Effective Education on Consumers' Food Safety Knowledge, Perceptions, and Behaviors at Local Area Farmers' Markets

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I am submitting herewith a thesis written by Molly Louise Albin entitled "Effective Education on Consumers' Food Safety Knowledge, Perceptions, and Behaviors at Local Area Farmers' Markets." I have examined the final electronic copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Food Science and Technology.

Jennifer K. Richards, Major Professor

We have read this thesis and recommend its acceptance:

Accepted for the Council:

Dixie L. Thompson

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)
Effective Education on Consumers’ Food Safety Knowledge, Perceptions, and Behaviors at Local Area Farmers’ Markets

A Thesis Presented for the
Master of Science
Degree
The University of Tennessee, Knoxville

Molly Louise Albin
May 2015
Abstract

Although extensive research has been conducted to understand consumers’ knowledge of food safety risks, there is a lack of research on consumers’ knowledge, perceptions, and behaviors towards risks associated with locally grown, processed, and manufactured foods sold at farmers’ markets. Recently, there has been a movement toward purchasing local foods to support local economies, out of concern for food miles, or because of a perception of higher quality goods. In Tennessee, the number of farmers’ markets has doubled in five years. Furthermore, previous research determined food safety education is most effective if developed with input from the target audience. The purpose of this research was to determine what, if any, food safety concerns, misconceptions, and current practiced behaviors exist amongst a targeted population of consumers who purchase locally grown, processed, and/or manufactured food commodities in a farmers’ market setting.

An instrument was developed and tested at a separate farmers’ market location. Screener questions were included for demographics and shopping frequency. Purchasing habits of perishable foods were used to determine participant qualification for the full survey. The survey instrument addressed commonly purchased goods, reasons for shopping at farmers markets, food safety knowledge, common misconceptions, and general disposition towards food safety. Data were collected during 6 markets from July-October (n=27) and analyzed to determine misconceptions. Eighty-nine percent of consumers believed “it is important or very important to purchase goods at farmers markets to avoid pesticides and other chemicals”. Additionally, 88.8% thought harmful bacteria grows in ≤2
hours in foods held between 40-140°F, yet only 13.0% of the 85.2% who planned on purchasing perishable goods brought a cooler or insulated bag indicating a knowledge gap exists on the relationship between harmful bacterial growth and how long perishable goods are left out.

The results of this study suggest that even though food safety educational material exists, somehow the material is not reaching some consumers. Consumers at farmers’ markets need to be further studied to improve their understanding of safe food handling at farmers’ markets, organic classification, pesticide use, the relationship between time and temperature, and proper planning for perishable food purchases.
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Chapter 1. Introduction

Statement of Problem
Studies have shown that consumers do not learn best from general education on foodborne pathogens or safe handling skills, but rather from education on specific preventative actions to reduce risk potential towards a targeted population \((2, 17)\). Furthermore, it has been determined that “the new focus on food safety encompasses the food safety continuum” \((18)\), yet limited food safety educational programs span the entire food safety continuum.

Purpose of the Study
This study was designed to assess misconceptions of purchasers at a farmers’ market related to perishable goods. According to Jevšnik et al \((2007)\), there are a handful of misconceptions for general food purchasing and preparing, like not washing cutting boards with hot water and detergent, using a cooler bag when transporting perishable goods, or thawing meats on countertops. Research investigating these food safety misconceptions spanning the food safety continuum is limited \((14)\). As such, the purpose of this research was to determine what, if any, food safety concerns, misconceptions, and current practiced behaviors exist amongst a targeted population of consumers who purchase locally grown, processed, and/or manufactured food commodities in a farmers’ market setting.

Importance of the Study
The findings of this study may assist consumers and educators by revealing current consumer food safety misunderstandings, perceptions, and behaviors while shopping at
farmers’ markets and allow for additional research to be conducted on a similar target population in the hopes to build consumer farmers’ market educational information.

**Context of the Study**

This study drew upon previously conducted research on farmers’ markets and the notion that consumers are concerned about food safety, yet there is a lack of understanding about the entire food chain – the farm-to-fork continuum (14, 17, 43). The state of Tennessee has seen the number of farmers markets double over the last five years. With this quickly growing trend, research has primarily investigated farmer education and safe handling practices, marketing strategies, and consumer expectations (3, 10, 11, 12, 21). However to decrease the likelihood of foodborne illness, it is important to investigate those participating in farmers’ markets by purchasing goods.

**Research Question**

To develop food safety education, validated and reliable instruments are needed to measure and determine farmers’ market consumers’ misconceptions and gaps in understanding related to food safety. The research questions proposed for this study was:

1) To what extent does a targeted population understand and have a concern for food safety? 2) What are their current food safety misconceptions? and 3) What food safety behaviors do they currently practice?

**Assumptions**

While conducting this study, the following assumptions were made:

1. The participants responded in an open and honest manner to the survey questions.
2. The interview questions were worded appropriately to generate responses relevant to the research questions.

Limitations
While conduction this study, the following limitations may have occurred:

1. Possible selection bias due to conducting all studies at Market Square Farmers’ Market instead of all seven found locally in Knox County, Tennessee
2. Lack of diverse demographics (socioeconomic status and race) due to location of farmers’ market
3. Selection based off volunteering to participate

Definition of Terms
For the purpose of this study, the following terminology shall be defined as follows:

Adult: a purchaser in the age group of 18-64 years of age (6)

Farm-to-Fork: “a food system including everything from farm to table” (29)

Farmers Market: a common facility or area where several farmers/growers gather on a regular, recurring basis to sell a variety of fresh fruit, vegetables and other farm products from independent stands directly to consumers (32)

Food Safety: suitable product which when consumed orally either by a human or an animal does not cause health risk to consume (41). Furthermore, the term refers to safe-handling practices that will more likely result in a safe food product like: personal hygiene, sanitation practices, cross-contamination, cooking and cooling temperatures, foodborne illness knowledge, and perceived risk.

