



Canadian Food  
Inspection Agency

Agence canadienne  
d'inspection des aliments

# Food Microbiology – Targeted Surveys

## FINAL REPORT

### Viruses in Fresh Berries and Frozen Fruits

April 1, 2014 – March 31, 2016



# Summary

Produce such as fresh and frozen fruits have previously been identified as sources of contamination with viruses. Produce can become contaminated with pathogens during production, harvest, post-harvest handling, processing, packaging and distribution. Viruses infect humans primarily through contaminated food and water. In general, symptoms of infection can include gastrointestinal symptoms (nausea, vomiting, diarrhea) as well as fever, chills and muscle aches. [Previous targeted surveys](#) have reported on the detection of hepatitis A (HAV), norovirus (NoV) (Genotype I and II (GI, GII)) and human rotavirus (HRV) RNA in fresh vegetables and berries. This report focuses on the detection of HAV and NoV (GI and GII) RNA in pre-packaged, ready-to-eat (RTE) fresh and frozen berries and frozen fruits.

Considering the factors mentioned above and their relevance to Canadians, fresh and frozen fruits were selected for targeted surveys. Over the course of this study (April 1, 2014 to March 31, 2016), a total of 1991 samples of fresh berries and frozen fruits were collected from retail locations in 11 cities across Canada and tested for viruses of concern (HAV and NoV (GI, GII)). HAV and NoV (GI) RNA was not detected in any of the samples tested, while NoV (GII) RNA was detected in 7 (0.4%) of the samples.

The Canadian Food Inspection Agency (CFIA) conducted appropriate follow-up activities for all viral RNA positive samples. These may include a variety of activities such as facility inspections, environmental and/or product sampling and removal of affected product from the marketplace. Following a food safety investigation, no product recalls or corrective actions were issued by the CFIA due to various reasons such as the inability to determine the source of the viral RNA and unavailability of product on the market. In addition, the analytical methods used to analyse the samples were unable to discriminate between infectious and non-infectious viral RNA rendering it difficult to determine the immediate health significance of a viral RNA positive sample. There were no reported illnesses linked to the viral RNA positive samples.

Overall, our survey results suggest that almost all fresh and frozen berries and frozen fruits are safe for consumption. Regardless, produce such as fresh and frozen berries and frozen 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?

Fresh fruits are frequently consumed by Canadians in all age groups<sup>1</sup> and frozen fruit consumption among Canadians is on the rise<sup>2</sup>. Unfortunately both fresh and frozen fruits have been implicated in numerous foodborne illness outbreaks worldwide due to contamination by viruses<sup>3-5</sup>. The Food and Agriculture Organization of the United Nations/World Health Organization (FAO/WHO) Expert Committee issued reports recognizing that viruses are important causes of foodborne illnesses and classified berries and melons as the second highest priority group of concern among fresh fruits and vegetables in terms of microbial hazards<sup>4,6</sup>. Produce such as berries and fruits can become contaminated with pathogens during production, harvest, post-harvest handling, processing, packaging and distribution. In addition, viruses can survive freezing temperatures.

Given the above, fresh and frozen berries and frozen fruits were selected for targeted surveys over a 2 fiscal year period starting in 2014. The purpose of these targeted surveys was to gather baseline information on the occurrence of viruses in pre-packaged, ready-to-eat (RTE) fresh and frozen fruits available at retail in Canada. This report details results of the entire survey period (April 1, 2014 to March 31, 2016).

## 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 ready-to-eat, pre-packaged fresh or frozen berries and frozen fruits were sampled. Samples included conventional and organic produce of domestic or imported origin.

## What Analytical Methods Were Used and How Were Samples Assessed?

Samples were analyzed using CFIA internally-validated methods (Table 1) that detect the presence of HAV and NoV (GI, GII) RNA.

At the time of writing this report, no assessment guidelines had been established in Canada for viruses in fresh produce. In addition, the analytical methods used to analyse the samples detect viral RNA and cannot discriminate between viable (potentially infectious) from non-viable (non-infectious) viruses. Consequently, the detection of viral RNA was assessed as investigative indicating that further consideration is warranted to determine which follow-up activities would be the most appropriate. (Table 1).

**Table 1 Analytical Methods and Assessment Guidelines for Viruses in Fresh Berries and Frozen Fruits**

Viral Analysis	Method Number	Assessment Criteria	
		Satisfactory	Investigative
Hepatitis A	CFIA-VAD-02	Not detected	Detected
Norovirus (GI, GII)	CFIA-CRNVA-05 RT-PCR	Not detected	Detected

## What Were the Survey Results?

A total of 1991 samples of fresh and frozen berries and frozen fruit were analysed for HAV and NoV (GI, GII). No virus RNA was detected in almost all (99.6%) of the samples tested, while NoV (GII) RNA was detected in seven (0.4%) samples. Sample assessment results can be found in Table 2.

**Table 2 Assessment Results of Fresh and Frozen Berries and Frozen Fruit**

Product Type	Total Number of Samples	Assessment Results			
		Satisfactory Assessment	Investigative Assessment		
			HAV	NoV(GI)	NoV(GII)
Fresh berries	930	926	0	0	4 (Blackberry, Blueberry (2), Strawberry)
Frozen berries	656	654	0	0	2 (Blueberry, Strawberry)
Frozen fruits	405	404	0	0	1 (Peach)
Total (%)	1991	1984 (99.6%)	0	0	7 (0.4%)

Of the 1991 samples tested, 1754 (88%) were conventional and 237 (12%) were organically produced. All seven NoV (GII) viral RNA positive samples were conventionally produced.

One thousand, three hundred sixty-five (69%) of the samples tested were imported, 558 (28%) were domestic and 68 (3%) were of unknown origin. Of the seven NoV (GII) RNA positive samples, three were imported and four were domestic.

## What Do the Survey Results Mean?

In this survey, over 99.6% of the fresh and frozen berries and frozen fruit samples analyzed were free of specific viruses. HAV and NoV (GI) RNA was not detected in any samples. NoV (GII) RNA was detected in seven (0.4%) samples.

Prevalence studies of viruses in samples not related to an outbreak are very limited. The results from this survey show a higher prevalence rate than a 2009-2010 European study<sup>7</sup> of enteric viruses in berries along the fruit production chain which showed a 0% prevalence rate for both HAV and NoV (GI, GII) in point-of-sale fresh and frozen raspberries and fresh strawberries

(n=120). The higher prevalence rate seen in our study may be attributed to differences in study design, sample size and testing methodologies.

The Canadian Food Inspection Agency (CFIA) conducted appropriate follow-up activities for all viral RNA positive samples. These may include a variety of activities such as facility inspections, environmental and/or product sampling and removal of affected product from the marketplace. Following a food safety investigation, no product recalls or corrective actions were issued by the CFIA due to various reasons such as the inability to determine the source of the viral RNA and unavailability of product on the market. In addition, the analytical methods used to analyse the samples were unable to discriminate between infectious and non-infectious viral RNA rendering it difficult to determine the immediate health significance of a viral RNA positive sample. There were no reported illnesses linked to the viral RNA positive samples.

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# References

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