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Agence canadienne
d'inspection des aliments

2021/22 Annual Report

National Microbiological Monitoring Program



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Summary

The Canadian Food Inspection Agency (CFIA) develops and delivers programs and services designed to protect Canadians from preventable food safety hazards. The CFIA works to ensure that food safety emergencies are effectively managed, that the public is aware of and contributes to food safety, and that consumers and the marketplace are protected from unfair practices. Canada's food safety requirements apply equally to the domestic and imported food sectors.

The National Microbiological Monitoring Program (NMMP) is a food surveillance program managed by the CFIA to verify industry compliance with microbial standards, facilitate access of Canadian food products to international markets, provide information on the effectiveness of food safety control measures and interventions, and maintain consumer confidence in the safety of the food supply. Under the NMMP, a broad range of imported and domestic food products are sampled by CFIA inspectors. These food products are frequently sampled at federal licence holding establishments (i.e., those that produce food products that are exported or traded inter-provincially), which are inspected by CFIA inspectors, but samples may also be collected at other establishment types, such as warehouses, distribution centres, and wholesalers.

Food products of the following commodities were tested under the NMMP in the 2021/22 sampling year (April 1, 2021 to March 31, 2022): red meat and poultry products, egg products, dairy products, fresh fruits and vegetables, processed fruit and vegetable products and fish and seafood. Food-hazard combinations, i.e. specific microorganisms in specific foods that are recognized to occur and whose presence indicates a food safety concern, deemed to pose the greatest potential health risks, recent outbreaks of foodborne illnesses, emerging food-hazard combinations and historical levels of compliance are taken into consideration when selecting foods for testing under NMMP monitoring sampling plans. Under the NMMP, environmental sampling was also performed at federal licence holding establishments to verify the producer's ability to control the presence of pathogens within the processing environment and confirm that food products are produced under sanitary conditions.

All product and environmental samples collected under the NMMP were tested at CFIA laboratories to verify industry compliance with food microbiological safety and quality standards. All samples were subject to follow-up actions by both industry and the CFIA. Such follow-up actions could include follow-up inspections, additional sampling, product disposal, corrective action requests, food safety investigations, product recalls, etc.

In the 2021/22 sampling year, 10,745 tests were performed on 4,720 domestic and imported food products collected from under the NMMP to verify compliance with food safety standards. Specifically, 7,898 tests were performed on 3,766 domestic products and 2,847 tests were performed on 954 imported products. Results indicated that domestic products were 99.0 % satisfactory whereas

imported products were 97.7 % satisfactory. Overall, a 98.8 % satisfactory rate was observed for combined domestic and imported products. In addition, there were 1,656 tests performed on 1,397 environmental samples, which were assessed as 97.1 % satisfactory.

The results of the 2021/22 NMMP sampling activities indicated that the vast majority of food products available in Canada during the 2021/22 sampling year (April 1, 2021 to March 31, 2022) were compliant with food safety standards. The few non-compliant samples that were detected resulted in follow-up actions by the CFIA and industry. These actions allowed the CFIA to continue to safeguard Canada's food system and the health and well-being of Canadians.

Food safety is a collective responsibility of government, industry and consumers. All food producers/importers are responsible under Canadian law for the safety of the food they produce and distribute. In 2021/22, under the NMMP, the CFIA tested food and environmental samples to verify that they met their obligations. Follow-up actions taken by both industry and the CFIA acted to improve Canadian manufacturing processes and identify imported products that did not meet Canadian standards.

What is the NMMP?

The National Microbiological Monitoring Program (NMMP) is a food surveillance program managed by the CFIA to verify industry compliance with microbial standards, facilitate access of Canadian food products to international markets, provide information on the effectiveness of food safety control measures and interventions, and maintain consumer confidence in the safety of the food supply. Under the NMMP, a broad range of imported and domestic food products are sampled at federal licence holding establishments (i.e., those that produce food products that are exported or traded inter-provincially), which are inspected by CFIA inspectors, but samples may also be collected at other establishment types, such as warehouses, distribution centres, and wholesalers.

All NMMP samples were tested at CFIA laboratories to verify industry compliance with food microbiological safety and quality standards. All samples were subject to appropriate follow-up actions by both industry and the CFIA e.g., follow-up inspection, additional sampling, product disposal, corrective action requests, food safety investigations, product recalls, etc.

In addition to the NMMP, the CFIA also manages the Targeted Survey Program, another food microbiology surveillance program which operates at the retail level. While the NMMP monitors known food-hazard combinations, the purpose of Targeted Surveys is to generate baseline information on the occurrence of additional potential hazards in foods. Should a food-hazard combination be identified under these Targeted Surveys, the food product may be subsequently monitored under the NMMP.

What was sampled?

In the 2021/22 sampling year, domestic and imported food products of the following commodities were tested: red meat and poultry products, eggs and egg products, dairy products, fresh fruits and vegetables, processed fruit and vegetable products, and fish and seafood. For the purpose of this report, domestic food products included unprocessed or minimally processed food products that were grown/ raised in Canada and food products that were processed or manufactured in Canada. Imported food products included unprocessed or minimally processed food products that were grown/ raised outside of Canada and food products that were processed or manufactured outside of Canada.

Food products within these commodities were selected for testing on the basis of known food-hazard combinations, i.e. specific microorganisms in specific foods that are recognized to occur and whose presence indicates a food safety concern. The number of samples that were taken for each product depended on various factors, including the number of establishments producing the food product, whether the food product would be consumed directly or would undergo further preparation, historical compliance levels, market access requirements, etc.

Sampling of imported food was performed at points of entry and distribution facilities, therefore test results of imported foods reflected the conditions the foods were exposed to during processing, handling and storage. Imported foods are required to meet the same safety standards as domestic products.

In addition to sampling domestic and imported food products, the CFIA also tested environmental samples collected from domestic food processing environments to verify the producer's ability to control the presence of pathogens within the processing environment and that food products were produced under sanitary conditions.

The CFIA's role is to provide oversight and verify that the industry is producing safe food and complying with standards in place. Industry is responsible for implementing controls and practices, which may include sampling and testing programs, to ensure that all food they produce or import into Canada is safe. Therefore, the CFIA does not test all imported or domestically produced lots of food. In the 2021/22 sampling year, a randomized strategy was employed under the NMMP to test representative samples of these foods.

What tests were performed?

Food and environmental samples collected under the NMMP were tested for microorganisms associated with known food-hazard combinations or manufacturing processes. Certain food samples were also tested for physicochemical properties or non-microbial indicators (see below). The majority of methods used for testing are found in Health Canada's Compendium of Analytical Methods (Health

Canada, 2008a). Non-compendium or modified versions of compendium methods were also used when appropriate. These methods included both rapid screening and confirmatory methods.

Pathogens are microorganisms that can cause illness when consumed. Samples collected under the NMMP were tested for the following pathogens in the 2021/22 sampling year: *Escherichia coli* O157:H7, *Staphylococcus aureus*, *Listeria monocytogenes*, *Salmonella* spp., *Vibrio parahaemolyticus*, *Trichinella spiralis* and *Cyclospora* spp.

Indicator organisms are microorganisms that do not cause illness but may be associated with pathogens or unsanitary practices. The presence of high levels of indicator organisms does not always imply the existence of a food-related health hazard but can expose unsanitary practices and conditions under which pathogens could contaminate food products. The following indicator organisms were tested by the NMMP in the 2021/22 sampling year: generic *E. coli*, *Listeria* spp., coliforms and Aerobic Colony Counts (ACC).

Physiochemical characteristics of foods are evaluated to assess the ability of such foods to support microbial growth. The physiochemical indicators tested for under the NMMP in the 2021/22 sampling year were pH and water activity.

Lastly, non-microbial indicators are not designed to determine the presence or absence of microorganisms. These criteria are used to obtain information pertaining to other aspects of food safety. Such tests may be performed to identify manufacturing processes that could support the introduction of potential food safety hazards. The following non-microbial indicators were tested for under the NMMP in the 2021/22 sampling year: presence of central nervous system tissue, meat species verification and phosphatase testing.

How were samples assessed?

Microbial test results are assessed using assessment criteria specific to a food type and test of interest. These assessment criteria set clear limits in determining if food products are safe for consumption and/or produced under conditions compliant with food standards. In Canada, Health Canada's Standards and Guidelines for Microbiological Safety of Food – An Interpretive Summary (Health Canada, 2008b) contains microbiological assessment criteria based on current regulatory standards and guidelines. Additional information on assessment criteria is also found in Health Canada's Policies on *Listeria monocytogenes* in Ready-to-Eat Foods (Health Canada, 2011) and *E. coli* O157:H7 and *E. coli* O157:NM in Raw Beef (Health Canada, 2014). International standards, such as those outlined by the International Commission on Microbiological Specifications for Foods (ICMSF), may also provide information on microbiological assessment criteria when appropriate (ICMSF, 2011).

Microbial assessment criteria for *L. monocytogenes* in ready-to-eat (RTE) food products in Canada are based upon Health Canada's Policy on *Listeria monocytogenes* in Ready-to-Eat Foods (Health Canada,

2011). This policy assigns a risk classification of RTE foods according to consumer risk. Category 1 RTE foods are those foods which can support the growth of *L. monocytogenes*. Category 2A RTE foods are those foods in which limited growth of *L. monocytogenes* to levels not greater than 100 CFU/g can occur throughout the stated shelf-life. Category 2B RTE foods are those foods in which the growth of *L. monocytogenes* cannot occur throughout the expected shelf-life of that food. As such, the assessment criteria specific to *L. monocytogenes* in RTE foods differ depending on the food category.

Assessment criteria for NMMP samples are shown in the Appendix. On the basis of these assessment criteria, samples tested were considered satisfactory, unsatisfactory or investigative. A satisfactory result indicated that there were no concerns identified with the food as all test results were considered acceptable by the assessment criteria. An unsatisfactory result indicated that one or more test results were considered unacceptable by the assessment criteria and the sample therefore did not meet regulatory standards and guidelines. An investigative result indicated that the sample may be satisfactory but that further information was required to make this determination. Thus, appropriate follow-up actions were taken in response to both unsatisfactory and investigative samples.

At the time of writing this report, no assessment guidelines had been established in Canada for parasites in fresh produce. In addition, the analytical methods used to analyse these samples only detected the presence of parasite genetic material and could not discriminate between viable (potentially infectious) and non-viable (non-infectious) parasites. The detection of parasite genetic material was therefore assessed as investigative, indicating that further consideration was warranted to determine which follow-up actions would be the most appropriate.

The number of samples of each food type and analyte tested and their assessment results, including their % satisfactory rates, were reported. Note that % satisfactory rates were calculated by dividing all satisfactory samples by total samples tested. As mentioned above, an investigative result indicates that the sample may be satisfactory, but that further information is required to make this determination. Therefore, the calculated % satisfactory rates may under-estimate the actual proportions of tested products that are satisfactory. The significance of % satisfactory rates derived from small numbers of samples/tests should be interpreted with caution. For this report, we considered that this included % satisfactory rates derived from fewer than 50 samples.

What were the 2021/22 NMMP results for red meat and poultry products?

i) **Ready-to-eat meat products**

Ready-to-eat meats are defined as meat products that have been subjected to a process sufficient to control and/or inactivate microorganisms so that they do not require further preparation before consumption except washing, thawing or exposing to sufficient heat to warm the products without cooking them. Ready-to-eat meats have been associated with foodborne illness due to recontamination from raw or undercooked products or exposure to environmental contaminants while being handled in processing establishments, catering establishments and in the home kitchen.

Under the NMMP in 2021/22, RTE meat products were sampled and tested for the following pathogens of concern: *Salmonella* spp., *L. monocytogenes* and *E. coli* O157:H7 (only on fermented RTE products containing beef). Additional RTE meat products were tested for *Listeria* spp. only. A total of 1,048 domestic samples were tested and determined to be 99.3 % satisfactory (Table 1). One domestic Category 1 product, a chicken pot pie, was assessed as unsatisfactory due to detection of *L. monocytogenes*, and one domestic Category 1 product, a beef tartar, was assessed unsatisfactory due to the detection of *Salmonella* spp. Additionally, five Category 2B products were assessed as investigative due to the detection of low levels (≤ 100 CFU/g) of *L. monocytogenes*: pepperoni, chicken Pad Thai, butter chicken, and two salami products.

An additional 77 imported RTE meat products were tested, the majority of which originated from Italy, Spain, France and the United States (Figure 1). The imported products tested were 98.7 % satisfactory (Table 1). One Category 2B product, a salami from Italy, was assessed as investigative due to the detection of low levels (≤ 100 CFU/g) of *L. monocytogenes*.

