

An Evaluation of British Columbia's Guideline for the Sale of Foods at Temporary Food Markets in Allowing the Sale of Potentially Hazardous Food

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Abstract

Background and the purpose: British Columbia's Guideline for the Sale of Foods at Temporary Food Markets is a document that Environmental Health Officers' (EHOs) and farmers' market managers will have to consult with when determining what food products are allowed to be sold in farmers' markets. This guideline plays a vital role because it indirectly influences EHOs' and farmers' market managers' judgments and the public's risk exposure to potentially hazardous foods (PHFs) in farmers' markets. It is necessary to evaluate and compare BC's guideline with other provinces' to see where it sits in the spectrum with respect to its permissibility in allowing the sale of PHFs in farmers' markets, perhaps contributing to the further revision or development of the farmers' markets guideline or policy.

Methods: An online Google Docs survey consisting of 20 questions was created to ask farmers' market managers from British Columbia and other provinces in Canada whether their farmers' markets allow the sale of the five food types: poultry, shell egg, sauerkraut, unpasteurized juice/cider and cheese and how these foods are handled and stored.

Results: There were 56 farmers' market managers who participated in this survey (46% from BC and 54% from outside BC). Chi-square results had p-values greater than 0.05 for all the five surveyed categories. Two-tail t test results had p-values less than 0.05 in the raw poultry and sauerkraut categories.

Discussion: Although no association between the location of farmers' markets in Canada and the sale of the five surveyed food categories, BC farmers' market managers disallowed the sale of raw poultry and unpasteurized juice more often than markets outside BC whereas fewer BC farmers' market managers disallowed the sale of eggs and cheese when compared to markets outside BC. A significant difference in the handling and storage practices of raw poultry and sauerkraut was identified between farmers' market managers in BC and outside BC. Also, BC's managers were shown to have safer food handling practices to raw poultry, sauerkraut and unpasteurized juice than managers from outside BC.

Conclusion: The types of foods sold in BC and outside BC appeared similar as this survey found no differences between the five surveyed PHF categories allowed for sale. However, handling practices of these foods did vary, and that might be associated with guidelines, or with farmers' market manager knowledge. Of concern, BC farmers' market indicated that eggs and juices were sourced and made on farms. These two categories required more attention and food safety awareness from both EHOs and farmers' market managers. Overall, the survey responses reaffirmed that review and approval for the sale of potentially hazardous food from EHOs and scrutiny from farmers' markets managers must be in place to ensure public's safety as well as minimizing public's risk exposure to improperly handled PHF sold in farmers' markets.

Key words: Guideline for the Sale of Foods at Temporary Food Markets, farmers' market, potentially hazardous food, British Columbia.

Introduction

A farmers' market is a physical food market where vendors make and sell products directly to the public and the majority of the vendors are selling farm products originating from British Columbia (BCAFM, 2011). Farmers' markets have considerable economical and social impacts to the communities. In 2002, the estimated direct sale of farmers' markets in British Columbia was \$113 billion (Connell, 2012). Also, farmers' markets foster local business development by providing an outlet for small-scale producers to sell directly to consumers (Lambla *et al.*, 2013). This in turn contributes to

community sustainability and food security which relate to people's access to food that fulfills their dietary needs, sustainable economic development, trade, and environment (Lambla *et al.*, 2013).

Due to the marketing scheme of selling directly to consumers, farmers' market stalls do not undergo inspections similar to what food premises or food service premises must do. Instead, vendors selling high risk foods or potentially hazardous foods (PHFs) are required to obtain an approval (Letter of Confirmation) from Environmental Health Officers (EHOs) of the local health authorities before selling in farmers' markets (BCCDC, 2015). High risk food or PHF is food in a form that is able to support the

growth of microbial pathogens or the production of microbial toxins (BCCDC, 2015). Thereby, these foods can be dangerous to public health and require careful evaluation before allowing for sale to the public. Besides EHOs, farmers' markets managers who are responsible for the overall operation of farmers' markets are also involved in guarding food safety in farmers' market. They are responsible for ensuring no sales of home prepared, PHFs in farmers' markets (BCCDC, 2015).

