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Assessment of Apple Packers' Training Needs and Attitudes on Food Safety and The Food Safety Modernization Act (FSMA)

ABSTRACT

In January 2014, Bidart Bros., an apple packer in Bakersfield, California, voluntarily recalled Granny Smith and Gala apples because of a listeriosis outbreak linked to prepackaged caramel apples from its facility. Around the same time, the final rules for the *Food Safety Modernization Act* (FSMA), a food safety law that places the focus on prevention rather than reaction to foodborne illness outbreaks, were near publication. Such a critical event provided the opportunity to assess the current food safety practices, training needs, and attitudes and opinions of apple packers regarding the FSMA. For this study, three surveys were administered, and a Food Safety Training Workshop was held for apple packers. Results revealed that the majority of apple packing facilities had necessary food safety practices in place or were working toward incorporating them into their facility. Survey respondents expressed a need for microbial-related trainings and FSMA trainings, with both being of highest priority for food safety training

topics. The attitudes and opinions of the apple packers showed that there are gaps that need to be addressed by the U.S. Food and Drug Administration (FDA) in terms of current processor practices affecting foodborne outbreaks and the resources provided to educate about the FSMA.

INTRODUCTION

Whole apples (*Malus domestica*) are not typically associated with foodborne illness, although apple cider has been implicated in at least 17 foodborne illness outbreaks in U.S. (3). Thus, the 2014 *Listeria monocytogenes* outbreak linked to caramel apples was an unusual occurrence. Even more surprising, the source of the outbreak was determined to be the apple and not the caramel (4). The specific conditions that *L. monocytogenes* needs for growth and survival are not generally found in either apples or caramel. To explain this rare occurrence, Glass et al. (8) hypothesized that inserting a stick into the apple (which is done during caramel apple processing) releases juice at the interface between the apple

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and the caramel, which could have provided a more favorable environment for *L. monocytogenes* growth and survival than either apple or caramel alone. The outbreak greatly impacted the industry, resulting in 35 illnesses across 12 states and seven deaths (4, 22).

Approximately 131 produce-related reported outbreaks associated with about 20 different fresh produce commodities occurred from 1996 to 2010, which resulted in 14,350 illnesses, 1,382 hospitalizations and 34 deaths (22). *The Food Safety Modernization Act* (FSMA), signed into law in 2011, is a food safety law that employs science- and risk-based preventive measures from farm to table (23); it has been referred to as “the most sweeping change in food safety in the past 70 years” (18). In less than a year following the 2014 *Listeria* outbreak, two specific rules that affect apple-packing facilities were published: (1) Standards for the Growing, Harvesting, Packing, and Holding of Produce for Human Consumption (the Produce Safety Rule) (24), and (2) Preventive Controls for Human Food Rule (Good Manufacturing Practices, GMPs) (25).

Prior to the FSMA, guidance documents addressed the food safety of fresh produce by focusing on the key areas of food contamination. This industry was without necessary food safety regulations and followed primarily the direction of these guidance documents. The apple packing industry adheres to Good Agricultural Practice (GAPs) and Good Manufacturing Practices (GMPs), which are prevention-based food production, processing, and marketing systems. Both serve as prerequisite programs for the Hazard Analysis Critical Control Point (HACCP) program, which is a preventive system of quality control (12). Thus, prior to promulgation of the FDA Produce Safety rules in 2015, the apple packing industry was without any mandatory in-depth food safety regulations. Furthermore, this industry had just experienced a major foodborne illness outbreak near the time of approaching food safety regulations. Thus, this outbreak event served as an opportune time to assess this industry with regard to food safety practices, training, and attitudes on and preparedness for food safety regulations.

