

Consumer Knowledge of Fresh Produce Safety and the Food Safety Modernization Act.

Project and Report

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Introduction

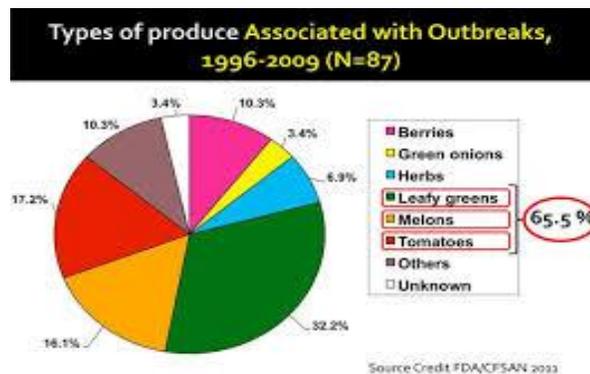
Between 1976 and 2012, there has been an increase in fresh fruit consumption from around 31 kg. (68 lbs.) of fruit per capita to around 136 kg. (300 lbs.) per capita and consumption of fresh vegetables has increased from around 45 kg. (100 lbs.) per capita to around 181 kg. (400 lbs.) per capita (Tables 2 and 3) (Cook, 2013). Most of the fresh produce is consumed raw. In the United States there are approximately 48 million cases of food borne illnesses reported every year resulting in 3,000 deaths (USDA- FSIS, 2013), and according to the Centers for Disease Control and Prevention (CDC) between the years of 1998 and 2008 almost half of the food borne illnesses were from consuming fresh produce (CDC, 2014a).

Consumption of fresh produce did not account for the highest number of outbreaks during the years of 1996 and 2009, but it was associated with the highest number of illnesses (Table 1)(Williams, 2014), with leafy greens, tomatoes, melons, berries, herbs, and green onions most commonly associated with foodborne illnesses (Figure 1)(Dawson, 2012).

Table 1.
Vehicles of Foodborne Illness in the U.S. 1996-2009 (FDA Only)

Category	Outbreaks	Illnesses
Processed Foods	44	4,822
Produce	88	11,054
Sprouts	32	1,964
Seafood	138	3,529
Eggs	209	6,730
Dairy	22	356

Figure 1. (Dawson, 2012)



The increase in imports of fresh fruits and vegetables may also be a contributing factor to the increased number of food borne illnesses associated with fresh produce. Between 1980 and 2001, USA increased imports of fresh fruit increased by 155% and imports of fresh vegetables increased by 265%.

Consumer Knowledge of Fresh Produce Safety and the Food Safety Modernization Act.

In 2002 the United States imported 7,417,776 metric tons (16.4 millions lbs.) on fresh fruit and 3,178,567 metric tons (7 million lbs.) of vegetables (Table 4).(Clemens, 2004). This huge increase in imports was the result of increased demand for fresh produce during the off growing seasons in the United States. Of the imports in 2002, bananas made up the largest amount of imported fruit totaling 55.9% of total imports. Tomatoes made up the largest amount of imported vegetables totaling 27% of all imports (See Table 4). Costa Rica and Mexico were two of the biggest suppliers of fresh produce to the United States (Clemens, 2004). In 2009, imports increased to 12.3 million metric tons (27.1 million lbs.) and in 2011 fresh produce imports exceeded \$18 billion (USDA- ERS, 2012), (Johnson, 2014).

Fresh produce can become contaminated with pathogens at any point during the farm to fork continuum. Growers and producers need to take proper measures to prevent as many sources of contamination as possible. Contamination can occur in fields or orchards, during harvest, transport, processing, packaging, distribution and marketing, to restaurants, food service facilities, and the home (Boyer, 2013b). The soil in which the produce is grown can harbor harmful bacteria such as *Salmonella*, *Listeria monocytogenes*, *E. coli* O157:H7, etc. Untreated animal manure and irrigation water are sources of pathogen contamination. Poor sanitation practices in processing facilities also pose a huge risk for contaminating fresh produce. In addition, consumers are also an important source of contamination. For example, a study conducted by the Center for Science in the Public Interest from 2002-2011 found that approximately 900 food borne illness outbreaks were related to meals cooked at home resulting in 13,000 illnesses (Preidt, 2014).

