Canadian Food Inspection Agency | Agence canadienne d'inspection des aliments

Bacterial Pathogens in Fermented Tea (Kombucha) - April 1, 2018 to March 31, 2019

Food microbiology - Targeted surveys - Final report

Food microbiology targeted surveys, September 2019

Summary

Fermented teas (kombucha) have been consumed for centuries in Asian and European countries. In recent years there has been an increase in popularity in North America. Kombucha is made by fermenting sweetened tea (usually black or green tea) with a symbiotic culture of bacteria and yeast (SCOBY). There is a food safety risk if good manufacturing practices are not followed, as the SCOBY or tea may become contaminated with harmful microorganisms. Even with its recent increase in popularity, there is currently an absence of food safety data on kombucha.

Considering the factors mentioned above and their relevance to Canadians, kombucha was selected to be part of a preliminary survey to gain basic food safety information. Over the course of this study (April 1, 2018 to March 31, 2019), a total of 60 kombucha samples were collected from retail locations in 11 cities across Canada. Samples were tested for the bacterial pathogens *Salmonella, Escherichia coli* O157 (*E. coli* O157), *Bacillus cereus* (*B. cereus*), *Staphylococcus aureus* (*S. aureus*) and generic *Escherichia coli* (*E.coli*) which is an indicator of the overall sanitation conditions throughout the food production chain.

Salmonella spp., *E. coli* O157, *B. cereus* (> 10^4 Colony Forming Units (CFU)/mL), *S. aureus* (> 10^4 CFU/mL) and generic *E. coli* (> 10^2 Most Probable Number (MPN)/mL) were not found in any of the samples tested and therefore it appears that they were produced under sanitary conditions.

Overall, our survey results suggest that fermented teas are safe for consumption. As the number of samples, product types and microorganisms tested in our study were limited; our results should be interpreted within that context. The Canadian Food Inspection Agency (CFIA) will continue to monitor the food supply to ensure all foods, including kombucha meets Canadian food safety standards. Additionally, as with all foods, safe food handling practices are recommended for producers, retailers and consumers.

What are targeted surveys

Targeted surveys are used by the CFIA 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. The 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

Fermented tea (kombucha) is made by placing a SCOBY into a broth of sugared tea[1] (usually black or green) and left to ferment at room temperature for several weeks. After fermentation the beverage can be bottled and then stored in the refrigerator. While this beverage is thought to have originated thousands of years ago[2], it has only recently started to be brewed and bottled on a worldwide commercial scale. The formulation of commercially sold kombucha often include the addition of juices, spices or other flavour ingredients and are sold in natural health product stores as well as mainstream grocery stores. Given the composition of the beverage and manufacturing process[3, 4], unsanitary production practices could lead to unsafe product. Consequently, the CFIA decided to conduct a small scoping survey of 60 samples.

What did we sample

A sample consisted of a single or multiple unit(s) (individual consumer-size container(s) from a single lot) with a total volume of at least 250 mL. All samples were collected from national and local/regional retail stores located in 11 major cities across Canada. These cities encompassed 4 geographical areas:

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

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

Sampling occurred throughout the fiscal year (April 1, 2018 to March 31, 2019) of a variety of domestic, imported, conventional and organic products. Almost all (56/60) kombucha samples were flavoured with a variety of ingredients such as spices, leafy greens, herbs, fruits, vegetables and flowers. The remaining 4 samples were kombucha samples with no additional flavour ingredients.

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*[5] (table 1).

Table 1 – Analytical methods and assessment criteria for bacteria in fermented tea (kombucha)

Bacterial analysis	Method identification number[a]	Satisfactory	Investigative	Unsatisfactory
Salmonella spp.	MFLP-49 MFHPB-20	Absent in 25g	Not Applicable (N/A)	Present in 25g
E.coli O157	MFLP-30 MFHPB-10	Absent in 25g	N/A	Present in 25g
B.cereus	MFLP-42	≤ 10^4 CFU/mL	> 10^4 CFU/mL	N/A
S. aureus	MFHPB-21	≤ 10^4 CFU/mL	> 10^4 CFU/mL	N/A
Generic *E. coli*	MFHPB-19	≤ 10^2 MPN/mL	> 10^2 MPN/mL	N/A

[a] The methods used were the published versions at the time of analysis

At the time of writing this report, no assessment guidelines had been established for the presence of indicator organisms or pathogenic bacteria in kombucha. As *Salmonella* spp. and *E. coli* O157 are considered pathogenic to humans their presence was considered to be a violation of the *Food and Drugs Act* (FDA) Section 4(1)a[6] and therefore in the absence of assessment guidelines, was assessed by the CFIA as unsatisfactory.