Little research has been conducted to assess the attitudes and beliefs of food processors regarding food safety regulations. Kaplowitz and Ten Eyck (11) addressed this gap by focusing on the distribution of attitudes toward safety regulations among businesses in the food industry. Research in this area is valuable because management’s enthusiasm, as well as knowledge and persistence, can help in changing habits and standards, especially with ‘lower level’ employees who lack motivation (10). Food handlers’ attitudes play an important role, as the right attitude can help reduce outbreaks of foodborne illnesses (17). Therefore, assessment of food handler training is important because it offers long-term benefits to the industry by increasing food safety (19), and also by aiding in effective implementation of new food safety programs such as HACCP (27). Educating food handlers in

safe practices is one of the most effective preventive measures for dealing with foodborne illness, as training can lead to changes in behavior, attitudes, and practices (6).

Lack of food safety training is associated with poor knowledge of pathogen risks and critical food safety practices (17). Food safety training increased knowledge about practices as well as improving the attitudes of food handlers (1, 20). The objective of this study was to assess the knowledge of the apple packing industry’s food safety practices and the implementation of the FSMA requirements. Our study determined current food safety practices used in apple packing facilities, identified critical food safety information and training needs, and provided food safety and FSMA training during a food safety workshop, with special emphasis on the 2014 caramel apple *L. monocytogenes* outbreak. A follow-up survey was used to assess the implementation of FSMA by the surveyed facilities and to gain broader knowledge about the attitudes and opinions of the apple packers towards FSMA.

MATERIALS AND METHODS

As part of the present research, three surveys were administered and a food safety training workshop was offered for the apple packers. Unless noted otherwise, the apple packers were from Michigan, New York, Pennsylvania, California, Illinois, and Missouri. Survey 1 focused on assessing commercial apple packers’ training needs and current practices following the 2014 outbreak of *L. monocytogenes* linked to caramel apples. Survey 2 was a post-workshop questionnaire administered after the food safety workshop to evaluate the workshop, provide commentary, and demonstrate comprehension of the topics presented. Survey 3 assessed the attitudes and opinions of the apple packers about FSMA regulations as well as their progress towards implementation and was conducted approximately ten months after the food safety workshop. The surveys were reviewed and approved by the Michigan State University human research Institutional Review Board.

Survey 1 – Apple packers’ training needs and current practices

The first survey focused on assessing commercial apple packers’ training needs and current practices following the 2014 *L. monocytogenes* outbreak linked to caramel apples. The list of survey participants (n = 49) and their contact information were provided by the Michigan Apple Committee, with additional packers identified by apple associations in California, New York and Pennsylvania. The objectives of this survey were to: (1) determine current food safety practices of apple packing facilities and (2) identify critical food safety information and training needs for the industry. Email surveys consisting of eight demographic questions, as well as 39 common-practices questions divided into six sections, were emailed to the participants in March

2015. The six sections for the common practice portion were: shipping/receiving, facility design and equipment, cleaning and sanitation of facility, pest control, food safety management and HACCP, and environmental monitoring. The apple packers were also given a list of food safety topics and asked to rate each topic as a low, medium or high training need for their facility. The accompanying email detailed the purpose of the survey, and a consent form was sent with the survey questionnaire.

Survey 2 – Food safety workshop evaluation

The second survey was conducted after the Food Safety Workshop held in April 2015 to evaluate the workshop and overall comprehension of the topics presented. The content of the food safety workshop had been developed on the basis of information collected during Survey 1 and was tailored to the training needs and current industry practices indicated by the packers. The objectives of the workshop were to address variables attributed to caramel apple causing illnesses in the outbreak and prepare for the implementation of FSMA. The workshop, held in Grand Rapids, Michigan, covered the following topics: the outbreak associated with caramel apples and related incidents, characteristics and control of *Listeria* in food facilities, practical aspects of *Listeria* control in the food facilities by cleaning and sanitation programs, new FSMA-related produce safety regulatory requirements, and sanitary design in food facilities. The expert speakers were representatives from academia, companies assisting with food safety compliance and training, and government agencies.