Cooking produce is an effective approach to prevent illnesses from fresh produce but most consumers prepare fresh uncooked produce. For this reason, children, pregnant women, the elderly, and immunocompromised individuals need to exercise caution when eating fresh produce. The CDC recommends that consumers follow the following guidelines for fresh produce: “when handling produce start with clean hands. Hands should be washed for at least 20 seconds with soap and warm water before and after handling fresh produce. Cut out any damage or bruising on the produce. Wash all produce before eating, cutting, or cooking; this includes organic and inorganically grown. Commercial produce washes or other soaps are not recommended”. The CDC states that even if the product is peeled, it is still important to wash it carefully, to prevent pathogens being transferred into the produce during the peeling/cutting process. The CDC recommends, scrubbing produce such as melons with a brush, then drying the produce with a clean towel or paper towel to further remove any bacteria (FDA, 2013a). Processes such as slicing, dicing, chopping, grinding, shucking destroys the physical barriers of the fresh fruits and produce. This can allow the interior of the food to become contaminated with pathogens. For example, *Salmonella*, has been shown to grow on the interiors of cut melons (Golden et al, 1993), and tomatoes (Lin and Wei, 1997).

Programs to Improve the Safety of Fruits and Vegetables

Fresh produce has increasingly been the source of many illnesses during the last several years, and the U.S. government has implemented new safety practices. For example, the FDA in 1998, in response to the 1996 outbreak of *Cyclospora* in Texas associated with raspberries from Guatemala published a food safety guide for produce called “*Guide to Minimize Microbial Food Safety Hazards for Fresh Fruits and Vegetables.*” More recently, the United States Department of Agriculture (USDA) has recommended implementation of Good Agriculture Practices (GAPs), and numerous universities have developed GAP training programs and increased their research efforts on fresh produce safety (Williams, 2014).

Consumer Knowledge of Fresh Produce Safety and the Food Safety Modernization Act.

Good Agricultural Practices (GAPs)

Good Agricultural Practices (GAP) is a voluntary fresh produce safety program designed to minimize the risk of food borne illness due to consumption of fresh produce. The main focus of the GAP program is food safety and prevention of food borne illnesses (Williams, 2014). The GAP programs provide farmer's with guidelines to follow to help ensure that proper hygienic practices are being followed on their farm. The GAP guidelines include proper soil management, proper manure and compost handling and preparation, identifying appropriate water sources for irrigation purposes, pest exclusion, field worker personal hygiene practices, and post harvest handling and transportation (Williams, 2014). Producer's can become GAP certified which includes yearly audits. Certification is not yet required at this time but becoming certified has many benefits such as: increased fresh produce safety and improved marketability of their products. Since GAP programs can be customized for each individual farm, farmers don't have to figure out how their farm and practices fit into a one-size-fits-all program increasing its effectiveness (Williams, 2014). The GAP training programs are offered through many universities online or in the classroom. For example, the Iowa State University extension service offers a two part offer GAP certification training workshops for local food producers. These presentations are offered throughout the state of Iowa. Level one of the program trains farmers who provide food directly to consumers through farmers' markets or retail foodservice sales.

Level two provides training to farmers on how to write a farm food safety plan that demonstrates that GAPs are in place providing food safety assurance to buyers. The GAP training programs are recommended for farmers who sell to retail foodservices, such as grocery stores, restaurants, hospitals and other institutions, and those interested in adding value to fresh produce (Klein, Snyder & Shaw, 2013).

