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# Development and Assessment of a Food Safety Training Program for Farmers' Market Vendors

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**Abstract.** Based on results collected through a comprehensive needs assessment of farmers market (FM) vendors in Pennsylvania, the purpose of this study was to develop and pilot-test a customized, food safety training program for FM vendors. A customized 3-hour, in-person, training program was developed and pilot tested. Using pre- and post-test assessment tests through piloted training, the results found participants scores on knowledge questions increased significantly by ~20%.

## INTRODUCTION

In many U.S. states, the farmers' market movement is thriving. The sale of locally-grown agricultural products directly to consumers has become commonplace and extremely popular. By 2017, the number of farmers' markets in the United States had increased to over 8,600 markets contributing about \$2.8 billion in agricultural sales (USDA, 2017). While direct-to-consumer sales still account for less than 1% of total agricultural sales in the United States, the impact is significant for the 130,056 farms which participated in direct-to-consumer marketing in 2017 and for the millions of consumers who purchased those agricultural products (USDA, 2017). The success of farmers' markets provides important economic and nutritional benefits for farmers and consumers. Despite these benefits, many public health experts have begun to realize the inherent food safety risks associated with this relatively unregulated food industry.

In most U.S. states, farmers' market vendors and their food products are not inspected by local, state, or federal public health inspectors; therefore, the safety of foods sold at farmers' markets is relatively unknown. In general, farmers' market vendors are uncertified or untrained in food processing and food safety concepts. For example, among 123 surveyed vendors and market managers in Texas and Arkansas, less than 37% reported having formal food safety training, and less than half were provided food safety materials from market managers or other sources (Mohammad et al., 2019). Studies have also revealed poor farmers' market vendor food safety knowledge and practices on farm and at farmers' markets. For instance, researchers in Ontario, Canada observed

17 farmers' market cheese vendors and reported that 47% were not properly refrigerating cheese, 88% did not wash their hands when handling cheese, and 24% stored cheese near raw foods (Teng et al., 2004). Similarly, Behnke et al. (2012), reported that among 18 ready-to-eat farmers' market vendors in Indiana, hand washing was observed only twice among 417 instances where it was required. A survey performed in Pennsylvania among 21 farmers' market poultry vendors revealed that 43% did not use any sanitizers or antimicrobials during their poultry processing operations, only 24% used chemical sanitizers to clean their processing areas, and 33% were found to be processing outside (Scheinberg et al., 2013). In another study, McIntyre et al. (2014) surveyed 107 farmers' market vendors in British Columbia, Canada on food safety-related behaviors and revealed that 34% of the farmers' market vendors were unable to identify potentially hazardous foods among a list of common foods, and 29% were unable to identify proper methods of reducing the temperatures of these potentially hazardous foods.

Although these studies have revealed high-risk behaviors and a lack of knowledge in food safety, these gaps can be addressed through educational programming and training. For decades, the retail food industry has incorporated employee food safety education into their operations to ensure successful and safe business practice. Research has shown that effective food safety training increases food safety-related knowledge and attitudes while improving skills and behaviors of employees (Medeiros et al., 2011; Soon et al., 2012). It is generally accepted that effectively-trained employees and managers can reduce the occurrence of food-

borne illness at the retail level (Medeiros et al., 2011; Soon et al., 2012). However, due to the unique conditions in which farmers' market vendors produce, store, transport, and sell their products at retail-like venues, common food safety programs such as ServSafe® may not be suited to address the unique issues related to farmers' market food safety. Based on the limited farmers' market training available in the United States and the results collected through a comprehensive needs assessment performed on farmers' market vendors in Pennsylvania (Scheinberg, 2015), the purpose of this study was to develop and test a customized food safety training program for farmers' market vendors.

## METHODOLOGY

### DEVELOPMENT OF THE FARMERS' MARKET VENDOR FOOD SAFETY TRAINING PROGRAM

All pre- and post-test tools, training slides, and reference materials have been previously published via open access in Appendices G-I of "A comprehensive food safety assessment of farmers' markets in Pennsylvania, A Dissertation of The Pennsylvania State University, available at <https://etda.libraries.psu.edu/catalog/27673> (Scheinberg, 2015).