Healthfulness: “beneficial to health of body or mind; healthy” (13)
Local: “located within the same state or not exceeding 275 miles from the farm” (35)

Market Square Farmers Market (MSFM): “an open-air farmers’ market located on Market Square in the heart of downtown Knoxville” (16)

Misconceptions: “a view or opinion that is incorrect because it is based on faulty thinking or understanding” (19)

Perishable: “any food of such type or in such condition as may spoil...which consists in whole or in part of milk or milk products, eggs, meat, poultry, fish, shellfish, or other ingredients capable of supporting rapid or progressive growth of infectious or toxigenic micro-organisms” (36)

Raw: “not cooked; not treated or prepared” (22)

Organization of Thesis

This thesis is organized as follows. Chapter one: Introduction, including the following sections – statement of the problem, purpose of the study, importance of the study, context, research questions, assumptions, limitations, and definition of terms. Chapter two: Review of Literature, contains a review of current literature and previous research on food safety education and farmers’ markets. The review of literature on foodborne illness and food safety education, consumer perception of foodborne illness and risky behavior, the current trend of farmers’ markets, and previously conducted farmers’ market studies. Chapter three: Journal Manuscript, including methodology, results, and discussion for Food Protection Trends.
Chapter 2. Literature Review

Foodborne Illness and Food Safety Education

Annually, 9.4 million cases of foodborne illness occur from thirty-one known pathogens, which results to 55,961 hospitalizations and 1,351 deaths; however, not all illnesses are detectable (26). These undetectable illnesses result in “an estimated 38.4 million” cases of “domestically acquired foodborne illness” from unspecific agents. These cases result to 71,878 hospitalizations and 1,686 deaths (27). Furthermore, with developing bacterial mutations and shifting epidemiology to sources previously unseen, it is important to continually modify food safety education to ensure most up-to-date information is being provided to consumers (14). Previous research indicated that in order for food safety education to be effective, the messages need to be targeted to specific populations – adolescents, caregivers, at risk consumers like pregnant woman, etc. (2, 17)

While it is difficult to reach certain audience, research conducted by Richards et al (2008) shows that when a specific target population has been provided the adequate foundation and educational structure targeted toward their specific needs, overall food safety knowledge increased overtime, and can lead to positive behavior modifications (24). In this study, students completed a validated weeklong interdisciplinary food safety education curriculum aligned with state testing standards. Upon a 2-week follow-up study, 62% of students’ self-reported washing hands more frequently. Additionally, 100% of students showed increases in food safety knowledge related to the importance of handwashing (24). This research demonstrated the importance of understanding the target audience, middle school aged students, their misconceptions and gaps in food safety
education by using pretest evaluations, real-world application, and interdisciplinary instructional design in order to reduce the likelihood of foodborne illnesses.

**Consumer Perception of Foodborne Illness and Risky Behavior**

Studies have investigated foodborne illness and consumers’ unsafe behaviors; however, often consumers do not have an understanding of what behaviors lead to risk, such as eating raw cookie dough, raw oysters, cooking hamburger meat until it is visibly done, or “not routinely wash[ing] hands or cutting boards after contact with raw meat or chicken” (2, 10, 23). Consumers do not see these as risky behaviors since they might not have previously become ill after performing such tasks or they retain the idea “it won’t happen to me” (23). Once risky behaviors or misconceptions have been identified, educators and scientists can take proper steps to modify behaviors and educate consumers on specific foodborne illness preventions. While the food industry has attempted to be proactive and warn consumers about risky foods, it is a concern that the dangerous warning signs might “not reach vulnerable populations” (2). Therefore, due to this concern it is imperative to have population targeted education.

**Current Trend: Farmers’ Markets**

In August 2014, “there were 8,144 farmers markets” which is a “3.6 percent increase from 2012” (39). According to Stiers’ article in *Farm Flavor*, in 2011 115 farmers’ markets were listed throughout Tennessee, meaning the number of markets has now doubled from the 58 in 2005 (29). This shows an increased number of consumers interested in purchasing locally grown, produced and manufactured consumable goods (28). Some farmers’ markets are open year around, while others stick to the growing season from May
to late October/November. Some states, like Tennessee, promote farmers’ markets by offering tips on purchasing the ideal produce, informing consumers of the local growing season, and funding additional growth of the movement. Unfortunately, the amount of consumer education about safely purchasing and handling consumable goods in open markets, like farmers’ markets, is limited. Roughly, three guides have been located; one from the United States Food and Drug Administration on the selection of raw produce and how to prepare it safely, which required a search through the USDA’s resource database, one is from the National Science Foundation entitled “Keeping It Safe at Farmers Markets” listing tips on safe produce handing, which was located once a title was known, and the last one is from the United States Department of Agriculture entitled “How Temperatures Affect Food” discussing the topic of the danger zone, which required searching four pages into the website (20, 37, 40). In addition to educational guides, there are non-profit programs for consumer education on local farmers’ markets, like Center for Urban Education about Sustainable Agriculture (CUESA) that provides consumers with cooking demonstrations, farm tours, and sustainability talks (5). However these non-profit organizations did not speak on consumer safe handling practices to reduce likelihood of foodborne illnesses. While consumer food safety initiatives exist, a disconnect lies between the organizations promoting them and reaching the hands of consumers.

Current Farmers’ Market Education
Both local and national, farmers and market managers have access to educational programs, resources, and tax reliefs to safety and fiscally grow farmers’ markets into a sustainable movement. The University of Tennessee Extension in conjunction with Pick TN
Products and the Center for Profitable Agriculture offers a “Farmers Market Booth to Business Boot Camp” at 6 locations across Tennessee during the early spring to educate farmers on proper labeling, regulations, best practices for product sampling, effective business practices and marketing, and insurance (33). Additionally, publications can be found covering the ideal farmers’ market size for a community and handbooks for farmers’ market managers complete with information on policies, educational material, and operating issues (32). Besides land-grant university extension publications, trainings, and workshops, non-profit associations, like Tennessee Associate for Farmers’ Markets consisting of state farmers and farmers’ market managers, work to act as an “educational resource for farmers markets and their managers” in the hopes of creating “certified farmers markets” in the state of Tennessee (34).