When determining what food products are allowed to be sold in farmers' markets, EHOs and farmers' market managers will have to consult with the Guideline for the Sale of Foods at Temporary Food Markets that is prepared by the BC Centre for Disease Control (BCCDC). This provincial guideline plays a vital role because it indirectly influences EHOs' and farmers' market managers' judgments and the public's risk exposure to PHFs in farmers' market. With the growing varieties of food sold in farmers' market, the BCCDC gets inquiries from EHOs if they should allow another type of PHF in farmers' markets every year. To address this issue effectively, the BCCDC suggested performing a survey to evaluate whether BC's Guideline is too permissive or too restrictive in allowing certain PHFs in farmers' markets by comparing it with other jurisdictions' guidelines. Another purpose for doing this survey study was that discrepancy and inconsistency exist in different provincial farmers' market guidelines. It is necessary to evaluate and compare BC's Guideline with other provinces' to see where it sits in the spectrum with respect to its permissibility in allowing the sale of PHFs in farmers' markets, perhaps contributing to the further revision or development of the farmers' markets guideline or policy.

Evidence Review

Potentially hazardous foods (PHFs) and foodborne illness (FBI)

PHFs require careful time and temperature control due to their intrinsic properties of allowing them to support the growth of disease-causing microorganisms and the production of microbial toxin (BCCDC, 2015). Typically, PHFs have a pH value > 4.6 and water activity (free available water for microbial growth in the food) > 0.85 (BCCDC, 2015). In the absence of proper control, PHFs can cause foodborne illness (FBI) which is associated with a huge economic burden to the healthcare system, loss of productivity and a large number of hospitalizations and deaths. An annual cost of acute gastrointestinal illness in Canada has been calculated

to be \$3.7 billion CAD (PHAC, 2008). Also, it was estimated that four million FBI cases happened in Canada each year, meaning one in eight Canadians experienced FBI (Government of Canada, 2015). Among these cases, there were about 11,600 hospitalizations and 238 deaths (Government of Canada, 2015).

Legislation and Guidelines regulating the PHFs

Although the implication of FBI is costly, FBI is a preventable public health problem. In BC, Public Health Act, Food Safety Act, Food Premises Regulation and Guideline for the Sale of Foods at Temporary Food Markets are documents that can be used by EHOs to regulate the sale of PHFs in farmers' markets as well as ensuring food safety compliance from farmers' market vendors. The Public Health Act is the overarching regulation that allows EHOs to protect the public from health hazards. Section 1 of the Public Health Act gives EHOs the discretion to disallow and remove PHFs that they believe are health hazards from the FMs (BC laws, 2008). Also, section 3 of the Food Safety Act and section 12 of the Food Premises Regulation prohibit the operators from selling and distributing contaminated food or food that is unfit for human consumption (BC laws, 2002 & 1999). In addition, section 14 of the Food Premises Regulation outlines the detailed information of time and temperature control regarding the processing, storage and display of PHFs (BC laws, 1999).

Limitation of the Guideline for the Sale of Foods at Temporary Food Markets

First, this guideline is a non-enforceable recommendation for preparing and displaying of food sold in farmers' markets and is written broad in scope. Thereby, it may not encompass all the food that vendors intend to sell in the farmers' markets. As a result, the protection of public health relies on EHOs and farmers' market managers to ensure that only low risk foods are offered for sale in farmers' markets. Second, the guideline delegates a major part of food safety responsibility from EHOs to farmers' market managers. A potential underlying problem with this shift in responsibility is that farmers' market managers are not obliged by the Guideline to be food safe certified (Herr & Heacock, 2013). Farmers' market managers will need to conduct risk assessment with the PHFs that might be sold at their farmers' markets, refer those vendors to apply for approvals and make sure they obtain approvals before selling the PHFs (PHAC, 2008).