The post-workshop questionnaire, along with a consent form, was given to the participants and collected on site. The questionnaire consisted of multiple choice and open-ended questions, and questions using a 4-point Likert scale (strongly agree, agree, strongly disagree, and disagree) to evaluate the workshop. Participants were also encouraged to provide additional comments. The 53 participants who filled out the questionnaire and attended the workshop included individuals who participated in Survey 1 and others who were interested in food safety training. Most of the attendees were employed in supervisory or decision-making managerial positions within their facilities.

Survey 3 – Opinions and attitudes of commercial apple packers on FSMA

The third survey focused on gauging the attitudes and opinions of the apple packers about FSMA regulations and their progress toward implementation of these rules. This survey was conducted about ten months after the food safety workshop. An online survey tool, SurveyMonkey, was used to collect responses for Survey 3, with the objective of increasing the response rate. The participants were emailed a link that directed them to the survey, explained the purpose of the survey, and informed participants of the time it would take to complete the survey. A consent form

prefaced the survey questions. The survey contained demographic questions, follow-up questions, and attitude questions using a 4-point Likert scale (strongly agree, agree, disagree, and strongly disagree). This survey was administered in March 2016.

The survey participants targeted were attendees of the food safety workshop and served as a follow-up on training and implementation (n = 16). The participants were given instructions to complete the survey within 12 days. After 12 days, a follow-up email was sent, which garnered more responses.

Statistical analysis

All responses were coded and descriptive statistics (means) were generated using Microsoft Excel.

RESULTS AND DISCUSSION

Assessing commercial apple packers' training needs and current practices

The overall response rate was 45% (n = 22). The response rates from Michigan were 65%, from New York 14%, from California 17%, and from Pennsylvania 100%.

Apple packers' characteristics

The characteristics of the apple packers who responded to the survey are detailed in [Table 1](#). Most (59%) of the respondents were from Michigan and made \$1,000,001 – 10,000,000 (64%) in sales, meaning that they were larger facilities. The FDA determines size from sales, so under the FSMA Produce Safety Rule, very small businesses are those with more than \$25,000 but no more than \$250,000 in average annual produce sales during the previous three-year period; small businesses are those with more than \$250,000 but no more than \$500,000 in average annual produce sales during the previous three-year period (23). Under the FSMA Preventive Controls for Human Food Rule, very small businesses average less than \$1 million per year (adjusted for inflation) in both annual sales of human food plus the market value of human food manufactured, processed, packed, or held without sale, and a small business is a business with fewer than 500 full-time equivalent employees (26).

Both of the definitions under the Produce Safety Rule and Preventive Controls for Human Food Rule are used, as apple-packing facilities may fall under either of the rules. Also, the majority of the respondents (62%) had both foreign and domestic customers (restaurants, institutional food services, and food hubs) and equipment dedicated to apples (95%), and 21–40% of their apples were used for further processing (59%). Half of the facilities had undergone government regulator inspections within the previous 12 months (surveyed in March 2015) which included inspections by FDA, USDA, and USDA GAPs, Michigan Department of Agriculture & Rural Development (MDARD), New York State Department of Agriculture & Markets (NY AG & MKTS), and Pennsylvania Department of Agriculture.

TABLE 1. Characteristics of apple packers responding to training needs and current practices survey (n = 22)

Characteristic of survey respondents	Percent of total survey respondents and number of survey respondents, % (n)
Business State:	
Michigan	59 (13)
New York	18 (4)
California	9 (2)
Pennsylvania	14 (3)
Size of Operation (\$ of annual produce sales):	
25,000 or less	0
25,001 – 500,000	5 (1)
500,001 – 1,000,000	0
1,000,001 – 10,000,000	64 (14)
10,000,001 – 50,000,000	23 (5)
> 50,000,000, but < 500 employees	5 (1)
> 500 employees	0
Customers:	
Domestic only	38 (8)
Foreign only	0
Both domestic and foreign	62 (13)
Subject to Customer-required Food Safety Audits/Certifications:	
No	18 (4)
Yes	82 (18)
Government Regulator Inspection in the Prior 12 Months:	
No	50 (11)
Yes	50 (11)
Equipment Dedicated to Apple Handling/Packing:	
No	5 (1)
Yes	95 (21)
Percentage of Apples Used for Further Processing:	
0–20	32 (7)
21–40	59 (13)
41–60	5 (1)
Unknown/depends	5 (1)