Table 1: Assessment of domestic and imported ready-to-eat meat products sampled under the NMMP in 2021/22.

Analysis	# Tests	# Satisfactory	# Investigative ^a	# Unsatisfactory	% Satisfactory ^b
Domestic					
<i>E. coli</i> O157:H7	9	9	n/a	0	100 ^c
<i>L. monocytogenes</i>	1048	1042	5	1	99.4
<i>Salmonella</i> spp.	434	433	n/a	1	99.8
Total domestic product samples	1048	1041	5	2	99.3
Imported					
<i>E. coli</i> O157:H7	0	0	n/a	0	n/a

<i>L. monocytogenes</i>	77	76	1	0	98.7
<i>Salmonella</i> spp.	77	77	n/a	0	100
Total imported product samples	77	76	1	0	98.7
Total samples	1125	1117	6	2	99.3

^a n/a = not applicable. The investigative assessment does not apply.

^b % satisfactory is calculated by dividing all satisfactory samples by total samples tested, and an investigative result indicates a sample may be satisfactory, but further information is required to make the determination. Thus, calculated % satisfactory rate may under-estimate the actual proportion of tested products that are satisfactory.

^c Due to small sample/test number, the significance of the % satisfactory rate should be interpreted with caution.

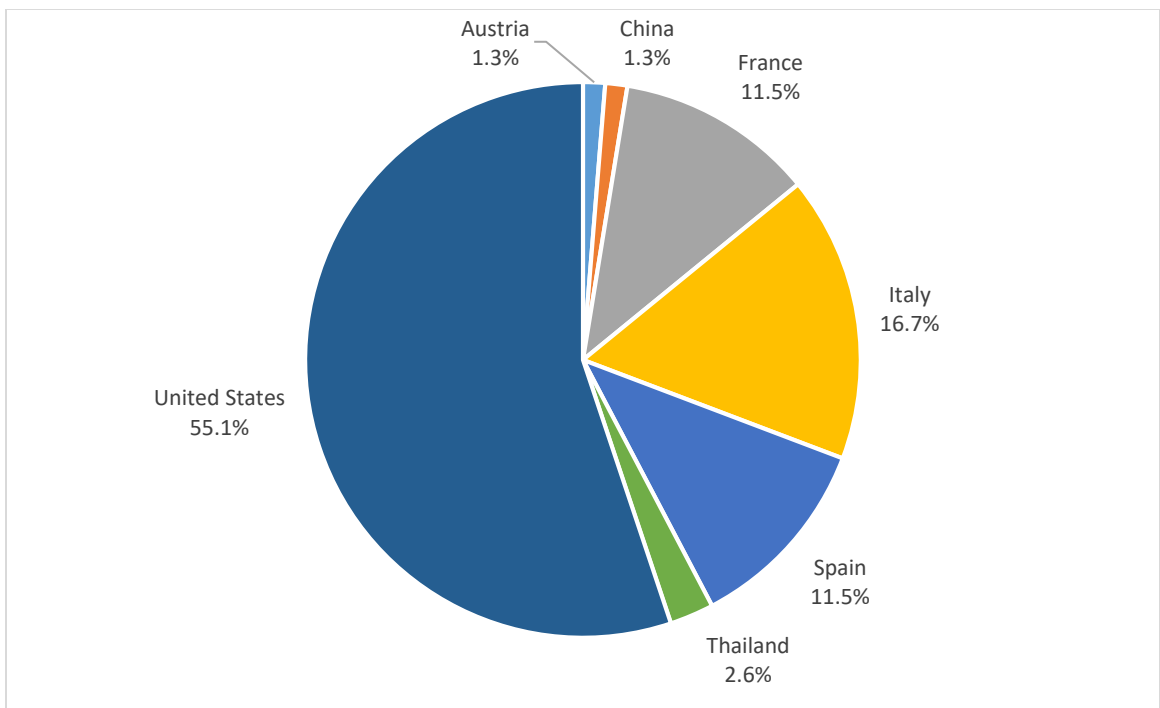


Figure 1. Percent distribution of imported ready-to-eat meat products analyzed by country of origin (n=77).

ii) Precursor materials and raw ground beef/veal

Precursor materials include any raw beef or veal products intended to be used for production of finished raw ground beef/veal products (i.e., raw ground beef/veal). This includes, but is not limited to, trims, bench trims, boneless beef, course ground beef, hearts, head meat, cheek meat, tongue roots and weasand meat. It also includes primal cuts, such as chucks, if they are intended to be used for production of finished raw ground beef/veal products. Pathogens, such as *E. coli* O157:H7 can contaminate the outer surfaces of whole intact pieces of precursor materials during slaughter and this

contamination may be introduced into raw ground beef/veal during grinding. Illness due to *E. coli* O157:H7 have occurred in ground beef/veal products that were not fully cooked.

Under the NMMP in 2021/22, precursor materials and raw ground beef/veal were sampled and tested for *E. coli* O157:H7 and generic *E. coli*. A total of 674 domestic precursor material samples and 602 domestic raw ground beef/veal samples were tested with a combined satisfactory rate of 98.8 % (Table 2). Of the domestic product samples, one sample of raw ground beef was assessed as unsatisfactory due to the detection of *E. coli* O157. Additionally, two precursor material samples and 12 raw ground beef product samples were assessed as investigative due to the detection of elevated levels of generic *E. coli* (> 100 CFU/g).

An additional 37 imported precursor material samples and 15 imported raw ground beef/veal samples from Australia, Chile, Denmark, Ireland, Italy, Mexico, New Zealand, Spain, the United Kingdom, the United States and Uruguay were tested (Figure 2). The imported products tested were 94.2 % satisfactory (Table 2). One imported precursor material sample and two samples of imported raw ground beef were assessed as investigative due to the detection of elevated levels of generic *E. coli* (> 100 CFU/g). No *E. coli* O157:H7 was detected in any of the imported products. (Table 2).

Table 2: Assessment of domestic and imported precursor material and raw ground beef/veal sampled under the NMMP in 2021/22.

Analysis	# Tests	# Satisfactory	# Investigative ^a	# Unsatisfactory ^b	% Satisfactory ^c
Domestic Precursor Material					
<i>E. coli</i> O157:H7	674	674	n/a	0	100
Generic <i>E. coli</i>	674	672	2	n/a	99.7
Domestic Raw Ground Beef/ Veal					
<i>E. coli</i> O157:H7	602	601	n/a	1	99.8
Generic <i>E. coli</i>	602	590	12	n/a	98.0
Total domestic product samples	1276	1261	14	1	98.8
Imported Precursor Material					
<i>E. coli</i> O157:H7	37	37	n/a	0	100 ^d
Generic <i>E. coli</i>	37	36	1	n/a	97.3 ^d
Imported Raw Ground Beef/ Veal					
<i>E. coli</i> O157:H7	15	15	n/a	0	100 ^d
Generic <i>E. coli</i>	15	13	2	n/a	86.7 ^d
Total imported product samples	52	49	3	0	94.2

Total samples	1328	1310	17	1	98.6
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^a n/a = not applicable. The investigative assessment does not apply.

^b n/a = not applicable. The unsatisfactory assessment does not apply.

^c % satisfactory is calculated by dividing all satisfactory samples by total samples tested, and an investigative result indicates a sample may be satisfactory, but further information is required to make the determination. Thus, calculated % satisfactory rate may under-estimate the actual proportion of tested products that are satisfactory.

^d Due to small sample/test number, the significance of the % satisfactory rate should be interpreted with caution.

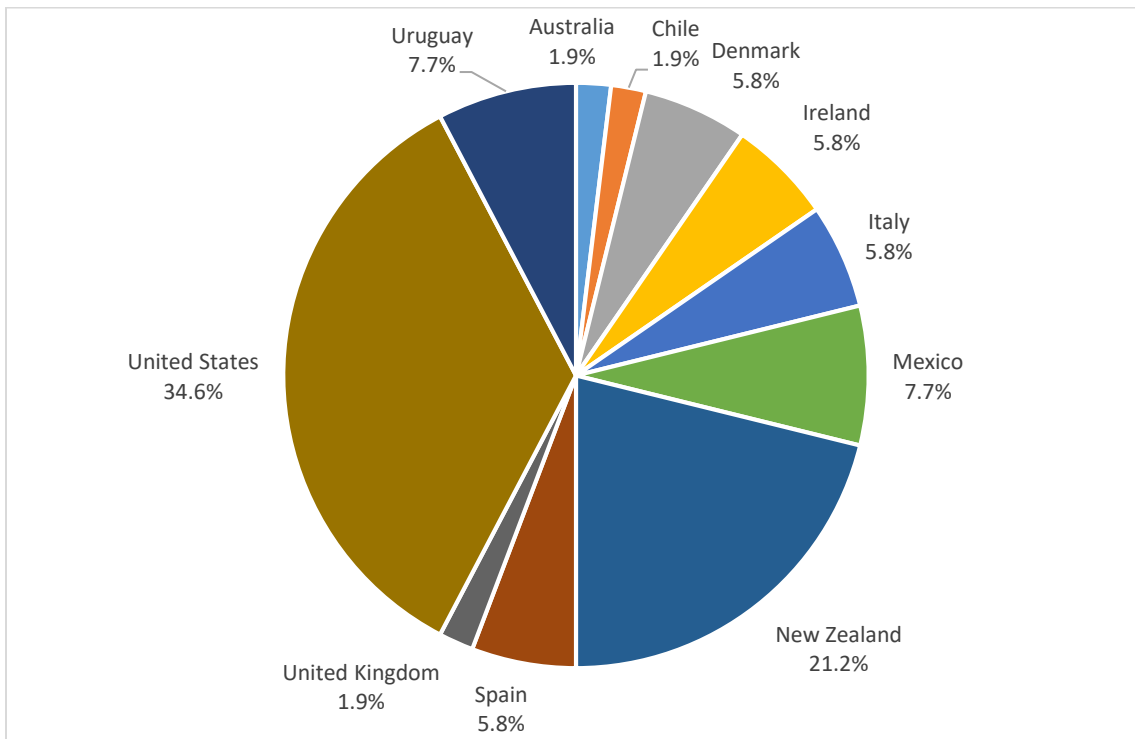


Figure 2. Percent distribution of imported precursor material and raw ground beef/veal analyzed by country of origin (n=52).

iii) Raw mechanically separated beef and finely textured beef

Mechanically separated beef and finely textured beef are edible beef products obtained by mechanically separating most of the bone and cartilage from portions of beef from which the bone and cartilage have not been previously removed. Bovine Spongiform Encephalopathy (BSE), more commonly known as Mad Cow Disease, is a progressive, degenerative neurological disease. The BSE prion is able to infect humans, causing variant Creutzfeldt-Jakob Disease (vCJD; FDA, 2012), through human consumption of contaminated meat products from BSE-infected cattle. Since BSE may be present in central nervous system (CNS) tissue of BSE-infected cattle, the spinal cord is removed from beef carcasses and portions of beef prior to their use as material for mechanical separation (CFIA, 2019). The CFIA tests domestic mechanically separated and finely textured beef products to verify the

absence of CNS tissue. Although detection of CNS tissue in a meat product does not necessarily mean the BSE prion is present, detection of CNS tissue is a trigger for follow up actions to ensure that the establishment in question is producing this type of product in a manner that meets Canadian standards.

In 2021/22, 22 domestic mechanically separated beef and finely textured beef samples were tested under the NMMP for the presence of CNS tissue, all of which were determined to be satisfactory.

iv) Raw pork and wild boar

Human infection by the parasitic roundworm *Trichinella spiralis* is traditionally associated with ingestion of infected raw and undercooked pork. Because of modern production methods of raising pigs in confinement and high quality feed, *T. spiralis* is rare in Canadian domestic swine populations. However, precautions must remain in effect due to the presence of *T. spiralis* in wildlife and the potential for its sporadic transfer to domestic herds. Government testing for *T. spiralis* in commercial pork and wild boar establishments also supports the Canadian pork industry's continued access to international markets.

Under the NMMP in 2021/22, market hogs, breeder hogs and wild boar were tested for *T. spiralis*. The analytical methodology for testing *T. spiralis* in pork allows for tissues from up to 100 animals to be pooled and submitted for analysis. A total of 337 samples, representing 29,984 individual animals, were tested under the NMMP in 2021/22. *T. spiralis* was not detected in any of these samples.

v) Meat species verification

Meat species verification is conducted on meat products to detect the presence of meat species not listed on the product label. In some cases, an operator may fraudulently substitute less expensive types of meat for some or all of the more expensive meat declared on the label. In other cases, the presence of other meat species may occur due to improper cleaning of equipment and contamination during processing, thus from a food safety perspective, species verification is performed to assess the effectiveness of sanitation procedures within the establishment.

