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Competencies of Those Assessing Food Safety Risks of Foods for Sale at Farmers' Markets in British Columbia, Canada

ABSTRACT

This study assessed the food safety knowledge of farmers' market personnel and inspectors by evaluating their competency to identify missing information that affects food safety risk in food applications received for sale at farmers' markets in British Columbia (BC), Canada. Two surveys were conducted involving farmers' market managers (FMMs, $n = 38$ survey 1; $n = 35$ survey 2), farmers' market vendors (FMVs, $n = 107$ survey 1) and environmental health officers (EHOs, $n = 83$ survey 2). We found no differences in the general food safety knowledge of FMMs and FMVs in survey 1; knowledge was not associated with experience or food safety training. However, poor scores, less than 70%, were found on questions that evaluated potentially hazardous foods. A follow-up of FMMs and EHOs (survey 2) found food safety knowledge scores higher among EHOs (80.6%) than FMMs (73.3%). Based on the application information provided, foods acceptable for sale were more frequently rejected by EHOs, while food applications not acceptable for sale were more frequently accepted by FMMs ($P < 0.001$). Although

food application scores were low, EHOs scored higher than FMMs when food safety risks were evaluated in food applications ($P = 0.04$). This study reinforces the need for education for EHOs and FMMs to recognize critical food safety risk information in the recipes and applications typically received for food sales at farmers' markets in BC.

INTRODUCTION

Farmers' markets are a growing industry in British Columbia (BC), Canada. Between 2006 and 2012, this province experienced a 62% increase in the number of operating markets, with more than 125 in operation in 2013 (10). The average market season spans 28 weeks, generally from May to October, with some markets operating year-round (2). Farmers' markets offer direct-to-consumer sales. Consumers shop at farmers' markets to have a direct connection with the food producer and to know where foods are grown and who makes them (14). Foods sold at farmers' markets include fresh fruits and vegetables, simple low-risk items prepared in vendors' homes, and more complex, potentially hazardous food (PHF) prepared in commercial

kitchens. Foods that are considered potentially hazardous are required to comply with the BC Food Premises Regulation (5), and they must be prepared in a facility that is approved by government health authorities. Vendors preparing PHF must apply for a temporary food service permit and prepare the PHF in an inspected commercial kitchen. Approvals are granted by the local health authority for the conditional sale of the PHF under the permit. A vendor wishing to sell PHF at a farmers' market must submit information about the food to the Farmers' Market Manager (FMM) on a standardized application form (4). These food applications should contain a full ingredient list, recipe, preparation method, and other relevant information. This information may include product labels that declare who made the product, a use-by date or storage information for refrigeration, laboratory test results to confirm that the product meets acidity (pH) and water activity (A_w) guidelines to verify it as non-PHF, or signage for the vendor stall.

Control of foods for sale and food safety in farmers' markets is a shared responsibility between the farmers' market management and the regional health authority environmental health officer (EHO) inspector. However, the onus of selling safe food is on the vendor. Farmers' markets may be run by a single FMM, or the market may also have an operations manager responsible for coordinating with several FMMs. Oversight of items sold at farmers' markets are under the immediate review of the FMMs, some of whom hold paid positions, while others are vendors who volunteer their time in this capacity (2). The FMM, the first person to review a vendor application, is tasked with assessing vendor applications, and accept foods as generally safe if they appear on a list of foods considered low risk. This list is developed by government health authorities and is contained within a document known as the Temporary Food Markets (TFM) guideline. It is managed by a provincial agency, the BC Centre for Disease Control (4). Generally, categories of foods appearing on the list that are not considered potentially hazardous are allowable for sale without further review. FMMs are requested to contact their local health authority and Environmental Health Officer (EHO) for review of food applications for foods not on this list, or for foods they have concerns about. Additionally, FMMs should refer the vendor to apply for health authority approval to sell the food item of concern. Prior to 2011, all food applications were reviewed by EHOs. After 2011, the responsibility to initially assess food applications was delegated to FMMs.

EHOs receive substantial instruction in food safety training. Food hygiene curriculum instruction is one of the core topics in the environmental health program, and food safety is one part of the health protection core competencies examined before certification is granted under the Canadian Institute of Public Health Inspectors (6, 8). In contrast, FMMs are recommended, but not required, to take food safety training. This differs from the situation for food

service establishments, such as restaurants, where food safety training for the owner or at least one on-site employee is required under the BC Food Premises Regulation (5).

The purpose of this study was to assess the food safety knowledge of farmers' market personnel and EHOs and to evaluate their competency in assessing food safety risk in applications received for food to be sold at farmers' markets. We first evaluated the effectiveness of experience and food safety training programs to levels of food safety knowledge of farmers' market personnel. Results of the first survey reported here led us to further explore the food safety knowledge of FMMs and EHOs, to assess their ability to distinguish between potentially and non-potentially hazardous foods, and to assess their competency to identify missing information required to control food safety risk in typical farmers' market food applications. We also evaluated these results against FMMs and EHOs experience and self-assessed food safety knowledge.

MATERIALS AND METHODS

Surveys of farmers' market managers, vendors and environmental health officers

Two separate surveys were conducted between July 2012 and March 2013. Surveys were developed and pilot tested in collaboration with stakeholders that included the BC Association of Farmers' Markets (BCAFM), local FMMs, and EHOs and managers from regional health authorities. Prior to distribution of the survey by e-mail, letters were mailed to FMMs and EHOs advising them of the study. The purpose of the first survey was to assess food safety knowledge of FMMs and farmers' market vendors (FMVs) within the province of BC. The purpose of the second survey was to assess the food safety knowledge of FMMs and EHOs, and to further assess their ability to evaluate the food safety risks in applications for foods commonly sold at farmers' markets. The populations surveyed included all FMMs and FMVs listed on the BCAFm web-site directory (3) and all EHOs in the directory provided by the health authorities. Ethics approval for the study was granted for both surveys by the University of British Columbia (UBC) and British Columbia Institute of Technology (BCIT). Surveys were conducted in Checkbox® Survey Inc. software version 5 (Prezza Technologies Inc., Watertown, MA, USA), and responses were stored on secure servers within Canada.