Apple packers' current practices

It is important to dissect the apple packers' current practices to further understand their training needs. As Egan et al. (6) state, in order to be effective, food hygiene training needs to target behaviors most likely to result in foodborne illness and focus on changing them. Common food safety practices questions about shipping/receiving, facility design and equipment, cleaning and sanitation, pest control, food safety management and HACCP, and environmental monitoring programs were asked in order to identify what practices each packing facility had in place or was currently working on establishing at the time of the survey. The apple packers were asked to answer 'no,' 'yes,' or 'in progress' to 39 common practices divided into six food safety categories. Table 2 shows 17 practices that were chosen because of their relevancy to the outbreak, along with the responses by the participants.

The 2015 practices for the industry generally followed GAPs, GMPs, and HACCP, although these were not mandatory for produce. Overall, the respondents had a high baseline for the common practices specified. The majority of the food safety

common practices were already in place or in progress. For example, all facilities had an HACCP plan or a written food safety plan. HACCP builds on prerequisite programs, so if an HACCP plan is in place, food safety issues under several categories are being addressed. Most of the respondents (86%) indicated that their facilities followed the written food safety protocol or HACCP at all times (results not shown).

The high baseline may be because 82% of the facilities had customer food safety audits and certifications that went beyond the legal requirements in the U.S.; PrimusGFS, USDA Harmonized, and USDA GMP/GAP/GHP were noted as some of the customer food safety audits and certifications for these apple-packing facilities. PrimusGFS audits alone can include Food Safety Management Systems (FSMS), GAPs, GMPs and HACCP (14). Customer standards seem to be one of the reasons for existing food safety practices for this industry, which until recently was not subject to formal federal food safety regulations. However, 91% of the facilities had passed a food safety audit (not including inspections by government authorities) within the past 12 months, and 9% were waiting on their results.

TABLE 2. Reported current practices of survey respondents (n = 22)

Current Practices	Yes	No	In Progress	N/A
There is a supplier approval program in place	91 (20) ¹	0	5 (1)	5 (1)
Our suppliers have a traceability process	86 (19)	0	9 (2)	5 (1)
The water in the flumes are changed on a routine basis	100 (22)	0	0	0
Sanitizer chemicals such as chlorine are used in the flume system	100 (22)	0	0	0
The pH of the water in the flumes system is regulated	91 (20)	9 (2)	0	0
There is a sanitation standard operating procedure in place for fruit bins and containers	64 (14)	36 (8)	0	0
There is a written sanitation standard operating procedure for the facility	100 (22)	0	0	0
Food contact surfaces are either stainless steel or food-grade plastic	55 (12)	45 (10)	0	0
Effective cleaning of food contact surfaces are monitored using validation tests	64 (14)	23 (5)	14 (3)	0
The facility has designated food safety program leader	100 (22)	0	0	0
Our employees receive regular training on food safety practices	100 (22)	0	0	0
The facility has HACCP plan or a written food safety program	100 (22)	0	0	0
The facility currently swabs for <i>Listeria monocytogenes</i>	68 (15)	14 (3)	14 (3)	5 (1)
Environmental monitoring (E.M.) swabs/tests are conducted	68 (15)	14 (3)	18 (4)	0
E.M. program has set microbiological criteria	50 (11)	27 (6)	23 (5)	0
Records are kept of all E.M. swab results and corrective actions	82 (18)	9 (2)	5 (1)	5 (1)
The water used in the facility is tested on a regular basis	95 (21)	5 (1)	0	0

¹Response: Percent (n)

Additionally, it has been shown that food safety-certified individuals have better food safety knowledge than non-certified individuals, although these certified individuals still had knowledge gaps and would benefit from additional training (15).

