Canadian Food Inspection Agency
Agence canadienne d'inspection des aliments

Food Safety Action Plan

REPORT

2010-2011 Targeted Surveys

Targeted Survey Investigating *Salmonella and Generic E. coli* in Tahini

RDIMS # 3907342

Canada

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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.

Foodborne outbreaks of salmonellosis associated with tahini have been reported worldwide in recent years. Tahini has been listed as an unusual food source for *Salmonella* contamination by the World Health Organization (WHO) International Food Safety Authorities Network (INFOSAN). Tahini is a sesame seed-based high fat and low moisture food or food ingredient. Tainted sesame seeds and/or cross-contaminations due to poor hygienic practices during processing are main sources and routes of contamination of tahini with *Salmonella*. If contaminated tahini is used as an ingredient in a high moisture food (e.g., hummus), the product subsequently becomes contaminated. *Salmonella* can survive in tahini and hummus during the shelf-life of the products and could cause illness upon consumption.

Considering these factors and their relevance to Canadians, tahini has been selected as one of the priority food ingredients for enhanced surveillance under the FSAP. Over the course of five years of targeted surveys (2008/09 to 2012/13), approximately 2,500 samples of tahini and sesame seeds were collected from Canadian retail locations and tested for the presence of bacterial pathogens of concern.

The main objectives of the 2010/11 survey were to generate baseline data on bacterial pathogen *Salmonella* and on generic *Escherichia coli* (*E. coli*), an indicator of fecal contamination, for tahini available in the Canadian market. A total of 543 tahini samples, including imported and domestic products, were collected and analysed. The results indicate that levels of generic *E. coli* were found to be satisfactory in all samples and *Salmonella* was not detected in the majority (99.6%) of the samples. Two samples (0.4%) were found to be contaminated with *Salmonella* and resulted in two product recalls. These results suggest that the majority of tahini products in the Canadian market sampled during this survey were generally produced under Good Manufacturing Practices (GMPs) and sanitary conditions. However, the results also indicate that contamination of tahini with *Salmonella* can occur, which could represent a food safety risk.

The CFIA regulates and provides oversight to the food industry, works with provinces and territories, and promotes safe handling of foods throughout the food production chain. However, it is important to note that the food industry, importers, and retail sectors are ultimately responsible for the food they produce, import, and sell, while individual consumers are responsible for the safe handling of the food they have in their possession.

Moreover, general advice for the consumer on the safe handling of foods is widely available. The CFIA will continue its surveillance activities and inform stakeholders of its findings.

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 Canada's safety system for food, health and consumer products. 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.

Within the current regulatory framework, some commodities, such as meat products, traded internationally and inter-provincially are regulated by specific Acts and Regulations. These commodities are referred to as federally registered commodities. On the other hand, commodities that are regulated solely under the *Food and Drugs Act* (3) and *Regulations* (4) are the non-federally registered commodities. These non-federally registered commodities encompass 70% of the food available for sale in Canada, including imported and domestic food products. Targeted surveys are primarily directed towards non-federally registered commodities. Sesame seeds and tahini are imported food ingredients that belong to the non-federally registered food category.

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. 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 or guidelines for regulatory purposes.

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 (5).

This targeted survey (2010/11) represents part of the collection of approximately 2,500 samples of sesame seed products over the five years of targeted surveys (2008/09 – 2012/13), which was designed to gather baseline information on the occurrence of bacterial pathogens of concern in sesame seed products 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 Food and Agriculture Organization of the United Nations (FAO)/World Health Organization (WHO) Codex Alimentarius Commission. Producers of tahini are encouraged to follow these international codes of practice. Of relevance for this survey are the *Regional Standard for Tehena* (*CODEX STAN 259-R-2008*) (6) and the *Recommended International Codes of Practice-General Principles of Food Hygiene* (CAC/RCP 1-1969) (7). The standard highlights hygienic requirements for the production of tahini products, and the code addresses Good Manufacturing Practices (GMPs) which, when applied, control and reduce the potential for contamination with microbial, chemical, and physical hazards at all stages of production of foods and food products from primary production to packaging.