**Farmers’ Market Studies**

A number of recent studies have investigated consumer and farmer expectations, economic impacts, farmers’ market shopper characteristics, and reasons for shopping at farmers’ markets. In North Carolina urban farmers’ markets were studied to better understand “the cultural relationships between the food-selling habits of farmers and the food-buying habits of consumers in a farmers market” (3). Andreatta and Wickliffe (2002) found that markets must be designed around the “local, seasonal agriculture” in order for markets to thrive since consumers “come to the market to purchase fresh, quality farm products...to support a local farm economy, rather than to save money” (3). Economically, farmers’ markets benefit not only the community where they are located but also the lives of the farmers. An Indiana study found that markets have “greater vendor participation”
when a fee is paid to participate (4). Additionally in Brown and Miller’s (2008) study and a study conducted by Wolf et al (2005), both farmer vendors and consumers consider direct contact with one-another to be an essential part to their experience and want to shop at local markets.

Three separate studies on farmers’ markets investigated the factors that drive consumers to purchase goods at local farmers’ markets. Govindasamy et al (2002) conducted a study at New Jersey farmers’ markets among 336 individuals found that primarily consumers are purchasing goods at farmers’ markets due to quality, freshness, and then convenience. Ninety percent of the consumers surveyed mentioned “direct contact with farmers” to be a main factor in addition to freshness influenced their shopping at farmers’ markets (9). Worsfold et al (2004) reviewed California farmers’ markets consumers and perceived products by interviewing 336 consumers. It was noted that “products are high quality” was the main reason by 32% of 140 farmers’ market shoppers shop at farmers’ markets over non-market shoppers who shop at farmers’ markets less frequently than once a month (43). Lastly, Gumirakiza et al (2014) studied 1,488 farmers’ market consumers at 16 markets across Utah and Nevada. Through in-person surveys, it was determined that consumers attend to purchase fresh produce, ready-to-eat foods, packaged foods, arts, and crafts, and for socializing (11).

In a 2004 published study by Worsfold et al (43), 50 market vendors and 50 consumers were interviewed in Scotland and Wales on management, monitoring, and inspection, variety of products, frequency of shopping at these types of markets, and hygiene, including perceptions and training. It was noted, “92% believed that their
consumers expected the products to be as safe as or safer than similar products in the supermarkets and they thought that their customers rated the safety and quality of the market products highly” (43). Yet, it is important to know that consumers interviewed “have a high level of overall satisfaction with the food purchased at the farmers’ markets and have few or no concerns about the food safety on sale” (43). Consumers seem to be more concerned about the origin and organic status of their purchased goods than their safety (43). While many farmers market consumers believe their products to be safer than supermarket products, a Pennsylvania study on poultry products from both farmers’ markets and supermarkets showed 28% and 90% of the chickens purchased at farmers’ markets were contaminated with Campylobacter spp. and Salmonella spp., respectively compared to 20% and 28% conventionally processed organic chicken, and 8% and 52% nonorganic chicken (28). A second study conducted by Harrison et al (2013) reviewed food safety practices of 226 farmers and 45 market managers in Georgia, South Carolina, and Virginia and found that a majority (56%) of farmers use a form of manure, like horses, goats, cattle, poultry, or human feces (12). For handwashing and bathrooms, 66.8% and 66.4% of farmers reported access to either handwashing or bathrooms when harvesting crops and 50% of farmers reported harvesting crops bare handed (12). As farmers’ market popularity grows, it is important for consumers to understand risks associated with purchasing potentially contaminated foods directly from farmers/vendors (28). Therefore, to ensure product safety to consumers’, research on farmer and consumer food safety education is essential to the continued growth of direct markets, like farmers’ markets.
**Conclusion and Summary**

While many resources and studies have focused on the education of farmers as vendors and market managers, few studies have examined consumers’ food safety knowledge and behaviors while shopping at farmers’ markets (43). Most consumer farmers’ market studies investigated marketing, trends, expectations, and preferences for shopping at farmers’ markets (1, 3, 4, 9, 11, 42), few have looked into food safety knowledge, perceptions, and behaviors among those shopping at farmers’ markets. A need exists, therefore, for further research into consumers’ food safety knowledge, perceptions, and behaviors while shopping at farmers’ markets.
Chapter 3. Journal Manuscript

Abstract
Although extensive research has been conducted to understand consumers’ knowledge of food safety risks, there is a lack of research on consumers’ knowledge, perceptions, and behaviors towards risks associated with locally grown, processed, and manufactured foods sold at farmers’ markets. Recently, there has been a movement toward purchasing local foods to support local economies, out of concern for food miles, or because of a perception of higher quality goods. In Tennessee, the number of farmers’ markets has doubled in five years. Furthermore, previous research determined food safety education is most effective if developed with input from the target audience. The purpose of this research was to determine what, if any, food safety concerns, misconceptions, and current practiced behaviors exist amongst a targeted population of consumers who purchase locally grown, processed, and/or manufactured food commodities in a farmers’ market setting.

An instrument was developed and tested at a separate farmers’ market location. Screener questions were included for demographics and shopping frequency. Purchasing habits of perishable foods were used to determine participant qualification for the full survey. The survey instrument addressed commonly purchased goods, reasons for shopping at farmers markets, food safety knowledge, common misconceptions, and general disposition towards food safety. Data were collected during 6 markets from July-October (n=27) and analyzed to determine misconceptions. Eighty-nine percent of consumers believed “it is important or very important to purchase goods at farmers markets to avoid
pesticides and other chemicals”. Additionally, 88.8% thought harmful bacteria grows in ≤2 hours in foods held between 40-140°F, yet only 13.0% of the 85.2% who planned on purchasing perishable goods brought a cooler or insulated bag indicating a knowledge gap exists on the relationship between harmful bacterial growth and how long perishable goods are left out.