Survey scoring and analysis

Scores assigned to food safety knowledge questions in both surveys were in keeping with good food safety principles; correct answers were scored 5 points, partially correct answers were scored 2 points, and incorrect or don't know answers scored zero points. For example, when asked about the acceptable storage of eggs, respondents who chose "at refrigeration temperatures (4°C (40°F) or lower)" were awarded 5 points; those who chose "below

10°C (50°F)” were awarded 2 points; and those who chose “on the table but not in direct sunlight” and all other choices

were awarded 0 points. Questions asked in survey 1 are shown in *Table 1*; questions asked in survey 2 are shown in *Table 2*. In

TABLE 1. Survey 1: Food safety knowledge questions given to farmers’ market managers and vendors (2012)

Survey 1

1. Which of the following foods are considered as “potentially hazardous foods”?

- Salsa with no meat but pH of higher than 4.2
- Ready-to-eat meat (beef jerky with water activity of 0.85 and lower)
- Egg salad
- Fresh eggs
- Sprouted seeds (e.g, bean, alfalfa or pea sprouts)
- Bean salad and creamed corn
- Herb flavored oils
- Herb flavored vinegar
- Fruit filled pies and muffins
- Cream filled pies and muffins
- Nut butters and jams with pH of 4.7 and higher
- Hard candy

2. What is the best way to reduce the temperature of “potentially hazardous foods” after the cooking process?

- Putting foods in an open container where there is air flow until the foods cool, then place them into the refrigerator
- Cool foods to room temperature in two hours, then further cool foods to refrigeration temperature in 4 hours
- Let foods cool outside first, no matter how long it takes, then place them into the refrigerator
- Refrigeration is not required for foods that have gone through a cooking process
- Don’t know

3. Acceptable storage of eggs is:

- On the table but not in direct sunlight
- At refrigeration temperatures (4°C (40°F) or lower)
- Between 4°C (40°F) and 60°C (140°F)
- Below 10°C (50°F)
- Don’t know

4. You’re preparing new jams, jellies and marmalades from old tried and true recipes. Based on the descriptions below, indicate whether these new products will need laboratory testing for safety (for pH, acidity and/or water activity testing).

- You decide to eliminate the lemon juice from your recipe
- You eliminate sugar in your jam using a sugar substitute such as Sucralose to make a sugar-free jam which has the same sweetness as regular jam but higher water activity
- You make the same type of jam as last year and use the same recipe
- You decide to make a new watermelon jelly product

Table 1 continued on next page

TABLE 1. Survey 1: Food safety knowledge questions given to farmers' market managers and vendors (2012) (cont.)

Survey 1

5. Which of the following statements are correct when samples are offered for tasting at the market:

- A hand-washing station must be readily accessible from your stall
- If you do not have hand-washing station you can use wipes for sampling
- Customers can help themselves if you provide antibacterial wipes at your stall
- Samples must be arranged in one layer with plenty of space between them
- Single use paper cups, squeeze bottles, tongs and toothpicks are convenient means for offering samples

6. To minimize cross-contamination:

- Use separate utensils for potentially hazardous foods and non potentially hazardous foods
- It is OK for customers to handle unwrapped baked goods
- Transportation vehicles must be checked for cleanliness before transporting foods
- All foods, equipment and utensils must be packed in food grade containers and covered in the transportation vehicle
- It is OK to keep extra food products on the floor under the table for fast and easy access
- Wind and rain cannot be sources of contamination in food products

7. The best definition for cleaning and sanitizing is:

- Cleaning is a process that removes surface dirt (soil load) using a detergent solution, followed by a sanitizing solution that eliminates harmful bacteria
- Cleaning and sanitizing sterilize dishes by eliminating harmful bacteria
- Proper dish cleaning and sanitizing with detergent eliminates harmful bacteria by washing and rinsing in a sanitizing solution
- Cleaning with a detergent and sponge and sanitizing with a water rinse eliminates harmful bacteria
- Don't know

8. The steps for washing dishes are:

- Scrape/ wash with detergent/ rinse/ sanitize/ air-dry
- Scrape/ sanitize/ wash with detergent/ rinse/ air-dry
- Scrape/ wash with detergent/ rinse/air-dry
- Scrape/ wash with detergent/ rinse/ dry with cloth
- Don't know

9. When should hands be washed before handling ready-to-eat foods?

- After working with raw meats
- After smoking
- After gloves are removed, and before putting on new gloves
- After using the washroom
- After eating or drinking
- After patting a pet
- After handling money

10. What are the requirements for a portable hand washing station?

- A source of drinkable water, and a liquid soap dispenser
- A source of drinkable water, a free running spout, and single use paper towels
- A source of drinkable water, a free running spout, liquid soap dispenser, single use paper towel, and refuse container for waste water
- Don't know

TABLE 1. Survey 1: Food safety knowledge questions given to farmers' market managers and vendors (2012) (cont.)

Survey 1

11. Hand sanitizers and wipes are acceptable when:

- Foods are already pre-packaged
- Food samples for tasting are not offered
- Whole fresh fruits and vegetables are sold
- All of the above
- Don't know

12. You are getting ready to make your products for the market, and feel sick (with nausea, vomiting, or diarrhea), what would you do?

- You cook the food product at home, but pass the selling job to your family member
- You must stay home out of kitchen and do not cook or sell food products that week
- You can go to the market to help with the food sampling at your stall in the market
- You can cook the product at home, and keep the food safe by wearing mask and gloves
- Don't know

13. Which of the following foods are considered as allergens?

- Mustard
- Milk
- Egg
- Tomato
- Peanut butter
- Shellfish
- Wheat
- Yogurt made with soy milk

14. Which of the following statements are correct?

- Allergic people should not shop at farmers' markets
- If allergens are present in small amount, they do not pose any risk
- The vendors must know all the ingredients including allergens in their food products to inform the customers
- The allergens' effect disappear by cooking process
- If the product contain allergens, they must appear on the labelling

15. What are the requirements for labelling on the food products? (choose the best option)

- The name of the product
- A list of ingredients
- Storage information
- A "packed on" or "batch" date
- A producers' name and contact information
- All of the above
- Don't know

TABLE 2. Survey 2: Food safety knowledge and food safety risk in food applications questions given to FMMs and EHOs (2013)