Food Safety Modernization Act (FSMA)

On January 4, 2011 the Food Safety Modernization Act (FSMA) was signed into law by President Barack Obama. The FSMA focuses on prevention rather than responding after outbreaks and other problems have occurred. The FSMA requires that fresh produce producers have safety and preventative controls in place. This is similar to the meat and poultry, sea food, and juice industries that are required to implement Hazard Analysis and Critical Control Point (HACCP) food safety programs (FDA, 2013b). The HACCP is an internationally recognized risk management food safety program to control biological, chemical, and physical hazards from the manufacturing, distribution and consumption of the finished product (FDA, 2013b). The FSMA is a food safety preventative program based on HACCP principles. it is "HACCP but not HACCP."

For the first time the FDA now has a legislative mandate to require comprehensive, science-based preventive controls across the food supply (FDA, 2013d). The mandate includes: mandatory preventative controls for food facilities, mandatory produce safety standards, and authority to prevent intentional contamination. Under mandatory preventative controls, food facilities are now required to implement a written preventative controls plan which involves: evaluating the hazards that could affect food safety, specifying what preventive steps, or controls, will be put in place to significantly minimize or prevent the hazards, specifying how the facility will monitor these controls to ensure they are working, maintaining routine records of the monitoring, and specifying what actions the facility will take to

Consumer Knowledge of Fresh Produce Safety and the Food Safety Modernization Act.

correct problems that arise. Under mandatory produce safety standards, the FDA must create science-based standards for the safe production and harvest of fresh produce (FDA, 2013d). Under authority to prevent intentional contamination, the FDA must issue regulations to protect against the intentional adulteration of food, including science-based strategies to prepare and protect the food supply chain at weak areas (FDA, 2013d).

The Food Safety Modernization Act has also increased inspection frequency. All high risk facilities will be inspected within five years of enactment and at least every three years after that. The FSMA also allows the FDA to have access to all records. The FSMA will allow testing of certain foods by laboratories accredited by the FDA (FDA, 2013d).

Regarding imported foods, the FDA now has more authority including: importer accountability, third party certification, certification for high risk foods, voluntary qualified importer program, and authority to deny entry (FDA, 2013d). The FSMA applies to shippers, receivers, and carriers who transport food into the United States by rail or motor vehicle and also applies to a person outside of the United States who ships food to the United States in an international freight container by oceangoing vessel or in an air freight container, and arranges for the transfer of the intact container in the United States onto a motor vehicle or rail vehicle for transportation in U.S. commerce (Federal Register, 2014). The FSMA has also outlined new imported produce regulations and has given the FDA mandatory recall authority (Boyer, 2013c). On January 4, 2013, the FDA proposed that growers and producers develop a formal plan to prevent food borne illness and to develop plans for correcting problems that do arise (FDA, 2013c). A second proposed rule is that there are enforceable safety standards for the production and harvesting of fresh produce on farms. This rule proposes science and risk based standards for the safe production and harvesting of fruits and vegetables (FDA, 2013c).

Consumer Survey

The survey used to collect data for this report was created and distributed through a survey site called surveymonkey.com (Appendix 1). The purpose of the survey was to collect data on the knowledge of Iowa consumers, 18 years of age and older, concerning fresh produce safety and the Food Safety Modernization Act (FSMA). These data were used in the report to show areas lacking knowledge and to help increase awareness of fresh produce safety. With the help of the local Louisa County Iowa State Extension Office, the survey was distributed to approximately 400 people with 166 responses returned (i.e., 41% response rate). All respondents lived in the state of Iowa and were at least 18 years of age. The majority of the respondents were between the ages of 45-64 and of mostly Caucasian descent. A large number of respondents were college graduates with the remaining respondents having at least a high school diploma. The average household income of the group of respondents was between \$50,000 and \$74,999 per year (Schrier, 2013).

The Consumer survey focused on *Listeria monocytogenes*, *Salmonella*, and *Escherichia coli* (O157:H7). These bacteria were chosen because they are some of the most frequently found pathogens on fresh produce.