The results of this study suggest that even though food safety educational material exists, somehow the material is not reaching some consumers. Consumers at farmers’ markets need to be further studied to improve their understanding of safe food handling at farmers’ markets, organic classification, pesticide use, the relationship between time and temperature, and proper planning for perishable food purchases. Introduction

Introduction

Annually, 9.4 million cases of foodborne illness occur from thirty-one known pathogens, which results to 55,961 hospitalizations and 1,351 deaths; however, not all illnesses are detectable (26). These undetectable illnesses result in “an estimated 38.4 million” cases of “domestically acquired foodborne illness” from unspecific agents. These cases result to 71,878 hospitalizations and 1,686 deaths (27). Due impart to “domestically acquired foodborne illness”, it is important to emphasize food safety education; however, difficulties exist in reaching out to target populations due to limited opportunities to reach out it them. Previous studies (17, 18, 24) have shown successful education by targeting a specific audience during the development of education intervention material, i.e. curriculum, handouts, and others increase the effectiveness of food safety education.
Currently, “there were 8,144 farmers markets” as of August 2014, which is a “3.6 percent increase from 2012” showing that the farm-to-fork movement is on the rise (39). Most farmers’ markets take place in open lots or warehouses during the summer months of May-October, which is also the peak time for occurrences of foodborne illnesses (38, 43). While many farmers’ markets actively advertise purchasing tips on best times to purchase produce, providing information on the local growing seasons, and fund the growth of more markets in the area; there is limited information about the safety of purchasing perishable consumable goods in such open markets (30).

Farmers’ markets involve multiple working parts to be a profitable business— the farmer, who grows and sells the crops; the market manager, who oversees the market, and the consumer, who purchases goods at the market. Due to being multifaceted, farmers’ market research needs to investigate all of these components. In three studies conducted by Worsfold et al (2007), Harrison et al (2013), and Scheinberg et al (2013), food safety agricultural growing practices, conditions, and farmers’ market hygiene were reviewed. These studies shed light on the conditions and operations on a smaller/mid-sized farm and the hygienic practices either on the farm or at the market (12, 28, 43). Through these studies, the importance of farmer and market manager food safety education, training, and proper venue planning can be better understood to increase sustainable community agriculture instead of causing a potential foodborne illness, which could possibly be detrimental to the farm-to-fork movement. Thankfully, due in part to extension and non-profit organization efforts, these resources are available. However, investigation of consumers’ knowledge, perceptions, and behaviors must also occur to better understand
farmers’ markets as a whole. Currently, many studies explored consumer and farmer expectations, consumer shopping characteristics and influences to shopping in this venue, and economic impacts for the farmers’ and communities \((1, 3, 4, 9, 11, 42)\). Primarily, these studies have determined the typical consumer to be Caucasian, educated, married, and female. Consumers most frequently report attending a farmers market to purchasing produce and ready-to-eat goods, or for social interactions. While it is important to understand why individuals enjoy farmers’ markets, few studies have looked into food safety knowledge, perceptions, and behaviors among those shopping at farmers’ markets. A need exists, therefore, for further research into consumers’ food safety knowledge, perceptions, and behaviors while shopping at farmers’ markets.

As such, the purpose of this research was to determine what, if any, food safety concerns, misconceptions, and current practiced behaviors exist amongst a targeted population of consumers who purchase locally grown, processed, and/or manufactured food commodities in a farmers’ market setting.

**Materials and Methods**

This descriptive study, using survey research methodologies, was driven initially due to an increased local food movement, localized outbreaks of foodborne illnesses due to less processed food products like raw or unpasteurized milk, and consumers’ lack of understanding about the structure of their foods, such as corn products being labeled gluten-free. From these discussions and an extensive literature review, it became apparent that farmers’ market research is uncharted and food safety education is an essential component to decreasing foodborne illnesses, both locally and nationally.
Data was collected at Market Square Farmers’ Market in Knoxville, Tennessee during the 2014 market season of May-November via a self-administered questionnaire designed using cross-sectional survey design.

**Participation**
Participants included adults, ages 18-64, who purchased perishable good(s) at Market Square Farmers’ Markets, which is held on Wednesdays from 11am-2pm and Saturdays from 8am-2pm during May-November in downtown Knoxville, Tennessee. Participation was on a volunteer basis contingent on 1) choosing to attend the market; 2) choosing to respond to the survey; and 3) limited to those who reported purchasing a perishable food that day at the market. This population is a cluster of those who shopped at local area farmers’ markets and is therefore not stratified (8).

**Instrument**
A survey instrument was developed after a thorough literature review of prior research on farmers’ market population. This review allowed for the understanding that there is a lack of research conducted in this field addressing food safety concerns. Existing instruments (15, 18, 23, 24) identified in the review of literature were modified with consultation from experts in the fields of consumer education, fruit and vegetable microbiology food safety, meat science, and survey research and education. The draft instrument contained screener questions and the survey instrument. A field-test of the draft instrument was conducted at a similar farmers’ market to prevent population saturation. Field test participants (n=18) reviewed the instrument (5 reviewed only screener questions, 7 reviewed only survey questions, and 6 reviewed all questions) for
question clarity, missing information, and concepts. After field-testing, the instrument was separated into two sections – screener and survey questionnaire, a question was added regarding miles traveled to the market, and minor wording changes were made to questions to enhance clarity. Results from the field test indicated that the instrument was valid and reliable (0.466).