Demographic questions

1. How would you describe your current position?

- Farmers' Market Manager
- Environmental Health Officer

2. How many years experience do you have in your position?

- Less than 1 year
- 1 to 3 years
- Between 3 and 5 years
- More than 5 years

Level of food safety knowledge and resources used to assess food applications

3. How would you rate your level of food safety knowledge? Please check one of the following options:

- I have good food safety knowledge
- I have somewhat better than average food safety knowledge
- I have average food safety knowledge
- I have somewhat less than average food safety knowledge
- I have little food safety knowledge

4. When assessing food applications, which of the following resources do you use to help you with your decisions?

- I look at a previous application from the same vendor
- I look at a previous application for similar food from a different vendor
- I consider illnesses and outbreaks associated with the food type or processing method
- I review the application with a colleague
- I consult with a food specialist
- I consult a reference book or on-line source
- I check the Temporary Food Market Guidelines
- I check Appendix I in the Guideline
- I look at the recipe in the application

Food safety knowledge questions

5. Which of the following statements do you consider correct?

- Intact shell eggs are low risk
- Containers of shell eggs should indicate the name of the producer
- Remolded chocolates are no concern and need no further evaluation
- A dry cereal product containing dried fruits is low risk to the consumer
- If tomatoes are used as an ingredient, the final product may be high risk
- Herb and flavoured oils are not associated with high risk
- Sprouted seeds need approval from the Health Authority
- Cheese pretzels are baked, therefore no concern and need no further evaluation

TABLE 2. Survey 2: Food safety knowledge and food safety risk in food applications questions given to FMMs and EHOs (2013) (cont.)

Food safety knowledge questions

6. According to the guideline for the sale of foods at temporary food markets, low risk food items do not require a permit from the local Health Authority. You received a food application with the following product list. Which products do not require a permit from the Health Authority (i.e., these are low risk foods)?

- Pickled vegetables (vinegar base, pH 4.6 or less)
- Sausages
- Apple pie
- Pesto
- White and herb vinegar
- Eggs
- Humus
- Low sugar jelly
- Honey
- Perogies

Food application food safety risk assessment questions

7. Please choose 4 of the following 6 food applications you would like to assess

- Salsa verde
- Beef jerky
- Sweet watermelon jelly
- Cheesy scones
- Chicken samosas
- Chocolate fudge

8. Please read the following food application carefully. This is all the information that you received from this vendor for this product:
[Food applications provided in the survey are shown in Table 3]
This food application is more complex than what I usually need to review

- Yes
- No

9. Having read this food application, please answer the following question: Would you accept this food for sale at your farmers' market? Please choose one answer:

- Yes, the information provided is satisfactory for acceptance
- No, the information does not warrant a safe application even if further information were provided
- Maybe, I need more information to assess this application

Table 2 continued on next page

TABLE 2. Survey 2: Food safety knowledge and food safety risk in food applications questions given to FMMs and EHOs (2013) (cont.)

Food application food safety risk assessment questions

10. You answered “Maybe”: please indicate what further information you would require. Choose as many as apply:

- the recipe requires more detail
- the preparation method requires more detail
- the application requires a label for contact information
- no allergen warning found on the label
- the label information should declare no product refrigeration is required
- the label information should declare product refrigeration is required
- no expiry date is given for the food product
- a laboratory test for pH is required to demonstrate the food is not potentially hazardous
- a laboratory test for water activity (A_w) is required to demonstrate the food is not potentially hazardous
- more information on the source of ingredients is required
- the product must be prepared in a commercial kitchen
- a sign for display in the vendor stall must state this “product prepared in an uninspected kitchen”

the second survey, participants chose and evaluated four of six food applications (Table 3). Each application contained a list of ingredients, the recipe steps for food preparation, and other information. Other information included the label, the date the product was made or best before date, laboratory test result for pH or water activity, and signage to be placed in the farmers’ market vendor stall. The initial choices for each application consisted of accepting or rejecting the food application, or accepting the food application if other information was provided. In the latter choice, participants were asked what other information would be required to accept the application from a pre-defined list of 12 selections. A perfect score for each food application was set at 20 points; correct selections of additional information from the check-list were awarded points, while incorrect selections resulted in point deductions from each application score (Table 4). Scoring of food applications were assessed on the initial response and on the additional information provided. Correct answers to “would you accept the product for sale?” were given 10 points (“yes” for scones, and “maybe” for all other food applications were given 10 points), partially correct answers were given 5 points (“maybe” for scones, and “no” for all other food applications), incorrect answers were given 0 points (“no” for scones, and “yes” for all other food applications). Extra information was assessed in the remaining 10 points. Only answers that contained the correct choices for extra information with no incorrect choices were awarded the full 10 points. Partially correct answers were awarded 0.5 points (for each correct choice), incorrect answers were awarded -1.0 points (for each incorrect choice). The sum of the four application assessment scores of each participant, added together, was used for statistical analyses.

Data from the surveys was transferred to Microsoft® Office Excel® 2007 (Microsoft, Redmond, WA, USA) for data tabulation and descriptive statistics. Inferential statistics were performed on JMP version 7 (SAS Institute Inc., Cary, NC, USA). Survey knowledge score data was assessed for normality using the Rule of Thumb test formula ($0.25 \leq S_m^2 / S_v^2 \leq 4$), where S_m is the standard deviation for FMMs and S_v is the standard deviation for FMVs (survey 1) and EHOs (survey 2). Pooled two-sample *t*-tests were employed for bivariate analyses to assess food safety knowledge between FMMs and FMVs (survey 1), FMMs and EHOs (survey 2), and to evaluate food application scores between FMMs and EHOs (survey 2). Contingency table analysis assessed differences between FMMs and EHOs in accepting or rejecting food applications, and Chi-squared tests assessed the effects of experience, training and self-assessed knowledge against actual food safety knowledge scores.

RESULTS

Food safety knowledge surveys

A total of 145 farmers’ market staff, managers ($n = 38$) and vendors ($n = 107$), participated in the first survey. We found no differences in the food safety knowledge of FMMs (79.7%) and vendors (80.7%), and overall scores were not affected by experience, geographic location or whether managers or vendors had taken any type of food safety training. However, scores of less than 70% were found on three questions that assessed the ability to determine whether a food was considered potentially hazardous in questions 1, 2, and 4 (Table 5). The average score for FMMs on these three questions was 65.3%.