The CFIA performs meat species verification on domestic and imported meat products. Products with label claims indicating they are composed of a single species or a combination of specific species are tested to verify these label claims. Selected products are those that have been ground to the point where it is impossible to determine through visual examination what species has been used. This includes raw ground meat products, RTE products and other products which have received heat treatment.

In 2021/22, 57 domestic meat products and 31 imported meat products, the majority originating from the United States (Figure 3), were tested to verify the meat species claimed. All samples were assessed as satisfactory.

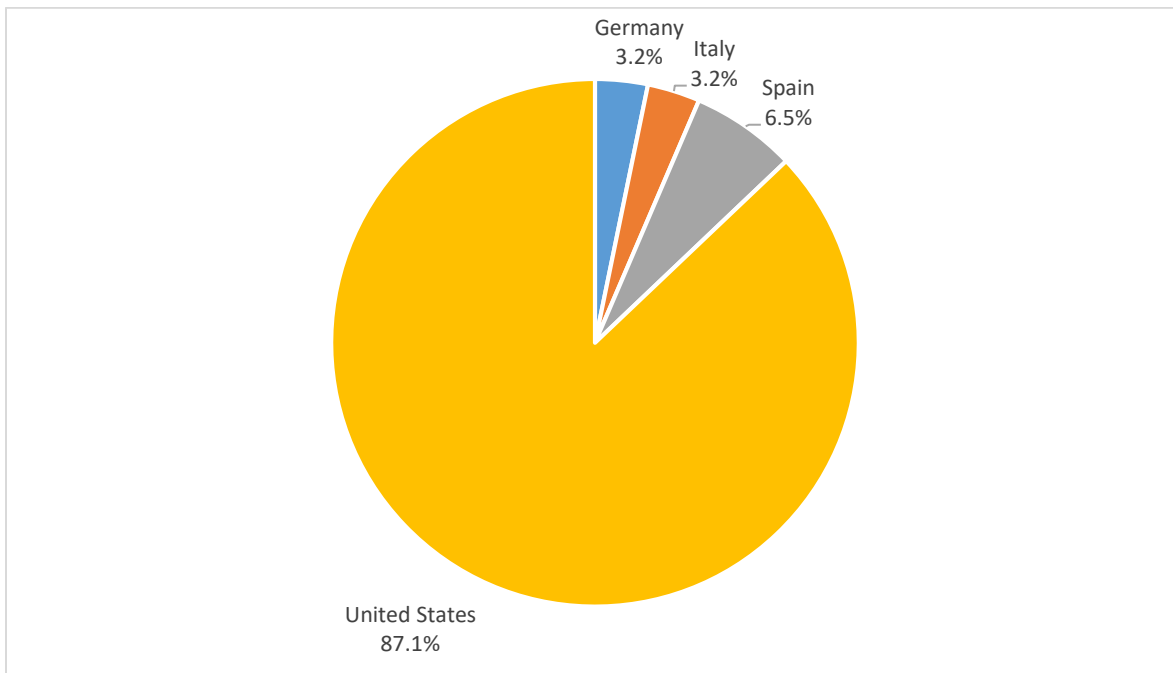


Figure 3. Percent distribution of imported meat products analyzed by country of origin (n=31).

vi) Environmental testing in ready-to-eat meat establishments

Environmental testing is also carried out at domestic federal licence holding establishments producing RTE meat products to verify the establishment's ability to control the presence of *Listeria* spp. within the processing environment. Surfaces within the RTE meat product establishments are swabbed during production, and the swabs are composited and tested for *Listeria* spp. If *Listeria* spp. are detected in an environmental sample, the sample is further tested to determine if *L. monocytogenes* is present.

In 2021/22, 980 environmental samples, representing approximately 9,800 food contact surfaces, were tested for *Listeria* spp. under the NMMP. Fifteen of the samples were assessed as unsatisfactory due to the detection of *L. monocytogenes*. Nineteen of the samples were assessed as investigative due to the presence of indicator organisms, i.e. *Listeria* spp. other than *L. monocytogenes*. The satisfactory rate was determined to be 96.5 %.

vii) % satisfactory history

The historical % satisfactory rates of domestic and imported red meat and poultry products and environmental samples tested under the NMMP between April 1, 2018 and March 31, 2022 are summarized in Table 3. Consistently high % satisfactory rates were observed in most samples of RTE meat products, precursor materials and raw ground beef/veal, raw pork and wild boar, meat species verification and in environmental samples.

Table 3: Historical percent satisfactory rates of red meat and poultry product and environmental samples.^a

	2021/22	2020/21	2019/20	2018/19
Ready-to-eat meat products	99.3 % (1125)	99.6 % (1063)	99.5 % (1150)	99.5 % (1128)
Precursor materials and raw ground beef/veal	98.6 % (1328)	98.0 % (1125)	99.0 % (1363)	99.0 % (1426)
Raw mechanically separated and finely textured beef	100 % (22) ^b	94.1 % (34) ^b	95.8 % (24) ^b	92.0 % (25) ^b
Raw pork and wild boar	100 % (337)	100 % (291)	100 % (319)	100 % (328)
Meat species verification	100 % (88)	95.5 % (67)	100 % (53)	100 % (20) ^b
Environmental testing	96.5 % (980)	98.4 % (901)	97.7 % (987)	97.5 % (957)

^a % satisfactory is calculated by dividing all satisfactory samples by total samples tested, and an investigative result indicates a sample may be satisfactory, but further information is required to make the determination. Thus, calculated % satisfactory rate may under-estimate the actual proportion of tested products that are satisfactory.

^b Due to small sample/test number, the significance of the % satisfactory rate should be interpreted with caution.

What were the 2021/22 NMMP results for eggs and egg products?

i) Egg products

Egg products include all frozen, liquid, or dried egg products which are subjected to the process of pasteurization. In addition to *Salmonella* spp., which are associated with shell eggs, other microorganisms may be introduced during the production of egg products.

Under the NMMP in 2021/22, domestic and imported egg products were tested for ACC, coliforms, *L. monocytogenes* and *Salmonella* spp. A total of 256 domestic egg products were tested, of which 99.2 % were satisfactory (Table 4). Two samples (one liquid whole egg and one dried whole egg) were assessed as unsatisfactory due to the presence of high coliform levels. Additionally, five imported egg products were tested, of which 100 % were satisfactory.

Table 4: Assessment of domestic and imported processed egg products sampled under the NMMP in 2021/22.

Analysis	# Tests	# Satisfactory	# Investigative ^a	# Unsatisfactory	% Satisfactory ^b
Domestic					
ACC	219	219	n/a	0	100
Coliforms	219	217	n/a	2	99.1
<i>L. monocytogenes</i>	256	256	0	0	100
<i>Salmonella</i> spp.	256	256	n/a	0	100
Total domestic product samples	256	254	0	2	99.2
Imported					
ACC	5	5	n/a	0	100 ^c
Coliforms	5	5	n/a	0	100 ^c
<i>L. monocytogenes</i>	5	5	0	0	100 ^c
<i>Salmonella</i> spp.	5	5	n/a	0	100 ^c
Total imported product samples	5	5	0	0	100 ^c
Total samples	261	259	0	0	99.2

^a n/a = not applicable. The investigative assessment does not apply.

^b % satisfactory is calculated by dividing all satisfactory samples by total samples tested, and an investigative result indicates a sample may be satisfactory, but further information is required to make the determination. Thus, calculated % satisfactory rate may under-estimate the actual proportion of tested products that are satisfactory.

^c Due to small sample/test number, the significance of the % satisfactory rate should be interpreted with caution.

ii) Environmental testing in domestic shell egg grading stations and egg product processing establishments

Environmental testing of surfaces is carried out at domestic federal licence holding establishment for shell egg grading stations and egg product processing to verify the operator systems' ability to control contaminants within the processing environment.

At shell egg grading stations in Canada, eggs are washed, checked for cracks, weighed, sorted and packaged. Within these domestic shell egg grading stations, surfaces from both graded and ungraded product areas within the establishments were swabbed under the NMMP in 2021/22, and the swabs from each area were composited and tested for *Salmonella* spp. A total 354 tests for *Salmonella* spp. were performed on 177 composited environmental samples (food contact and non-food contact surfaces) (Table 5), representing approximately 1,770 surfaces within the shell egg grading establishments. Samples were assessed as 98.9 % satisfactory.

Processed egg products are produced at egg product processing establishments in Canada. In domestic egg product processing establishments, surface swabs are taken on food contact surfaces and non-food contact surfaces along the manufacturing line, both prior to production and during production. Samples taken prior to production were tested for *Salmonella* spp., while samples taken during production were tested for *Salmonella* spp. and *Listeria* spp. If *Listeria* spp. were detected, the sample was further tested to determine if *L. monocytogenes* is present. Under the NMMP in 2021/22, 41 environmental samples, representing approximately 410 surfaces from both raw and finished product areas within the processing establishments, were subjected to 41 tests for *Listeria* spp. and 82 tests for *Salmonella* spp. (Table 5). The overall satisfactory rate was 100 %.

In total, in 2021/22, 218 environmental samples were tested with an overall satisfactory rate of 99.1 %.

Table 5: Assessment of environmental samples from domestic shell egg grading stations and egg product processing establishments sampled under the NMMP in 2021/22.

Analysis	# Tests	# Satisfactory	# Investigative ^a	# Unsatisfactory	% Satisfactory ^b
Shell egg grading station environmental swabs					
<i>Salmonella</i> spp.	354	352	n/a	2	99.4
Total egg grading station samples	177	175	n/a	2	98.9
Egg processing establishment environmental swabs					
<i>L. monocytogenes</i>	41	41	0	0	100 ^c
<i>Salmonella</i> spp.	82	82	n/a	0	100
Total egg processing samples	41	41	0	0	100 ^c
Total environmental samples	218	216	0	2	99.1

^a n/a = not applicable. The investigative assessment does not apply.

^b % satisfactory is calculated by dividing all satisfactory samples by total samples tested, and an investigative result indicates a sample may be satisfactory, but further information is required to make the determination. Thus, calculated % satisfactory rate may under-estimate the actual proportion of tested products that are satisfactory.

^c Due to small sample/test number, the significance of the % satisfactory rate should be interpreted with caution.

iii) % satisfactory history

The historical % satisfactory rates of domestic and imported egg products and environmental samples tested under the NMMP between April 1, 2018 and March 31, 2022 are summarized in Table 6. % satisfactory rates for both product and environmental samples were consistent over the years.

Table 6: Historical percent satisfactory rates of egg product and environmental samples.^a

	2021/22	2020/21	2019/20	2018/19
Egg products	99.2 % (261)	100 % (127)	98.3 % (292)	100 % (334)
Environmental testing	99.1 % (218)	100 % (78)	96.6 % (496)	96.4 % (580)

^a % satisfactory is calculated by dividing all satisfactory samples by total samples tested, and an investigative result indicates a sample may be satisfactory, but further information is required to make the determination. Thus, calculated % satisfactory rate may under-estimate the actual proportion of tested products that are satisfactory.

What were the 2021/22 NMMP results for dairy products?

i) Flavoured fluid milk products

Flavoured fluid milk products were targeted for testing in 2021/22. Imported fluid milk represents only about 1 % of what is consumed by Canadians (Catford *et al*, 2014); therefore only domestic flavoured fluid milk products were tested under the NMMP.

Under the NMMP in 2021/22, flavoured fluid milk products at domestic dairy producers were tested for generic *E. coli*, *L. monocytogenes* and ACC. A total of 60 domestic flavoured fluid milk products were tested with an overall satisfactory rate of 98.3 %. One sample was unsatisfactory due to high levels of generic *E.coli* (Table 7).

Table 7: Assessment of domestic flavoured fluid milk products sampled under the NMMP in 2021/22.

Analysis	# Tests	# Satisfactory	# Investigative ^a	# Unsatisfactory	% Satisfactory ^b
ACC	59	59	n/a	0	100

Generic <i>E. coli</i>	60	59	n/a	1	98.3
<i>L. monocytogenes</i>	60	60	n/a	0	100
Total samples	60	59	n/a	1	98.3

^a n/a = not applicable. The investigative assessment does not apply.