The development of the farmers' market vendor food safety training program utilized the Program Development Logic Model, commonly used in Cooperative Extension for the development and evaluation of new training programs (Scheinberg, 2015). A comprehensive needs assessment performed separately from the survey itself satisfied the situational analysis portion of the logic model (Scheinberg et al., 2018). This needs assessment utilized retail food safety vendor observational analysis, vendor and health inspector surveys, and structured group interviews with farmers' market managers to determine gaps, needs, the knowledge and attitudinal base of farmers' market vendors, and training preferences. Based on responses from vendor surveys and market manager group interviews, it was determined that a 3-hour, in-person, semi-interactive program in a classroom setting would be appropriate for training this audience.

The farmers' market food safety (FMFS) training program utilized PowerPoint presentation slides and a FMFS resource guide (available for purchase at <https://extension.psu.edu/farmers-market-food-safety-resource-guide>). The PowerPoint presentation slide deck and associated training activities were designed by Cooperative Extension educators experienced in retail food safety education. The educators selected the topics for the training program to address the gaps identified in the comprehensive needs assessment (Scheinberg et al., 2018) and cover the major areas of the FDA Food Code and applicable Pennsylvania state food safety regulations. The major training topics chosen were organized into seven sections or chapters of the FMFS resource guide. The resource guide discusses the topics in

more detail, while the associated slides were brief and used to facilitate classroom learning. Content for each topic was developed, reviewed, and critiqued by members of the Penn State Farmers' Market Food Safety Team, which consisted of Cooperative Extension food safety specialists, academic food safety experts, and food science doctoral students. Content was mainly derived from the FDA Food Code, USDA's Good Agricultural Practices, and applicable Pennsylvania state regulations. The content was written specifically for farmers' market vendors to improve their knowledge, change their attitudes, and promote behavior changes associated with proper retail food safety practices at farmers' markets. Although researchers made an effort to develop the content at a high-school grade level, the necessary use of food safety-related regulatory terminology meant that the readability grade level among chapters of the training resource guide and associated slides ranged from grades 12–16 based on the Flesh-Kincaid readability test.

### DEVELOPMENT OF THE PILOT PROGRAM AND PRE- AND POST-TEST ASSESSMENT

To determine whether the developed training program would improve knowledge and change attitudes of farmers' market vendors on topics associated with food safety at farmers' markets, researchers performed a pilot test study. The pilot test aids in the improvement of the training program and identifies areas which could be modified or changed to better educate the select audience. A pre- and post-test assessment specifically assesses the change in knowledge and attitudes of farmers' market vendors during the pilot program. An identical 30-question pre- and post-test consisted of three sections, including knowledge (19 multiple choice questions), attitudes (5 five-point Likert scale style questions), and demographics (6 questions), in which key concepts were assessed before and after the training program (Scheinberg, 2015). The paper-based pre- and post-test assessment was printed on 8.5" x 11" inch paper using a font size of 12, and questions were printed on both the front and back of the paper. Professors in the Department of Food Science at Penn State, graduate students, and multiple lay persons outside of the food science field reviewed and critiqued the draft test assessment in order to evaluate the overall validity. The areas in which the assessment was evaluated included readability of questions, length of time of completion, whether questions were understandable, and identification of grammatical errors. Reviewers expected the final 30-question pre- and post-test assessment to take participants 15–20 minutes to complete. Since the pre- and post-test assessment portion of the pilot program involved the use of human subjects and their participation in a written test, approval from the Pennsylvania State Universities' Institutional Review Board (IRB) was necessary to perform this research. Researchers submitted the proposed methods and materials of the pre-

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and post-test assessment to the IRB through the Office of Research Protections at The Pennsylvania State University. It was determined on May 6, 2015, that the pre- and post-test assessment (STUDY00002587) was considered exempt from requiring IRB review and approval. However, for the sake of consistency with the previously performed comprehensive needs assessment, researchers provided participants with a consent form, and participant identities were not associated with their responses. Participant identities remained confidential and only known to the approved researchers and principle investigator of this study. Collected data were kept secure in password-protected computer files and in locked cabinets and offices.