TABLE 3. Survey 2: Food application recipes and information provided for food safety risk assessment

Food description	Recipe	Preparation Method	Additional information provided
Salsa verde	<p>Chopped, cored, peeled, green tomatillos</p> <p>Jalapeno peppers, seeded, finely chopped</p> <p>Chopped, red onion</p> <p>Garlic, finely chopped</p> <p>Lime juice</p> <p>Finely chopped cilantro</p> <p>Ground cumin</p> <p>Dried oregano</p> <p>Salt</p> <p>Ground black pepper</p>	<ol style="list-style-type: none"> 1. Heat jars and lids in simmering water until ready for use. Set bands aside. 2. Combine tomatoes, peppers, onion, garlic and lime juice in a large saucepan. 3. Bring to a boil and stir in cilantro, cumin, oregano, salt and pepper. 4. Reduce heat and simmer 5 minutes. 5. Distribute hot salsa into hot jars leaving ½ inch headspace. 6. Remove air bubbles. Tightly fit lids. 7. Process filled jars in a boiling water canner for 20 minutes. 8. Remove jars and cool. 9. Check lids for seals after 24 hours. Lid should not flex up and down when centre is pressed. 10. Product is ready for sale at market. 	<p>Product name and expiry date stamped on jar top.</p>
Beef jerky	<p><u>Base recipe for 36 pieces:</u></p> <p>3 pounds flank steak</p> <p><u>Marinade:</u></p> <p>½ cup dark soy sauce</p> <p>4 Tbsp honey</p> <p>4 Tbsp sweet red wine</p> <p>6 large garlic cloves, minced</p> <p>1 Tbsp fresh minced ginger</p> <p>1 Tbsp crushed dried red pepper</p> <p>1 Tbsp sesame oil</p> <p>1/8 tsp white pepper</p>	<p>Whisk together marinade ingredients. Pour into a heavy freezer zip-top bag. Semi-freeze flank steak for 30 minutes, then slice into paper-thin strips, about 4 inches long and 1 ½ to 2 inches wide. Massage marinade into meat. Arrange meat on racks in foil-lined shallow baking sheets, pieces not touching. Let dry overnight on the countertop in a cool room. Preheat oven to 250°F. Remove and replace foil lining under racks. Bake jerky for 30 minutes. Reduce heat to 175°F. Bake for additional 40 minutes until lightly browned but not burnt. Let jerky continue to dry overnight in a cool room. Pack into airtight bags for storage.</p>	<p>Product will be sold vacuum-packed. Photo of labelled product attached. Information on label indicates:</p> <ul style="list-style-type: none"> - Date of packaging - Expiry date - Address and phone number of vendor's home address
Sweet watermelon jelly	<p><u>Base recipe:</u></p> <p>6 cups pureed aromatic melon</p> <p>5 cups white sugar</p> <p>1 packet powdered pectin</p>	<p>Whisk together sugar and powdered pectin until they are fully integrated. Combine watermelon puree, sugar/pectin and lemon juice in a large, non-reactive pot. Bring to a boil and let cook until the temperature of the nascent jelly reaches 220 degrees. This can take anywhere from 15-30 minutes. Remove from the heat and pour into prepared jars. Wipe rims, apply lids and screw on bands. Process in boiling water canner for 10 minutes. Then remove from canner and let jars cool. Remove rings and test seals. Write name on glass jar with Sharpie pen. Store for up to a year.</p>	<p>Laboratory test result attached: $A_w=0.86$ Expiry date stamped on lid</p>

Table 3 continued on next page

TABLE 3. Survey 2: Food application recipes and information provided for food safety risk assessment (cont.)

Food description	Recipe	Preparation Method	Additional information provided
Cheesy scones	<p>Recipe per batch: 20 cups flour 150 mL baking powder Salt Pinch of chilli powder 2500 mL strong cheddar cheese from Balderson Cheese company 150 mL vegetable oil 1250 mL pasteurized milk 10 Grade B eggs</p>	<p>Mix flour, baking powder, salt, cayenne pepper and cheese. Beat the egg and milk together in a separate bowl and add the oil. Add the milk/egg/oil mixture into the flour mixture and mix the dough until it clumps together, but is not too dry. Press the dough out on a flat clean floured surface until it is about 5mm thick, then fold it over on top of itself, flatten it again, using the palm of your hand. Do not use a rolling pin. Cut out scones by using a round cutter. Place them on a baking tray; pop them into the oven at 180 Celsius for twenty minutes.</p>	<p>Prepared in Sally Brown's residence at 6789 Ponderosa Dr., Langley, BC, V7H 1S6. Tel: 604-971-2121 Sold in individual paper bags. Sign will be displayed at market stating that product was prepared in a kitchen that is not inspected by regulatory authority.</p>
Chicken samosas	<p><u>Dough:</u> 2 cups all-purpose flour ½ teaspoon salt 6 tablespoons vegetable oil 6 tablespoons warm water</p> <p><u>Filling:</u> ¼ cup vegetable oil 2 teaspoons ground cumin 1 teaspoon ground red chilli powder ½ teaspoon cinnamon 4 tablespoons curry powder 1 pound ground chicken from Costco 1 small onion, finely chopped 2 cloves of garlic, minced 2 teaspoons of minced fresh ginger 1 cup of canned cooked chickpeas, washed and drained 1 cup frozen spinach Kosher salt and freshly ground black pepper Vegetable oil, for frying</p>	<p>Prepare dough in a large mixing bowl (flour, salt and oil). Add water, mix until mixture holds as a ball. Knead for 10 minutes until dough becomes smooth. Set back in bowl, cover with plastic wrap to rest for 30 minutes.</p> <p>In pot over medium-high heat add vegetable oil, spices, stir until fragrant. Add ground chicken and sauté until slightly coloured. Add onion, garlic, and ginger and sweat. Add chickpeas and spinach, then simmer for 10 minutes until liquid evaporates. Season with salt and pepper. Divide dough into 4 equal parts. Roll into a nice ball then using a rolling pin roll out into discs. Cut in half down the middle to form two half-circles. Working with one half at a time, rub a little water around the edges using your finger. Form a cone by folding along the straight edge overlapping the seam. Holding the cone in your hand fill with 2 tablespoons of filling. Seal the top.</p> <p>Heat vegetable oil to 360 degrees F in a large heavy-based pot. Semi-fry samosas in batches until puffy but not yet golden. Freeze in labelled freezer bags.</p>	<p>Photo of label provided indicates: All ingredients</p>

TABLE 3. Survey 2: Food application recipes and information provided for food safety risk assessment (cont.)