^b % satisfactory is calculated by dividing all satisfactory samples by total samples tested, and an investigative result indicates a sample may be satisfactory, but further information is required to make the determination. Thus, calculated % satisfactory rate may under-estimate the actual proportion of tested products that are satisfactory.

ii) Cheese products

Cheese is a manufactured product for which microbial contamination may be introduced during handling and fermentation. A broad range of types of cheeses made from various milk sources, of various moisture contents and using various manufacturing techniques are tested. Because the microbial contaminants in cheese products made from pasteurized milk and those made from raw milk may differ, the sampling results for these two categories of cheese products will be presented separately.

Under the NMMP in 2021/22, domestic and imported cheeses were sampled and tested for generic *E. coli*, *Salmonella* spp., *L. monocytogenes*, and *S. aureus*. In addition, *E. coli* O157:H7 testing was performed on cheeses claimed to be made from raw milk, and phosphatase testing was performed, when deemed appropriate, to verify claims of pasteurization.

A total of 309 domestic pasteurized milk cheeses were tested and determined to be 99.7 % satisfactory (Table 8). One sample of halloumi cheese was assessed as unsatisfactory due to the presence of generic *E. coli*. In addition, 199 samples of imported pasteurized milk cheeses were tested and found to be 93.5 % satisfactory (Table 8). The largest proportion of these samples were from Italy, France, Greece and the United States, but numerous other countries were also represented (Figure 4). Of the imported cheeses, three Category 1 cheese samples (a taleggio cheese, a burrata cheese and a blue cheese from Italy) were unsatisfactory due to the detection of *L. monocytogenes*. One other Category 1 cheese sample (a kefalograviera cheese from Greece) was unsatisfactory due to the detection of both *L. monocytogenes* and high levels of generic *E. coli*. An additional imported cheese sample, a kefalotyri cheese from Greece, was assessed unsatisfactory due to both high levels of *S. aureus* and high levels of generic *E. coli*. Eight cheese samples (four from Italy, two from Greece, one from France and one from Denmark) were unsatisfactory due to detection of high levels of generic *E. coli*. These cheeses included havarti, stracciatella, graviera, myzithra, burrata, and semi-soft cheese.

Table 8: Assessment of domestic and imported pasteurized milk cheeses sampled under the NMMP in 2021/22.

Analysis	# Tests	# Satisfactory	# Investigative ^a	# Unsatisfactory	% Satisfactory ^b
Domestic					
Generic <i>E. coli</i>	309	308	n/a	1	99.7
<i>L. monocytogenes</i>	309	309	0	0	100
Phosphatase	1	1	n/a	0	100 ^c
<i>S. aureus</i>	309	309	n/a	0	100
<i>Salmonella</i> spp.	309	309	n/a	0	100
Total domestic product samples	309	308	0	1	99.7
Imported					
Generic <i>E. coli</i>	199	189	n/a	10	95.0
<i>L. monocytogenes</i>	199	195	0	4	98.0
Phosphatase	0	0	n/a	0	n/a
<i>S. aureus</i>	199	198	n/a	1	99.5
<i>Salmonella</i> spp.	199	199	n/a	0	100
Total imported product samples	199	186	0	13	93.5
Total samples	508	494	0	14	97.2

^a n/a = not applicable. The investigative assessment does not apply.

^b % satisfactory is calculated by dividing all satisfactory samples by total samples tested, and an investigative result indicates a sample may be satisfactory, but further information is required to make the determination. Thus, calculated % satisfactory rate may under-estimate the actual proportion of tested products that are satisfactory.

^c Due to the limited number of samples analyzed, the % satisfactory rate should be interpreted with caution.

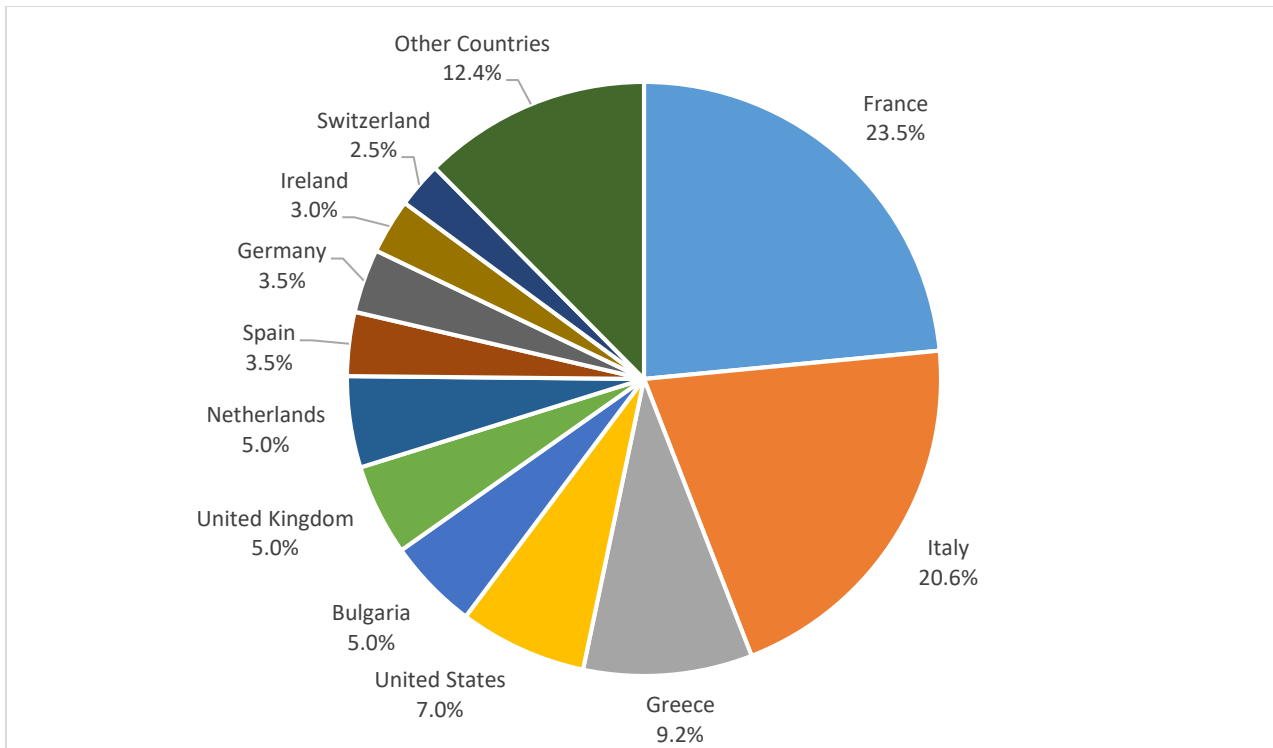


Figure 4. Percent distribution of imported pasteurized milk cheeses analyzed by country of origin (n=199).

Under the NMMP in 2021/22, 40 domestic cheeses made with raw milk were tested and were determined to be 100 % satisfactory (Table 9). In addition, 60 imported raw milk cheese samples were tested and were determined to be 93.3 % satisfactory (Table 9). The imported raw milk cheeses sampled were from France, Italy, Switzerland, Bulgaria, Germany and Austria (Figure 5). Two goat milk cheese samples from France were assessed as unsatisfactory due to high levels of generic *E. coli*. Two additional samples, one taleggio cheese from Italy and one semi-hard cheese from Switzerland, were assessed as unsatisfactory due to high levels of *S. aureus*.

Table 9: Assessment of domestic and imported raw milk cheeses sampled under the NMMP in 2021/22.

Analysis	# Tests	# Satisfactory	# Investigative ^a	# Unsatisfactory	% Satisfactory ^b
Domestic					
<i>E. coli</i> O157:H7	37	37	n/a	0	100 ^c
Generic <i>E. coli</i>	40	40	n/a	0	100 ^c
<i>L. monocytogenes</i>	40	40	0	0	100 ^c

<i>S. aureus</i>	40	40	n/a	0	100 ^c
<i>Salmonella</i> spp.	40	40	n/a	0	100 ^c
Total domestic product samples	40	40	0	0	100 ^c
Imported					
<i>E. coli</i> O157:H7	60	60	n/a	0	100
Generic <i>E. coli</i>	60	58	n/a	2	96.7
<i>L. monocytogenes</i>	60	60	0	0	100
<i>S. aureus</i>	60	58	n/a	2	96.7
<i>Salmonella</i> spp.	60	60	n/a	0	100
Total imported product samples	60	56	0	4	93.3
Total samples	100	96	0	4	96.0

^a n/a = not applicable. The investigative assessment does not apply.

^b % satisfactory is calculated by dividing all satisfactory samples by total samples tested, and an investigative result indicates a sample may be satisfactory, but further information is required to make the determination. Thus, calculated % satisfactory rate may under-estimate the actual proportion of tested products that are satisfactory.

^c Due to small sample/test number, the significance of the % satisfactory rate should be interpreted with caution.

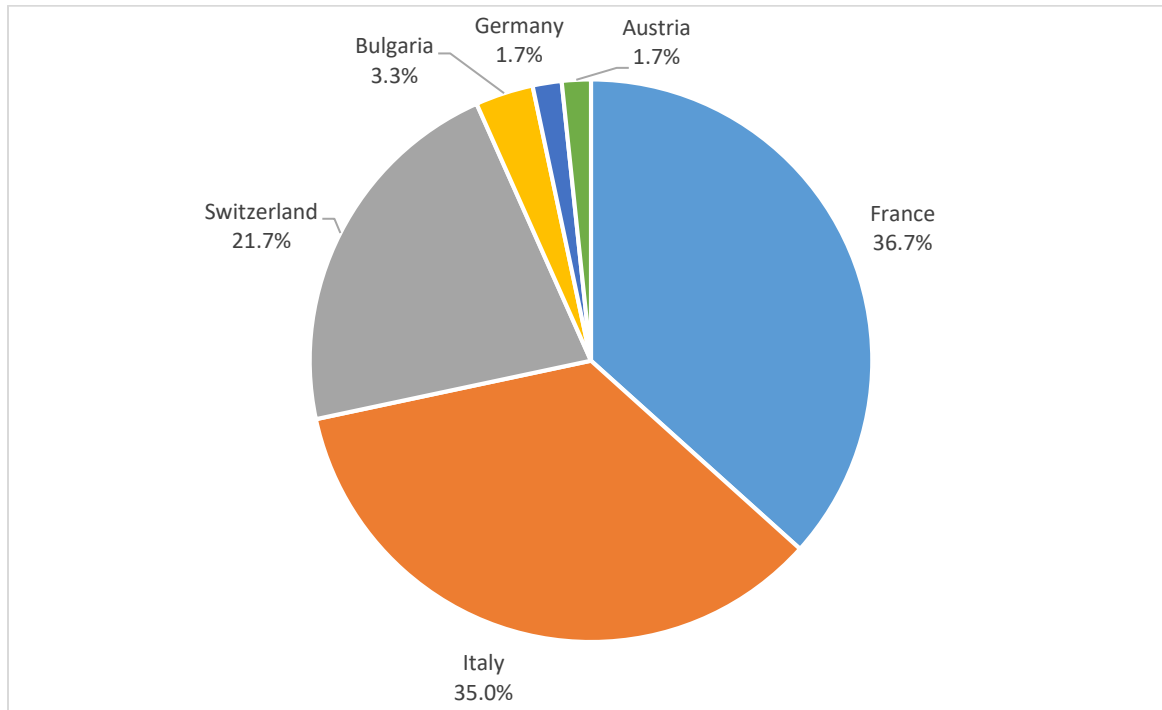


Figure 1. Percent distribution of imported raw milk cheeses analyzed by country of origin (n=60).

iii) **Environmental testing in cheese manufacturing establishments**

Environmental testing is carried out at domestic federal licence holding establishments producing cheese to verify the operator systems' ability to control the presence of *Listeria* spp. within the processing environment. Under the NMMP in 2021/22, surfaces within these establishments were swabbed and the swabs from each area were composited and tested for *Listeria* spp. If *Listeria* spp. were detected in an environmental sample, the sample was further tested to determine if *L. monocytogenes* is present.

A total of 119 environmental samples, representing approximately 1,190 food contact surfaces, were tested for *Listeria* spp. The samples were 100 % satisfactory.

iv) **% satisfactory history**

The historical % satisfactory rates of domestic and imported dairy products and environmental samples tested under the NMMP between April 1, 2018 and March 31, 2022 are shown in Table 10. Typically, satisfactory rates were consistent for all products over the years, with those for raw milk cheeses being lower than those for cheeses made with pasteurized milk.