Listeria monocytogenes is a bacteria usually associated in ready-to-eat deli type meats but is also found in produce. In 2011 the CDC reported a *Listeria* outbreak involving several states and the source was traced back to cantaloupe from Jensen Farms in Colorado (CDC, 2012a). *Listeria* is very hardy and

Consumer Knowledge of Fresh Produce Safety and the Food Safety Modernization Act.

can survive or even grow at refrigerated temperatures and can also be resistant to drying and heating conditions. People who are immunocompromised are especially susceptible to Listeriosis (Boyer, 2013a). People consuming fresh produce need to be aware of possible contaminants and steps they can take to minimize risk such as cleaning the refrigerator on a regular basis and washing hands and kitchen surfaces often (FDA, 2014). The Food and Drug Administration (FDA) recommends that all refrigerated foods are kept at 4.4C (40F) or lower. Freezer temperatures should be at -18C (0F) (FDA, 2014).

Salmonella is another pathogenic bacteria commonly associated with fresh produce. Salmonellosis causes diarrhea, fever, and abdominal cramping approximately 12-72 hours after consuming contaminated food (CDC, 2014b). Most people recover without treatment, but those who are immunocompromised may suffer severe symptoms or even death. In 2012 the FDA issued a recall of cantaloupe contaminated with *Salmonella* from Chamberlain Farms. This outbreak caused 261 illnesses in 24 states and resulted in 3 deaths (CDC, 2012b). This outbreak was associated with *Salmonella* Typhimurium. To prevent contamination of fresh produce, the CDC recommends that raw meats are kept separate from ready-to-eat foods such as fresh produce. Proper hand washing and utensil washing and, cooking meats to the proper temperatures will also reduce chances of *Salmonella* contamination (CDC, 2011).

Escherichia coli is also commonly associated with fresh produce. Fresh produce can become contaminated in a number of ways but most commonly if grown in a field using untreated manure as fertilizer, or in a field where livestock were previously held. There are six Shiga toxin-producing *E. coli* (STEC)- that can cause sickness in humans: Enteropathogenic (EPEC), Enterotoxigenic (ETEC), Enterovasive (EIEC), Enteroaggregative (EAEC), Diffusely adhering (DAEC), and Enterohemorrhagic (EHEC). Of these, enterohemorrhagic *E. coli* or O157:H7 is the most common (Boyer, 2013a). Washing fresh produce thoroughly in warm tap water can reduce the number of bacteria on the produce, but can still leave enough to make you sick, since it can take as little as 10 organisms of *E. coli* O157:H7 to cause illness. Data on the effectiveness of commercially available fresh produce washes is mixed, with some studies showing it to be as effective as warm tap water and other studies showing it to be less effective compared with warm tap (Dr. Gupta, 2007).

According to the survey, consumers and those preparing food had a general understanding of what was required to prevent food borne illnesses, but most were lacking detailed knowledge of the subject (Appendix 1). Approximately 69% of respondents did know that food borne illnesses are associated with fresh produce. However, 36% of survey respondents were not aware that washing fresh produce sometimes isn't sufficient to prevent food borne illness, although 85% of respondents did wash their fresh produce with tap water, as recommended by the CDC (CDC, 2014c). When respondents were asked the question, "Do you wash your fresh produce before consuming to prevent sickness?", 80% said yes but 22% said only sometimes. Although washing produce isn't always enough to prevent illness it can help reduce some of the infectious organisms on the produce (Schrier, 2013).

Seventy six percent of survey respondents never heard of the Food Safety Modernization Act and 84% did not know how it affected fresh produce. The respondents were asked if fresh produce should be regulated under the same food safety Hazard Analysis and Critical Control Point (HACCP) programs as meat and poultry. The majority of respondents were against more regulation. Many respondents believed that the government was already too involved in everything. There were also some comments

Consumer Knowledge of Fresh Produce Safety and the Food Safety Modernization Act.

stating HACCP was not required, because consumption of fresh produce was less of a risk of food borne illness than meat and poultry. Respondents were also concerned about the additional cost associated with implementing HACCP for fresh produce. Others mentioned that HACCP is currently not very effective in the meat industry due to poor enforcement. One respondent was pro HACCP for imported fresh produce but not for locally grown produce (Schrier, 2013). However, 66% of survey respondents indicated that it was very important that they were knowledgeable about prevention of food borne illness from fresh produce (Schrier, 2013).