Food description	Recipe	Preparation Method	Additional information provided
Chocolate fudge	4 c. confectioners' sugar ½ c. unsweetened cocoa powder 6 Tbsp butter ¼ c. milk 1 Tbsp vanilla extract ¼ tsp salt 1 c. mix of chopped pecans Topping: 1 cup remolded chocolate 1/3 cup butter	Combine all ingredients – except pecans – in the top of a double boiler over simmering water. Cook, stirring, until smooth. Remove from heat and beat until mixture loses its gloss. Stir in chopped nuts and pour quickly into prepared pan. Melt chocolate with butter till gooey, pour over cooled fudge.	Product prepared in home kitchen by Kelly Preston at 12B-222 Maple Leaf Court, Terrace, BC, Tel: 778-111-5789 Sample product provided. Label indicates: - Product requires no refrigeration - Weight of packaged fudge

TABLE 4. Survey 2 question #10: Answers to food application food safety risk assessment questions

Missing information that would be required for approval of each food application (based on the recipes and information provided for each mock application in the survey). Scoring matrix for each recipe gives a maximum of 20 points. Correct choices “Yes”, incorrect choices –1, neutral choices 0.

Food application recipes given in survey	Recipe requires more detail	Preparation method requires more detail	Label for contact information	Allergen warning on label	Label information declaring no product refrigeration required	Label information declaring product refrigeration required	Expiry date	Lab test for pH	Lab test for A _w	Source of ingredients	Product must be prepared in a commercial kitchen	Sign for display “product prepared in an un-inspected kitchen”
Salsa verde	Yes	-1	Yes	-1	-1	-1	-1	Yes	-1	-1	-1	Yes
Beef jerky	-1	-1	-1	Yes	-1	-1	-1	-1	Yes	Yes	Yes	-1
Watermelon jelly	-1	-1	Yes	-1	-1	-1	-1	Yes	-1	-1	-1	Yes
Cheesy scones	-1	-1	-1	0	-1	-1	-1	-1	-1	-1	-1	0
Chicken samosas	-1	-1	Yes	Yes	-1	Yes	-1	-1	-1	-1	Yes	-1
Chocolate fudge	-1	Yes	-1	Yes	-1	-1	Yes	-1	-1	0	-1	Yes

There were 35 FMM and 83 EHO responses to the second survey. Overall food safety knowledge scores for the two questions that asked them to identify potentially hazardous foods were higher in EHOs (80.6%) than FMMs (73.3%), and this result was significant ($P = 0.004$) (Table 6). No relationship was found for pooled knowledge scores (EHOs and FMMs) based on experience; however, self-assessed knowledge was related to total knowledge (Chi-squared test, $P = 0.002$). Participants who assessed themselves as having better than average or good knowledge scored higher (78 – 80%) than those who assessed themselves as having average or less than average food safety knowledge (63 – 69%).

Food application food safety risk assessments

When asked what resources were used to assess food applications, the majority of FMMs reported consulting the TFM guidelines (77%), and specifically reported consulting Appendix I (71%) to review the list of non-PHFAs in the TFM guideline (Fig. 1). This was followed by reviewing the recipe in the food application (63%) and reviewing the food application with a colleague (63%). In contrast, the majority of EHOs first consult the recipe (84%), consider any illnesses previously associated with the food or processing method (83%), and then consult the TFM guideline (72%). As expected, EHOs were more likely to incorrectly reject a food application and FMMs were more likely to incorrectly accept a food application ($P < 0.001$). EHOs and FMMs had difficulties assessing recipes and food applications for compliance with the TFM guidelines. Cheese scones were acceptable for sale without requiring further information, and perfect scores (of 20 marks) were received by 47% of EHOs ($n = 18$) and 40% of FMMs ($n = 10$) who chose this food application in the survey. Of the remaining 409 food application assessments, perfect scores were achieved on six occasions in two other applications, salsa verde and watermelon jelly. One FMM received a perfect score for their watermelon jelly assessment, with five perfect scores achieved by EHOs. No perfect scores were achieved for applications for beef jerky, chicken samosas, or chocolate fudge by either group. The overall marks achieved by both groups were very low. Out of a possible 80 points, the average score for EHOs in this portion of the survey was 31.5% and for FMMs was 28.3%. Although the scores were low for both groups, food application assessments between the groups was found to be significantly different ($P = 0.04$). Scores received for each food application are shown in Table 7.

Nearly half of FMMs reported that the food applications used in this study were more complex than what they usually see (47.1%, $n = 66$), while less than one-quarter of EHOs (22.9%, $n = 76$) felt that these food applications were more complex than they usually dealt with. Among both groups, beef jerky was rated as the most complex of the food applications (66.7% of FMMs, $n = 16$ and 39.7% of EHOs, $n = 25$), followed by chicken samosas (FMMs 55.6%, $n =$

15; EHOs 21.9%, $n = 16$) and salsa verde (FMMs 48.1%, $n = 14$; EHOs 20.3%, $n = 13$). When food application scores were assessed against the self-reported complexity of the application evaluated, we found that lower scores were achieved by those EHOs who agreed these applications were more complex than they usually dealt with ($P = 0.017$), but not with FMMs ($P = 0.374$). The most frequently missed information on the food applications was the requirement for an allergen warning. The most frequently requested information not needed for food application approval was that the product be prepared in a commercial kitchen.