Table 9: Historical percent satisfactory rates of dairy product samples and environmental samples.^a

	2021/22	2020/21	2019/20	2018/19
Fluid milk ^b	98.3 % (60)	95.1 % (61)	98.9 % (89)	100 % (88)
Pasteurized milk cheese	97.2 % (508)	98.4 % (440)	97.4 % (539)	98.9 % (532)
Raw milk cheese	96.0 % (100)	98.6 % (70)	96.3 % (107)	96.7 % (122)
Environmental testing	100 % (119)	100 % (115)	99.2 % (125)	98.5 % (131)

^a % satisfactory is calculated by dividing all satisfactory samples by total samples tested, and an investigative result indicates a sample may be satisfactory, but further information is required to make the determination. Thus, calculated % satisfactory rate may under-estimate the actual proportion of tested products that are satisfactory.

^b Prior to 2020/21, both flavoured and unflavoured fluid milk products were tested.

What were the 2021/22 NMMP results for fresh and ready-to-eat fresh-cut fruits and vegetables?

i) Fresh fruits and ready-to-eat fresh-cut fruits

Whole fresh fruits may be contaminated with pathogens. Ready-to-eat fresh-cut fruits may also be exposed to environmental contaminants during processing. Both whole fresh and RTE fresh-cut fruits are often consumed without further processing that might kill or remove pathogens thus, if pathogens are present, they are a food safety concern. Because the microbial contaminants in whole fresh and RTE fresh-cut fruits may differ, the sampling results for these two categories of products will be presented separately.

A variety of domestic and imported whole fresh fruits were targeted for sampling at both federal licence holding establishments and at retail under the NMMP in 2021/22 (Figure 6). All whole fresh fruit were tested for generic *E. coli*, *E. coli* O157:H7 and *Salmonella* spp., except for whole cantaloupe, which could not be tested for generic *E. coli* due to difficulty extracting this particular microorganism from its netted rind. Some imported berries were tested for the parasite *Cyclospora*.

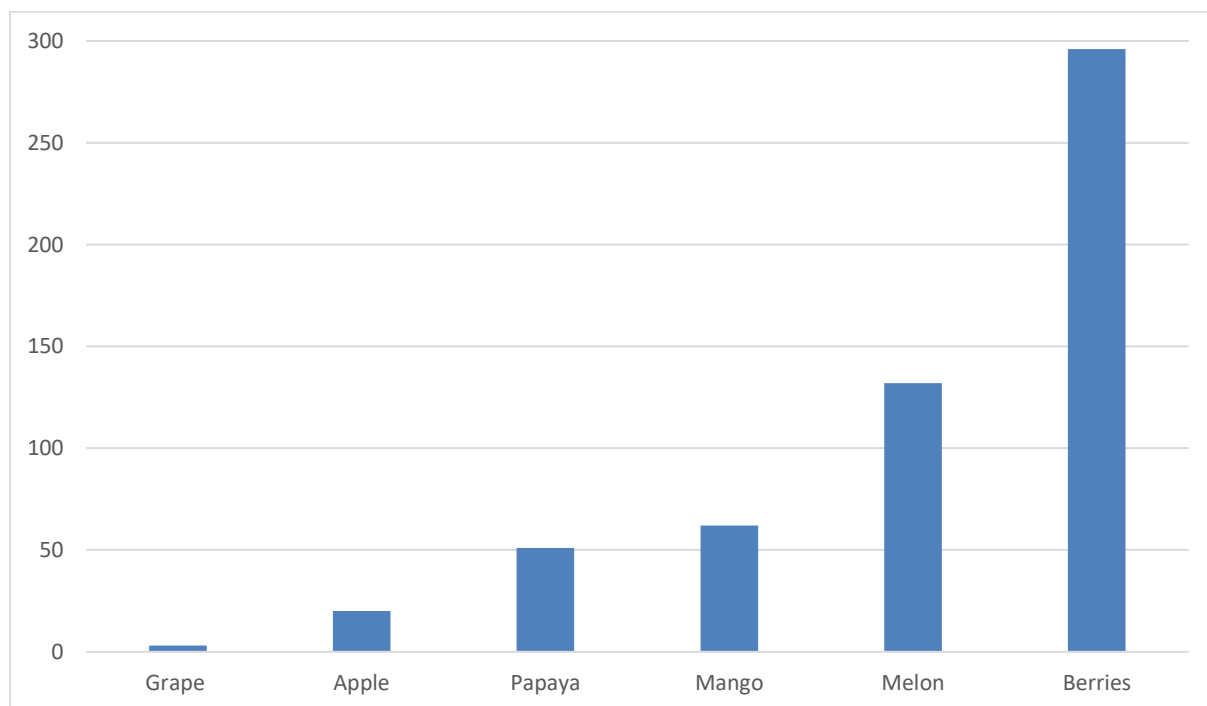


Figure 2. Number and types of whole fresh fruits and ready-to-eat fresh-cut fruits sampled under the NMMP in 2021/22.

Table 11 summarizes test results of whole fresh fruit samples collected by CFIA inspectors under the NMMP. A total of 20 domestic whole fresh fruit samples and 188 imported whole fresh fruit samples were tested for bacteria. Both domestic and imported whole fresh fruit samples were 100 % satisfactory. An additional 26 samples of fresh berries were tested for *Cyclospora* and were 96.1 % satisfactory, with one raspberry sample being assessed as investigative due to the detection of genetic material of *Cyclospora*. As mentioned previously, the analytical methods used to analyse samples for parasites can only detect the presence of genetic material and cannot discriminate between viable (potentially infectious) and non-viable (non-infectious) parasites. Thus when parasite genetic material is detected in samples, the results are assessed as investigative.

Table 11: Assessment of domestic and imported whole fresh fruit sampled under the NMMP in 2021/22.

Analysis	# Tests	# Satisfactory	# Investigative ^a	# Unsatisfactory ^b	% Satisfactory ^c
Domestic					
<i>E. coli</i> O157:H7	20	20	n/a	0	100 ^d
Generic <i>E. coli</i>	13	13	n/a	0	100 ^d
<i>Salmonella</i> spp.	20	20	n/a	0	100 ^d
Total domestic product samples	20	20	n/a	0	100 ^d
Imported					
<i>Cyclospora</i> spp.	26	25	1	n/a	96.1 ^d
<i>E. coli</i> O157:H7	188	188	n/a	0	100
Generic <i>E. coli</i>	78	78	n/a	0	100
<i>Salmonella</i> spp.	187	187	n/a	0	100
Total imported product samples	214	213	1	0	99.5
Total samples	234	233	1	0	99.6

^a n/a = not applicable. The investigative assessment does not apply.

^b n/a = not applicable. The unsatisfactory assessment does not apply.

^c % satisfactory is calculated by dividing all satisfactory samples by total samples tested, and an investigative result indicates a sample may be satisfactory, but further information is required to make the determination. Thus, calculated % satisfactory rate may under-estimate the actual proportion of tested products that are satisfactory.

^d Due to small sample/test number, the significance of the % satisfactory rate should be interpreted with caution.

A variety of domestic RTE fresh-cut fruits were also targeted for sampling under the NMMP in 2021/22 (Figure 6). All RTE fresh-cut fruits were tested for generic *E. coli*, *E. coli* O157:H7, *L. monocytogenes* and *Salmonella* spp.

Table 12 summarizes test results of RTE fresh-cut fruit samples collected by CFIA inspectors under the NMMP. A total of four domestic and four imported RTE fresh-cut fruit samples were tested for bacteria. Since RTE fresh-cut fruit is minimally processed, the country in which fruit used in an RTE fresh-cut fruit product is grown determines whether the product is considered domestic or imported. All RTE fresh-cut fruit samples collected by CFIA inspectors under the NMMP were assessed as satisfactory. The majority of the 218 imported whole fresh fruit and RTE fresh-cut fruit samples collected under the NMMP in 2021/22 were from Mexico and the United States (Figure 7). The overall satisfactory rate for domestic and imported whole fresh fruit and RTE fresh-cut fruit samples was 99.6 %.

Table 12: Assessment of domestic and imported ready-to-eat fresh-cut fruit sampled under the NMMP in 2021/22.

Analysis	# Tests	# Satisfactory	# Investigative ^a	# Unsatisfactory	% Satisfactory ^b
Domestic/Domestically Processed					
<i>E. coli</i> O157:H7	4	4	n/a	0	100 ^c
Generic <i>E. coli</i>	4	4	n/a	0	100 ^c
<i>L. monocytogenes</i>	4	4	0	0	100 ^c
<i>Salmonella</i> spp.	4	4	n/a	0	100 ^c
Total domestic product samples	4	4	0	0	100 ^c
Imported					
<i>E. coli</i> O157:H7	4	4	n/a	0	100 ^c
Generic <i>E. coli</i>	4	4	n/a	0	100 ^c
<i>L. monocytogenes</i>	4	4	0	0	100 ^c
<i>Salmonella</i> spp.	4	4	n/a	0	100 ^c
Total imported product samples	4	4	0	0	100 ^c
Total samples	8	8	0	0	100^c

^a n/a = not applicable. The investigative assessment does not apply.

^b % satisfactory is calculated by dividing all satisfactory samples by total samples tested, and an investigative result indicates a sample may be satisfactory, but further information is required to make the determination. Thus, calculated % satisfactory rate may under-estimate the actual proportion of tested products that are satisfactory.

^c Due to small sample/test number, the significance of the % satisfactory rate should be interpreted with caution.

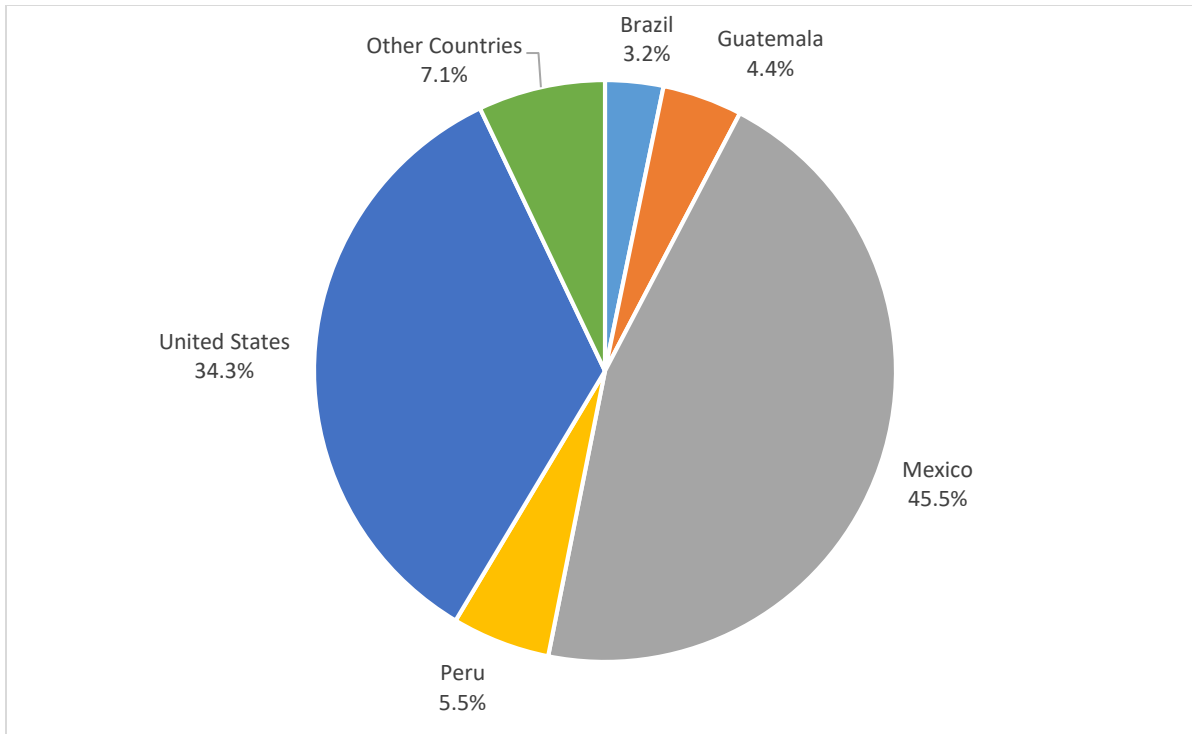


Figure 3. Percent distribution of imported fresh fruit and ready-to-eat fresh-cut fruit samples analyzed by country of origin (n=218).

ii) *Fresh vegetables and ready-to-eat fresh-cut vegetables*

Fresh vegetables may be contaminated with pathogenic microorganisms. Ready-to-eat fresh-cut vegetables may also be exposed to environmental contaminants during processing. These products are often consumed without further processing that might kill or remove pathogens thus, if pathogens are present, they are a food safety concern. Because the microbial contaminants in fresh and RTE fresh-cut vegetables may differ, the sampling results for these two categories of products will be presented separately.

