



Canadian Food  
Inspection Agency

Agence canadienne  
d'inspection des aliments

# Bacterial Pathogens in Mechanically Tenderized Beef Steaks - April 1, 2018 to March 31, 2019

## Food microbiology - Targeted surveys - Final report



# Summary

Mechanically tenderized beef (MTB) is a solid cut of raw beef that for the purpose of tenderizing the raw meat has been pierced with blades, needles or other similar instruments. The practice of mechanically tenderizing beef is a common, longstanding process that has been used by meat processors, retailers, the food service industry and consumers. The risk inherent in the mechanical tenderization process lies in the possible transfer of bacteria from the surface of the beef or instrument to the centre of the meat where it is more likely to survive the cooking process. In 2012, a Canadian *Escherichia coli* O157 (*E. coli* O157) outbreak involving a total of 18 cases of which some were likely linked to the consumption of MTB highlighted the need for changes to meat labelling regulations. Consequently, in 2014 Canada introduced new regulations that mandated that these products be identifiable to consumers through new labelling requirements.

Considering the factors mentioned above and their relevance to Canadians, MTB steaks were selected for targeted surveys. The purpose of this survey was to generate baseline information on the levels of generic *E. coli* and occurrence of pathogenic bacteria of concern on Canadian retail MTB steaks.

Over the course of this study (April 1, 2018 to March 31, 2019), a total of 975 samples of MTB steaks were collected from retail locations in 11 cities across Canada. All 975 samples were tested for *E. coli* O157:H7 and generic *E. coli*. Of the 975 samples, 386 samples were also tested for non-O157 Verotoxigenic *E. coli* (non-O157 VTEC). Generic *E. coli* is an indicator of the overall sanitation conditions throughout the food chain from production to the point of sale.

In this study, 99.7% (973/975) of the MTB steak samples were assessed as satisfactory. *E. coli* O157:H7 and non-O157 VTEC were not found in any samples. Generic *E. coli* at levels >100 Most Probable Number (MPN) or Colony Forming Units (CFU)/g were found in 3 (0.3%, 3/975) samples for which the Canadian Food Inspection Agency (CFIA) conducted appropriate follow-up activities.

Overall, our survey results indicate almost all of the MTB steak samples tested appear to have been processed under sanitary conditions. However, our results demonstrate the benefit of monitoring sanitation controls along the food chain to potentially identify areas for improvement. Consequently, as with all foods safe handling practices are recommended for producers, retailers and consumers.

# What are targeted surveys

Targeted surveys are used by the Agency to focus its surveillance activities on areas of highest health risk. The information gained from these surveys provides support for the allocation and prioritization of the Agency's activities to areas of greater concern. Originally started as a project under the Food Safety Action Plan (FSAP), targeted surveys have been embedded in the CFIA's regular surveillance activities since 2013. Targeted surveys are a valuable tool for generating information on certain hazards in foods, identifying and characterizing new and emerging hazards, informing trend analysis, prompting and refining health risk assessments, highlighting potential contamination issues, as well as assessing and promoting compliance with Canadian regulations.

Food safety is a shared responsibility. CFIA works with federal, provincial, territorial and municipal governments and provides regulatory oversight of the food industry to promote safe handling of foods throughout the food production chain. The food industry and retail sectors in Canada are responsible for the food they produce and sell, while individual consumers are responsible for the safe handling of the food they have in their possession.

## Why did we conduct this survey

MTB is a solid cut of raw beef that, for the purpose of tenderizing the raw meat, has been pierced by blades, needles or other similar instruments. The practice of mechanically tenderizing beef is a common, longstanding process that has been used by meat processors, retailers, the food service industry and consumers. The risk inherent in the mechanical tenderization process lies in the possible transfer of bacteria from the surface of the beef or instrument to the centre of the previously sterile meat where it is more likely to survive the cooking process. Several *E. coli* O157 outbreaks<sup>1</sup> in the United States have been linked to MTB. Also, in 2012, a Canadian *E. coli* O157 outbreak<sup>2</sup> involving a total of 18 cases of which some were likely linked to MTB, highlighted the need for changes to meat labelling regulations. Consequently, in 2014 Canada introduced new regulations<sup>3</sup> that mandated that these products be identifiable to consumers through new labelling requirements. In 2014 Health Canada also published a guidance document<sup>4</sup> for industry on the labelling requirements for MTB sold in Canada.

Considering the factors mentioned above and their relevance to Canadians MTB steaks were selected for targeted surveys. As hygienic production practices are important control measures in the processing of tenderized beef steaks and given the possibility that some consumers may not take note of the specific cooking instructions found on the product label, this survey was undertaken after the implementation of the new labelling requirements<sup>3</sup> to gain information on

the levels of generic *E. coli* and occurrence of pathogenic bacteria (*E. coli* O157:H7 and non-O157 VTEC) of concern on Canadian retail MTB steaks. Generic *E. coli* is an indicator of the overall sanitation conditions throughout the food chain from production to the point of sale.

## What did we sample

For this study, a sample consisted of a single or multiple consumer-size package(s) from a single lot of raw MTB steaks with a total weight of at least 250 g. All samples were collected between April 1, 2018 and March 31, 2019 from national and local/regional retail stores located in 11 major cities across Canada. These cities encompassed 4 geographical areas:

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

The number of samples collected from these cities was in proportion to the relative population of the respective areas.

## What analytical methods were used and how were samples assessed

Samples were analyzed using analytical methods published in Health Canada's *Compendium of Analytical Methods for the Microbiological Analysis of Foods*<sup>5</sup> and a CFIA internally developed method (table 1).