The final instrument, beginning with a cover letter and consent form addressing the project’s research objectives and participant expectations, consisted of two parts – screener questions and survey questions. The screener questions collected demographics, shopping frequency, and items purchased that day. If a participant was within the targeted age range and indicated they had purchased a consumable good, they were directed into the survey questionnaire, which included ten, forced-response items. The survey section contained one open-ended, three continuous scale, three categorical scale, and two multiple-choice questions. These questions asked about commonly purchased goods, important reasons for shopping at farmers’ markets, relationship between time and temperature, travel time and distance home, and a general disposition toward food safety, Appendix A.

The researcher administered the survey to all participants during six different Wednesday and Saturday farmers’ markets using an iPad. Data were collected via Qualtrics and analyzed using SPSS, Version 22. All questions were given in a uniform order with selected questions having randomized answers to decrease the chance for bias due to answer option sequence (8).
Data Collection
Permission was secured from Nourish Knoxville in order to conduct research at local farmers’ markets and through The University of Tennessee’s Institutional Review Board, which “regulated all research activities involving human subjects on the UT Knoxville campus” (31).

Market Square Farmers’ Market (MSFM) “is an open-air farmers’ market located on Market Square in the heart of downtown Knoxville” (16). Specifically, this market is a “producer only market” meaning the selling vendor has either grown or handmade the items being sold (16). During the 2014 market season, MSFM had “84 craft vendors”, “75 agriculture vendors including raw agricultural products to perishable goods like meats and dairy”, and “29 prepared goods vendors, including foods trucks to canned goods” (21).

When obtaining data, the researcher stood near the intersection of the market entrances near a city-parking garage and addressed consumers who were walking toward the center of the market or leaving the market entirely. The majority of participants were approached as they were leaving the market to insure that a purchase had been made. Typically, consumers carrying goods were approached and were more willing to participate in the research study.

Each participant was required to read a cover letter that addressed the project’s research objectives and what would be expected of him/her and digitally indicate informed consent prior to participation. Upon completion of the survey instrument, incentives were provided to participants from The University of Tennessee, Department of Food Science Extension – an at home freezer/refrigerator thermometer and a refrigerator magnet for safe internal temperatures of cooked meats.
Data Analysis
The data were analyzed using descriptive statistics and Chi-squared tests to evaluate differences within the sample by gender (male and female), age category (18-29 years, 30-49, and 50-59), and education level (less than a Bachelor’s degree, a Bachelor’s degree, and more than a Bachelor’s degree). Significant differences were evaluated at $p<0.05$.

Assumptions
While conducting this study, the following assumptions were made:

1. The participants responded in an open and honest manner to the survey questions.
2. The interview questions were worded appropriately to generate responses relevant to the research questions.

Limitations
Demographics might have been skewed due to the location of the farmers’ market as well as possible selection-bias due to volunteering to participate. Due to restricted location and small sample size, the results of this study are not intended to be generalizable, rather to serve as a reference point for future studies.

Results and Discussion
In this study ($n=27$), fifty-nine percent identified as female with 92.6% identifying as Caucasian, non-Hispanic and 7.4% as Hispanic. Twenty-six percent earned some college or less including an associates degree or technical training, 40.7% a Bachelor’s degree, and 33.3% reported having an advanced or professional degree. Thirty-three percent of those surveyed were between 20-29 years of age, 22.2% between 30-39, 7.4% between 40-49,
and 37.0% between 50-59. While these demographics are not stratified, it is a representation of the population due to the location of studied farmers’ markets, and demographics of community. These demographics were similar to three farmers’ market studies. The first study of 336 consumers at New Jersey farmers’ market found 84% identified themselves as Caucasian (9). A second study of 1,488 consumers in 16 markets in Nevada and Utah had married females of higher income levels as the primary produce shopper (11). The third study from California found 56% of the 336 interviewed consumers identified as females (42).

Of the participants, 22.2% percent were first time shoppers at a farmers’ market, 22.2% had previously shopped 1-3 times a season (May-November), 11.1% four-six times, 7.4% once a month, 18.5% twice a month, 14.8% weekly, and 3.7% two or more times a week, Figure 1.

A majority (62.9%) lived within “10 miles or less” or would be home within “30 minutes or less” (55.5%) from making purchases. Eleven percent expressed they lived “over 20 miles away” and 11.1% mentioned it would take “more than 2 hours” to get home or they “do not travel home immediately after the farmers’ market”. All participants (n=27) made a purchase at the farmers’ market on the day of they were surveyed; however, twenty-three planned on making a purchase while four did not and were impulse buyers.

**Factors for Shopping at Farmers’ Markets**

Participants were asked to rank 15 factors that might influence their decision to shop at farmers’ markets using a 5-point scale, where 1=unimportant and 5=very important. One hundred percent of participants stated that “product freshness,” “product
taste,” “to assist our local famers,” and “to assist our local economy” were “moderately important”, “important”, or “very important” factors. Additionally, 96% percent of shoppers listed “atmosphere,” “good vendor service,” and “eating local for environmental concerns” as a “moderately important”, “important”, or “very important” factor when shopping at farmers’ markets. Eighty-nine percent reported “product healthfulness” and “to avoid pesticides and other harmful chemicals” to be an “important” or “very important” factor. Seventy-four percent ranked “variety of products” “important” or “very important” and 70.3% reported ”product availability” to be an “important” or “very important” factor. Of note, “price” was of lower importance with only 66.7% ranking it “important” or “very important”, yet it is the only factor that is statically correlated by education level ($\chi^2(2) = 8.545, p = 0.014$). Education level has a large effect on one’s shopping at farmers’ markets ($V=0.563$). As for important factors to shopping at farmers’ markets, this study’s participants want to avoid pesticides and other chemicals, purchase fresh products, and receive good vendor service, similar to results found in Govindasamy et al (2002), Wolf et al (2005), and Worsfold et al (2004). Table 1 displays mean responses for important factors for shopping at farmers’ markets.