A variety of domestic and imported whole fresh vegetables were targeted for sampling under the NMMP in 2021/22 (Figure 8) and tested for the bacteria generic *E. coli*, *E. coli* O157:H7, and *Salmonella* spp.

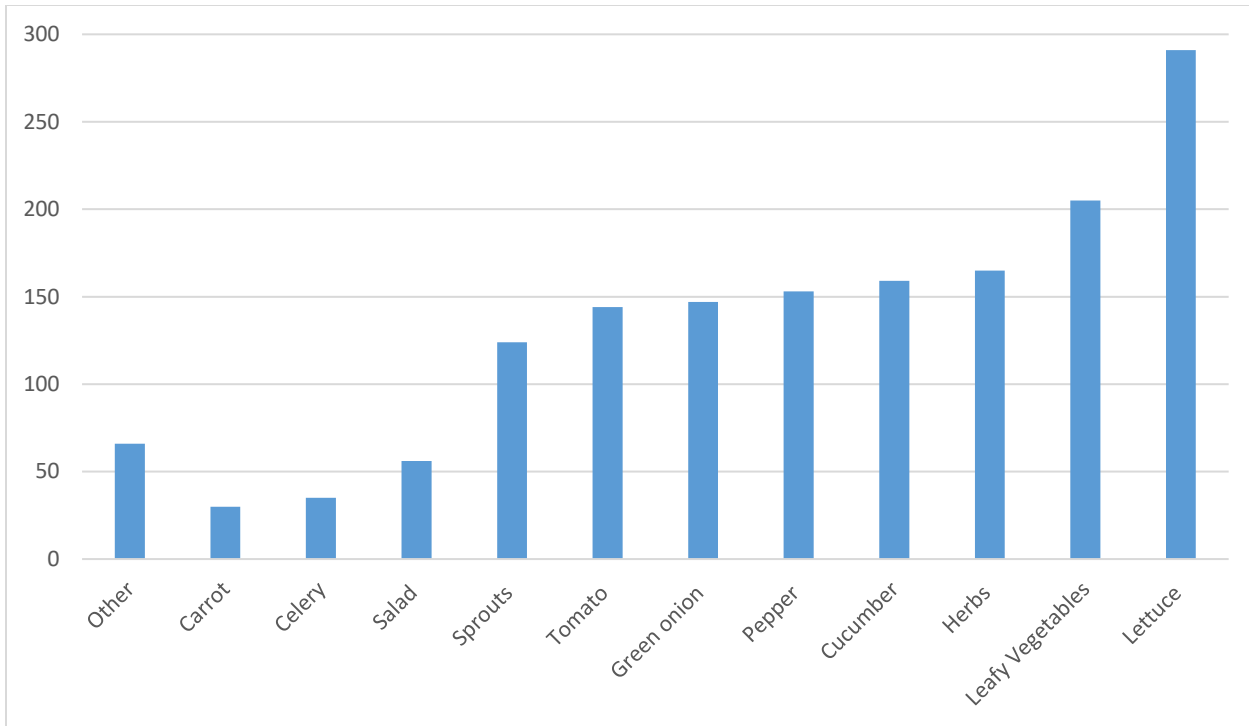


Figure 4. Number and types of fresh whole vegetables and ready-to-eat fresh-cut vegetables sampled under the NMMP in 2021/22.

Table 13 summarizes test results of whole fresh vegetable samples collected by CFIA inspectors under the NMMP. A total of 221 domestic whole fresh vegetable samples and 247 imported whole fresh vegetable samples were tested for bacteria. The domestic and imported whole fresh vegetable samples were 100 % satisfactory.

Table 13: Assessment of domestic and imported whole fresh vegetables sampled under the NMMP in 2021/22.

Analysis	# Tests	# Satisfactory	# Investigative ^a	# Unsatisfactory	% Satisfactory ^b
Domestic					
<i>E. coli</i> O157:H7	221	221	n/a	0	100
Generic <i>E. coli</i>	163	163	n/a	0	100
<i>Salmonella</i> spp.	221	221	n/a	0	100
Total domestic product samples	221	221	n/a	0	100
Imported					
<i>E. coli</i> O157:H7	247	247	n/a	0	100

Generic <i>E. coli</i>	245	245	n/a	0	100
<i>Salmonella</i> spp.	247	247	n/a	0	100
Total imported product samples	247	247	n/a	0	100
Total samples	468	468	n/a	0	100

^a n/a = not applicable. The investigative assessment does not apply.

^b % satisfactory is calculated by dividing all satisfactory samples by total samples tested, and an investigative result indicates a sample may be satisfactory, but further information is required to make the determination. Thus, calculated % satisfactory rate may under-estimate the actual proportion of tested products that are satisfactory.

A variety of RTE fresh-cut vegetables were also sampled under the NMMP in 2021/22 (Figure 8). Ready-to-eat fresh-cut vegetables were tested for generic *E. coli*, *E. coli* O157:H7, *L. monocytogenes*, and *Salmonella* spp.

Table 14 summarizes test results of RTE fresh-cut vegetable samples collected at by CFIA inspectors under the NMMP. A total of 21 domestic and 40 imported RTE fresh-cut vegetable samples were tested for bacteria. Since RTE fresh-cut vegetables are minimally processed, the country in which a vegetable used in an RTE fresh-cut vegetable product is grown determines whether the product is considered domestic or imported. The overall satisfactory rate for domestic/domestically processed products was determined to be 100 %.

The 287 imported fresh vegetables and RTE fresh-cut vegetable samples tested in 2021/22 had an overall satisfactory rate of 100 %. The majority of these originated from Mexico and the United States (Figure 9).

Table 14: Assessment of domestic and imported ready-to-eat fresh-cut vegetables sampled under the NMMP in 2021/22.

Product Type / Pathogen	# Tests	# Satisfactory	# Investigative ^a	# Unsatisfactory	% Satisfactory ^b
Domestic/Domestically Processed					
<i>E. coli</i> O157:H7	21	21	n/a	0	100 ^c
Generic <i>E. coli</i>	21	21	n/a	0	100 ^c
<i>L. monocytogenes</i>	18	18	0	0	100 ^c
<i>Salmonella</i> spp.	21	21	n/a	0	100 ^c
Total domestic product samples	21	21	0	0	100 ^c
Imported					
<i>E. coli</i> O157:H7	40	40	n/a	0	100 ^c

Generic <i>E. coli</i>	40	40	n/a	0	100 ^c
<i>L. monocytogenes</i>	33	33	0	0	100 ^c
<i>Salmonella</i> spp.	40	40	n/a	0	100 ^c
Total imported product samples	40	40	0	0	100 ^c
Total samples	61	61	0	0	100

^a n/a = not applicable. The investigative assessment does not apply.

^b % satisfactory is calculated by dividing all satisfactory samples by total samples tested, and an investigative result indicates a sample may be satisfactory, but further information is required to make the determination. Thus, calculated % satisfactory rate may under-estimate the actual proportion of tested products that are satisfactory.

^c Due to small sample/test number, the significance of the % satisfactory rate should be interpreted with caution.

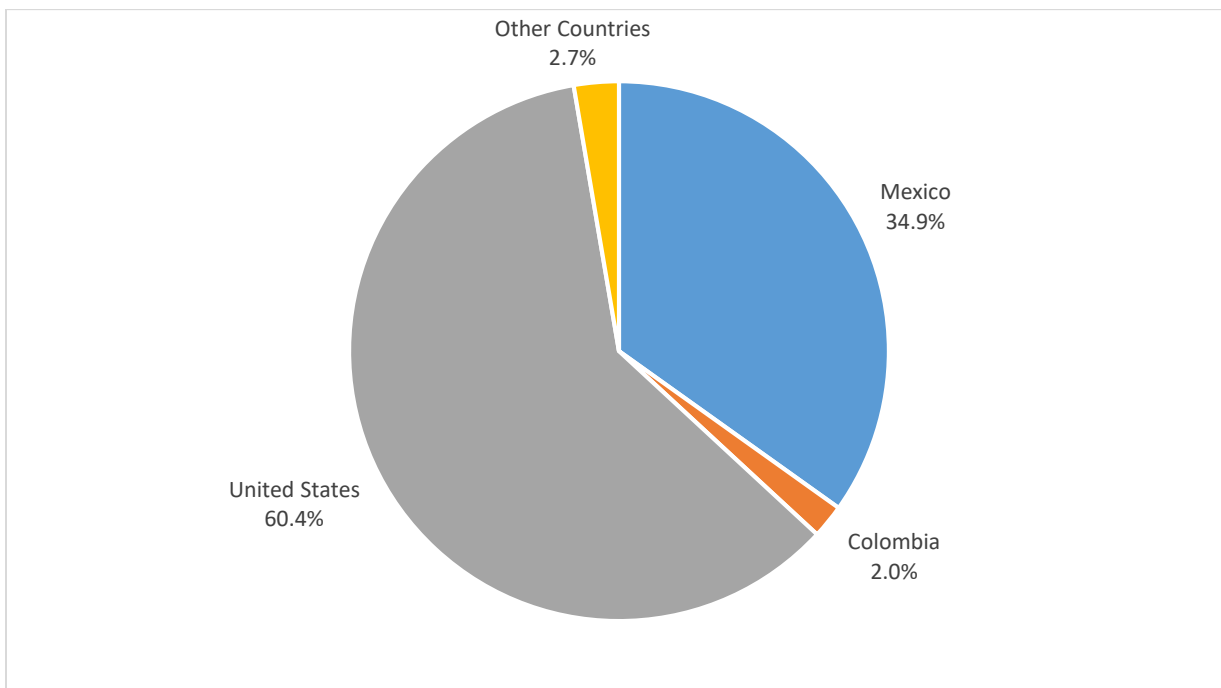


Figure 5. Percent distribution of imported fresh vegetable and ready-to-eat fresh-cut vegetable samples analyzed by country of origin (n=287).

iii) % satisfactory history

The historical % satisfactory rates of domestic and imported fresh fruit and vegetables and RTE fresh-cut fruit and vegetables tested under the NMMP between April 1, 2018 and March 31, 2022 is shown in Table 15. Satisfactory rates of samples for these products were consistent over the years.

Table 15: Historical percent satisfactory rates of fresh fruit and vegetable samples.^a

	2021/22 ^b	2020/21 ^b	2019/20	2018/19
Fresh fruit	99.6 % (234)	100 % (116)	100 % (584)	100 % (623)
Fresh-cut fruit	100 % (8) ^c	100 % (3) ^c	100 % (5) ^c	100 % (10) ^c
Fresh vegetables	100 % (468)	100 % (217)	99.9 % (1,645)	99.7 % (1,700)
Fresh-cut vegetables	100 % (61)	100 % (28) ^c	99.2 % (360)	98.7 % (378)

^a % satisfactory is calculated by dividing all satisfactory samples by total samples tested, and an investigative result indicates a sample may be satisfactory, but further information is required to make the determination. Thus, calculated % satisfactory rate may under-estimate the actual proportion of tested products that are satisfactory.

^b Reduced fruit and vegetable sampling in 2020/21 and 2021/22 was due to a shift of retail sampling from the NMMP to the Targeted Survey Program.

^c Due to small sample/test number, the significance of the % satisfactory rates should be interpreted with caution.

What were the 2021/22 NMMP results for processed fruit and vegetable products?

i) **Frozen fruits**

Frozen fruits may be contaminated with pathogens. These products are often consumed without further processing that might kill or remove pathogens thus, if pathogens are present, they would present a food safety concern. A variety of domestic and imported frozen fruits were targeted for sampling under the NMMP in 2021/22. These frozen fruit samples were tested for the bacteria *L. monocytogenes* and *Salmonella* spp. (frozen berries only).

Table 16 summarizes test results of frozen fruit samples collected under the NMMP. A total of 11 domestic frozen fruit samples and 13 imported frozen fruit samples, mainly from Brazil and the United States (Figure 10), were tested for bacteria. All samples were assessed as satisfactory.

Table 16: Assessment of domestic and imported frozen fruit sampled under the NMMP in 2021/22.

Analysis	# Tests	# Satisfactory	# Investigative ^a	# Unsatisfactory	% Satisfactory ^b
Domestic					
<i>L. monocytogenes</i>	11	11	0	0	100 ^c

<i>Salmonella</i> spp.	10	10	n/a	0	100 ^c
Total domestic product samples	11	11	0	0	100 ^c
Imported					
<i>L. monocytogenes</i>	13	13	0	0	100 ^c
<i>Salmonella</i> spp.	6	6	n/a	0	100 ^c
Total imported product samples	13	13	0	0	100 ^c
Total samples	24	24	0	0	100^c

^a n/a = not applicable. The investigative assessment does not apply.