Tahini and tahini products available in the Canadian market must comply with the *Food and Drugs Act* (FDA) (3) and the *Food and Drug Regulations* (FDR) (4), 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.

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 will 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 Tahini

2.1 Rationale

Tahini is a sesame seed-based high fat and low moisture food or food ingredient. Low moisture foods do not support the growth of bacterial pathogens and traditionally have been considered safe food products. However, outbreaks of salmonellosis associated with tahini have been reported worldwide over the last few years (Appendix B). Increased surveillance activities in Canada (8) and the U.S. (9) have also triggered non-outbreak associated recalls of tahini products (Appendix C). Tahini has been reported as an unusual food source of *Salmonella* by the World Health Organization (WHO) International food safety authorities network (INFOSAN) (10).

Salmonella contamination in tahini has been attributed to contaminated sesame seeds and/or cross-contamination (11) (12). Raw sesame seeds are agricultural products that can be contaminated by *Salmonella* during primary production and storage (12). The prevalence of *Salmonella* in sesame seed samples was found to be 12.5% (2/16) in a study of sesame seed samples from the retail market in Germany in 2001 (13) and 11% (20/177) in a study of imported sesame seed shipments offered for entry to the U.S during the fiscal years 2007-2009 (14). Tahini is commonly produced by milling, hulling and roasting sesame seeds. Roasting seeds is the kill step for pathogens in sesame seeds during the processing of tahini (11). However, insufficient roasting process and /or low roasting temperatures (for producing raw tahini products) may not be sufficient to eliminate *Salmonella* in contaminated seeds (11). Studies from isolated cases of *Salmonella* contaminated sesame-based food products, such as halva (13) and tahini (15) found that sources of contamination were likely associated with contaminated sesame seeds. In addition, cross contamination after the heat treatment due to poor sanitation practices and poor hygienic conditions during production, packaging, or storage has been believed to be the main route of entry of bacterial pathogens into processed products (12).

Salmonella can survive in tahini during an extended period of storage (11) and can be more resistant to heat treatment in the high fat and low moisture environment of food (16). Even low levels of *Salmonella* in tahini were able to cause foodborne illness outbreaks (15, 17). If contaminated tahini is used as an ingredient in a high moisture food such as hummus, *Salmonella* can survive during the product shelf life under refrigeration conditions (18), and could cause illness upon consumption. Several cases of salmonellosis associated with hummus and tahini have been reported (15, 17).

Based on the above information, tahini has been selected for targeted surveillance under FSAP. The overall objective is to gather baseline information on the occurrence of

bacterial pathogens of concern in sesame seed products including tahini available to Canadians at retail. This targeted survey (2010/11) is part of the information collection with a focus on investigating the presence of bacterial pathogen *Salmonella* spp. and the presence and levels of generic *Escherichia coli* (*E. coli*) in tahini.

2.2 Targeted Micro-organisms

2.2.1 *Salmonella* spp.

Salmonellae are found naturally in the intestines of animals, such as poultry and swine (19). Most outbreaks associated with *Salmonella* are linked to consumption of contaminated food of animal origin (e.g., chicken, eggs, and pork). However, over the last few years, foodborne illnesses of salmonellosis have been reported to be associated with the consumption of contaminated sesame seed-based foods, such as tahini and hummus (15, 17).

2.2.2 Generic *E. coli* as an Indicator of Fecal Contamination

Typically, *E. coli* bacteria that inhabit the large intestines of humans and animals are harmless. Due to their regular presence in stools of humans and animals, the occurrence of *E. coli* in foods indicates direct or indirect contamination with fecal matter. The presence of generic *E. coli* in foods can also indicate potential contamination with pathogenic enteric micro-organisms, such as *Salmonella* that also live in the intestines of infectious humans and animals. It is important to note that the presence of generic *E. coli* in food only implies an increased risk of contamination with pathogenic micro-organisms but does not conclusively indicate that these pathogenic organisms are present. A high level of generic *E. coli* in tahini and tahini products is an indication that contamination occurred at some point between primary production and final packaging of the product.