**Location of Farmers’ Markets**

“Convenience to your residence” was evenly distributed among all levels of importance and 14.8% considered “convenience to work” an “important or very important” factor for shopping at farmers’ market yet neither are significantly correlated to age, gender, or education level.
Food Safety Responsibility

Participants were asked to consider who was most responsible for ensuring the safety of their food and rank a list of individuals using a 4-point ordinal scale, where 1=most responsible and 4=least responsible. Options consisted of “you, as a consumer”, “farmers”, “government including food safety and health inspectors”, and “vendors”. Sixty-seven percent listed farmers are the most responsible, 44.4% believe vendors as the #2 most responsible, and 59.3% believe government as the least responsible. As for ranking “you, as the consumer”, opinions were split between 3rd responsible at 40.7% and most responsible at 37.0% with 22.2% ranking themselves the 2nd most responsible. While consumers were unsure of their role in the safety of their foods, 70.3% of shoppers said “food safety concerns” were an “important” or “very important” factor for shopping at farmers’ markets, Figure 3. Similar to Jevšnik et al (2008), consumers view the farmer as the primary individual responsible for the safety of their goods.

When asked about their concern for the safety of their perishable goods, 44.4% stated they were “slightly concerned” or “not at all concerned” and 55.5% reported with being “somewhat, moderately, or extremely concerned”. There is no significant correlation between gender, age, or education.

Relationship between Time and Temperature

Participants were asked how long foods could be held between 40-140°F before harmful bacterial growth occurs. Nineteen percent believed harmful bacterial growth to begin in “less than 30 minutes”, 48.1% selected “30-60 minutes”, 22.2% selected “1-2 hours”, and 11.1% selected “greater than 2 hours.” While few selected the correct answer, results were not significant by gender, age, or education level. Of the three participants
who correctly answered that harmful bacteria can grow in 2 or more hours, two lived less than 15 minutes from the market and the third lived over 2 hours away. When asked how often they pack a cooler, insulated bag, ice chest, or ice pack when they plan to purchase a perishable food at a farmers’ market, these three participants responded “never” or “rarely”. These responses are interesting for the consumer who travels over 2 hours and does not arrive prepared with a means to maintain a cool system. Coinciding with these results, participants, who answered the time/temperature question incorrectly, 29.6% (n=8) “never” pack a means to maintain a cool system, 18.5% (n=5) “rarely”, and 40.7% (n=11) “sometimes or often”. When asked their purchasing intent, 85% planned to purchase that day at the market, yet only 12.5% (n=3) brought a means to maintain a cool system on their day of purchase demonstrating that, similar to Jevšnik et al (2008) results, few participants plan ahead for perishable purchases even with the intent to purchase a perishable good.

The survey also addressed how often participants checked for a thermometer at farmers’ market vendor booths and measured their at home refrigerator temperature. Ninety-six percent (n=26) “never or rarely” checks at farmers’ markets while 74.0% (n=20) “never or rarely” checks at home. Interestingly enough, one participant stated “often” checking at farmers’ markets but never at home and a different participant stated “always” at home but never at the farmers’ markets. In addition, sixty-three percent of those surveyed reported awareness of the types of foods at farmers markets that can cause foodborne illness, but there were no significant differences in these responses by gender, age, or education.
Conclusion

While this study's sample size is smaller than previous farmers’ market studies, there are consistencies found amongst this market population and others. The primary shopper for this study was found to be a college-educated, white, female shopper, similar to other studies \((9, 11, 41)\). Secondly, most consumers view farmers as the most responsible person for their good’s food safety and do not plan ahead for perishable purchases even with the intent to purchase a perishable good \((14)\). As for important factors to shopping at farmers’ markets, this study’s participants want to avoid pesticides and other chemicals, purchase fresh products, and receive good vendor service all the while being cost efficient, similar to \((9, 42, 43)\).

As farmers' market popularity increases, educating consumers about safe food handling practices is a critical component to the local food movement, specifically the relationship between time and temperature, the importance of maintaining a cool system for perishable goods, and understanding how produce is grown under conventional agricultural methods. Further research with a larger and more diverse sample should be conducted covering these topic areas to better understand why knowledge and behaviors are unclear to consumers and to identify ways to better target food safety education messages to the farmers market consumer.

Acknowledgments

Nourish Knoxville for providing research support and allowing research to be conducted at area farmers’ markets and The University of Tennessee Extension for providing refrigerator/freezer thermometers and magnets for participants.
List of References


Appendices
Appendix A

Market Square Farmers’ Market Survey Instrument
Dear Knoxville Market Square Farmers’ Market customer,

Thank you again for your willingness to participate in my graduate thesis research study by completing this questionnaire. In taking this questionnaire, I ask that you please take your time answering each question as honest as you can.

As you begin this instrument, we ask that you:

(1) Complete opening questions. Based off your results, you will be stopped or proceed to the final questions.

(2) As you complete the questionnaire, if you have any concerns or questions please ask your interviewee.

(3) Upon completion of the questionnaire, you will be asked if you’d like to participate in an additional testing on the surface temperature of your purchased good(s). Your decision in this will not affect your previous results.

(4) Once you have completed your questionnaire, please hand back the iPad to your interviewee.

The data collected will be used to help determine the knowledge and perception of food safety in a farm-to-fork eating consumer. Your results will be used in the final report on this research project; however, all results and data will be anonymous.

I appreciate you taking the time to participate in my research study.

Sincerely,
Molly Albin, Graduate Research Assistant
The University of Tennessee, Department of Food Science and Technology
PARTICIPANTS INFORMED CONSENT STATEMENT FOR:
“Food Safety Knowledge and Perception on Farm-to-Fork Eating”

THE UNIVERSITY OF TENNESSEE,
DEPARTMENT OF FOOD SCIENCE & TECHNOLOGY

A. Introduction You have been invited to voluntarily participate in the testing for a graduate thesis research study of consumers for the evaluation of food safety knowledge and perception at Knoxville’s Market Square Farmers Market. The purpose of this survey is to assess the knowledge and perception of food safety on farm-to-fork consumers.

