



# Food Safety Action Plan

## REPORT

2010-2011 Targeted Surveys

Targeted Survey Investigating *Salmonella* in  
Cantaloupes



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## Executive Summary

The Food Safety Action Plan (FSAP) aims to modernize and enhance Canada's food safety system in order to better protect Canadians from unsafe food and ultimately reduce the occurrence of foodborne illness.

Cantaloupes have been reported to be responsible for numerous outbreaks of foodborne illness worldwide. Increased surveillance activities have also triggered several non-outbreak associated recalls of cantaloupes in the United States (U.S.) and Canada in recent years. The Food and Agriculture Organization of the United Nations/World Health Organization (FAO/WHO) has ranked melons, including cantaloupes, as the second highest priority group of concern in terms of microbiological hazards among fresh fruits and vegetables. Cantaloupes can become contaminated with pathogens in production, harvest, post-harvest handling, processing and distribution. Once contaminated, cantaloupes are difficult to clean because the rough netted surface of the melon provides areas for bacteria to attach and be protected from sanitization. The presence of pathogens in cantaloupes creates a potential risk for foodborne illnesses as cantaloupes are consumed raw. The bacterial pathogen *Salmonella* is the most commonly identified pathogen in cantaloupe-associated outbreaks of foodborne disease and in recalled cantaloupes in the U.S. and Canada in recent years.

Considering these factors and their relevance to Canadians, cantaloupes have been selected as one of the priority commodity groups of fresh fruits and vegetables for enhanced surveillance under the FSAP.

Between 2008/09 and 2012/13, over 3,500 cantaloupe samples were collected from Canadian retail locations and tested for the presence of bacterial pathogens of concern. This targeted survey (2010/11) focussed on pathogenic bacteria *Salmonella* species (spp.). The main objective of this survey was to generate baseline surveillance data on the presence and distribution of bacterial pathogen of concern *Salmonella* spp. in imported and domestically produced cantaloupes.

In this survey, a total of 499 whole cantaloupe samples were collected and analysed; 385 were imported and 114 were domestically produced. *Salmonella* was not detected in 99.8% of the samples. One sample (1/499, 0.2%) was found to be unsatisfactory due to the presence of *Salmonella* spp. The CFIA initiated a food safety investigation and appropriate follow-up activities upon receiving this unsatisfactory result. To assist in the food safety investigation, the serotype and DNA fingerprint (pulsed field gel electrophoresis, PFGE pattern) of the isolate from the *Salmonella* positive sample were identified. A product recall resulted from the positive sample and investigation. However, it is important to note

that there were no reported illnesses associated with consumption of any of the products sampled during this survey.

Results of the 2010/11 survey indicate that the vast majority of the cantaloupes tested were not contaminated with *Salmonella*. However, the results also indicate that contamination of cantaloupes with pathogenic bacteria can occur. These findings suggest that cantaloupes available in the Canadian market are typically produced under Good Agricultural Practices (GAPs) and Good Manufacturing Practices (GMPs), and are safe for consumption. On rare occasions, improper handling may lead to contamination with *Salmonella*, which could represent a food safety risk. Results of the two remaining microbiological targeted surveys on cantaloupes will be released annually upon completion.

# 1 Introduction

## 1.1 Food Safety Action Plan

In 2007, the Canadian government launched a five-year initiative in response to a growing number of product recalls and concerns about food safety. This initiative, called the Food and Consumer Safety Action Plan (FCSAP) (1), aims to modernize and strengthen the food safety regulatory system. The FCSAP initiative unites multiple partners in ensuring safe food for Canadians.

The Canadian Food Inspection Agency's (CFIA's) Food Safety Action Plan (FSAP) (2) is one element of the government's broader FCSAP initiative. The goal of FSAP is to identify risks in the food supply, limit the possibility of occurrence of these risks, improve import and domestic food controls, and identify food importers and manufacturers.

Within the FSAP, there are 12 main areas of activity, one of which is risk mapping and baseline surveillance. The main objective of this area is to better identify, assess and prioritize potential food safety hazards through risk mapping, information gathering and analysis of foods in the Canadian marketplace. Targeted surveys are one tool used to test for the presence and level of particular hazards in specific foods.