DISCUSSION

Although the food safety knowledge scores obtained by farmers' market personnel in survey 1 were high, with average scores of 80% for both managers and vendors, lower marks were received on three questions, which all dealt with the same topic: recognition and assessment of potentially hazardous foods. The higher marks demonstrated good understanding of important principles of food handling, such as how to properly offer samples at the market, proper product labelling and recognition of allergens, how to prevent cross-contamination, procedures for cleaning and sanitizing, washing dishes, handwashing, and use of hand sanitizers. Results also demonstrated that food safety training did not affect food safety knowledge. This was a disappointing result, as 81% of the participants indicated they had taken at least one kind of food safety training course. Moreover, adequate training was one of the top three priorities identified by members of the BC Association of Farmers' Markets in their strategic plan for 2011 to 2016 (1). That strategic plan also recognizes that one of the threats to expansion of farmers' markets is the possibility that a food safety or public health scandal could damage consumer confidence (1). Clearly, both farmers' market management and public health share a concern for the safety of food. Of concern, FMMs scored less than 70% on questions asking them to distinguish between potentially and non-potentially hazardous foods, and these results provided the rationale for the second survey.

Results of self-assessed knowledge of FMM from survey 2 demonstrate that participants are well aware of their need for further food safety training. While all EHOs rated themselves as having good (84%) or somewhat better than average (16%) food safety knowledge, fewer FMMs self-assessed their knowledge as good (43%) or better than average (28%), with the remainder assessing themselves as having average or less than average food safety knowledge (28%). This self-assessment is also reflected in the overall scores achieved by these two groups. The results also demonstrated that food safety knowledge of EHOs was significantly higher than that of FMMs, which is expected given the training EHOs receive. We also noted that both EHO and FMM respondents with more than five years of experience had higher food safety scores (median 83%) than those with less than five years of

TABLE 5. Survey 1: Food safety knowledge of FMMs and FMVs

Question No.	Food safety questions	Correct response (%)	
		FMMs ¹	FMVs ¹
1	Which of the following foods are considered as “potentially hazardous foods”?	63.8	65.9
2	What is the best way to reduce the temperature of “potentially hazardous foods” after the cooking process?	68.9	71.2
3	Acceptable storage of eggs is	78.4	77.8
4	You’re preparing new jams, jellies and marmalades from old tried and true recipes. Based on the descriptions below, indicate whether these new products will need laboratory testing for safety (for pH, acidity and/or water activity testing).	63.2	71.5
5	Which of the following statements are correct when samples are offered for tasting at the market	73.2	78.3
6	To minimize cross-contamination	89.4	89.7
7	The best definition for cleaning and sanitizing is	77.9	73.8
8	The steps for washing dishes are	84.2	81.5
9	When should hands be washed before handling ready-to-eat foods?	96.2	96.7
10	What are the requirements for a portable hand washing station?	94.2	91.0
11	Hand sanitizers and wipes are acceptable when	82.6	77.8
12	You are getting ready to make your products for the market, and feel sick (with nausea, vomiting, or diarrhea), what would you do?	86.8	88.8
13	Which of the following foods are considered as allergens?	80.7	77.7
14	Which of the following statements (allergens) are correct?	95.8	95.5
15	What are the requirements for labelling on the food products?	90.5	96.6
	Overall average score	79.7	80.7

¹ FMMs: farmers’ market managers; FMVs: farmers’ market vendors

TABLE 6. Survey 2: Food safety knowledge of FMMs and EHOs

Question No.	Food safety questions	Correct response (%) (Std. Dev. %)	
		EHOs ¹	FMMs ¹
1	Which of the following statements (about food risks) do you consider correct?	76.3 (12.8)	66.8 (15.8)
2	According to the guideline for the sale of foods at temporary food markets, low risk food items do not require a permit from the local Health Authority. Which products do not require a permit from the Health Authority (i.e., these are low risk foods)?	84.0 (19.5)	78.6 (17.4)
	<i>Overall average score</i>	80.6 (11.2)	73.3 (14.9)

¹EHOs: environmental health officers; FMMs: farmers' market managers

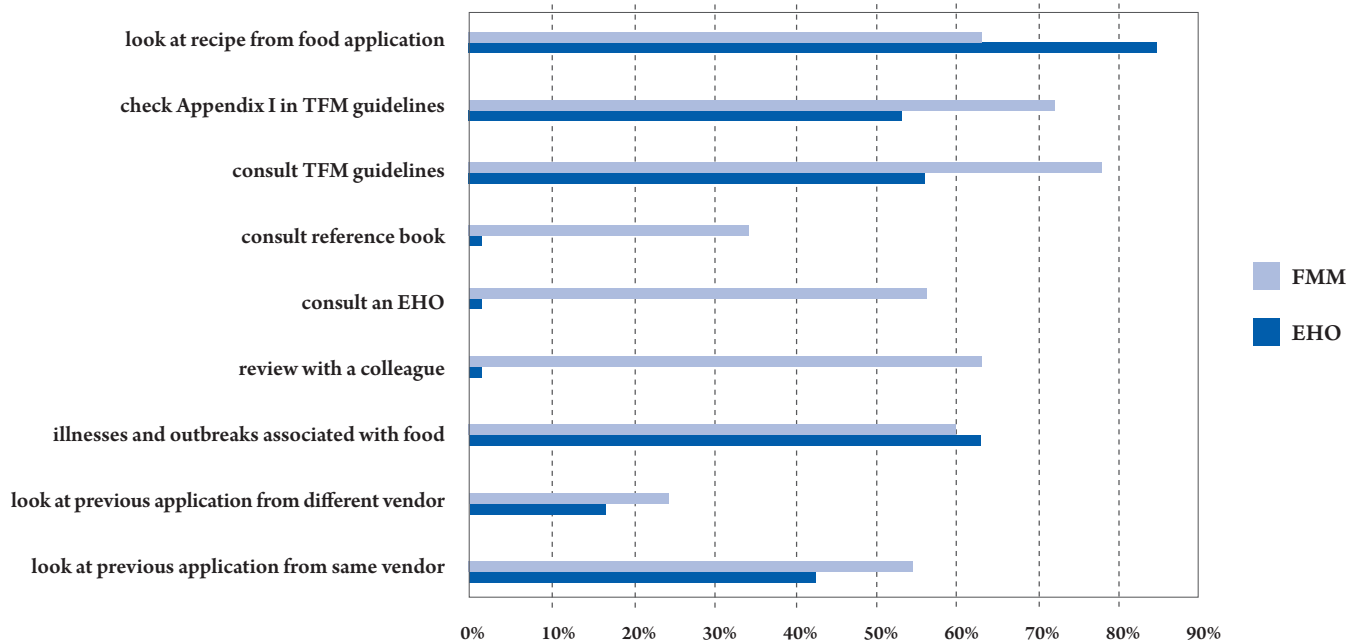


Figure 1. Resources consulted by EHOs and FMMs when assessing vendor food applications from farmers' markets