B. Information about Participants’ Involvement in the Study Your involvement in the study would include participating in a screener survey consisting of six questions prior to participating in a survey consisting of 9 questions. Followed by the ability to have your perishable good’s surface temperature tested. This study will take you around 10 minutes to complete.

C. Risk There is minimal risk to you as a participant in this research study.

D. Anonymous Participants will not be asked to put their name on the survey. These surveys will be electronically stored on a secure, password protected server for a period of 2 years then will be destroyed. The surveys will be made available only to the investigator and her graduate committee members at the University of Tennessee. Selected survey comments made may be included in the thesis; however, your name will not be released with these comments.

F. Contact Information If you have questions at any time about the study or the procedures you may contact the investigator, Molly Albin, at the University of Tennessee; 2510 River Drive; Knoxville, TN 37996, or call (865) 974-7107.

G. Participation Your participation in this study is voluntary; you may decline to participate without penalty. If you decide to participate, you may withdraw from the study at any time without penalty. If you decide to not have your food’s surface temperature tested, it will not affect your participation in this study.

CONSENT
I have read the above information. I have received a copy of this form. I agree to participate honestly in this study.

- I do agree to the conditions of this research experiment
- I do not agree to the conditions of this research experiment
**Screener Instrument**

Gender

- Male (1)
- Female (2)

Age

_____ years (1)

Education

- High school or less (1)
- Associates degree or Technical Training (2)
- Some college (3)
- Bachelor’s degree (4)
- Advanced or Professional degree (5)

What race category do you identify with?

- American Indian or Alaska Native (1)
- African American, non-Hispanic (2)
- Asian (3)
- Caucasian, non-Hispanic (4)
- Hispanic (5)
- Native Hawaiian or Other Pacific Islander (6)
- Other (7) ____________

Did you make a perishable food purchase today at the Farmers’ Market?

- Yes (1)
- No (2)
- I’m not sure (3)

**Answer If Did you make a perishable food purchase today at the Farmers’ Market? I’m not sure Is Selected**

If not sure, did you purchase any of the following good(s) today while visiting the Market Square Farmers’ Market? (Select all that apply.)

- Cheese(s) (1)
- Milk (2)
- Meat(s) (3)
- Fruit(s) (4)
- Vegetable(s) (5)
- Other dairy products (6)
- Other food item: (7) ______________
Assuming the Farmers’ Market runs from May through November, how often do you make purchases at the farmers’ market?

- First Time (1)
- 1-3 times a season (May-November) (2)
- 4-6 times a season (May-November) (3)
- Once a month (4)
- Twice a month (5)
- Weekly (6)
- 2 or more times a week (7)
Survey Instrument

What perishable good(s) do you purchase most frequently from the Market Square Farmers’ Market?

How important are the following when considering purchasing perishable good(s) at the Market Square Farmers’ Market?

<table>
<thead>
<tr>
<th></th>
<th>Unimportant (1)</th>
<th>Of Little Importance (2)</th>
<th>Moderately Important (3)</th>
<th>Important (4)</th>
<th>Very Important (5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atmosphere (1)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Product availability (2)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Product freshness (3)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Product taste (4)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Product healthfulness (5)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>To avoid pesticides and other chemicals (6)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Convenience to your residence (7)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Convenience to your work (8)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Eating local for environmental concerns (9)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Eating local to assist our local economy (10)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Eating local to assist our local farmers (11)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Food safety concerns (12)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Price (13)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Variety of products (14)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Good vendor service (15)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>
Thinking about the safety of farmers’ market products, who is responsible for your products’ safety? Rank the below individuals 1-4, with 1 = most responsible; 4 = least responsible.

<table>
<thead>
<tr>
<th>Responsibility (11)</th>
</tr>
</thead>
<tbody>
<tr>
<td>You, the consumer (1)</td>
</tr>
<tr>
<td>Farmers (2)</td>
</tr>
<tr>
<td>Government, including Food Safety Inspectors and Health Inspectors (3)</td>
</tr>
<tr>
<td>Vendors (4)</td>
</tr>
</tbody>
</table>

How long does it typically take you to get home after purchasing perishable goods at the Market Square Farmers’ Market?

- <15 minutes (1)
- 15-30 minutes (2)
- 31-45 minutes (3)
- 46-60 minutes (4)
- 1-2 hours (5)
- >2 hours (6)
- Don’t go home after the Market Square Farmers’ Market (7)

How many miles do you live from the Farmers’ Market?

- <5 miles (1)
- 5-10 miles (2)
- 10-15 miles (3)
- 15-20 miles (4)
- >20 miles (5)

How long does it take for pathogenic bacteria to cause foodborne illness in foods held between 40°F-140°F?

- <30 minutes (1)
- 30-60 minutes (2)
- 1-2 hours (3)
- >2 hours (4)
How concerned are you about the safety of perishable farmers’ market purchases?
○ Not at all concerned (1)
○ Slightly concerned (2)
○ Somewhat concerned (3)
○ Moderately concerned (4)
○ Extremely concerned (5)

Are you aware of which types of foods sold at farmers’ markets can cause foodborne illness?
○ Yes (1)
○ No (2)

How often do you do the following:

<table>
<thead>
<tr>
<th></th>
<th>Never (1)</th>
<th>Rarely (2)</th>
<th>Sometimes (3)</th>
<th>Often (4)</th>
<th>Always (5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pack a cooler, insulated bag, ice chest, or ice packs when you plan to purchase a perishable food at a farmers market? (1)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Check for a thermometer at farmers’ market vendor booths? (2)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Measure your home refrigerator temperature? (3)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