## 1.2 Targeted Surveys

Targeted surveys are used to gather information regarding the potential occurrence of hazards in food commodities. The microbiological targeted surveys aim to establish baseline data on priority and/or emerging microbiological hazards in targeted commodities, primarily fresh fruits and vegetables and imported food ingredients. A statistically significant number of samples will be collected over five years to allow for seasonal and/or production variations. This work differs from regular CFIA microbiological monitoring activities, which test samples of a broad range of commodities for multiple hazards to determine the compliance of defined lots with established microbial standards.

To identify food-hazard combinations of greatest potential health risk for the targeted surveys, the CFIA uses a combination of scientific literature, documented outbreaks of foodborne illness, and/or information gathered from the Food Safety Science Committee (FSSC), a group of Canadian federal, provincial and territorial subject matter experts in the area of food safety (3).

This targeted survey (2010/11) represents part of the collection of over 3,500 cantaloupe samples over five years (2008/09 – 2012/13), which was designed to gather baseline

information on the occurrence of bacterial pathogens of concern in cantaloupes available to Canadians at retail.

### **1.3 Codes of Practice, Acts, and Regulations**

International food safety standards, codes of practice, and guidelines relating to food, food production and food safety are developed under the joint FAO/WHO Codex Alimentarius Commission. Producers of fresh fruits and vegetables are encouraged to follow these international codes of practice. Of relevance for this survey are the *Code of Hygienic Practices for Fresh Fruits and Vegetables* (CAC/RCP 53-2003) (4) and the *Recommended International Codes of Practice-General Principles of Food Hygiene* (CAC/RCP 1-1969) (5). These codes address GAPs and GMPs which, when applied, control and reduce the potential for contamination with microbial, chemical, and physical hazards at all stages of production of fresh fruits and vegetables, from primary production to packaging.

Fresh fruits and vegetables available in the Canadian market must comply with the *Food and Drugs Act* (FDA) (6) and the *Food and Drug Regulations* (FDR) (7), which prescribe certain restrictions on the production, importation, sale, composition and content of foods and food products. Section 4(1)a of the FDA prohibits the sale of food contaminated with foodborne pathogens, while sections 4(1)e and 7 prohibit the sale of unsafe food and food produced under unsanitary conditions.

Fresh fruits and vegetables sold in Canada must also comply with safety requirements of the *Fresh Fruit and Vegetable Regulations* (8) under the *Canada Agricultural Products Act* (9). These regulations are intended to ensure that fresh fruits and vegetables sold to consumers are safe, wholesome and properly graded, packaged and labelled. Both the *Fresh Fruit and Vegetable Regulations* and the food-related portions of the FDA and FDR are enforced by the CFIA.

As stated previously, FSAP targeted surveys are primarily conducted for surveillance and not for regulatory compliance verification purposes. However, bacterial pathogens detected in any samples tested under this survey would trigger food safety investigations, including activities such as follow-up sampling, inspections of facilities, and health risk assessments. Depending on the findings of the investigation, a recall of the affected product may be warranted.

## 2 Survey on Cantaloupes

### 2.1 Rationale

Cantaloupes and other melons have been reported to be responsible for numerous outbreaks of foodborne illness worldwide (10). From 1998 to 2010, there were 12 documented outbreaks associated with cantaloupes contaminated with bacterial pathogens (Appendix B). Cantaloupes were also identified as one of the five produce commodities (along with leafy vegetables, leafy herbs, tomatoes, and green onions) attributed to increased produce-associated foodborne disease outbreaks in the U.S. from 1998 to 2006 (11). Furthermore, increased surveillance activities in the U.S. (12) and Canada (13) have triggered several non-outbreak associated recalls between 2008 and 2010 (Appendix C). *Salmonella* is the most commonly identified pathogen in cantaloupe-associated outbreaks of foodborne disease and in recalled cantaloupes in the U.S. and Canada in recent years.

Cantaloupes can become contaminated with pathogens in production, harvest, post-harvest handling, processing and distribution (10). Since cantaloupes sit on top of the soil, they can easily be contaminated with pathogens from the soil through the use of improperly composted manure, contaminated irrigation water, or wildlife feces. Post-harvest handling can also bring cantaloupes into direct contact with pathogens through contaminated processing water or poor hygienic practices of workers handling the cantaloupes (14;15). Once contaminated, the bacteria can be difficult to remove due to the rough surface of the melon which provides areas for bacterial attachment and protection from sanitization (15;16).