Poultry and Shell egg risks and concerns

Salmonella spp. is the major concern for poultry and shell eggs. It can cause acute gastroenteritis and children, elderly, pregnant women and immunocompromised are most at risk (Galis *et al.*, 2013). *Salmonella spp.* naturally presents in the chicken's GI tract, oviduct and poultry farm environment (Galis *et al.*, 2013). To inhibit the rapid multiplication of *Salmonella spp.*, the guideline only allows the sale of frozen raw poultry and refrigerated shell eggs (4°C) at farmers' markets.

Previous study that had shown that freezing (-18C or below) was effective in preventing the proliferation of *Listeria* and *Salmonella spp.* population (Pradhan *et al.*, 2012). Further, studies from Betts *et al.* (2003) and Simpson Beauchamp *et al.* (2010) had shown that *Listeria* populations at 4C could proliferate. These studies suggest that freezing would be a good intervention for preventing the growth of both *Listeria* and *Salmonella spp.* population on raw poultry and that refrigeration could potentially promote the growth of *Listeria*.

Refrigeration is required for the sale of shell eggs because it can reduce the likelihood of contaminated eggs transmitting *Salmonella spp.* to consumers (Galis *et al.*, 2013). Besides, storage temperature, Gast and Holt's findings (2000) showed that *S. enteritidis* multiplication was also dependent on the initial contamination dosage, and amount of time passed. They conducted a study to determine the extent of growth of *S. enteritidis* inoculated at different places of eggs at different sites, different temperature over three days (Gast & Holt, 2000). They found that the growth of *S. enteritidis* was the most substantial at 25°C in yolk which was highest in nutrient content (Gast & Holt, 2000).

Sauerkraut risks and concerns

Improperly home-canned sauerkraut can be contaminated with *Clostridium botulinum* whose toxin can cause a rare but lethal food poisoning. In Canada, 20 botulism outbreaks involving the consumption of improperly canned food were recorded from 1919 to 2011 (BCCDC, n.d). Among the 20 outbreaks, 86 illness and 12 deaths occurred (BCCDC, n.d). Most recent botulism cases in BC involved people consuming improperly home canned green beans and watermelon jelly in 2011 and 2013 respectively (BCCDC, n.d).

C. botulinum presents in soil, ocean, or lake water. The optimal growth requirement of *C. botulinum* is 3-48°C, pH of 4.6-8.9 and water activity of 0.95 (Savard & Barrette, 2010). Leaving the canned sauerkraut at room temperature, the pH of the

sauerkraut and anaerobic condition in canned food are factors that may facilitate the growth of *C. botulinum* and the production botulism toxin (BCCDC, n.d). A study had been conducted to test the rising trend of reducing salt and unpasteurization in home-canning fermentation (BCCDC, n.d). The study showed that *C. botulinum* spores were able to survive over 80 days in the fermented cabbage (BCCDC, n.d). This demonstrated that home-canned fermented vegetable should not be allowed for sale in farmers' markets due to its high risk nature. Also, this study highlighted the importance of preparing canned food in approved commercial premises and having the processing steps reviewed and approved by Processing Authority as outlined in the Guideline.

Unpasteurized Juice/Cider risks and concerns

The risk associated with unpasteurized cider is contamination with *Escherichia coli* which can be found in the environment, food and human or animal fecal material (Salam *et al.*, 2011). The source of *E. coli* contamination in food can be attributed to the use of fecally contaminated water, poor hygiene of workers, and improper food handling practices (Salam *et al.*, 2011). *E. coli O157:H7* is an enterohemorrhagic strain *E. coli* that can cause hemolytic uremic syndrome (HUS), a permanent kidney damage, or even death (Salam *et al.*, 2011). As there is no lethal step involved in the production of unpasteurized juice, the survival of *E. coli O157:H7* is permitted. A previous outbreak study showed that the low pH of cider could still allow the survival of *E. coli O157:H7* to cause illness due to the low infectious dose of *E. coli O157:H7* (Salam *et al.*, 2011).