According to the survey, Iowa consumers seemed to generally understand that they need to wash their fresh produce before consuming, but they did not know the specifics (Schrier, 2013). For example, the survey showed that 40% of 144 respondents never heard of *Listeria monocytogenes* (Schrier, 2013). In addition, of the 144 responses on the fresh produce survey, only 12% of respondents heard of *E. coli*, and 77% indicated little knowledge of *Salmonella* (Schrier, 2013).

Conclusions

The results of the consumer survey can serve as a source of information to help consumers understand fresh produce safety. This is important, since one of the most recent fresh produce outbreaks in Iowa occurred between June and August 2013 due to salad mix contaminated with *Cyclospora*. There were a total of 631 people infected in 25 states and 49 hospitalizations (CDC, 2013).

It is clear that consumers are willing to learn about how to prevent food borne illness. The survey identified areas where consumers lack knowledge on specific food borne illnesses. Information collected from this survey can be used to develop programs to provide information to consumers on the specific illnesses associated with fresh produce. The results can be incorporated into the local Iowa State Extension Office website. Consumer education is one of the most important methods to prevent food borne illness. The local Iowa State Extension Office has many different types of food safety training programs for adults and children. This Consumer Survey is another tool that Cooperative Extension Agents can use to educate the public. Everyone including growers, processors, and retail stores have a responsibility to prevent illness from fresh produce.

Recommendations

The new Food Safety Modernization Act will help the industry improve the safety of fresh produce. Illnesses associated with *Listeria monocytogenes*, *Salmonella*, and *Escherichia coli* (O157:H7) and other food borne pathogens can be reduced with proper knowledge of handling and preparation procedures of fresh produce.

The CDC recommends that: “when handling produce start with clean hands. Hands should be washed for at least 20 seconds with soap and warm water before and after handling fresh produce. Cut out any damage or bruising on the produce. Wash all produce before eating, cutting, or cooking; this includes organic and inorganically grown. Commercial produce washes or other soaps are not recommended.” Scrub firm produce such as melons with a brush then dry produce with a clean towel or paper towel to further remove any bacteria (FDA, 2013a). These recommendations along with pathogen specific

Consumer Knowledge of Fresh Produce Safety and the Food Safety Modernization Act.

handling procedures should be offered in easily understood format using brochures, pamphlets and websites. The Cooperative Extension Programs at State Universities should focus on providing this information to consumers at locations such as grocery stores, farmer's markets, physician offices, and through workshops at churches, community centers and other locations where consumers are more likely to listen to the messenger.

Consumer Knowledge of Fresh Produce Safety and the Food Safety Modernization Act.

Table 2. Vegetable Increase Per Capita From 1976-2012 (Cook, 2013)