Melons including cantaloupes were identified as the second highest priority group of concern in terms of microbiological hazards among fresh fruits and vegetables during a 2007 joint FAO/WHO Experts Meeting (17), based on multiple factors, such as historical outbreaks and the potential for contamination.

Based on the above information and the Food Safety Science Committee's recommendations (3), cantaloupes have been selected for targeted surveillance under FSAP. The overall objective is to gather baseline information on the occurrence of bacterial pathogens of concern in cantaloupes available to Canadians at retail. This targeted survey (2010/11) is part of the information collection with a focus on investigating the presence and distribution of bacterial pathogen *Salmonella* spp. in imported and domestically produced cantaloupes.

## **2.2 Targeted Micro-organism - *Salmonella* spp.**

There are over 2,500 serotypes of *Salmonella* spp., many of which are capable of causing human disease, known as salmonellosis.

*Salmonella* normally live in the intestines of animals such as poultry, swine, wild birds, domestic pets and reptiles. Therefore, *Salmonella* contamination often occurs in food of animal origin (e.g. poultry, eggs, and meat). However, in the last decade, foodborne illnesses of salmonellosis have been increasingly reported to be associated with the consumption of contaminated fruits and vegetables (18). Cantaloupe associated outbreaks of salmonellosis were found mainly resulting from melon contamination with *Salmonella* in the field and/or post-harvest handling (14).

## **2.3 Sample Collection**

All samples were collected from national chain and local/regional grocery stores, other conventional retail and natural food stores located in various cities across Canada. The number of samples collected in the various regions was based on the relative proportion of the population in the respective regions. Domestic samples were collected during the summer months (June-September). Imported samples were collected primarily in the fall, winter, and spring months.

In this survey, a sample consisted of one whole cantaloupe. Collected samples were required to be shipped under conditions that limited the growth of micro-organisms during transit. If issues or questions arose about the conditions in which the sample was shipped, the sample was declared unfit for analysis.

## **2.4 Sample Distribution**

A total of 499 whole cantaloupe samples were collected, including 385 (77.2%) imported and 114 (22.8%) domestically produced cantaloupes.

The imported cantaloupe samples originated from the U.S.(50.9% of imported samples), Guatemala (24.7%), Honduras (11.9%), Costa Rica (7.5%), Mexico (2.6%) and Chile (0.3%). Country of origin could not be identified for eight samples (2.1%).

The domestic samples were obtained from multiple provinces across Canada.



## 2.5 Method Details

All samples were analysed using the analytical methods published in Health Canada's *Compendium of Analytical Methods* for the Microbiological Analysis of Foods (19) (Appendix D). These methods are used for regulatory testing by the CFIA and are fully validated for the analysis of fresh fruits and vegetables, including cantaloupes.

For the detection of *Salmonella*, a two-step procedure was employed. Samples were first screened by polymerase chain reaction (PCR)-based methods. Any presumptive positive results required confirmation by isolation, purification and identification procedures.

If *Salmonella* was detected, the isolate was further characterised by pulsed field gel electrophoresis (PFGE) (i.e., DNA fingerprint) at the CFIA's PFGE Centre. Serotyping for *Salmonella* spp. was performed at the *Salmonella* Typing Laboratory, Laboratory for Foodborne Zoonoses, PHAC.

## 2.6 Assessment Guidelines

No criteria have been established by Health Canada at this time for *Salmonella* in fresh fruits and vegetables. However, in the absence of specified criteria, presence in foods is considered to be a violation of FDA Section 4(1)a and is therefore assessed by the CFIA as unsatisfactory. The assessment criteria presented below (Table 2) are based on principles of the *Health Products and Food Branch Standards and Guidelines for Microbiological Safety of Foods* (20) and associated methods published in Health Canada's *Compendium of Analytical Methods* (19).

**Table 1. Assessment Guidelines for *Salmonella* spp. in Cantaloupes**

<b>Bacterial Analysis*</b> <b>(Method Identification Number)</b>	<b>Assessment Criteria</b>	
	<b>Satisfactory</b>	<b>Unsatisfactory</b>
<b><i>Salmonella</i> spp.</b> (MFLP-29 & MFHPB-20)	Absent	Present

\* *Compendium of Analytical Methods* (19).

Unsatisfactory sample assessments were subject to follow-up actions, such as directed follow-up sampling, inspection of establishment, health risk assessment, and/or product action (e.g., product recall).