Cheese risks and concerns

L. monocytogenes is the foodborne pathogen concern for cheese. It can be found in food processing environments and infected domestic farm animals (McIntyre *et al.*, 2015). It can cause gastroenteritis in healthy individuals and can lead to fatality in high risk groups. In BC, there were 130 FBI cases associated with two soft ripened cheese outbreaks in 2002 (McIntyre *et al.*, 2015). It had identified contamination of *L. monocytogenes* from the environment was the cause for the two outbreaks (McIntyre *et al.*, 2015). In the first outbreak, *L. monocytogenes* was transmitted from the infected farm animals to workers then to the solution used to wash cheese (McIntyre *et al.*, 2015). In the second outbreak, infected wild birds dropped fecal material that contaminated the water that was used for washing the cheese (McIntyre *et al.*, 2015). These two outbreak studies demonstrated that the

manufacturing of cheese requires careful control and strict regulation to prevent environmental contamination and cheese must be thoroughly inspected. As a result, homemade cheese should not be allowed for sale in the less regulated and controlled farmers' markets.

Methods

A self-administered Google Doc (2015) online questionnaire consisting of 20 questions was emailed to BC Association of Farmers' Market, every second farmers' market managers on the Ontario, Alberta, Nova Scotia, Manitoba, Newfoundland and Labrador, Prince Edward Island, Saskatchewan, New Brunswick's farmers' market association websites, Farm Folk City Folk (BC), BC Food Systems Network, Food Security Gateway (BC), Canadian Association Food Studies and Food Secure Canada.

The questionnaire asked the farmers' markets managers the inspection frequency of their markets, whether their markets allowed the sale of five PHFs of interest, the handling and storage temperature for those PHFs sold in their markets. Also, the questionnaire was set up to quantify the risk associated with the PHFs sold in farmers' markets by assigning risk scores ranging from zero to ten to farmers' market managers' responses. Responses that were consistent with the handling and storage temperature outlined in the guidelines would receive a score of zero. In contrast, a score of ten would be assigned to responses from farmers' market managers who did not know the handling and storage temperature of the PHFs sold in their markets. Overall higher risk scores were assigned to PHFs sold in riskier conditions. For example, a score of ten was assigned to PHF categories sold in unrefrigerated condition, five for refrigerated inside a cooler without ice or ice packs, three for refrigerated or frozen inside a cooler with ice or ice packs and one for mechanically refrigerated (<4C) and frozen (<-18C). This is based on the aforementioned studies from Pradhan *et al.* (2012), Betts *et al.* (2003) and Simpson Beauchamp *et al.* (2010). Besides storage temperature, proper handling of PHFs was also crucial as it prevents the potential contamination of food from environment or food handling personnels. Any PHF categories that were produced, prepared or treated in approved commercial facilities would receive a score of zero.

Any deviations from the reparation and production requirements outlined by the guidelines would receive various risk scores depending on

different degrees of potential contamination that the PHF categories could subject to. Home-slaughtered poultry, uninspected raw eggs, home prepared unpasteurized juice, homemade sauerkraut, homemade cheese and unpasteurized cheese were assigned with a score of ten due to the high degree of environmental contamination that these foods could potentially be subjected to when prepared in the uncontrolled settings. In addition to the preparation and production, different types of PHF in the same PHF category could have different levels of risk associated with them due to their inherent characteristics or past outbreak history. For instance, unpasteurized apple juice was assigned with a score of ten due to past foodborne illness outbreaks associated with it whereas other types of unpasteurized juice types were assigned with risk scores of five. Due to the difference in capability of supporting foodborne pathogens specifically *L. monocytogenes*, each type of cheese was assigned with different risk scores. A risk score of ten was assigned to soft cheese and soft fresh cheese, five for medium cheese and cheese spread and one for hard cheese.