## RECRUITMENT AND PREPARATION OF THE PILOT TEST PROGRAMS

In an effort to reach farmers' market vendors in multiple areas of Pennsylvania, researchers decided to perform four consecutive pilot test programs, offered free of charge, in four different cities in Pennsylvania. Organizers selected these pilot program sites based on their location relative to major farmers' market hubs, their location within the state of Pennsylvania, the interest of farmers' market vendors in those areas, and their availability. The first pilot program was located at the Department of Food Science in University Park, PA; the second was performed at the Lancaster Extension Educational Center, Lancaster, PA; the third took place at a farmer training center called The Seed Farm located in Emmaus, PA; and the fourth occurred at the Penn State Center in Philadelphia, PA. Through collaborations with Penn State Cooperative Extension, a program description and associated online sign-up web page (C-vent; Tysons Corner, VA) was created and posted publicly on the Penn State Cooperative Extension, Food Safety Courses and Workshops site. Recruitment for the training program involved posting online public press releases, posting local newspaper advertisements, utilizing word of mouth, and by sending emails to Cooperative Extension educator farmers' market contacts. Food safety Extension educators and market managers were also encouraged to attend the program to provide additional feedback. Recruitment materials stated that vendors would receive a free lunch and extra food safety materials, such as thermometers and a free washable farmers' market canvas shopping bag.

## CONDUCTING THE PILOT TEST TRAINING PROGRAM AND PRE- AND POST-TEST ASSESSMENTS

Prior to the start of each pilot program session, program organizers greeted participants and provided them with a binder containing the Farmer's Market Food Safety Resource Guide and associated Power Point slides. Once all participants had arrived, organizers distributed consent forms (Scheinberg, 2015) and allowed time for participants to read

them and ask questions. Once participants signed the consent forms, organizers provided each participant with the pre-assessment test. Each participant was assigned a number to be used to link pre- and post-test results. Once all participants had completed the pre-assessment test and the forms were collected, the training program began. The training program lasted approximately three hours and consisted of traditional presentation-style instruction using the developed PowerPoint training slides (Scheinberg, 2015). Two instructors, experienced and trained in retail food safety education, led the presentations. Presentations were split into chapters, with short breaks taken after two to three chapter presentations; there was a lunch break after approximately two hours of instruction. During each chapter presentation, instructors referenced applicable areas of the resource guide to promote its use as a reference tool and encouraged participants to ask questions throughout the instruction. During some chapters, instructors utilized pre-planned interactive activities to increase participant learning and comprehension of the selected training topics. These activities included a demonstration of how to make and use a temporary hand washing and warewashing station, a thermometer calibration exercise, and an activity where participants would point out improper vendor behaviors from images taken at actual farmers' markets. The presentations included numerous pictures to further illustrate the concepts. At the conclusion of the training program, participants completed the post-test assessment and received free food safety and incentive materials upon leaving. Participants were encouraged to take the training notebook, share the information with colleagues, and use the resource guide soon.

## ANALYSIS OF THE PRE- AND POST-TEST ASSESSMENTS

Study organizers analyzed pre- and post-test responses and calculated measures of central tendency and percent responses to determine changes in individual and overall participant performance before and after attending the program. A one-way ANOVA was performed to compare the overall average of correct scores from the knowledge section between pre- and post-test assessments. A paired t-test was used to determine significant differences in attitudinal question responses between pre- and post-test assessments. All statistical testing was carried out using SPSS (IBM Corp, 2013).