Apple packers' training needs

The apple packers were given a list of food safety topics and asked to rate each topic as a low, medium or high training need for their facility (Table 3). The ratings were coded (low = 1, medium = 2, high = 3), and the average rating was assigned as that topic's rank. The topics that received the highest rankings and were deemed of higher priority for the facilities were: (1) *Listeria*, (2) Cleaning and Sanitization of Facility, Equipment, Bins, etc., (3) Other Microbial Pathogens and (4) FSMA Produce Safety Rule and Preventive Controls Rule. These topics ranked from 2.5 to 2.1. Three of these topics focus on reducing and eliminating microbial loads and the fourth focused on a new and fast-approaching food safety law. It is understandable that these topics are ranked highest, as there was a major outbreak involving *L. monocytogenes*, and FSMA-related regulations focus on preventing such outbreaks.

With the *Listeria* topic ranked the highest food safety topic, the perceived need seemed to be influenced by the outbreak to some extent. However, it is not possible to determine the influence of the outbreak on the apple packers' perceptions of training needs, because a survey assessing training needs before the outbreak was not

administered. That survey would have served as a baseline and helped in determining the shift in training needs from before to after the outbreak. For example, Kaplowitz et al. (11) observed that managers of businesses that sell and produce food who completed a survey after the terrorist attacks of September 11, 2001 were less opposed to regulation than those who completed the survey prior to the attacks; this shows that catastrophic events of public importance may play a role in the decision making of individuals. The lowest ranking topics, those determined to be of a lower priority, were: (1) Facility Design and Appropriate Construction, (2) Worker Health and Hygiene, and (3) Private Food Safety Standards; rankings were 1.6, 1.7, and 1.7, respectively. These topics are less relevant to the outbreak compared with the three that ranked highest.

Despite not having a baseline survey assessing the apple packers' training needs before the outbreak, a 2019 study by Reynolds and Dolasinski (16) provides insight into food safety training topics primarily for commercial food handlers; it identified hand hygiene, temperature controls, personal hygiene, cleaning and sanitizing, and cross-contamination to be the most important food safety topics. Hand hygiene and personal hygiene were ranked the first and third covered training topics, respectively, while the apple packers ranked the worker health and hygiene training topics as lower priority. That study (16) also found cleaning and sanitizing to be ranked fourth, while the apple packers ranked the cleaning and sanitization of facility, equipment, and bins training topic as the second highest priority.

TABLE 3. Food safety topics in ranking of priority for trainings for apple packers (n = 22)

Topics	Response Ranking
<i>Listeria</i>	2.5
Cleaning and Sanitization of Facility, Equipment, Bins, etc.	2.2
Other Microbial Pathogens	2.1
FSMA Produce Safety Rule and Preventive Controls Rule	2.1
Washing and Sanitization of Received Fruit	2.0
Environmental Monitoring	1.9
Food Safety Management Systems	1.8
Characteristics of Food Safety in General	1.8
Private Food Safety Standards	1.7
Worker Health and Hygiene	1.7
Facility Design and Appropriate Construction	1.6

The apple packers were asked to rate the topics as a 'low,' 'medium,' or 'high' need for their facility. Answers were coded as following: low = 1, medium = 2, and high = 3. The ranking represents the mean of the responses.

Food safety workshop for commercial apple packers

Egan et al. (6) point out that the primary aims of food safety training are to bring about change in behavior towards less risky food handling practices and improve knowledge about food safety practices. A four-point Likert scale was used to measure the participants' attitude toward the workshop, and all participants either strongly agreed or agreed that participating in the workshop helped improve their knowledge of appropriate food safety practices. The response rate for the post-workshop questionnaire was 77.4% (41 of the 53 individuals who attended the workshop). The response rate on various questions ranged from 95% to 100% "strongly agree" or "agree" (*data not shown*).