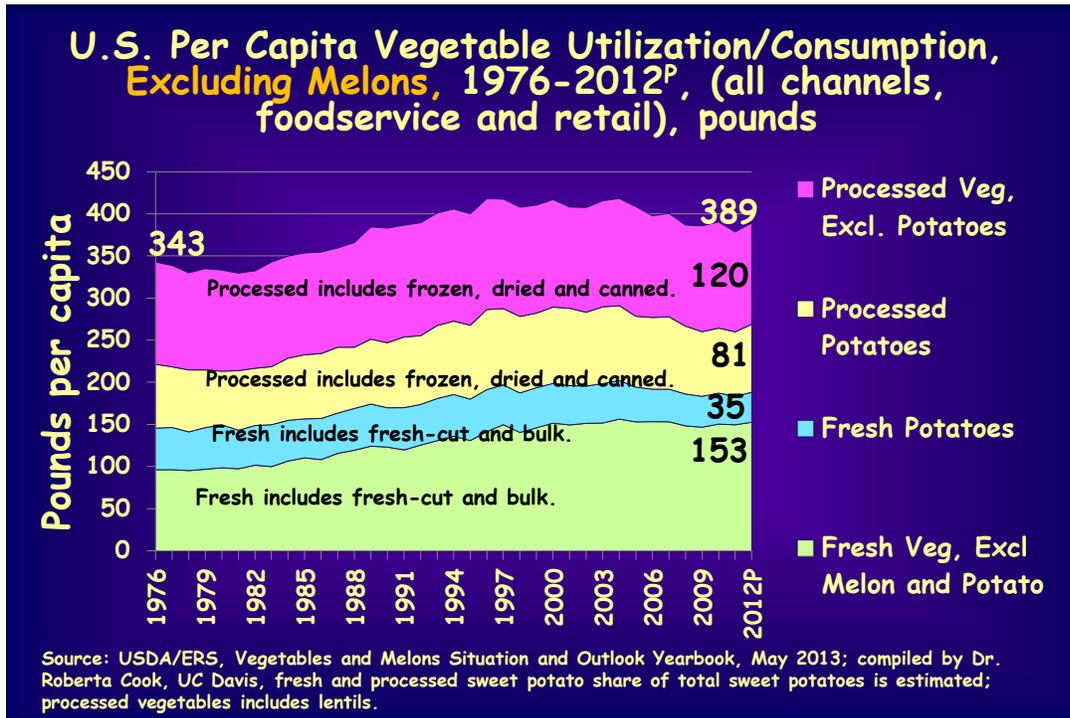
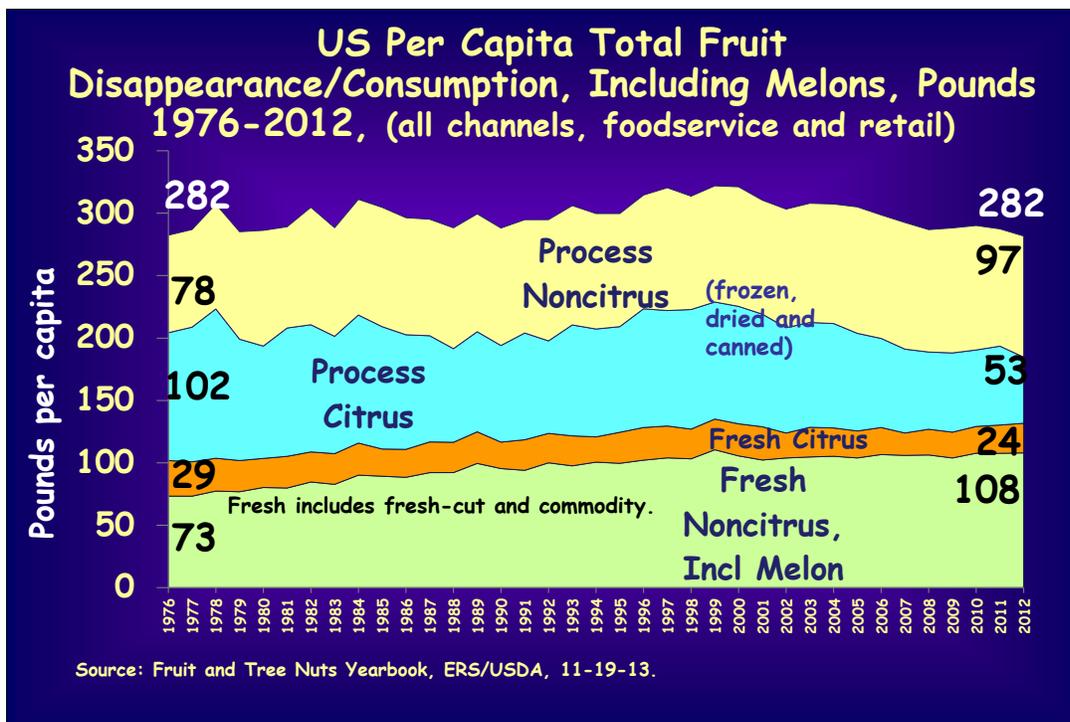


Table 3. Fruits Increase Per Capita from 1976-2012 (Cook, 2013)



Consumer Knowledge of Fresh Produce Safety and the Food Safety Modernization Act.