## 2.7 Limitations

All samples in this survey were collected at retail. Sampling at retail imposes certain limitations with respect to the traceability of products in the case of positive results. It may not be possible to identify the source of contamination since the samples were collected from bulk or from units pre-packaged at packing facilities or at the retail level.

In addition, sampling under targeted surveys consists of collecting single sample units from partial lots displayed at retail across Canada. The microbial guidelines used to assess these samples were originally designed to assess the compliance of entire lots and are based on the analysis of five sample units. Therefore, when a positive result is obtained for a targeted survey sample, only limited conclusions can be drawn about the safety of the original lot. Further testing may be needed for health risk assessment purposes, and/or to scope the issue.

Imported samples were collected from available products at retail without a requirement for the number of samples to be collected per foreign country. The country of origin could not be identified for some samples based on the information available at retail. In cases of positive results, unsatisfactory rates between countries are not considered to be statistically comparable.

### 3 Results

*Salmonella* spp. were not detected in 99.8% (498/499) of cantaloupe samples (Table 3). One cantaloupe sample (0.2%, 1/499) was found to be contaminated with *Salmonella*. Serotype *S. Michigan* (17.I, v.1,5) was identified from the sample.

**Table 2. Summary of Assessment Results for *Salmonella* spp.**

Product Origin	Number of Samples	Assessment			
		Unsatisfactory		Satisfactory	
		Number of Samples	Percentage of Samples	Number of Samples	Percentage of Samples
<b>Imported</b>	385	1	0.3	384	99.7
<b>Domestic</b>	114	0	0	114	100
<b>Total</b>	<b>499</b>	<b>1</b>	<b>0.2</b>	<b>498</b>	<b>99.8</b>

As a result of this finding, the CFIA conducted a food safety investigation and appropriate follow-up activities. The investigation identified that the contaminated cantaloupe was taken from a bulk bin in a retail store and that the country of origin was not indicated on the cantaloupe. Further investigation found that the cantaloupe likely originated from either the U.S. or Mexico, however, the retail store lacked clear records. The product in this particular retail store was recalled, as a result of the health risk assessment, for which Health Canada was consulted.

### 4 Discussion and Conclusion

Surveillance of cantaloupes under the FSAP was initiated in fiscal year 2008/09. Cantaloupe samples have so far been collected and analysed for bacterial pathogens in three consecutive years: 2008/09, 2009/10, and 2010/11 (Appendix E).

In this survey (2010/11), most (99.8%, 498/499) of the cantaloupe samples tested were not contaminated with *Salmonella*. One cantaloupe sample (1/499, 0.2%) was found to be contaminated with *Salmonella*. The surveillance results suggest that contamination of cantaloupes with *Salmonella* does occur, though at a very low level, in the Canadian market.

As part of the five years of microbiological targeted surveys on cantaloupes, the 2010/11 targeted survey found that of the 499 samples tested:

- *Salmonella* was not detected in the majority of samples (99.8%); and
- one cantaloupe sample (0.2%) was found to be unsatisfactory due to the presence of *Salmonella*.

The CFIA conducted follow-up activities on the unsatisfactory sample, including a food safety investigation. One product was recalled from a particular retail location as a result of this survey. There were no reported illnesses associated with consumption of cantaloupes during this survey.

## **5 Acknowledgement**

We would like to express our sincere thanks to Judy D. Greig, Public Health Agency of Canada for providing the summary of outbreaks (Appendix B).

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## Appendix A: List of Acronyms

**CDC:** Centres for Disease Control and Prevention

**CFIA:** Canadian Food Inspection Agency

**CFU:** colony forming unit

***E. coli:*** *Escherichia coli*

**FAO:** Food and Agriculture Organization of the United Nations

**FDA:** *Food and Drugs Act*

**FDR:** *Food and Drug Regulations*

**FCSAP:** Food and Consumer Safety Action Plan

**FSAP:** Food Safety Action Plan

**GAPs:** Good Agricultural Practices

**GMPs:** Good Manufacturing Practices

**HC:** Health Canada

**MPN:** Most Probable Number

**PCR:** Polymerase Chain Reaction

**PHAC:** Public Health Agency of Canada

***Salmonella spp.:*** *Salmonella* species

**USFDA:** United States Food and Drug Administration

**WHO:** World Health Organization

**°C:** Degree Celsius

**g:** gram

## Appendix B: Global Foodborne Disease Outbreaks Associated with Cantaloupes Contaminated with Bacterial Pathogens (1998-2010)

