



Canadian Food
Inspection Agency

Agence canadienne
d'inspection des aliments

Bacterial Pathogens and Indicators in Pasteurized Goat, Sheep, and Water Buffalo Milk - April 1, 2019 to March 31, 2023

Food microbiology - Targeted surveys - Final report



Summary

A 4-year targeted survey¹ analysed 699 samples of pasteurized goat, sheep, and water buffalo milk for the presence of the pathogens *Salmonella* species (spp.), and *Listeria monocytogenes* (*L. monocytogenes*). All samples were also tested for total coliforms and Aerobic Colony Count (ACC) which are indicators of the overall hygienic and sanitary conditions of the food supply chain from production to the point of sale.

Over 86.8% of the samples tested were found to be satisfactory. *Salmonella* spp., and *L. monocytogenes* were not found in any of the samples. ACC at elevated levels were found in 72 of the 699 (10.3%) samples. Total coliforms at elevated levels were found in 5 of the 699 (0.7%) samples. Both total coliforms and ACC at elevated levels were found in 15 of the 699 (2.1%) samples. The Canadian Food Inspection Agency (CFIA) conducted appropriate follow-up activities.

Overall, our survey results indicate that pasteurized goat, sheep, and water buffalo milk sold in Canada are generally safe for consumption. However, as with all foods, and especially those that are ready-to-eat (RTE) good hygienic practices are recommended for producers, retailers, and consumers.

Why was this survey conducted

The survey was conducted to generate baseline information on the quality and safety of pasteurized goat, sheep and water buffalo milk sold at retail in Canada. A similar survey² was conducted from 2017 to 2020 of flavoured milk, however almost all of the samples tested were cow milk.

In Canada, milk undergoes pasteurization to kill any harmful bacteria that may be present in the raw milk. Therefore their presence in the final product may be due a variety of factors such as inadequate pasteurization, or contamination of the milk post-pasteurization. Given that milk is RTE, the possible presence of bacterial pathogens in the final product creates the potential for foodborne illness.

When was the survey conducted

The survey was conducted over a 3-year period from April 1, 2019 to March 31, 2023.

Where were the samples collected from

Samples were collected from national retail chains and local or regional grocery stores located in the following 11 major cities across Canada:

- Halifax
- Moncton
- Quebec City
- Montreal
- Toronto
- Ottawa
- Vancouver
- Victoria
- Calgary
- Saskatoon
- Winnipeg

The planned number of samples to be collected from each city was based on the population of the province in which the city was located relative to the total population of Canada.

How many and what kind of samples were collected

A total of 699 refrigerated, pasteurized goat, sheep, and water buffalo milk samples were collected. Shelf-stable products were excluded from this survey. A sample consisted of a single or multiple consumer sized packages of the same lot with a volume of at least 250mL.

What were the samples tested for

All samples were tested for *Salmonella* spp., *L. monocytogenes*, total coliforms, and ACC. *Salmonella* spp., and *L. monocytogenes* are pathogenic bacteria while total coliforms and ACC are indicators of the overall hygienic and sanitary conditions under which the samples have been produced, processed, stored, and transported. Elevated ACC ($>10^6$ CFU/g) or coliform ($>10^3$ CFU/g) levels detected during the shelf life of the product may contribute to spoilage and be an indicator of poor sanitation conditions throughout the food production chain from the rearing conditions of the mammals through to milk production and inadequate storage temperatures during transportation to the point of sale or while on display for sale at retail.

What methods were used to test the samples

Samples were analyzed using analytical methods published in Health Canada's *Compendium of Analytical Methods for the Microbiological Analysis of Foods*³ that were appropriate for the testing of goat, sheep and water buffalo milk.

How were the samples assessed

The samples were assessed using criteria based on the principles of the following Health Canada documents: *Health Products and Food Branch Standards and Guidelines for Microbiological Safety of Food – An Interpretive Summary*⁴, *Policy on Listeria monocytogenes in Ready-to-Eat Foods*⁵, the *Food and Drugs Act*⁶ (Section 4(1)), and guidelines developed by international food safety authorities⁷⁻⁹.

Table 1 - Assessment criteria

Bacteria	Satisfactory	Investigative	Unsatisfactory
<i>Salmonella</i> spp.	Not detected	Not applicable	Detected
<i>L. monocytogenes</i>	Not detected	Not applicable	Detected
Total coliforms	$\leq 10^3$ CFU/g	$> 10^3$ CFU/g	Not applicable
ACC	$\leq 10^6$ CFU/g	$> 10^6$ CFU/g	Not applicable

No assessment guidelines had been established in Canada for the presence of *Salmonella* spp. or indicator organisms in goat, sheep and water buffalo milk at the time of writing this report.

As *Salmonella* spp. is considered to be pathogenic to humans its presence was assessed as unsatisfactory as it is considered to be a violation of the *Food and Drugs Act*⁶ Section 4(1)a.