Table 4. U.S. Fresh Produce Imports by Largest Suppliers 2002 (Clemens, 2004)

Product	Metric Tons	Percentage of Total Imports	Percentage of Product by Country
Total Fruit	7,417,776		
Bananas	4,144,627	55.9	
Ecuador	1,094,600		26.4
Guatemala	968,941		23.4
Costa Rica	914,235		22.1
Melons	680,275	9.2	
Guatemala	213,393		31.4
Costa Rica	174,159		25.6
Mexico	128,106		18.8
Grapes	518,267	7.0	
Chile	399,015		77.0
Mexico	103,175		19.9
Pineapples	405,714	5.5	
Costa Rica	344,731		85.0
Total Vegetables	3,178,567		
Tomatoes	859,502	27.0	
Mexico	723,425		84.2
Canada	100,499		11.7
Peppers	401,159	12.6	
Mexico	322,627		80.4
Canada	41,545		10.4
Cucumbers/Gherkins	394,040	12.4	
Mexico	334,681		84.9
Vegetables, Fresh	351,239	11.1	
Mexico	293,685		83.6
Potatoes	281,890	8.9	
Canada	281,785		99.9
Onions and Shallots	270,243	8.5	
Mexico	157,468		58.3
Canada	55,133		20.4

Consumer Knowledge of Fresh Produce Safety and the Food Safety Modernization Act.

Appendix 1. (Schrier, 2013)

Fresh Produce Safety and the Food Safety Modernization Act.

The following is a survey about consumer knowledge of fresh produce safety and handling. By completing this survey you are allowing me to collect anonymous information and data about consumers' knowledge of how to safely handle fresh produce and the Food Safety Modernization Act (FSMA). The information will be used in report that I am writing for my Virginia Tech Agricultural and Life Sciences Graduate program. My report is going to focus on fresh produce safety, how produce should be handled, how to prevent food borne illnesses caused by produce, and FSMA. The survey will give me great insight to what people already know or don't know so we can focus on areas that are lacking. No names will be used in the report. Those surveys completed by anyone under 18 will not be included in the report. I greatly appreciate your time. It is important that the survey be completed within a week after being received. Thanks!

Stevie Schrier

***1. What is your age?**

18 to 24

25 to 34

35 to 44

45 to 54

55 to 64

65 to 74

75 or older

***2. What is your race? Mark one or more.**

White

Black or African American

Asian

Native Hawaiian or Other Pacific Islander

American Indian or Alaska Native

Other

***3. What is the highest level of education you have completed?**

Consumer Knowledge of Fresh Produce Safety and the Food Safety Modernization Act.

Fresh Produce Safety and the Food Safety Modernization Act.

***4. What is your approximate average household income?**

- \$0-\$24,999
- \$25,000-\$49,999
- \$50,000-\$74,999
- \$75,000-\$99,999
- \$100,000-\$124,999
- \$125,000-\$149,999
- \$150,000-and up

***5. Which Iowa county do you live in?**

***6. How many children age 17 or younger live in your household?**

- None
- 1
- 2
- 3
- 4
- More than 4

***7. Are you the primary grocery shopper in your household?**

- YES
- NO [GO TO QUESTION 18]

8. Are you responsible for the majority of food preparation and cooking in your household?

- YES
- NO [GO TO QUESTION 18]

Consumer Knowledge of Fresh Produce Safety and the Food Safety Modernization Act.