All survey responses data was analyzed using the Chi-square and two tail t-test from Statistical Analysis Software (SAS, 2015). Chi-square test was performed to compare the frequencies or proportions of farmers' markets in BC and other parts of Canada selling the PHF categories of interest. Two tail t-test was applied to the mean of the risk scores achieved by the farmers' market managers in each individual PHF category to evaluate handling and storage practices to assess risk.

Results

There were 56 farmers' market managers who participated in this survey. Participation was nearly equal between two groups: BC farmers' market managers comprised 46% of the participants (n=26) and the remaining 54% (n=30) identified themselves as farmers' market managers from outside BC.

Overall, farmers' market managers reported 38.5% of BC markets were inspected once, twice or more than twice in a calendar year. In contrast, 73% of markets outside of BC were inspected once, twice or more than twice in a calendar year. Reports of farmers' markets receiving no (or close to no) inspections in a year were similar between the two groups, 38.5% of BC markets, and 23% of markets outside of BC.

Table 1. Survey results for five foods in farmers' markets in BC and Canada

Food category	Location	Foods allowed for sale in market		Evaluation of handling practices	
		n	Chi-squared p	Mean risk score ± S.D.	t-test p
Poultry	In BC	14	0.104	6.6 ±6.8	0.012
	Outside BC	23		11.8±8.2	
Whole shell eggs	In BC	25	0.372	24.0±5.7	0.096
	Outside BC	27		20.6±9.1	
Sauerkraut	In BC	17	0.712	11.7±10.4	0.038
	Outside BC	21		18.1±12.2	
Unpasteurized juice/cider	In BC	10	0.266	11.1±16.3	0.0811
	Outside BC	15		20.8±23.3	
Cheese	In BC	16	0.217	27.6±22.1	0.9410
	Outside BC	16		27.3±26.2	

Chi-square results demonstrated that there was no association between the location of farmers' markets in Canada and the sale of the five surveyed food categories. Two-tail t test results showed that there was a statistically significant difference between the mean risk score achieved by farmers' market managers in BC and outside BC on the raw poultry and sauerkraut questions. Type II error could exist in Chi-square data analysis for raw poultry, raw egg, cheese questions and two tail-t test for sauerkraut and unpasteurized juice questions. Type I error could exist in two-tail t test data analysis for raw poultry, raw egg and cheese questions. However, the standard deviation of the risk scores achieved by farmers' market managers in BC and outside BC were large and even greater than the mean risk scores for raw poultry and unpasteurized juice categories. This was due to more variability in the data as a result of the small sample size. The variation of risk scores could range from zero (when the PHF was disallowed to be sold) to a really high score (when multiple types of a PHF category were sold in combination with improper handling, production or storage temperature that were practiced in the farmers' markets).

Discussion

The purpose of this survey study was to compare BC's guideline with other jurisdictions' guidelines (BCCDC, 2015). This study was directed at farmers' market managers who were responsible

for the overall operation of farmers' markets and overseeing the sale of PHFs in farmers' markets. Managers were asked whether their markets allowed the sale of the five PHF categories of interest: poultry, shell egg, sauerkraut, unpasteurized juice/cider and cheese. To evaluate risk of these foods, managers were asked about the source of their foods (for instance, meat from a farm or licensed slaughterhouse), various handling practices of the foods at the market, such as storage temperature (refrigerated or frozen), and where the food was prepared (home or commercial kitchen).

One aim of this survey was to evaluate whether BC's guideline is too permissive or too restrictive compared to other farmers' markets guideline in Canada with respect to allowing the sale of the five PHF categories of interest in farmers' markets. The result indicated that there was no association between the location of farmers' markets in Canada and the sale of the five surveyed food categories (Chi-squared, $p > 0.05$). However, BC farmers' market managers disallowed the sale of raw poultry and unpasteurized juice more often than markets outside BC, while fewer BC farmers' market managers disallowed the sale of eggs and cheese when compared to markets outside BC. Although not significant, it did reflect regional differences that exist in the types of foods sold in farmers' markets in BC and other parts of Canada. The small sample size of the survey was a contributing factor in weakening the statistical association in these analyses. Future

studies with larger samples will aid in confirming or rejecting the findings of this study.