Thirty-six participants answered 'yes' to the question, "Will you use the information from this workshop to train others from your organization?" and 31 provided the number of individuals that they would train. The willingness to train others is important for implementing critical food safety practices in the workplace. Egan et al. (6) state that effective training depends on both attitude and willingness on the part of the manager to provide the resources and systems for food handlers to implement good practices. Studies have also identified a correlation between management attitude towards training, levels of food hygiene knowledge and standards of food handling practice (27). Additionally, food-handler training increases food safety and consequently offers long-term benefits to the food industry (5, 6). More than one-third of all food recalls between 1999 and 2003 were related to ineffective employee training (18). Companies not in compliance can face civil and criminal penalties (18).

Opinions and attitudes of commercial apple packers on FSMA

Egan et al. (6) recognize that attitude is a cognitive element that may influence food safety behavior and practice. Bas et al. (2) agree and add that attitudes ensure a downward trend of foodborne illness and are an important factor in addition to knowledge and enforcement. With the introduction of FSMA and an industry recently impacted by an outbreak, we hypothesized that attitudes regarding food safety by company personnel would be a key factor that potentially affects implementation of food safety measures by companies in response to this new law. Survey 3 was conducted to assess the attitudes and opinions of the apple packers about FSMA regulations and their progress towards implementation about ten months after the food safety workshop. The response rate for this survey was 52%: 31 companies were sent the survey via email, and 16 companies responded.

Apple packers' characteristics

The respondents of this survey were from Michigan, New York, Illinois, Pennsylvania, and Missouri, with the majority from Michigan (73%) and male (69%) (*Table 4*). Most

(87%) of the facilities were relatively large facilities, with \$1,000,001 – 10,000,000 in annual sales. The respondents were also well educated, with 31% having a 4-year college degree and 19% having a graduate level degree.

FSMA preparation

The apple packers were asked two questions about their FSMA preparation. The first question focused on the apple packers taking the initiative and attending training programs that discussed FSMA-related food safety requirements in addition to attending the workshop in April 2015. This question asked, "Besides the Food Safety Workshop you attended in Grand Rapids, have you personally participated in any other training programs for FSMA-related food safety requirements?" The results showed 69% of the respondents being proactive and attending more training programs on FSMA after the Food Safety Workshop in April. The Empire State Training Global GAP workshop, USDA's Webinar on the Final Rule of FSMA, the Train the Trainers Seminar for FSMA (Produce Safety Regulation) in Kalamazoo, and the 2015 Food Safety Summit were among the training programs listed. The second question concentrated on changes that the facilities had made in response to FSMA and its new regulatory requirements: "In the past year, have you made changes to your company's food safety program in response to new regulatory requirements associated with FSMA?" Almost a third (31%) of the respondents had already made changes and another third (31%) planned to do so in the future. Some of the changes that the 31% who answered 'yes' had made were: implementing a crisis management team, having environmental testing completed by an outside vendor, doing in-house adenosine triphosphate (ATP) tests, increasing water testing, completing a HACCP plan, revamping cleaning and sanitizing standards of procedures, adding a food fraud program, and water testing for farms. One facility planned to develop a water management team.

Following up on the apple packers from the Food Safety Workshop showed that a significant percentage of these facilities were continuing to educate themselves on FSMA and also making changes so as to be compliant with the new requirements. This proactiveness is an indication of a strong food safety culture (13).

Apple packers' opinions and attitudes on FSMA

Table 5 displays the opinions and attitudes of commercial apple packers on FSMA (n = 16). Sixty-three percent of the packers admitted to not having fully understood the requirements for FSMA, and 67% disagreed or strongly disagreed that the FDA had provided enough tools and information to help their company prepare for FSMA. Over half (56%) of the respondents disagreed with the statement: "FSMA requirements address all current processor practices which may contribute to a foodborne outbreak." Additionally, 60% agreed that "FSMA requirements will give the FDA too much control over their facility."