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. Samples were collected year round.

In this survey, a sample consisted of one consumer size packaged tahini. Tahini samples were shipped at room temperatures and while maintaining the integrity of the sample. Samples were declared “unfit” for analysis if there were issues regarding the conditions in which the sample was handled or shipped.

2.4 Sample Distribution

A total of 543 tahini samples were collected, including 152 (28.0%) domestically processed tahini samples and 391 (72.0%) imported samples. Approximately half of the tahini samples (51.0%, 277 samples) originated from seven Middle Eastern countries (Table 1). Organic tahini samples (93 samples) accounted for 17.1% of the total samples tested. In addition, a small percentage (3.7%, 20) of the tahini samples was raw tahini products, in which sesame seeds were not roasted under standard heating temperatures in the production of tahini.

Table 1 Sample Distribution by Country of Origin and Production Practices

Country of Origin	Production Practices		Total	
	Conventional	Organic*		
	Number of Samples	Number of Samples	Number of Samples	Percentage of Samples
Canada**	105	47	152	28.0
China	8	0	8	1.5
Greece	37	10	47	8.7
Liberia	1	0	1	0.2
United States	15	26	41	7.6
Vietnam	6	0	6	1.1
Egypt	4	0	4	0.7
Israel	13	1	14	2.6
Jordan	1	0	1	0.2
Lebanon	233	8	241	44.4
Saudi Arabia	3	0	3	0.6
Syria	5	0	5	0.9
Turkey	8	1	9	1.7
Subtotal (Middle Eastern countries)	*267*	*10*	*277*	*51.0*
Unidentified***	11	0	11	2.0
Subtotal Imported	*345*	*46*	*391*	*72.0*
Total	**450**	**93**	**543**	**100**

*Tahini that was mechanically processed from organic sesame seeds with a label bearing organic certification number was considered organic tahini.

** Imported ingredients may have been used.

*** Imported product without indication of country of origin.

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 (20) (Appendix D). These methods are used for regulatory testing by the CFIA and are fully validated for the analysis of food samples.

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.

Salmonella isolates from positive samples were 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, Public Health Agency of Canada (PHAC).

Enumeration of generic *E. coli* was obtained using the most probable number (MPN) or direct plating procedure.

2.6 Assessment Guidelines

The assessment criteria used for this survey are based on the principles of the *Health Products and Food Branch Standards and Guidelines for Microbiological Safety of Foods* (21) and associated methods published in Health Canada's *Compendium of Analytical Methods* (20).

Table 2 Assessment Guidelines for *Salmonella* and Generic *E. coli* in Tahini**

Analysis*	**Assessment Criteria**		
	Satisfactory	**Investigative**	**Unsatisfactory**
***Salmonella* spp.** (MFLP-29 modified & MFHPB-20 if required for confirmation)	Absent in 25 g	N/A	Present in 25 g
Generic *E. coli* (MFHPB-19 or 27)***	≤ 100 /g	100 < x ≤ 1000 /g	> 1000 /g

* Compendium of Analytical Methods (20).

**No criteria have been established by Health Canada at this time for tahini. However, in the absence of specified criteria, the presence of *Salmonella* in tahini is considered to be a violation of FDA Section 4(1)a and the detection of generic *E. coli* at levels above 1,000 CFU/g or MPN/g is considered to be a violation of FDA Section 7, and are therefore assessed by the CFIA as unsatisfactory.

*** Concentration unit for MFHPB-19 method: MPN/g, for MFHPB-27 method: CFU/g.

Based on the current regulatory standards and microbiology testing criteria, results of these surveys were assessed as “satisfactory”, “investigative” or “unsatisfactory”.

Samples assessed as investigative due to elevated levels of generic *E. coli* in this survey would require some form of follow-up activity. This could include, for example, further sampling to verify the levels of generic *E. coli* in the samples in question.