Another aim of this study was to assess the risk associated with the PHFs of interest by evaluating the handling and storage practices in farmers' markets. There was a significant difference in the handling and storage practices of raw poultry and sauerkraut between farmers' market managers in BC and outside BC (two-t test, $p < 0.05$). Also, BC's managers were shown to have safer food handling practices to raw poultry, sauerkraut and unpasteurized juice than managers from outside BC (lower mean risk scores). It could be possible that BC farmers' market managers are more knowledgeable about food safety risks associated with those food categories, the differences in prescriptiveness between the guidelines leading to different food safety practices in farmers' markets or that BC farmers' market managers followed the guideline more closely. However, there was a food safety concern over the result of BC farmers' market indicated that eggs and juices were sourced and made on farms.

Poultry

Although farmers' market managers in BC and outside BC allowed different storage conditions ($p < 0.05$) almost all only accepted raw poultry from licensed slaughterhouses. Most BC farmers' market managers answered that raw poultry was sold in frozen condition; whereas most of the farmers' market managers outside BC allowed raw poultry to be sold in refrigerated condition (4°C or below). This could be attributed to the difference between guidelines in outlining the storage condition for the sale of raw poultry. For example, BC's guideline (2015) required raw poultry to be sold in frozen state. In contrast, Alberta's guideline (2014) outlined that raw poultry must be sold at either refrigerated (4C or below) or cooked (60C or above).

Sauerkraut

Besides poultry, sauerkraut was another food category that farmers' market managers from BC and outside BC scored significantly different on. BC farmers' market managers appeared to handled the sale of sauerkraut more safely (lower mean risk scores). A higher proportion of BC farmers market managers indicated that only commercially prepared sauerkraut was allowed and that its recipe would be checked by EHOs. In contrast, a higher proportion of farmers' market managers outside BC would allow homemade sauerkraut in their market. This outcome could be because BC farmers' market managers

follow the guideline more closely. Other provincial farmers' market guidelines including Alberta (2014), Nova Scotia (2015), New Brunswick (2013), and Ontario (2012) outline that sauerkraut must be tested and verified by a processing authority before allowing for sale in farmers' markets. *E. coli* O157:H7 and other verotoxigenic *E. coli* are food safety concerns associated with fermented food. A recent outbreak caused by enterotoxigenic *E. coli* O169 was noted to be associated with the consumption of kimchi, a traditional Korean fermented vegetable dish similar to sauerkraut (Cho *et. al.*, 2012). In this outbreak, the fermentation of kimchi did not complete. This illustrated the consequence of improper formation of fermented vegetables and stressed the importance of having recipe approved by a processing authority. Another food safety concern associated with sauerkraut was the rising trend of reducing salt in canning due to the increased public awareness of salt intake in contribution to hypertension and cardiovascular diseases (Taormina, 2010). The process of making sauerkraut required adding salt in sufficient quantities (ie. 2.25%) to allow lactic acid bacteria to grow and produce acid (Steinkraus, 2002). However, salt reduction in fermentation might make the food favourable for *C. botulinum* growth. Studies had shown that addition of salt was critical in controlling *C. botulinum* because it reduced the water activity of food products (Webb *et al.*, 2007). Salt addition (at concentrations of 2% and 3%) into growth media was found to reduce the probability of *C. botulinum* spore germination and the probability of germinated spore developing into mature cells (Webb *et al.*, 2007). This demonstrated the necessity of having the recipes of fermented vegetables verified by EHOs and tested by processing authorities.