At the time of writing this report, no assessment guidelines had been established in Canada for the presence of indicator organisms or pathogenic bacteria in MTB. As *E. coli* O157:H7 is considered pathogenic to humans its presence was considered to be a violation of the *Food and Drugs Act* (FDA) Section 4(1)a<sup>6</sup> and therefore in the absence of assessment guidelines was assessed by the CFIA as unsatisfactory (table 1). The detection of non-O157 VTEC was assessed as investigative, indicating that further follow-up actions may be warranted depending upon the virulence profile<sup>7</sup> (such as the serotype and associated virulence gene(s)) identified.



**Table 1 - Analytical methods and assessment criteria for MTB steak samples**

Bacterial analysis	Method identification number <sup>a</sup>	Satisfactory	Investigative	Unsatisfactory
<i>E. coli</i> O157:H7	MFLP-30 MFHPB-10	Absent in 65 g	Not applicable (N/A)	Present in 65 g
Non-O157 VTEC	MFLP-52	Absent in 65 g	Present in 65 g	N/A
Generic <i>E. coli</i>	MFHPB-19 MFHPB-34 CFIAFMWG-001 <sup>b</sup>	≤ 10 <sup>2</sup> MPN or CFU/g	> 10 <sup>2</sup> MPN or CFU/g	N/A

<sup>a</sup> The methods used were the published versions at the time of analysis.

<sup>b</sup> CFIA internally developed method. Similar to MFHPB-34, bacterial culture plates are inoculated with a liquid suspension of the sample. The culture plates are then incubated to promote growth and colonies typical of *E. coli* are enumerated.

Unlike harmful bacterial pathogens (such as *E. coli* O157:H7), generic *E. coli* is commonly found in the intestines of humans and animals and most strains are harmless. It is considered to be an indicator organism and levels of generic *E. coli* found in a food product are used to assess the overall sanitation conditions throughout the food chain from production to the point of sale. An investigative assessment is associated with levels of generic *E. coli* >100 MPN or CFU/g (table 1), which may result in further follow-up actions. As the results are based on the analysis of one unit (n=1), further sampling may be required to verify the levels of generic *E. coli* of the lot.

## What were the survey results

All 975 samples of MTB steaks were tested for *E. coli* O157:H7 and generic *E. coli*. Of the 975 samples, 386 were also tested for non-O157 VTEC. Assessment results can be found in table 2.

**Table 2 - Assessment results of bacterial analyses in MTB steak samples**

Bacterial analysis	Investigative (% of total)	Satisfactory (% of total)	Number of samples tested
<i>E. coli</i> O157:H7	N/A	972	975
Generic <i>E. coli</i>	3		
Non-O157 VTEC*	0		
	<b>3 (0.3)</b>	<b>972 (99.7)</b>	<b>975</b>

\* 386 samples tested for non-O157 VTEC.

*E. coli* O157:H7 and non-O157 VTEC were not found in any samples. Generic *E. coli* (>100 MPN/g or CFU/g) were found in 3 samples (0.3%, 3/975) samples.

Of the 975 samples tested, 700 were domestic and the remainder were of unknown origin (table 3).

**Table 3 – Product origin of MTB steak samples**

Product origin	Total number of samples tested (% of total)
Domestic	700 (71.8) <sup>a</sup>
Unknown	275 (28.2) <sup>b</sup>
<b>Total</b>	<b>975 (100)</b>

<sup>a</sup> 1 sample >100 MPN/g of generic *E.coli* (480 MPN/g).

<sup>b</sup> 2 samples >100 MPN or CFU/g of generic *E.coli* (220 CFU/g, 3100 MPN/g).

The specific cuts of steaks sampled are detailed in table 4.

**Table 4 – MTB steak samples by cut type**

Cut of MTB steak	Total number of samples tested (% of total)
Bottom Sirloin	1
Chuck	7
Flank	31
Rib	65
Round	438 <sup>a</sup>
Sirloin	232
Tenderloin	11
Top Sirloin	1
Short Loin	174 <sup>b</sup>
Unknown	15
<b>Total</b>	<b>975</b>

<sup>a</sup> 2 samples >100 MPN or CFU/g of generic *E. coli* (220 CFU/g, 3100 MPN/g).

<sup>b</sup> 1 sample >100 MPN/g of generic *E. coli* (480 MPN/g).

## What do the survey results mean

In this study, 99.7% of MTB steak samples were assessed as satisfactory. *E. coli* O157:H7 and non-O157 VTEC were not found in any samples. Generic *E. coli* at levels >100 MPN or CFU/g were found in 3 (0.3%, 3/975) samples for which the CFIA conducted appropriate follow-up activities.

In 2003 a study<sup>8</sup> was conducted in the United States to investigate the microbial load and prevalence of pathogens in various cuts of fresh non-MTB samples (n=1022) taken from 2 processing plants. The average level of generic *E. coli* observed on the fresh beef cut samples was  $0.9 \pm 0.5$  log CFU/g<sup>7</sup> and no trends were observed related to the beef cut type. The incidence rate of *E. coli* O157 was found to be 0.3%<sup>8</sup> which was higher than the rate observed

in our study but in line with another similar study<sup>9</sup> conducted in the United States on cuts of non-MTB which found an incidence rate of 0.2% (n=1014). All *E. coli* O157 positive samples in this study<sup>9</sup> were isolated from sirloin cuts.

Overall, our survey results indicate that most of the MTB steak samples tested appear to have been processed under sanitary conditions. However, our results demonstrate the benefit of monitoring sanitation controls along the food chain to potentially identify areas for improvement. As with all foods, safe handling practices are recommended for producers, retailers and consumers.

## References

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