^b % satisfactory is calculated by dividing all satisfactory samples by total samples tested, and an investigative result indicates a sample may be satisfactory, but further information is required to make the determination. Thus, calculated % satisfactory rate may under-estimate the actual proportion of tested products that are satisfactory.

^c Due to small sample/test number, the significance of the % satisfactory rate should be interpreted with caution.

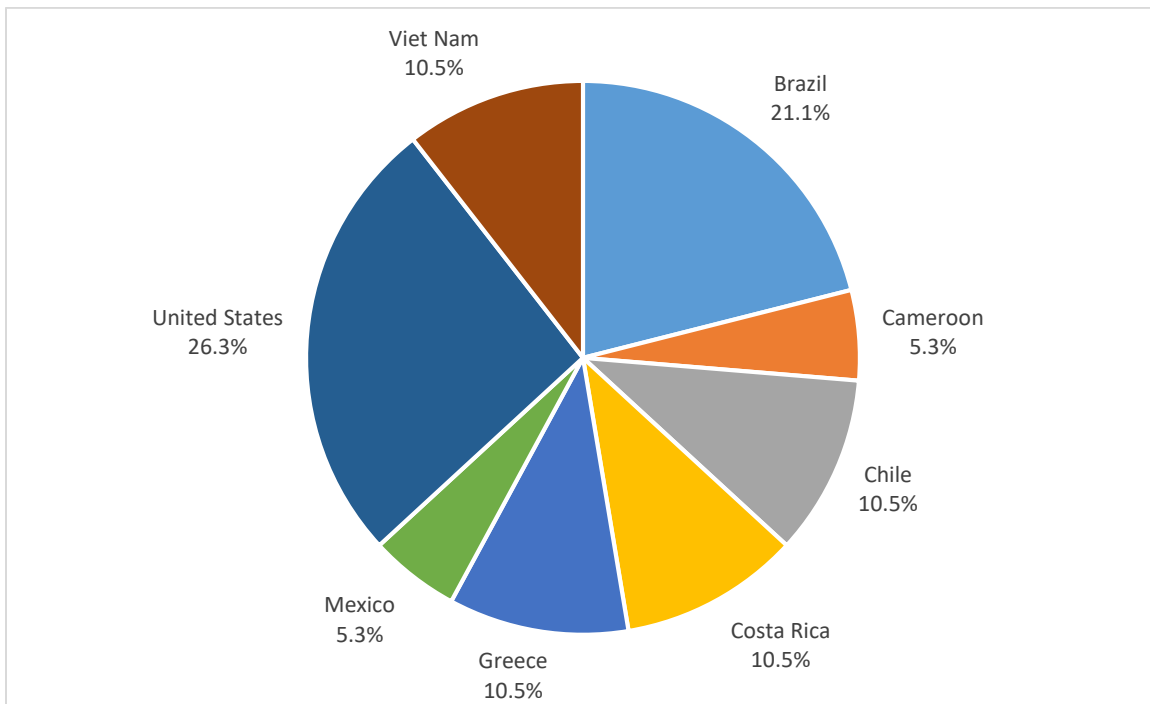


Figure 10. Percent distribution of imported frozen fruit analyzed by country of origin (n=13).

ii) **Frozen vegetables**

Frozen vegetables may be contaminated with pathogens. Typically, frozen vegetables are heated or cooked prior to serving. Many frozen vegetables are clearly labelled with cooking instructions that, if followed, will kill any pathogens that may be present but some types of frozen vegetables are not clearly labelled with cooking instructions, for example, frozen spinach. Frozen vegetables that are not

clearly labelled with cooking instructions are not always subjected to cooking prior to consumption and thus may be considered RTE. Frozen vegetables with or without clearly labelled cooking instructions were tested for ACC, generic *E. coli* and *L. monocytogenes* to confirm that these products are produced under good manufacturing conditions.

Table 17 summarizes test results of frozen vegetables collected under the NMMP in 2021/22. In total, eight domestic frozen vegetable samples and 12 imported frozen vegetable samples, originating from China, Greece, India, Israel and the United States (Figure 11), were tested. All samples were assessed as satisfactory.

Table 17: Assessment of domestic and imported frozen vegetables sampled under the NMMP in 2021/22.

Analysis	# Tests	# Satisfactory	# Investigative ^a	# Unsatisfactory	% Satisfactory ^b
Domestic					
ACC	8	8	n/a	0	100 ^c
Generic <i>E. coli</i>	8	8	n/a	0	100 ^c
<i>L. monocytogenes</i>	8	8	0	0	100 ^c
Total domestic product samples	8	8	0	0	100 ^c
Imported					
ACC	12	12	n/a	0	100 ^c
Generic <i>E. coli</i>	12	12	n/a	0	100 ^c
<i>L. monocytogenes</i>	12	12	0	0	100 ^c
Total imported product samples	12	12	0	0	100 ^c
Total samples	20	20	0	0	100^c

^a n/a = not applicable. The investigative assessment does not apply.

^b % satisfactory is calculated by dividing all satisfactory samples by total samples tested, and an investigative result indicates a sample may be satisfactory, but further information is required to make the determination. Thus, calculated % satisfactory rate may under-estimate the actual proportion of tested products that are satisfactory.

^c Due to small sample/test number, the significance of the % satisfactory rate should be interpreted with caution.

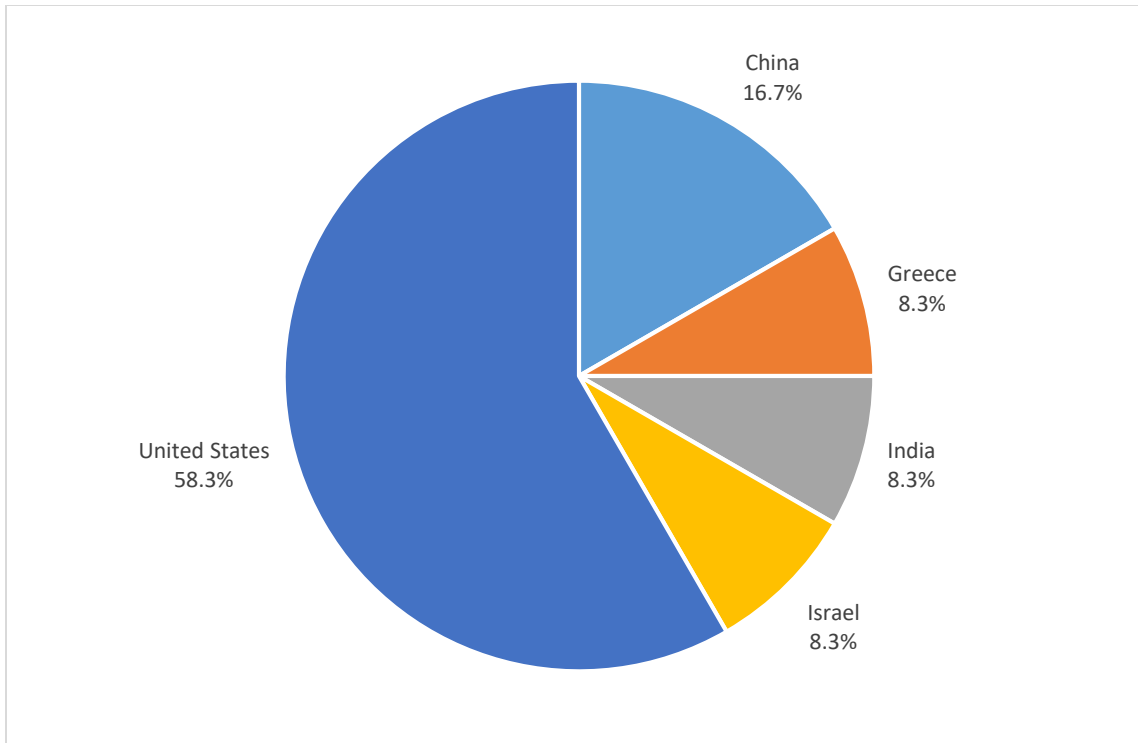


Figure 11. Percent distribution of imported frozen vegetables analyzed by country of origin (n=12).

iii) % satisfactory history

The historical satisfactory rates of domestic and imported processed fruit and vegetables tested under the NMMP between April 1, 2018 and March 31, 2022 is shown in Table 18. Satisfactory rates of samples of these products were consistent over the years.

Table 18: Historical percent satisfactory rates of processed fruit and vegetable product samples.^a

	2021/22 ^b	2020/21 ^b	2019/20	2018/19
Frozen fruit	100 % (24) ^c	100 % (15) ^c	99.7 % (640)	99.8 % (608)
Frozen vegetables	100 % (20) ^c	100 % (13) ^c	100 % (14) ^c	95.1 % (61)

^a % satisfactory is calculated by dividing all satisfactory samples by total samples tested, and an investigative result indicates a sample may be satisfactory, but further information is required to make the determination. Thus, calculated % satisfactory rate may under-estimate the actual proportion of tested products that are satisfactory.

^b Reduced fruit and vegetable sampling in 2020/21 and 2021/22 was due to a shift of retail sampling from the NMMP to the Targeted Survey Program.

^c Due to small sample/test number, the significance of the % satisfactory rate should be interpreted with caution.

What were the 2021/22 NMMP results for fish and seafood products?

i) **Raw bivalve molluscan shellfish**

Raw seafood may be contaminated with pathogenic microorganisms. These products are often consumed without further processing that might kill or remove pathogens, thus if pathogens are present, they are a food safety concern. Raw molluscan shellfish were targeted for sampling under the NMMP and tested for the bacteria *Vibrio parahaemolyticus*.

Table 19 summarizes test results for domestic raw molluscan shellfish samples collected under the NMMP in 2021/22. In total, 76 domestic raw molluscan shellfish samples were tested for *V. parahaemolyticus*. The overall satisfactory rate was 86.6 %, with ten samples being assessed as unsatisfactory due to the presence of high levels of *V. parahaemolyticus*.

Table 19: Assessment of domestic raw molluscan shellfish sampled under the NMMP in 2021/22.

Analysis	# Tests	# Satisfactory	# Investigative ^a	# Unsatisfactory	% Satisfactory ^b
<i>Vibrio parahaemolyticus</i>	76	66	n/a	10	86.6
Total samples	76	66	n/a	10	86.6

^a n/a = not applicable. The investigative assessment does not apply.

^b % satisfactory is calculated by dividing all satisfactory samples by total samples tested, and an investigative result indicates a sample may be satisfactory, but further information is required to make the determination. Thus, calculated % satisfactory rate may under-estimate the actual proportion of tested products that are satisfactory.

ii) **Environmental testing in ready-to-eat fish product establishments**

Ready-to-eat fish may become exposed to environmental contaminants during processing. These products are often consumed without further processing that might kill or remove pathogens, thus if pathogens are present, they are a food safety concern. Environmental testing is carried out at domestic federal licence holding establishments producing RTE fish products to verify the operator systems' ability to control the presence of *Listeria* spp. within the processing environment. Under the NMMP in 2021/22, surfaces within these establishments were swabbed and the swabs from each area were composited and tested for *Listeria* spp. If *Listeria* spp. was detected in an environmental sample, the sample was further tested to determine which *Listeria* species were present.

A total of 80 environmental samples, representing approximately 800 food contact surfaces, were tested for *Listeria* spp. The overall satisfactory rate was 93.8 %, with five samples being assessed as unsatisfactory due to the presence of *L. monocytogenes*.

iii) % satisfactory history

The historical % satisfactory rates of samples of domestic and imported fish and seafood products and environmental samples tested under the NMMP program between April 1, 2018 and March 31, 2022 and shown in Table 20. Satisfactory rates of samples of these products were consistent over the years.

Table 20: Historical percent satisfactory rates of fish and seafood product and environmental samples.^a

	2021/22	2020/21	2019/20	2018/19
Raw molluscan shellfish	86.8 % (76)	100 % (8) ^b	87.7 % (81)	86.5 % (74)
Environmental testing	93.8 % (80)	100 % (7) ^b	97.6 % (41) ^b	100 % (11) ^b

^a% satisfactory is calculated by dividing all satisfactory samples by total samples tested, and an investigative result indicates a sample may be satisfactory, but further information is required to make the determination. Thus, calculated % satisfactory rate may under-estimate the actual proportion of tested products that are satisfactory.

^bDue to small sample/test number, the significance of the % satisfactory rate should be interpreted with caution.

What do the NMMP results mean?