Year	Country	Province/State	Microorganism	Vehicle	Number of Cases	Number of People Hospitalized	Number of Deaths	Source
1998	Canada	Ontario	<i>Salmonella</i> Oranienburg	Cantaloupe	20			Can Commun Dis Rep. 1998 Nov 15;24:177-8; discussion 178-9)
2000	United States	Multiple	<i>Salmonella</i> Poona	Cantaloupe	47	9		MMWR 2002 Nov 22;51(35):1044-1047
2001	United States	California	<i>Salmonella</i> Poona	Cantaloupe	27			CDC
2001	United States	Multiple	<i>Salmonella</i> Poona	Cantaloupe	50	9	2	MMWR Nov 22, 2002;51(35):1044-1047
2002	United States and Canada	Multiple	<i>Salmonella</i> Poona	Cantaloupe	58	10		MMWR Nov 22, 2002;51(35):1044-1047
2002	United States	Washington State	<i>Salmonella</i> Berta	Cantaloupe	29			CDC
2004	United States	Montana	<i>Escherichia coli</i> 0157:H7	Cantaloupe	6	0		Yellowstone City-County Health Department & ProMed
2006	Australia	New South Wales	<i>Salmonella</i> Saintpaul	Cantaloupe	100			ProMed & GideonOnline
2007	United States	California	<i>Salmonella</i> Litchfield	Cantaloupe	11	6		CDC
2008	Canada	Multiple	<i>Salmonella</i> Litchfield	Cantaloupe	9			CFIA
2008	United States	Multiple	<i>Salmonella</i> Litchfield	Cantaloupe	51			CDC
2009	United States and Canada	Multiple	<i>Salmonella</i> Carrau	Cantaloupe, honeydew, watermelon (suspect)	US: 32 cases, Canada: 35 cases			PHAC 2009

Prepared by Judy D. Greig, Public Health Agency of Canada



## Appendix C: Cantaloupe Recalls in the U.S. and Canada (2008-2010)

Date of Issue	Recalled Products	Reason for Recall	Authority
2008-03-22, 25, 26 (3 recalls)	Whole and cut cantaloupes	<i>Salmonella</i> spp.	CFIA
2008-03-22, 26, 27, 28 (11 recalls)	Whole and cut cantaloupes	<i>Salmonella</i> spp.	USFDA
2008-06-02*	Whole cantaloupes	<i>Salmonella</i> spp.	CFIA
2009-08-27	Whole cantaloupes	<i>Salmonella</i> spp.	USFDA
2010-10-21	Whole cantaloupes	<i>Salmonella</i> spp.	USFDA
2010-12-13*&**	Whole cantaloupes	<i>Salmonella</i> spp.	CFIA

\* These recalls resulted from positive samples collected under FSAP targeted surveys.

\*\* This product recall was limited to one store.

## Appendix D. Analytical Methods Used for Microbial Analysis

Bacterial Analysis	Method Identification Number (Date Issued)	Title of Method*
<i>Salmonella</i> spp.	MFLP-29 (July 2007, modified)	The Qualicon Bax® System Method for the Detection of <i>Salmonella</i> in a Variety of Food and Environmental Samples
	MFHPB-20 (March 2009)	Methods for the Isolation and Identification of <i>Salmonella</i> from Foods and Environmental Samples

\**Compendium of Analytical Methods* (19).

## Appendix E. Summary of the CFIA Surveillance on Cantaloupes (2008/09 - 2010/11)

Survey year	Number of Cantaloupe Samples	Targeted Bacterial Pathogens		
		<i>Salmonella</i>	<i>Shigella</i>	<i>E. coli</i> O157
		Number of Unsatisfactory Sample (Percentage)	Number of Unsatisfactory Sample (Percentage)	Number of Unsatisfactory Sample (Percentage)
2008/09	558 whole (all imported)	1 (0.2%)	0	0
2009/10	895 whole (593 imported, 302 domestic); 312 fresh-cut (all imported)	0	0	Not tested
2010/11	499 whole (385 imported, 114 domestic)	1 (0.2%)	Not tested	Not tested