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

2.7 Limitations

Results obtained for a targeted survey sample are from the analysis of a single sample unit. This sampling and testing strategy generally precludes the extrapolation of the laboratory result to the whole production lot as it is not statistically representative. This imposes certain limitations in the generalisation of the results in the absence of additional information.

Given the varying channels of commerce, the source of the products can change dramatically from one year to the next. As such, there was an insufficient number of samples in this study to carry out a detailed analysis of the results based on country of origin. In cases of positive results, unsatisfactory rates between countries are not considered to be statistically comparable.

3 Results

Generic *E. coli* counts were not found to exceed 100 CFU/g in all samples (Table 3). The bacterial pathogen *Salmonella* was not detected in 99.6% (541/543) of the samples. Therefore, the majority (99.6%) of the samples were assessed as satisfactory. Two samples (0.4%, 2/543) were found to be unsatisfactory due to the presence of *Salmonella*.

Table 3 Summary of Results of the Tahini Samples
(Percentage are shown in brackets)

Product	Total Number of Samples	Assessment		
		Investigative	Unsatisfactory	Satisfactory
Tahini	543 (100%)	0 (0%)	2 (0.4%)	541 (99.6%)

Both *Salmonella* contaminated tahini samples were imported from Lebanon (Table 4). *Salmonella* Montevideo and *Salmonella* Liverpool were identified from the isolates of the *Salmonella* positive samples.

Table 4 Summary of Unsatisfactory Samples

Product Type/Production Practice/Country of Origin/Brand	Reason for Unsatisfactory Assessment
Tahini /Conventional /Lebanon/Brand A	*Salmonella* Montevideo
Tahini /Conventional /Lebanon/Brand B	*Salmonella* Liverpool

As a result of these findings, the CFIA conducted food safety investigations and appropriate follow-up activities. Two product recalls resulted from the referral of the unsatisfactory samples to the appropriate CFIA program and subsequent investigations. It is important to note that there were no reported illnesses associated with consumption of any of the *Salmonella* contaminated products during this survey.

4 Discussion and Conclusion

In this survey (2010/11), 543 tahini samples were tested for pathogenic bacteria *Salmonella* and indicator bacteria generic *E. coli*. The survey results indicate that levels of generic *E. coli* were found to be satisfactory in all samples and *Salmonella* was not detected in most (99.6%) of the tahini samples. Two (0.4%) tahini samples were found to be contaminated with *Salmonella.*

As a result of the unsatisfactory findings, the CFIA conducted appropriate follow-up activities including food safety investigations, health risk assessment, directed sampling and review of importation procedures. Two tahini product recalls resulted from the subsequent investigations, however, there were no reported illnesses linked to recalled products.

The 2010/11 survey results also indicate that about half (51.0%) of the tahini samples collected from the Canadian retail market were from the Middle East. In addition, the two *Salmonella* contaminated tahini samples were imported from one Middle Eastern country. In recent years, outbreaks of salmonellosis associated with tahini have been reported worldwide. *Salmonella* contaminated tahini products were implicated in salmonellosis that occurred in Australia and New Zealand between 2002 and 2003 (15) and in the US in 2011 (17). The implicated tahini products were imported from Middle Eastern countries (15, 17). Various Middle-Eastern tahini products contaminated with *Salmonella* were also found in the United Kingdom and Canadian marketplaces in 2003 following the tahini associated salmonellosis outbreaks in Australia (15). These data suggest that tahini products from Middle Eastern countries are globally distributed (15, 17) and contamination of these products with *Salmonella* can occur.

The overall findings of this survey suggest that the majority of the tahini products on the Canadian market are produced under GMPs. However, contamination of tahini with *Salmonella* can occur, which could represent a food safety risk.

While the food industry, importers, and retail sectors are ultimately responsible for the food they produce, import, and sell, and individual consumers are responsible for the safe handling of the food they have in their possession, the CFIA regulates and provides oversight to the food industry, and promotes safe handling of foods throughout the food production chain. The CFIA will continue its surveillance activities and will inform stakeholders of its findings.