TABLE 4. Characteristics of apple packers responding to questions on FSMA preparation, and opinions and attitudes survey (n = 16)

Characteristic of survey respondents	Percent and number of survey respondents, % (n)
Business State^a	
Michigan	73 (11)
New York	7 (1)
Illinois	7 (1)
Pennsylvania	7 (1)
Missouri	7 (1)
Size (\$)^a	
25,000 or less	0
25,001 – 500,000	0
500,001 – 1,000,000	13 (2)
1,000,001 – 10,000,000	87 (13)
10,000,001 – 50,000,000	0
> 50,000,000, but < 500 employees	0
> 500 employees	0
Gender	
Female	31 (5)
Male	69 (11)
Education	
Some high school, but no diploma	0
High school diploma (or GED)	6 (1)
Some college or technical school	31 (5)
2-year college degree	13 (2)
4-year college degree	31 (5)
Graduate level degree	19 (3)
None of the above	0

^aOne respondent skipped some demographic questions, resulting in 15 responses for certain questions.

This highlights that there likely is a gap between new FDA regulatory requirements and what the packers actually believe is necessary to ensure safety of their products. Ten Eyck et al. (21) call this a “disjoint constitution.” The researchers describe a similar scenario in the apple cider industry during promulgation and implementation of FDA Juice HACCP requirements, wherein the processors did not believe their regulatory inspectors to be knowledgeable about the business and saw the inspectors as outsiders (21).

More than two-thirds (69%) of the apple packers agreed or strongly agreed that “FSMA requirements will help reduce

instances of foodborne outbreaks,” but only 56% agreed that “FSMA requirements will improve food safety for the apple packing industry.” Along that line, 53% disagreed with the statement “this is the right time for the implementation of FSMA requirements” despite the impact of the outbreak associated with caramel apples and FSMA’s purpose of reducing such outbreaks. Cost was noted as a concern, as 69% either strongly agreed or agreed that implementing the FSMA requirements is too expensive. It is unclear whether these individuals had already spent a great amount making their facility FSMA compliant, as 75% either strongly

**TABLE 5. The Opinions/Attitudes of Commercial Apple Packers on FSMA
(% response, n = 16)**

Opinion/Attitude	Strongly Agree	Agree	Disagree	Strongly Disagree
FSMA requirements are necessary for food safety within my facility.	0	63	31	6
The FDA has provided enough tools and information to help my company prepare for FSMA.	0	33	60	7
FSMA requirements will help reduce instances of foodborne outbreaks.	6	63	31	0
Implementing FSMA requirements is too expensive.	13	56	31	0
The implementation of FSMA requirements in my facility will have a positive impact on the relationships with my customers.	13	50	38	0
My facility is currently ready for the implementation of FSMA requirements.	13	63	25	0
FSMA requirements will improve food safety for the apple packing industry.	0	56	38	6
FSMA requirements address all current processor practices which may contribute to a foodborne outbreak.	0	44	56	0
I fully understand the requirements for FSMA.	6	31	63	0
FSMA requirements will cause too many changes within my facility.	0	25	75	0
FSMA requirements will give the FDA too much control over my facility.	0	60	40	0
Government regulations are necessary for food safety.	13	47	40	0
This is the right time for the implementation of FSMA requirements.	0	47	53	0

agreed or agreed that their facility is currently ready for the implementation of FSMA requirements, or if they are in the planning stage and foresee major costs. Despite the cost and timing, over half (60%) of the packers agree that government regulations are necessary for food safety, and 63% agreed that FSMA requirements are necessary for food safety within their facility.

The apple packers shared additional comments to further explain their opinions of the FSMA. One packer commented, “FSMA seems to be a wide-ranging set of regulations that are going to be enforced on facilities which are mostly complying with similar requirements (or higher standards) through currently required food safety programs which have been customer-driven by market demand. [...] In addition, customers are not aware of this and are under the false assumption that FSMA will treat everyone equally and therefore make all food equally safe.”