TABLE 7. Food application results accepted, rejected or scored for completeness

Food application recipes given in survey	Group ¹	Total number choosing food application <i>n</i>	Incorrectly accepted food applications “Yes” chosen(%)	Incorrectly rejected food applications “No” chosen(%)	Average scores for food application evaluations (/20)
Salsa verde	EHO	64	4.7	6.3	8.88
	FMM	27	7.4	3.7	8.20
Beef jerky	EHO	63	4.8	54.0	6.65
	FMM	24	12.5	4.2	7.10
Watermelon jelly	EHO	63	6.3	46.0	7.32
	FMM	18	33.3	27.8	5.44
Cheesy scones	EHO	38		28.9	10.34
	FMM	25		28.0	8.88
Chicken samosas	EHO	73	2.7	30.1	8.18
	FMM	27	14.8	33.3	6.94
Chocolate fudge	EHO	31	35.5	16.1	5.63
	FMM	19	50.0	11.1	4.84

¹EHO = environmental health officer; FMM = farmers’ market manager

experience (median 78%) ($P = 0.06$). The answers given regarding the resources employed to assess food applications reveal a more risk-based approach for EHOs than for FMMs. EHOs review the recipe and consider prior foodborne illnesses associated with the food or processing method before consulting the TFM guidelines.

EHOs tended to reject food applications that would be acceptable if further information had been provided, and FMMs accepted food applications without requiring necessary information. This bias reflects the differing roles these groups have. The primary concern of EHOs is the protection of public health, and out of prudence they may disallow foods that would be fit for sale with further information. In contrast, the primary concern of FMMs is growing the market business and providing access to local, nutritious food for consumers. Missing food safety information that was overlooked when applications were assessed (illustrated in [Fig. 2](#)) was information on allergens, the fact that the recipe required more detail or failed to

identify the source of ingredients, and the requirement for PHFs to be prepared in an inspected commercial kitchen. Regarding allergens, 85% missed the presence of the allergens soy and sesame in the beef jerky food application. Whether a pH or A_w test was correctly identified appeared dependent on the type of food application. The overall food application assessment scores for both groups were less than 40%, and very few perfect scores (< 1.5%) were achieved for food applications that required missing information in this survey. Many FMMs reported finding these applications more complex than those they would normally review (47%), potentially lowering the scores received by this group. EHOs are generalists, and although most reported that these food applications were not more complex than those they normally review, many do not routinely handle farmers’ market food application assessments, and this may likewise have contributed to their lower scores.

Home-made products have been linked to serious illness in BC. In 2011, a single case of botulism was linked to

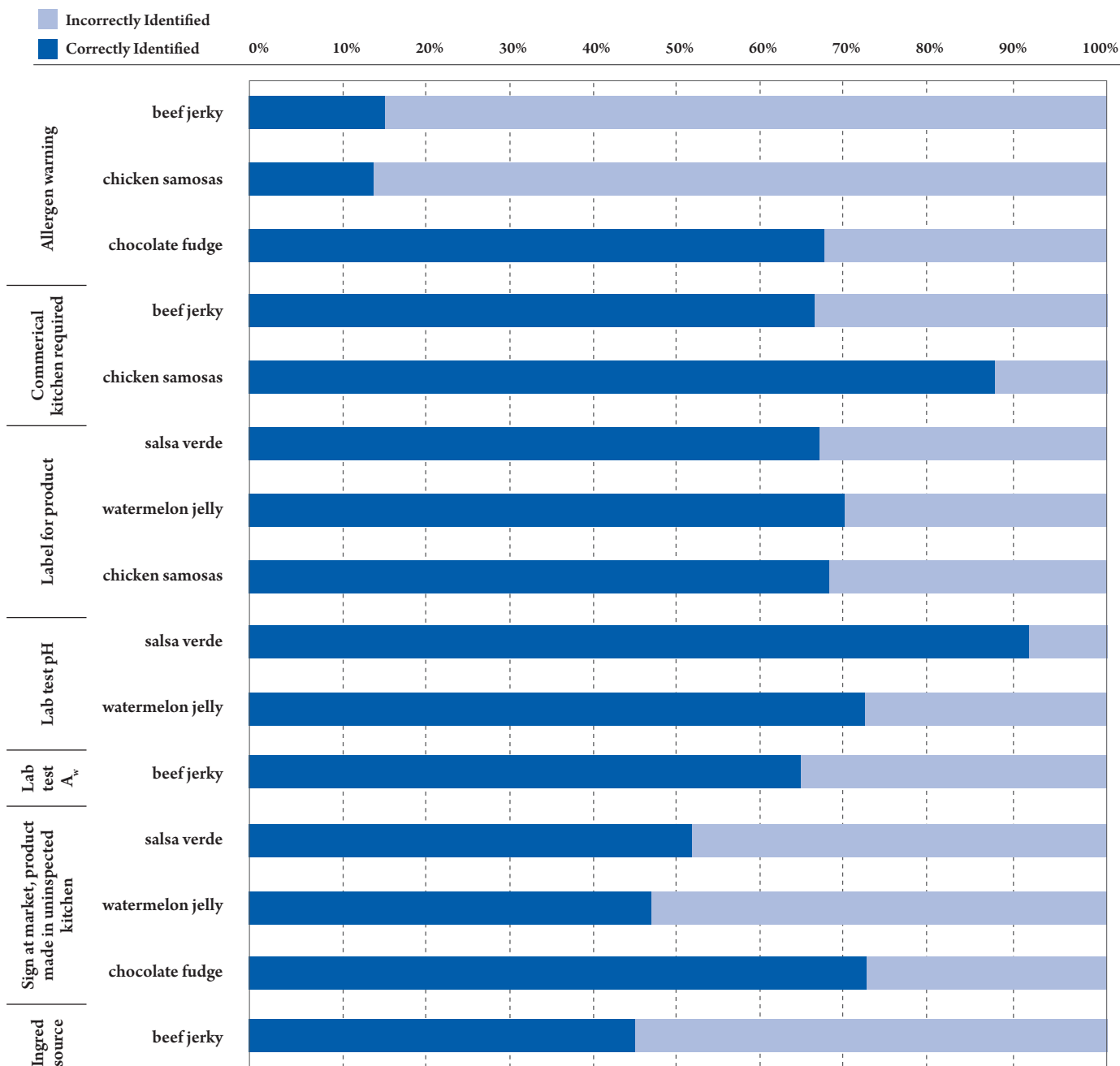


Figure 2. Missing food application information that was correctly or incorrectly identified