5 Acknowledgement

We would like to express our sincere thanks to Judy D. Greig, Laboratory for Foodborne Zoonoses, Public Health Agency Canada, for providing data on global foodborne disease outbreaks associated with various food products including tahini (Appendix B).

6 Reference

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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

GMPs: Good Manufacturing Practices

HC: Health Canada

INFOSAN: International Food Safety Authorities Network

MPN: Most Probable Number

PCR: Polymerase Chain Reaction

PFGE: Pulsed field gel electrophoresis

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 Tahini Contaminated with Bacterial Pathogens (2000- 2011)

List Number	Year	Country	Microorganism	Vehicle	Number of Cases	Source
1	1995	USA	*Salmonella* Brandenburg	Tahini	137	CDC Line list
2	2001	Sweden, Norway, Germany	*Salmonella* Typhimurium	Halva	41	CDR Weekly Aug 16 2001
3	2002	Australia	*Salmonella* Montevideo	Tahini	55	Eurosurveillance Weekly 2003 Volume 7 / Issue 38 Cases linked to imported Egyptian tahini
4	2003	Australia	*Salmonella*	Tahini	3	OzFoodNet Annual Report
5	2004	Australia	*Salmonella* Typhimurium	Hummus	920	Department of Human Services Victoria Australia
6	2007	USA	*Salmonella* Heidberg	Hummus	802	CDC line list
7	2007	USA	*Salmonella* Heidberg	Hummus	11	CDC line list
8	2011	USA	*Salmonella* Bovismorbificans	Hummus & Tahini	23	MMWR Vol.61 (46)

Information in this appendix was prepared by Judy D. Greig, Laboratory for Foodborne Zoonoses , PHAC (Public Health Agency of Canada The data presented were collected from several sources of information, such as peer-reviewed journals, newspapers, press releases, health units, national laboratory and government websites.

Appendix C: Tahini Recalls in the U.S. and Canada (2007- 2011)

Date of Issue	Recalled Products	Reason for Recall	Authority
2007-05-10, 24, 28 *	Tahini, imported from the U.S.	*Salmonella*	CFIA
2007-05-22	Tahini, U.S. products	*Salmonella*	US FDA
2007-05-25*	Tahini, U.S. products	*Salmonella*	US FDA
2009-09-04	Tahini, U.S. Products	*Salmonella*	US FDA
2010-07-19 **	Tahini, imported from Lebanon	*Salmonella*	CFIA
2010-08-23 **	Tahini, imported from Lebanon	*Salmonella*	CFIA
2011-02-10, 14	Tahini, Imported from Syria	*Salmonella*	CFIA
2011-09-23	Tahini, imported from Lebanon	*Salmonella*	CFIA

* These recalls related to the same brand of tahini products distributed in Canada and the U.S.

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

Appendix D: Analytical Methods Used for Microbial Analysis

Bacterial Analysis	Method Identification Number (Date Issued)	Title of Method*
***Salmonella* spp.**	MFLP-29 (July 2007, modified)**	The Qualicon Bax® System Method for the Detection of Salmonella in a Variety of Food and Environmental Samples
	MFHPB-20 (March 2009)	Methods for the Isolation and Identification of *Salmonella* from Foods and Environmental Samples
Generic *E. coli*	MFHPB-19 (April 2002)	Enumeration of Coliforms, Faecal Coliforms and *E. coli* in Foods
	MFHPB-27 (September 1997)	Enumeration of *Escherichia coli* in Foods by the Direct Plating (DP) Method

**Compendium of Analytical Methods* (19).

** MFLP-29 was performed as written with the following modification: Secondary enrichment was performed as outlined for cantaloupes, i.e., transferred from buffered peptone broth as specified to RVS and TBG broths (Rappaport-Vassiliadis Soya Peptone broth and Tetrathionate Brilliant Green broth) and incubated for 24 ± 2 h at 42.5°C. After incubation 2 ml from each of RVS and TBG are combined to one sample and analysis proceeds at step 7.3.1.4 of the method.