Another commented, “Many of my answers came from the point of view that our customer base has required 3rd party audits which in most sections of coverage are more stringent than FSMA. Years ago, maybe our attitude was more to create

a system to pass.[...] However, I do feel it is necessary and feel they missed the boat from requiring all levels of farms to comply. [...] I just wish that the FDA would work or approve USDA and other 3rd party audits as OFFICIAL means of proof to compliance with FSMA.”

The apple packers surveyed appeared to agree with the food safety aspect of the FSMA, but not with its timing, potential implementation costs, or the degree of control that the FDA will have. Additionally, these packers did not believe that they have been given enough tools and information from the regulating body to implement the FSMA requirements and believe that their understanding of the law is inadequate. Despite these concerns, the packers believe that the FSMA requirements will not cause too many changes within their facility and that their facility is currently prepared for the implementation. Also, despite their concerns regarding the new FSMA requirements, the apple packers indicated they were still preparing for implementation. The packers generally have a positive attitude toward the food safety aspect of the FSMA; this is critical, as the attitudes of food handlers can influence the success of a food safety

program (7). Also, the participants' managerial positions and understanding of the importance of the FSMA highlight two of the six food culture-associated factors that can contribute to food safety performance: leadership and commitment to food safety (9).

CONCLUSION

The apple packing industry was impacted by a *L. monocytogenes* outbreak linked to caramel apples in late 2014. This outbreak was contemporaneous with FDA's promulgation of the FSMA regulations, particularly the produce safety regulation, which aims to reduce the number of foodborne illnesses associated with fresh produce. This incident presented an ideal opportunity to learn about the apple packing industry's current practices, provide training, and assess the opinions and attitudes of the industry on the FSMA, as it may play a role in implementation.

Despite the lack of formal regulatory food safety requirements (during the timeframe of this research), many of the apple packing facilities already had critical food safety practices in place or were working toward incorporating them into their facilities. Feedback from surveys of the packers indicated a need for additional training on microbial pathogens and the FSMA regulatory requirements. When provided with food safety training, the apple packers agreed

that the information received would help them to implement practices in their operation to ensure the production of safe products and expressed willingness to train others in their companies. Additionally, the apple packers indicated belief in the importance of the FSMA by attending more FSMA-related training and making the necessary changes within their facility. The attitudes and opinions of the apple packers revealed that there are gaps that need to be addressed by the FDA in terms of current processor practices affecting foodborne outbreaks and the resources provided to educate the industry about the FSMA.

This research helped compile a list of training topics that this industry needs, which can be used to develop future training for this industry. Future work can also focus on the changes made in current practices after the implementation of the FSMA.

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In Memory

Dr. Lloyd L. Bullerman

Dr. Lloyd L. Bullerman, Professor Emeritus in the Food Science & Technology Department at the University of Nebraska-Lincoln (UNL), recently passed away. Dr. Bullerman was an expert in fungi and mycotoxins and served as a faculty member for 40 years in the Department of Food Science & Technology at UNL. Dr. Bullerman received his B.S. in dairy and animal science and M.S. in bacteriology from South Dakota State University. He received his Ph.D. in microbiology and food technology from Iowa State University.

Dr. Bullerman was a long-time member of IAFP (formerly IAMFES) and served with distinction in many capacities since joining the organization in 1970. Dr. Bullerman was instrumental in establishing the Developing Scientist Competition and had served on the *Journal of Food Protection* Editorial Board for over 20 years. In 1988, he was selected to be the Scientific Editor of the Journal and served through 1995. He also received the Elmer Marth Educator Award in 1985, the IAFP Fellow Award in 1998 and Honorary Life Membership in 2005.

IAFP will always have sincere gratitude for his contribution to the Association and the profession.