a home-made watermelon jelly sold during community events and outside of major retail stores to raise funds for a charitable organization. *C. botulinum* toxin Type B was detected in the opened implicated jar and in an additional two unopened jars of the watermelon jelly. The pH and water activity was not sufficient to inhibit growth of botulism in the jelly (pH values of unopened jars were 5.55 and 5.41; A_w was 0.966 and 0.977). Between October 2010 and March

2011, approximately 2,000 jars of watermelon jelly were manufactured and sold throughout BC. No pH tests were conducted by the manufacturer. Higher risk (lower acid) products made by the same manufacturer included pink guava, green tea and mangosteen jelly. Sugar concentrations in these products were estimated at 25–30% by weight, and water activity was expected to be insufficient to limit *C. botulinum* growth (> 0.95). Fortunately, products were

adequately labelled for consumer identification, enabling a successful public warning. Although this incident did not occur in a product sold at a farmers' market, foods made at home and offered for sale to the public can pose a significant risk when improperly prepared. We were influenced by this incident to include watermelon jelly as one of the six food applications in this assessment. A pH test was not identified as required missing information by 27% of EHO and FMM respondents, and a label for this food product was not identified by 30%. According to the TFM guidelines, jams and jellies prepared at home with a pH below 4.6 are acceptable for sale at farmers' markets, and labels that identify the manufacturer must be available. Given the prevalence of home prepared jams and jellies in BC farmers' markets and given the potential for high pH jams and jellies to provide conditions that lead to botulinum food poisoning, we are concerned that this very basic information, requesting a pH test and a food label for this product, was overlooked by EHOs and FMMs in this survey.

Lee et al. (13) found that food safety knowledge of food vendors at a festival did not correlate to observed temperature food safety violations. This observation is similar to those of our study, in which we found that although farmers' market personnel demonstrated good knowledge of food safety principles, this did not correlate to good hand-washing behaviors (15). After examining food safety violations in festivals, farmers' markets, other temporary events and restaurants, Choi and Almanza (2013) concluded that effective training for personnel in temporary events such as farmers' markets should be different from that offered to restaurant workers (9). In our study, although the majority of farmers' market vendors and managers had taken some food safety training, most (82%) had taken FOODSAFE, a training program targeted towards restaurant workers (16). A newer training program specifically designed for farmers' market personnel, called MarketSafe, has had poor enrollment since it was launched in 2010 (12). However, neither of these training programs specifically addresses food risk assessment strategies or management of consumer complaints and illnesses. Aside from training, poor scores may be a result of jurisdiction. Requirements for food labels and allergen information are federally mandated (7), and EHOs in BC do not typically assess labelling requirements of foods in any setting. Federal food inspectors from the Canadian Food Inspection Agency (CFIA) oversee product labelling; however, they rarely inspect foods sold at farmers' markets. The TFM guideline advises vendors that they should check with their local CFIA office to ensure that packages and labels comply with federal requirements. In this study, EHOs

failed to choose allergen warnings on labels as important missing information on food applications twice as often as FMMs. This shows the importance of cross-jurisdiction communication and collaboration.

Barriers to farmers' market operations have been linked to regulations that may impact food production and food safety (14). Regulations and requirements for farmers' markets in BC are generally similar to those described in the United States and the United Kingdom (11, 14, 17, 18). Farmers' markets are classified as temporary food establishments, and foods and other products sold there must be made, grown, and produced locally. Foods made in the home must be limited to non-potentially hazardous items if they are offered for sale at farmers' markets. Preserved foods should be acidified below a pH of 4.6 or have an A_w of 0.85, and best practices for hygiene, processing, transportation, display, and storage should be followed. Specific certification and licensing requirements may be required for some vendors and markets, but food safety training for food vendors is not usually required. As in a survey of farmers' markets in South-East Wales, FMMs in our study did not demonstrate a good understanding of foodborne hazards and the risk factors relevant to food safety (18).

Although FMMs and EHOs demonstrated good theoretical knowledge of food safety principles, improvements in practice in evaluating food safety risk in food applications received for sale in farmers' markets is warranted. FMMs and EHOs would benefit from more structured guidance on what types of foods are acceptable, what food processes are considered higher risk, and what key information would be required to allow sale. We recommend that health authorities, farmers' markets and their associations, and federal agencies work together to deliver specific educational programs that address risk management, food risk assessment, and food/product recall procedures to provide food safety assurance at BC farmers' markets.

ACKNOWLEDGMENTS

We gratefully acknowledge the advice of Martin Macleod, Dr. Helen Heacock and Bobby Sidhu (British Columbia Institute of Technology), Jasmira Egeler and Brian Johnston (Vancouver Coastal Health Authority), Jon Bell and Elizabeth Quinn (BC Association of Farmers' Markets), Roberta LaQuaglia (Vancouver Farmers' Market), Eileen Dwillies (Haney Farmers' Market) and food safety council members from the five regional health authorities for their support.

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In Memory

Sidney Barnard
Richard Brazis

IAFP recently learned that Sidney Barnard passed away in January 2013 and Richard Brazis passed away in May 2013. We extend our deepest sympathy to their families. Mr. Barnard was President of the Association in 1986 and Mr. Brazis was President of the Association in 1984. IAFP will always have sincere gratitude for their contribution to the Association and the profession.