Unpasteurized juice/cider

BC farmers' market managers appeared more knowledgeable of the risk associated with unpasteurized juice in comparison to farmers' market manager outside BC because they achieved a lower mean risk score on this food category (BC: 11.1, outside BC: 20.8, $p = 0.08$). In addition, a higher proportion of BC farmers' market managers disallowed the sale of unpasteurized juice/cider. This could be attributed to a previous *E. Coli* O157:H7 outbreak caused by the consumption of unpasteurized apple juice in British Columbia (Centers for Disease Control and Prevention, 1996; Cody *et. al.*, 1999). A majority of farmers' market managers who allowed the sale of unpasteurized juice indicated that juice sold in their markets was either prepared on the farm and transported to market or prepared on site. This actually raised a food safety concern of *E. coli*

contamination (Salam *et al.*, 2011). Hygienic food preparation environment, good hand hygiene among farm workers and food handlers and proper food handling practices are necessary to prevent *E. coli* contamination. In addition, a few farmers' market managers who allowed the sale of unpasteurized juice answered that unpasteurized juice was allowed to be sold at ambient temperature. Storing unpasteurized juice at ambient temperature could lead to proliferation of foodborne pathogens in juice and pose a risk to the consumers. In fact, there was a previous foodborne illness outbreak caused by storing unpasteurized carrot juice at ambient temperature (Sheth *et al.*, 2008). In the outbreak, the customer's failure of proper refrigeration and storage of carrot juice allowed the activation of dormant of *C. botulinum* spores and the production of botulism toxin. Although this outbreak was not about unpasteurized juice, it highlighted the importance of temperature control on the customer side for food product that relied on refrigeration as the only barrier to *C. botulinum* growth. This should be considered by farmers' market managers when evaluating any food products that rely on refrigeration as the only barrier to prevent pathogenic microorganism growth.

Egg and Cheese

While there were no differences noted in allowing cheese or eggs to be sold in markets, BC farmers' market managers appeared to handle eggs less safely than farmers' market managers outside (mean risk scores for BC: 24.0, outside BC: 20.6, $p > 0.05$). This may be attributed to the differences in prescriptiveness between BC and other provincial guidelines. BC's guideline did not specify that eggs sold in farmers' markets must be inspected/graded. In contrast, Ontario's guideline (2012) prohibited the sale of ungraded eggs in farmers' markets and Alberta's guideline (2014) outlined that un-inspected eggs could be sold directly from producer to consumer if they were clearly labelled with "un-inspected". This difference could contribute to why BC farmers' market managers scored higher as almost all BC farmers' market managers responded that the eggs sold in their markets were not inspected (directly from farm). Eggs that were directly from farm posed a higher risk than eggs that were inspected and graded because egg inspection (grading) would reject defective and low quality eggs unfit for human consumption (CFIA, 2012). Also, eggs grading was completed in federally registered egg grading stations which were inspected by CFIA to ensure eggs were handled in a sanitary environment. CFIA routinely sampled, monitored or detected the presence of *Salmonella spp.* which was the major foodborne pathogen associated with eggs

(CFIA, 2012). Although there was no specific foodborne illness cases or outbreaks found associated with the consumption of eggs sold in BC farmers' markets, the criteria of only allowing graded eggs could be considered and reviewed by BC's guideline developers to ensure public's health and safety.

In contrast to the risk score result for eggs, farmers' market managers from BC and outside BC scored equally on the cheese questions, indicating a similar level of risk associated with the sale of cheese in farmers' markets across Canada. With respect to the sale of cheese, all guidelines required that cheese to be sold in farmers' markets must be from approved commercial facilities with advanced approval from health authorities. However, none of the guidelines outlined which cheese types were allowed to be sold in farmers' markets. This could be a food safety concern as different cheese type have different levels of risk associated with them. Among all the cheese categories, soft cheese and soft fresh cheese present the most risk due to their high water activity ($A_w = 0.965-0.967$) being capable of supporting the growth of *Listeria* (Bannister, 1987). In contrast, hard cheese presents the least risk due to its lower water activity being less favourable for the growth of *Listeria* (Bannister, 1987). In addition, soft cheese made of unpasteurized milk is more hazardous compared to hard cheese or soft cheese made with pasteurized milk (USFDA, 2015). It was estimated that unpasteurized soft cheese is 50-160 times more likely to cause *Listeriosis* than pasteurized cheese (USFDA, 2015). To minimize the public's health risk due to the consumption of cheese, EHOs and farmers' markets managers must ensure that cheese sold in farmers' markets are from approved commercial facilities and must be sold in proper storage temperature.