## RESULTS

The average correct response rates for knowledge questions from the pre- and post-test assessments were 63% (12/19) and 79% (15/19), respectively (Table 2). One-way ANOVA analysis demonstrated that the increase in correct response rate observed in post-test assessments was statistically significant ( $p < 0.05$ ). On average, individual participants increased

**Table 1.** Demographic Profile of Pilot Test Participants

Education levels of participants					
No formal education	Elementary school (1st to 6th grade)	Middle School (6th to 8th grade)	Attended high school, but did not graduate	High school graduate (or completed GED)	Some college credit, but less than 1 year
0%	3% (1/38)	0%	3% (1/38)	3% (1/38)	3% (1/38)
1 or more years of college, no degree	Associate degree	Bachelor's degree	Master's degree	Doctoral degree	I do not wish to answer
24% (9/38)	16% (6/38)	37% (14/38)	11% (4/38)	3% (1/38)	0%

Years of farming among participating vendors						
Less than 1 year	1–2 years	2–3 years	3–4 years	4–5 years	More than 5 years	I do not wish to answer

Completion of previous food safety courses among participating vendor		
Yes	No	I don't know
37% (14/38)	63% (24/38)	0%

Demographics of age, gender, and race among participating vendors						
18–21	22–34	35–44	45–54	55–64	65 and over	I do not wish to answer
13% (5/38)	37% (14/38)	37% (14/38)	16% (6/38)	8% (3/38)	8% 0%	3% (1/38)
White (Non-hispanic) 82% (31/38)		Hispanic	African American	Native American	I do not wish to answer	
		0%	16% (6/38)	3% (1/38)	3% (1/38)	3% (1/38)
Male				Female		
32% (12/38)				68% (26/38)		

their number of correct knowledge question scores by 21% (4/19) when compared to pre-test assessment scores. However, changes in the number of correct knowledge question scores among participants ranged from -1/19 to 11/19. Further analysis, focusing on the change in scores among individual knowledge questions, revealed a wide range of change (Table 3). Changes in correct responses by participants observed between pre- and post-test assessments ranged from -3/38 to 27/38. Participant responses for Question 8 changed positively from 24% (9/38) to 71% (27/38) between pre- and post-test assessments. Questions 1e, 2, 5, 6, 7, 9, 11, and 15 also showed a positive change of 10 correct responses between pre- and post-test assessments. In contrast, questions 1, 4, and 13 showed a negative change of 1 correct response between assessments. Additionally, a one-way ANOVA comparison of participant knowledge question scores organized by education level (Bachelor's degree and above, versus Associate degrees and below), years of farming (>3 years vs <3 years of farming), completion of previous food safety courses (yes versus no), and age (>35 vs <35),

revealed no statistical differences between pre- and post-test assessment results.

Responses to demographic questions revealed that 68% (26/38) of participants identified as female and 32% (12/38) identified as male. Eighty-two percent (31/38) of participants identified as white (non-Hispanic), 16% (6/38) identified as African American, and 1 participant identified as Native American. Exactly half (19/38) of participants had achieved a Bachelor's degree or higher, as opposed to an Associate's degree or lower, and 37% (14/38) had stated they had previously attended a food safety training course. Additionally, over half (58%; 22/38) of the vendors had been farming less than two years, with 18% (7/38) stating they have farmed for over five years (Table 1).

The results of the attitudinal section of the pre- and post-test assessment revealed little change between assessments (Figure 1). Among the five five-point Likert scale (1-Strongly Disagree, 5-Strongly Agree) questions, participants demonstrated an overall average agreement (>4.5) for all five questions, with little change between pre- and post-

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**Table 2.** Individual Knowledge Question Results and Change in Scores Among Pre- and Post-test Assessments

Question	1a	1b	1c	1d	1e	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Pre-test correct responses (n=38)	33	30	34	27	24	15	36	35	17	21	14	9	22	24	22	26	23	21	7
Percent of correct responses	87	79	89	71	63	39	95	92	45	55	37	24	58	63	58	68	61	55	18
Post-test correct responses (n=38)	37	32	37	32	36	29	37	32	27	31	27	36	36	29	33	27	20	20	20
Percent of correct responses	97	84	97	84	95	76	97	84	71	82	71	95	95	76	87	71	53	53	53
Change in response	4	2	3	5	12	14	1	-3	10	10	13	27	14	5	11	1	-3	-1	13
Percent change	11	5	8	13	32	37	3	-8	26	26	34	71	37	13	29	3	-8	-3	34

test assessments. Only responses to question 4 changed significantly ( $p < 0.05$ ) between assessments.