The assessment guidelines for *L. monocytogenes* are based on Health Canada's Policy on *Listeria monocytogenes* in RTE foods and is dependent upon the sample type analysed (Category 1, 2A or 2B)⁵. Fluid milks are considered to be Category 1 products (foods in which the growth of *L. monocytogenes* can occur).

Total coliforms are a group of bacteria that are commonly found in the environment and in the intestines of humans and animals. ACC is the total number of bacteria that are able to grow in an oxygenated (aerobic) environment. Unlike bacterial pathogens, both coliforms and ACC are generally harmless and are considered to be indicators of the microbial quality of food. Total coliforms and ACC are indicators of the conditions under which a food is produced, processed, packaged, and stored. Their levels in a food product are used to assess the overall sanitation conditions throughout the food chain from production to the point of sale. Their presence at some levels is tolerated, however elevated levels were assessed as investigative, possibly resulting in further follow-up actions.

What were the survey results

Over 86.8% of the samples tested were found to be satisfactory. *Salmonella* spp., and *L. monocytogenes* were not found in any of the samples. ACC at elevated levels ($>10^6$ CFU/g) were found in 72 of the 699 (10.3%) samples. Total coliforms at elevated levels ($> 10^3$ CFU/g) were found in 5 of the 699 (0.7%) samples. Both total coliforms and ACC at elevated levels were found in 15 of the 699 (2.1%) samples.

Table 2 - Assessment results

Bacterial analysis	Number of samples tested	Satisfactory (%)	Investigative (%)	Unsatisfactory
<i>Salmonella</i> spp.	699	607	Not applicable	0
<i>L. monocytogenes</i>			Not applicable	0
Total coliforms			5	Not applicable
ACC			72	Not applicable
Total coliforms and ACC			15	Not applicable
Total	699	607 (86.8)	92 (13.2)	0

High levels of ACC ($>10^6$ CFU/g) were primarily found in samples nearing the end of their shelf life.

Table 3 - Assessment results by days remaining of product shelf life^a when sampled

Days remaining of product shelf life ^a when sampled	Number of samples tested (%)	Satisfactory	Investigative	Investigative (%) (ACC $>10^6$ CFU/g)
≤ 5	157 (22.5)	117	40	39 (44.8)
6 to 10	262 (37.5)	226	36	33 (37.9)
11 to 15	204 (29.2)	188	16	15 (17.2)
16 to 20	66 (9.4)	66	0	0
21 to 25	10 (1.4)	10	0	0
Total	699	607	92	87 (100)

^a shelf life = best before date - sampling date

Survey results are also presented by the animal source (table 4), and production practice (table 5).

Table 4 - Assessment results by animal source

Animal source	Number of samples tested (%)	Satisfactory	Investigative
Goat	628 (89.9)	574	54
Water Buffalo	42 (6.0)	23	19
Sheep	29 (4.1)	10	19
Total	699	607	92

Table 5 - Assessment results by production practice

Production practice	Number of samples tested (%)	Satisfactory	Investigative
Conventional	664 (95.0)	578	86
Organic	35 (5.0)	29	6
Total	699	607	92

What do the survey results mean

A previous Canadian study² also investigated the microbiological quality and safety of flavoured, pasteurized milk, however almost all (99.9%, 1493/1495) of the samples were from cows. Similar in both studies, *L. monocytogenes* was not detected in any of the samples. However, in the previous study², ACC at levels $> 10^6$ CFU/g were found in 1.1% of the samples, while in this study ACC at levels $> 10^6$ CFU/g were found in 12.4% of the samples. This observation is most likely attributable to differences in the milk production systems between cows and other animals (goat, sheep, water buffalo). Contamination usually occurs during production (milking, storage, delivery)¹⁰⁻¹² and as the volume of production of cow's milk is significantly higher in Canada as compared to milk from other animals¹³, its production system is likely to be more refined (milking by machine vs. hand, shorter on-farm storage time) leading to milk of higher microbiological quality^{11,12}.

All of the samples taken in both the current and previous² studies were from retail and all of the samples found to have ACC $> 10^6$ CFU/g had time remaining in their shelf life when sampled. This observation may have been a result of improper storage conditions during distribution and/or at retail as every 2°C increase in temperature reduces the shelf life of pasteurized milk by 50%¹⁴.

Overall, our survey results indicate that pasteurized sheep, goat, or water buffalo milk alternatives sold in Canada is generally safe for consumption. However, as with all foods, and especially with those that are RTE, good hygienic practices are recommended for producers, retailers and consumers.

What is done with the survey results

All results are used to:

- inform risk management decisions
- support program design and re-design

The investigative samples triggered appropriate follow-up activities including:

- follow-up with the manufacturer
- facility inspections
- review of manufacturer production, sanitation, hygiene, and distribution practices
- review of records, including product receiving procedures and company laboratory test results

Can I access the survey data

Yes. The data will be accessible on the [Open Government Portal](#).

References

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