Recommendations

The following recommendations were proposed to BC's guideline based on participants' various responses. First, all BC farmers' market managers answered that the eggs sold in their markets were directly from the farm. As there was a certain level of risk associated with un-inspected eggs, further research, guideline review and development is needed to evaluate the risk associated with the sale of un-inspected eggs in farmers' market. Second, all BC farmers' market managers indicated that their juice was prepared on a farm, at home or on site while BC's guideline outlined that juice could be sold only if it was prepared in approved commercial facilities with prior approval from health authorities. Therefore, unpasteurized juice is a food category that

requires more attention and food safety awareness from both EHOs and farmers' market managers. Third, EHOs and farmers' market managers will have to consult with BCCDC and pay attention to the different cheese types sold in farmers' markets and their storage conditions because BC's guideline did not specify which cheese types are allowed and their required storage conditions.

Limitations

The study would be more robust with a larger sample size. Increasing sample size would reduce Type II error and would allow for a more meaningful evaluation on whether BC's guideline was truly more or less permissible in allowing the sale of the five surveyed food categories; as well as determining whether there were significant differences in risk scores of the five food items under investigation. There was sample of convenience bias because farmers' market managers who were members of farmers' market associations and had access to internet would receive the survey invitation email. Some farmers' market managers might not be accessing emails during the winter months when fewer farmers' markets are operational. In addition, there could be biases in the survey responses due to the way that survey was administered. It could be possible that farmers' market managers did not answer truthfully or consulted with farmers' market guidelines to provide the best answers. Besides, the assigned risk scores may not be reflective in quantifying the actual risks associated with the surveyed food categories. For example, the general storage method for cheese sold in farmers' markets was asked but it was unknown as to how each cheese type was stored specifically. Therefore, the risk associated with each cheese type could not be quantified.

Future research suggestions

Future research that can be done to improve the evaluation of the permissibility of BC's guideline includes administering survey through phone calls so that farmers' market managers can provide more specific answers. Also, further surveys on farmers' market should be launched when farmers' markets are in season so that a higher response rate and larger sample size can be obtained. Moreover, a better risk quantifying method can be developed to analyze the survey responses so that risks associated with the surveyed food categories can be characterized. In addition, further research can be conducted to explore the foodborne illness rate caused by consumption of farmers' market food products. This will help EHOs

and guideline developers to see which area requires more food safety education and whether more stringent guideline standards should be applied to those foods.

Conclusion

The types of foods sold in BC and outside BC appeared similar as this survey found no differences between the five PHF categories under investigation. However, handling practices of these foods did vary, and that might be associated with guidelines, or with farmers' market manager knowledge. The results reflected that higher proportions of BC farmers' market managers disallowed the sale of raw poultry and unpasteurized juice. Also, BC farmers' market managers appeared to have better food handling practices for raw poultry, sauerkraut and unpasteurized juice. This could be attributed to BC farmers' market managers having a better food safety knowledge for these food categories, the differences in prescriptiveness between the guidelines leading to different food safety practices in farmers' markets or that BC farmers' market managers followed the guideline more closely. Although the result for this survey was inconclusive, the survey responses provided insights into the conditions in which raw poultry, egg, sauerkraut, unpasteurized juice and cheese were sold in farmers' markets in Canada. Also, these survey responses could be useful to guideline developers or health authorities to consider whether more stringent criteria for certain food categories should be implemented. In addition, the survey responses reaffirmed that review and approval for the sale of potentially hazardous food from EHOs and scrutiny from farmers' markets managers must be in place to ensure public's safety as well as minimizing public's risk exposure to improperly handled potentially hazardous food sold in farmers' markets.

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Competing interest

The authors declared that they have no competing interests.

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