## DISCUSSION

Sources estimate that U.S. organizations spent \$164.2 billion on employee learning and development in 2012 (Association for Talent Development, 2013). In the U.S. retail food industry, food safety training has been universally adopted to comply with food safety regulations and ensure the safety of consumers. The growth of farmers' markets in the United States and the risks associated with them have resulted in many local and state municipalities viewing farmers' markets as a retail environment, and in turn, requiring farmers' market vendors to comply with certain food safety regulations. In fact, between 2010 and 2011, Arizona, Florida, New Jersey, South Dakota, Washington, Pennsylvania, Maryland, and Oklahoma all passed state-specific legislation addressing farmers' markets in the areas of food safety, food fraud, and licensing (Love, 2011). If the trend in farmers' market growth continues across the United States, regulatory oversight and the need for food safety training designed specifically for farmers' market vendors will both likely increase.

In this study, organizers developed and pilot-tested a practical and customized 3-hour, in-person farmers' market food safety training program in Pennsylvania. The results of the study demonstrated that a combination of a training resource guide with traditional slide presentation training methods resulted in a significant gain in knowledge and change in attitudes among farmers' market vendor participants. However, since behavior changes were not measured in the pre- and post-test assessment, it is unknown whether the increased knowledge and change in attitudes would result in behavior changes. It is important to note that improve-

ments in correct knowledge scores between pre- and post-test assessments varied among participants; five participants received lower scores in the post-test assessment. Alternatively, 12 participants improved their scores dramatically, improving knowledge scores by over 30% between pre- and post-test assessments.

Interestingly, the results of the attitudinal section of the pre-test assessment revealed an already high agreement among participants on the importance of hygiene, hand washing, cross contamination, thermometer use, and food safety hazards at farmers' markets. Thermometer use was the only topic in which participants showed a significant increase in agreement between pre- and post-test assessments. The authors suspect that the thermometer calibration exercise during the training program improved participant appreciation of its importance, potentially revealing the success of the use of interactive exercises to change participant attitudes. The results of this study also revealed that age, educational degree attainment, years of farming, or the completion of a previous food safety course did not result in significantly different scores among participants. These results suggest that demographic and even educational background differences among participants had little bearing on their knowledge question performance and that the training was effective in reaching participants of varied backgrounds.

While the results of this pilot test study revealed positive gains in knowledge and attitudes about farmers' market food safety, future evaluation of this training program is needed to measure its effectiveness for behavior changes at farmers' markets. Short (3–6 month) and long term (1–2 year) evaluations using the post-test assessment could reveal whether knowledge is retained or lost, while direct observation of participants' behaviors at the farmers' market could measure actual behavioral changes.

