 82.4% (28/34), 8.8% (3/34) and 8.8% (3/34) of the positive samples, respectively (Table 5).

Table 5 - Level of *L. monocytogenes* in fresh whole stone fruit samples

Product type	Number of samples tested	Total number of <i>L. monocytogenes</i> positive samples	Number of samples < 5 CFU/g	Number of samples 5 to 100 CFU/g (level)	Number of samples > 100 CFU/g (level)
Nectarine	764	15	13	2 (25, 80)	0
Peach	944	18	14	1 (<50)	3 (120, 150, 260)
Plum	1018	1	1	0	0
Total	2726	34	28	3	3

Further analysis revealed that the occurrence of *L. monocytogenes* positive samples was higher during the second year of the survey (2018 to 2019), where a 2.2% (21/952) positive rate was found (Table 6). Both domestic and imported *L. monocytogenes* contaminated products contributed to this positive rate, however 13 of the 21 *L. monocytogenes* positive samples in the second year of the survey (2018 to 2019) were all imported from the US and represented 4 different brands with 1 brand (Brand A) accounting for 7 of the 13 positive samples. The 7 *L. monocytogenes* positive samples from Brand A were collected from different retail stores in 5 cities between August and October, 2018 and therefore it was more likely that the contamination was introduced at an earlier point in the food production chain prior to distribution to the retail stores.

Table 6 - Number of *L. monocytogenes* positive samples by survey year and origin

Origin	Number of <i>L. monocytogenes</i> positive samples in year 1 (2016 to 2017)	Number of <i>L. monocytogenes</i> positive samples in year 2 (2018 to 2019)	Number of <i>L. monocytogenes</i> positive samples in year 3 (2019 to 2020)
Domestic	0	8	2
Imported	3	13	8
Total	3	21	10
Positive rate	0.3% (3/1001)	2.2% (21/952)	1.0% (10/994)

What do the survey results mean

In this 3-year survey, 98.8% of the stone fruit samples were assessed as satisfactory as *Salmonella* spp., *E. coli* O157:H7, and *Shigella*, as well as generic *E. coli* (>1000 MPN/g) were not found in any of the fresh whole stone fruit samples analyzed. The survey results suggest that most of the stone fruit samples were produced under good hygienic practices. However, *L. monocytogenes* was present in 1.15% (34/2947, 95% CI, [0.83, 1.60]) of the stone fruit samples. The result suggests that stone fruits are susceptible to contamination with *L. monocytogenes*.

At the time of writing this report, results from other similar studies were not available to allow for a comparison of study results. The CFIA did however conduct targeted surveys from 2012 to 2016 involving other types of stone fruits. These surveys investigated the presence of bacterial pathogens on the surface of fresh whole mangoes⁶, and in fresh-cut mangoes⁷ on the Canadian retail market. The bacterial pathogens *Salmonella* spp., *E. coli* O157:H7 and *Shigella* were not identified on any of the whole mango samples (0/2267) tested⁶. The bacterial pathogens *Salmonella* spp., *E. coli* O157:H7, *Shigella* and *L. monocytogenes* were not found in any of the fresh-cut mango samples tested (0/194)⁷. While these targeted surveys are not directly comparable due to differences in the portion of the sample tested, commodity type, and processing, the prevalence of *L. monocytogenes* in stone fruits found in this study was higher than that of fresh-cut mangoes.

The CFIA conducted follow-up actions such as facility inspections and additional sampling and testing. In some cases, enhanced sanitation procedures were implemented by packing facilities. As there are currently no established Canadian guidelines or policies on the presence of *L. monocytogenes* in fresh whole stone fruits and there were no known stone fruit-associated human listeriosis illness cases or outbreaks while the food safety investigations were being conducted, no product recalls were undertaken.

Overall, the survey results suggest that most of the stone fruit samples have been produced under hygienic practices. However, they can be infrequently contaminated with *L. monocytogenes*. Consequently, as with all foods, and especially those that are eaten raw, good hygienic practices are recommended for producers, retailers and consumers.

References

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