B. cereus and *S. aureus* are commonly found in the environment and are bacteria that at elevated levels (table 1), can produce toxins capable of causing foodborne illness. Therefore, an investigative assessment which may result in further follow-up actions is associated with elevated levels of these bacteria (> 10^4 CFU/mL). As the results are based on the analysis of one unit (n=1), further sampling might be required to verify the levels of the bacteria of the lot. The *B. cereus* method used in this survey is unable to discriminate *B. cereus* from other closely related organisms and therefore results are considered presumptive for *B. cereus*.

Unlike harmful bacterial pathogens (such as *Salmonella spp., E. coli* O157:H7), generic *E. coli* is commonly found in the intestines of animals and humans 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 elevated levels of generic *E. coli* (>100 MPN/mL) (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 might be required to verify the levels of generic *E. coli* of the lot.

What were the survey results

Over the course of this study (April 1, 2018 to March 31, 2019), a total of 60 samples were collected. All fermented tea (kombucha) samples were assessed as satisfactory (table 2) as *Salmonella* spp., *E. coli* O157, *B. cereus* (> 10^4 CFU/mL), *S. aureus* (> 10^4 CFU/mL) and generic *E. coli* (> 10^2 MPN/mL) were not found in any of the samples tested.

Table 2 - Assessment results of fermented tea (kombucha)

Bacterial analysis	Number of samples tested	Satisfactory
Salmonella spp.	60	60
E.coli O157		
B.cereus		
S.aureus		
Generic *E. coli*		
Total	**60**	**60**

Of the 60 samples tested, 31 (52%) were produced in Canada while the remainder of the samples (29, 48%) were imported from the United States.

What do the survey results mean

In this preliminary survey, *E. coli* O157, *Salmonella* spp., *S. aureus* (> 10^4 CFU/mL), *B. cereus* (> 10^4 CFU/mL), and generic *E. coli* (>100 MPN/mL) were not found in any of the samples, therefore it appears that the kombucha samples tested have been produced under sanitary conditions. Kombucha has been studied by researchers for its inhibitory effects on many pathogenic microorganisms[7, 8] due to its low pH. However, contamination can still occur during the first few days before the fermentation process has lowered the pH to a low enough level to exert its inhibitory effects.

As the number of samples, product types and microorganisms tested in our study were limited; our results should be interpreted within that context. CFIA will continue to monitor the food supply to ensure all foods, including kombucha meets Canadian food safety standards. Additionally, as with all foods, safe food handling practices are recommended for producers, retailers and consumers.

References

1. Crum, H., A. LaGory, and S.E. Katz, *The Big Book of Kombucha: Brewing, Flavoring, and Enjoying the Health Benefits of Fermented Tea*. 2016: Storey Publishing, LLC.
2. Baschali, A., et al., *Traditional low-alcoholic and non-alcoholic fermented beverages consumed in European countries: a neglected food group.* Nutrition Research Reviews, 2017. 30(1): p. 1-24.
3. Nummer, B.A., *Kombucha brewing under the Food and Drug Administration model Food Code: risk analysis and processing guidance.* J Environ Health, 2013. 76(4): p. 8-11.
4. BC CDC, *Food Safety Assessment of Kombucha Tea Recipe and Food Safety Plan*, BC CDC, Editor. 2015.
5. Health Canada, *Compendium of Analytical Methods for the Microbiological Analysis of Foods*. 2011.
6. Department of Justice Canada, *Food and Drugs Act*. 2014.
7. Greenwalt, C.J., R.A. Ledford, and K.H. Steinkraus, *Determination and Characterization of the Antimicrobial Activity of the Fermented TeaKombucha.* LWT - Food Science and Technology, 1998. 31(3): p. 291-296.
8. Sreeramulu, G., Y. Zhu, and W. Knol, *Kombucha Fermentation and Its Antimicrobial Activity.* Journal of Agricultural and Food Chemistry, 2000. 48(6): p. 2589-2594.