Did you intend to purchase a perishable good when you arrived at the Market Square Farmers’ Market today?
○ Yes (1)
○ No (2)

Answer If Did you intend to purchase a perishable good when you arrived at the Market Square Farmers’ Market today? Yes Is Selected

Did you bring a cooler, insulated bag, ice chest, or ice packs with you today?
○ Yes (1)
○ No (2)

Comments Additional Comments or Concerns:
Appendix B

Permission to Conduct Research
Hi Molly,
Thanks for getting in touch. We'd be happy to have you conduct research at the MSFM. We'd also love to have educational materials about food safety to provide to our patrons. And I'm sure our patrons would be happy to have some free cooling materials. Just let me know if you need anything from us.
Charlotte

On Wed, Jul 9, 2014 at 11:14 AM, Albin, Molly Louise wrote:
Good morning, Ellie

My name is Molly Albin and I was given your contact information from Dr. Faith Critzer at the University of Tennessee. I am a graduate student working towards my Masters in Food Science with studies in Food Safety Education. My thesis research is on consumer perception and knowledge of food safety at local farmers markets.

Dr. Critzer, who is a member of a graduate research committee, recommended that I contact you to make sure it is okay for me to conduct my research at the Market Square Farmers Market and field test my survey instrument at the Ebenezer UMC Farmers Marker. I would like to be able to begin field testing and research once approved by you and the university.

In order to perform my research, I will be interviewing attendees and asking them if they'd be willing to answer a few questions about general food safety (to understand what knowledge our Knox area consumers actually do know), their purchasing habits at the farmers market, and why they typically purchase perishable goods at local farmers markets. There is a final question asking participants if they'd like to have their purchased perishable good's external temperature read to see if goods are within a 'danger zone' for foodborne bacteria. If the good is so found to be in that zone, proper cooling materials will be provided to the consumer. The reading will not harm the food in anyway nor alter the quality or taste.

It is my research goal to create a one page (6"x3") education brochure that can be available at all local farmers markets reminding citizens of items to throw in their car, key times and temperatures to make sure their goods stay safe while they enjoy their time at the local farmers markets!

I will be more than happy to provide you with my procedures, survey instrument, or personally meet you on day if you have any questions or concerns about my research intentions. Currently, my research is going through the approval processing required by The University of Tennessee.

Sincerely,
Molly Albin
Hi Molly,

I have looked over your proposed Form A human subjects’ research protocol “Food Safety Knowledge and Perception on Farm-to-Fork Eating”. I will certify it to be exempt from IRB review under 45 CFR 46 Exempt Category #2. You may proceed with your research.

Best,
Brenda

Brenda Lawson
Compliance Officer and IRB Administrator Office of Research and Engagement Phone: (865) 974-7697
Fax: (865) 974-7400
blawson@utk.edu
Appendix C

Tables
Table 1. Mean responses of important factors for shopping at farmers’ markets among those surveyed

<table>
<thead>
<tr>
<th>Factors influencing shopping at farmers’ markets</th>
<th>Mean(^1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atmosphere</td>
<td>4.04 ± 0.898</td>
</tr>
<tr>
<td>Product Availability</td>
<td>3.93 ± 0.917</td>
</tr>
<tr>
<td>Product Freshness</td>
<td>4.81 ± 0.483</td>
</tr>
<tr>
<td>Product Taste</td>
<td>4.70 ± 0.465</td>
</tr>
<tr>
<td>Product Healthfulness</td>
<td>4.41 ± 0.888</td>
</tr>
<tr>
<td>To avoid pesticides and other chemicals</td>
<td>4.37 ± 0.792</td>
</tr>
<tr>
<td>Convenience to your residence</td>
<td>3.04 ± 1.372</td>
</tr>
<tr>
<td>Convenience to your work</td>
<td>2.19 ± 1.241</td>
</tr>
<tr>
<td>Eating local for environmental concerns</td>
<td>4.00 ± 0.920</td>
</tr>
<tr>
<td>Eating local to assist our local economy</td>
<td>4.48 ± 0.753</td>
</tr>
<tr>
<td>Eating local to assist our local farmers</td>
<td>4.56 ± 0.698</td>
</tr>
<tr>
<td>Food safety concerns</td>
<td>4.00 ± 1.209</td>
</tr>
<tr>
<td>Price</td>
<td>3.74 ± 0.813</td>
</tr>
<tr>
<td>Variety of products</td>
<td>3.96 ± 0.898</td>
</tr>
<tr>
<td>Good vendor service</td>
<td>4.22 ± 0.801</td>
</tr>
</tbody>
</table>

\(^1\)Calculated using a 5-point Likert scale (1=unimportant, 5=very important)
Appendix D

Figures
Figure 1. Shopping frequency at Market Square Farmers’ Market among those surveyed
Figure 2. Consumers’ knowledge of the relationship between time and temperature food is held for growth of harmful bacteria
Figure 3. Consumers’ perceptions of who is responsible for product safety at farmers’ markets
Vita

Molly Albin was born in Memphis, TN, to David and Pamela Albin on June 10, 1991. She has one older sister, Mallory. She grew up in Collierville, TN and graduate from Houston High School in 2009. After graduation, she attended The University of Tennessee, Knoxville where she majored in Food Science and Technology with a concentration in Science. As an undergraduate student, her involvement in student life and research with a food safety education program sparked her interest in continuing her education. Upon graduation in May 2013, Molly began working full time for Dr. Jennifer Richards and the Hands On: Real-World Lessons for Middle School Classrooms program. She accepted a dual assistantship appointment in teaching and research under Dr. Jennifer Richards with the Department of Food Science and Technology. Molly graduated in May 2015 with a Masters of Science in Food Science with a certificate in Food Safety. Beginning in August, she will begin a Doctoral program of study at North Carolina State University under direction of Dr. Clint Stevenson in the Department of Food, Bioprocessing, and Nutrition.