In the 2021/22 sampling year, 10,745 tests were performed on 4,720 domestic and imported food products collected from under the NMMP. Specifically, 7,898 tests were performed on 3,766 domestic products and 2,847 tests were performed on 954 imported products to verify compliance with food safety standards. Results indicated that domestic products were 99.0 % satisfactory whereas imported products were 97.7 % satisfactory. Overall, a 98.8 % satisfactory rate was observed for combined domestic and imported products. In addition, there were 1,656 tests performed on 1,397 environmental samples, which were assessed as 97.1 % satisfactory.

The % satisfactory rates were calculated by dividing all satisfactory samples by total samples tested. As mentioned previously, an investigative result indicated that the sample may be satisfactory, but that further information is required to make this determination. Therefore, the calculated % satisfactory rates may under-estimate the actual proportions of tested products that were satisfactory. As well, the significance of % satisfactory rates derived from small numbers of samples/tests should be interpreted with caution. For this report, this included % satisfactory rates derived from fewer than 50 samples.

A total of 34 product samples and 22 environmental samples were assessed as unsatisfactory in 2021/22 under the NMMP. Of the 34 unsatisfactory food product samples, 18 were assessed as unsatisfactory due to the presence of one or more pathogens, 14 were assessed as unsatisfactory due to the presence of high levels of indicator organisms, and two were assessed as unsatisfactory due to the presence of both a pathogen and high levels of indicator organisms (one due to the presence of both *L. monocytogenes* and generic *E. coli*, and one due to the presence of both *S. aureus* and generic *E. coli*). Twenty unsatisfactory environmental samples were due to the presence of *L. monocytogenes* and two unsatisfactory environmental samples were due to the presence of *Salmonella*.

The presence of a pathogen in a food sample represents a direct food hazard. The presence of a pathogen in an environmental sample indicates that pathogens are present in the production environment and that the food product is at a higher risk of being contaminated. The presence of indicator organisms does not always imply the existence of a food-related health hazard but can expose unsanitary practices and conditions under which pathogenic microorganism could contaminate food products.

A total of 24 product samples and 19 environmental samples were assessed as investigative in 2021/22 under the NMMP. Of the investigative product samples, six were assessed as investigative due to the presence of pathogens detected at low levels (<100 CFU/g), i.e. *L. monocytogenes* in Category 2B RTE foods, one was assessed as investigative due to the detection of genetic material of *Cylcospora*, and 17 were assessed as investigative due to the presence of high levels of indicator organisms. The 19 environmental samples were assessed as investigative due to the presence of indicator organisms, i.e. *Listeria* spp. other than *L. monocytogenes*.

These results indicate that Canada maintains a very high overall level of quality and safety, for both domestic and imported food products and for the environments under which domestic products were produced. In addition, the levels of satisfactory products being observed in the 2021/22 sampling year were relatively consistent with previous years, indicating that this high level of quality and safety is being maintained over time.

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Appendix: Assessment criteria for NMMP Samples

Assessment criteria (n, c, m and M) are used to assess test results to determine if a sample is satisfactory, unsatisfactory or investigative. For all sample plans, “n” represents the number of sample units (i.e., subsamples) from a single lot of product to be analyzed. Collectively, these samples units represent one sample. “c” represents the maximum allowable number of unacceptable sample units in a 2-class plan (i.e, only two possible results) or marginally acceptable sample units in a 3-class plan. “m” represents a microbiological limit which, in a 2-class plan, separates sample units of acceptable from unacceptable quality or, in a 3-class plan, “m” separates sample units of acceptable quality from those of marginally acceptable quality. “M” represents a microbiological limit which, in a 3-class plan, separates sample units of marginally acceptable quality from those of unacceptable quality.

Commodity	Analyte	n	c	m	M	Satisfactory	Investigative ^a	Unsatisfactory ^b
Red Meat & Poultry Products								
Category 1 RTE Meat Products	<i>L. monocytogenes</i>	5	0	0	-	Not Detected	n/a	Detected
Category 2A/2B RTE Meat Products	<i>L. monocytogenes</i>	5	0	100	-	Not Detected	≤m/g in all sub sample units tested	>m/g in any sub sample unit tested
RTE Meat Products	<i>Salmonella</i> spp.	5	0	0	-	Not Detected	n/a	Detected
RTE Dry & Semi-dry Fermented Meat Products	<i>E. coli</i> O157:H7	5	0	0	-	Not Detected	n/a	Detected
Raw Ground Beef/Veal	generic <i>E. coli</i>	5	0	10 ²	-	≤10 ² /g	>10 ² /g	n/a
Raw Ground Beef/Veal	<i>E. coli</i> O157:H7	5	0	0	-	Not Detected	n/a	Detected
Beef/Veal Trims	generic <i>E. coli</i>	60	0	10 ²	-	≤10 ² /g	>10 ² /g	n/a
Beef/Veal Trims	<i>E. coli</i> O157:H7	60	0	0	-	Not Detected	n/a	Detected
Mechanically Separated & Finely Textured Beef	CNS	3	n/a			Not Detected	n/a	Detected

Commodity	Analyte	n	c	m	M	Satisfactory	Investigative ^a	Unsatisfactory ^b
Pork Carcasses	<i>Trichinella spiralis</i>	100		n/a		Not Detected	n/a	Detected
Raw Meat & RTE Meat Products	Species Verification	1		n/a		Detected as declared or not detected and not declared	n/a	Not detected but declared or detected but not declared
Environmental - RTE Meat Establishments	<i>Listeria</i> spp.	10		n/a		Not Detected	<i>Listeria</i> spp. other than <i>L. monocytogenes</i> detected	<i>L. monocytogenes</i> detected
Eggs and Egg Products								
Processed Egg	ACC	5	0	5×10 ⁴	-	≤m/g	n/a	>m/g in one or more sample units
Processed Egg	Coliforms	5	0	10	-	≤m/g	n/a	>m/g in one or more sample units
Processed & Cooked Egg Products	<i>Salmonella</i> spp.	10	0	0	-	Not Detected	n/a	Detected
Category 1 RTE Processed Egg Products	<i>L. monocytogenes</i>	5	0	0	-	Not Detected	n/a	Detected
Category 2A/2B RTE Processed Egg Products	<i>L. monocytogenes</i>	5	0	100	-	Not Detected	≤m/g in all sub sample units tested	>m/g in any sub sample unit tested
Environmental - Shell Egg Grading Stations	<i>Salmonella</i> spp.	5	0	0	-	Not Detected	n/a	Detected
Environmental - Processed Egg Establishments	<i>Listeria</i> spp.	3	0	0	-	Not Detected	<i>Listeria</i> spp. other than <i>L. monocytogenes</i> detected	<i>L. monocytogenes</i> detected
Environmental - Processed Egg Establishments	<i>Salmonella</i> spp.	3-4	0	0	-	Not Detected	n/a	Detected

Commodity	Analyte	n	c	m	M	Satisfactory	Investigative ^a	Unsatisfactory ^b
Dairy Products								
Flavoured Fluid Milk Products	generic <i>E. coli</i>	5	0	0	-	Not Detected	n/a	Detected
Category 1 RTE Flavoured Fluid Milk Products	<i>L. monocytogenes</i>	5	0	0	-	Not Detected	n/a	Detected
Category 2A/2B RTE Flavoured Fluid Milk Products	<i>L. monocytogenes</i>	5	0	100	-	Not Detected	≤m/g in all sub sample units tested	>m/g in any sub sample unit tested
Flavoured Fluid Milk Products	ACC	5	2	5×10 ⁴	10 ⁶	≤m/g or if c is not exceeded	n/a	>M/g in one or more sample units or if c is exceeded
Cheese (pasteurized milk)	generic <i>E. coli</i>	5	2	10 ²	2×10 ³	≤m/g or if c is not exceeded	n/a	>M/g in one or more sample units or if c is exceeded
Cheese (raw milk)	generic <i>E. coli</i>	5	2	5×10 ²	2×10 ³	≤m/g or if c is not exceeded	n/a	>M/g in one or more sample units or if c is exceeded
Cheese (raw milk)	<i>E. coli</i> O157:H7	5	0	0	-	Not Detected	n/a	Detected
Cheese (pasteurized and raw milk)	<i>Salmonella</i> spp.	5	0	0	-	Not Detected	n/a	Detected
Category 1 RTE Cheese Products (pasteurized and raw milk)	<i>L. monocytogenes</i>	5	0	0	-	Not Detected	n/a	Detected
Category 2A/2B RTE Cheese Products	<i>L. monocytogenes</i>	5	0	100	-	Not Detected	≤m/g in all sub sample units tested	>m/g in any sub sample unit tested

Commodity	Analyte	n	c	m	M	Satisfactory	Investigative ^a	Unsatisfactory ^b
(pasteurized and raw milk)								
Cheese (pasteurized milk)	<i>S. aureus</i>	5	2	10 ²	10 ⁴	≤m/g or if c is not exceeded	n/a	>M/g in one or more sample units or if c is exceeded
Cheese (raw milk)	<i>S. aureus</i>	5	2	10 ³	10 ⁴	≤m/g or if c is not exceeded	n/a	>M/g in one or more sample units or if c is exceeded
Cheese (pasteurized milk)	Phosphatase	3	2	5ug	10ug	≤m/g or if c is not exceeded	n/a	>M/g in one or more sample units or if C is exceeded
Environmental - Cheese Establishments	<i>Listeria</i> spp.	10	0	0	-	Not Detected	<i>Listeria</i> spp. other than <i>L. monocytogenes</i> detected	<i>L. monocytogenes</i> detected
Fresh Fruits & Vegetables								
Fresh and RTE Fresh-Cut Fruits & Vegetables	generic <i>E. coli</i>	5	2	10 ²	10 ³	≤m/g or if c is not exceeded	n/a	>M/g in one or more sample units or if c is exceeded
Fresh and RTE Fresh-Cut Fruits & Vegetables	<i>E. coli</i> O157:H7	5	0	0	-	Not Detected	n/a	Detected
Sprouted Seeds and Beans	generic <i>E. coli</i>	5	2	10 ²	10 ³	≤m/g or if c is not exceeded	n/a	>M/g in one or more sample units or if c is exceeded
Sprouted Seeds and Beans	<i>E. coli</i> O157:H7	5	0	0	-	Not Detected	n/a	Detected
Fresh and RTE Fresh-Cut Fruits & Vegetables	<i>Salmonella</i> spp.	5	0	0	-	Not Detected	n/a	Detected

Commodity	Analyte	n	c	m	M	Satisfactory	Investigative ^a	Unsatisfactory ^b
Category 1 RTE Fresh-Cut Fruit & Vegetable Products	<i>L. monocytogenes</i>	5	0	0	-	Not Detected	n/a	Detected
Category 2A/2B RTE Fresh-Cut Fruit & Vegetable Products	<i>L. monocytogenes</i>	5	0	100	-	Not Detected	≤m/g in all sub sample units tested	>m/g in any sub sample unit tested
Blackberries and Raspberries	<i>Cyclospora</i>	5	0	0	-	Not Detected	Detected	n/a
Environmental - Fresh Produce Establishments	<i>Listeria</i> spp.	10	0	0	-	Not Detected	<i>Listeria</i> spp. other than <i>L. mono</i>	<i>L. monocytogenes</i> detected
Processed Fruit and Vegetable Products								
Frozen Vegetable Products	ACC	5	0	-	2.5×10 ⁵	≤M/g	n/a	>M/g
Frozen Vegetable Products	generic <i>E. coli</i>	5	2	10 ²	10 ³	≤m/g or if c is not exceeded	n/a	>M/g in one or more sample units or if c is exceeded
Category 1 Frozen Fruit & Vegetable Products	<i>L. monocytogenes</i>	5	0	0	-	Not Detected	n/a	Detected
Category 2B Frozen Fruit & Vegetable Products	<i>L. monocytogenes</i>	5	0	100	-	Not Detected	≤m/g in all sub sample units tested	>m/g in any sub sample unit tested
Frozen Berries	<i>Salmonella</i> spp.	5	0	0	-	Not Detected	n/a	Detected
Fish and Seafood								
Raw molluscan shellfish	<i>Vibrio parahaemolyticus</i>	5	0	10 ²	n/a	≤m	n/a	>m in any sample unit
Environmental - RTE Fish Establishments	<i>Listeria</i> spp.	-	n/a			Not Detected	<i>Listeria</i> spp. other than <i>L. mono</i>	<i>L. monocytogenes</i> detected

^a n/a = not applicable. The investigative assessment does not apply.

^b n/a = not applicable. The unsatisfactory assessment does not apply.

^c n/d = not determined.