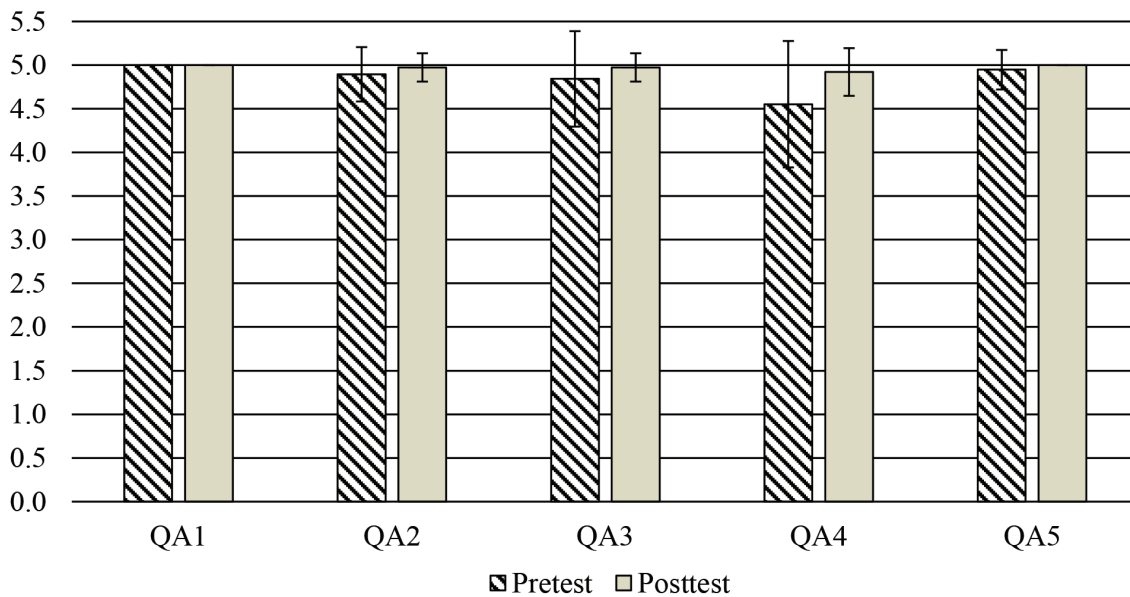
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**Table 3.** Individual and Average Participant Knowledge Question Results and Change in Performance Among Pre- and Post-test Assessments

Vendor (n=38)	Pre-test number of correct questions (n=19)	Percent score	Post-test number of correct questions (n=19)	Percent score	Change in number of correct questions	Percent change in score
1	14	74	16	84	2	11
2	7	37	18	95	11	58
3	15	79	18	95	3	16
4	13	68	16	84	3	16
5	9	47	16	84	7	37
6	7	37	13	68	6	32
7	7	37	10	53	3	16
8	14	74	16	84	2	11
9	14	74	13	68	-1	-5
10	14	74	18	95	4	21
11	11	58	16	84	5	26
12	15	79	16	84	1	5
13	11	58	16	84	5	26
14	15	79	17	89	2	11
15	9	47	15	79	6	32
16	14	74	18	95	4	21
17	9	47	16	84	7	37
18	12	63	15	79	3	16
19	15	79	14	74	-1	-5
20	11	58	14	74	3	16
21	12	63	18	95	6	32
22	16	84	17	89	1	5
23	17	89	18	95	1	5
24	8	42	15	79	7	37
25	12	63	14	74	2	11
26	16	84	17	89	1	5
27	16	84	15	79	-1	-5
28	8	42	11	58	3	16
29	14	74	18	95	4	21
30	10	53	17	89	7	37
31	11	58	17	89	6	32
32	13	68	18	95	5	26
33	12	63	11	58	-1	-5
34	6	32	12	63	6	32
35	7	37	6	32	-1	-5
36	7	37	13	68	6	32
37	11	58	16	84	5	26
38	8	42	14	74	6	32
<b>Total Average Score</b>	<b>12/19 (63%)<sup>a</sup></b>		<b>15/19 (79%)<sup>b</sup></b>		<b>4/19 (21%)</b>	

Note. Superscripts denote significant difference between total average pre- and post-test scores by one-way ANOVA analysis ( $p < 0.05$ ).

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QA1	Hygiene: how important is practicing good hygiene habits when preparing and selling food at the farmers' market? (n=38)
QA2	Hand washing: how important is practicing proper hand washing habits when preparing and selling food at the farmers' markets? (n=38)
QA3	Cross contamination: how important is preventing cross contamination while preparing and selling food at the farmers' market? (n=38)
QA4	Thermometer use: how important is it to use a calibrated thermometer while preparing and selling TCS foods at the farmers' market? (n=38)
QA5	Food safety hazards: how important is it to understand food safety hazards while preparing and selling food at the farmers' market? (n=38)

**Figure 1.** Average attitudinal question scores among pre- and post-test assessments.

As a result of the success of this pilot study, a 4-hour online version of the training developed from this study is currently offered by Penn State Extension at the following link: <https://extension.psu.edu/farmers-market-food-safety-online>.

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