Fresh Produce Safety and the Food Safety Modernization Act.

9. Do you buy fresh produce from both grocery stores and farmers markets?

- YES
 NO

10. What are recommended procedures at home to maintain the safety of your fresh produce?

- Wash your hands with hot soapy water before and after handling the products
 Wash kitchen surfaces, cutting boards, and utensils with hot, soapy water after preparing each food item.
 Keep fresh produce refrigerated at 40 degrees or below
 All of the above

11. Do you wash your fresh produce before consuming to prevent sickness? (select all that apply)

- YES
 NO
 SOMETIMES

12. Are you aware that washing fresh produce may not be enough to prevent food borne illness?

- YES
 NO

***13. Please select which process you use to remove possible contaminants (select all that you use in your home.)**

- Not removed, no process
 Wash with tap water
 Wash with distilled water
 Wash with soap and water
 Use commercial fruit and vegetable washes
 Wet wipe
 Dry wipe
 Physical process, such as shaking
 Other (please specify)

Consumer Knowledge of Fresh Produce Safety and the Food Safety Modernization Act.

Fresh Produce Safety and the Food Safety Modernization Act.

***14. Are commercial fruit and vegetable washes effective in removing contaminants from fresh produce?**

- YES
- NO
- Don't Know

15. When buying fresh produce do you buy organic?

- YES
- NO

16. Are organic fresh produce more safe compared with non-organic fresh produce?

- YES
- NO
- Don't Know

17. Do you grow your own fresh produce?

- YES
- NO
- SOMETIMES
- NEVER

***18. Have you or anyone in your household had a food borne illness?**

- YES [ANSWER QUESTION 19]
- NO

19. Was the food borne illness from fresh produce?

- YES
- NO
- Unable to be sourced

Consumer Knowledge of Fresh Produce Safety and the Food Safety Modernization Act.

Fresh Produce Safety and the Food Safety Modernization Act.

***20. Where can contamination of fresh produce occur? (select all that apply)**

- Field/ orchards
- During harvesting/transport
- During processing/ packaging
- During distribution/ marketing
- Restaurants/ food service facilities
- At home
- All of the above

***21. Fresh produce is often contaminated from the irrigation system.**

- TRUE
- FALSE

***22. Fresh produce is often contaminated from the soil.**

- TRUE
- FALSE

***23. Where is the most important step to ensure produce safety? (select all that apply)**

- On the farm it came from
- During transportation
- In the Store
- At home
- All of the above

***24. More food borne illnesses are associated with fresh produce than meats.**

- TRUE
- FALSE

***25. Do you believe fresh produce should be regulated under the same HACCP plans as meats? YES or NO. If NO please explain why not.**

Consumer Knowledge of Fresh Produce Safety and the Food Safety Modernization Act.

Fresh Produce Safety and the Food Safety Modernization Act.

***26. Have you heard of the Food Safety Modernization Act (FSMA)?**

- YES
 NO

***27. How does the Food Safety Modernization act (FSMA) effect fresh produce?**

- Introduces fresh produce regulation
 Takes away fresh produce regulation
 Neither Choice
 Don't Know

***28. What is the focus of the Food Safety Modernization Act (FSMA)?**

- Better response to food borne illness outbreaks
 Prevention
 Treatment of Food Borne Illnesses
 Don't Know

***29. Of the following pathogenic bacteria, which two, cause the most illness from consumption of fresh produce?**

- Staphylococcus aureus
 Clostridium perfringens
 Listeria monocytogenes
 Salmonella
 Escherichia coli (E. coli O157:H7)

***30. How would you rate your knowledge of Staphylococcus aureus?**

- I know everything
 I know quite a bit
 I know a little
 I've only heard of Staphylococcus aureus
 I've never heard of Staphylococcus aureus

Consumer Knowledge of Fresh Produce Safety and the Food Safety Modernization Act.

Fresh Produce Safety and the Food Safety Modernization Act.

*31. How would you rate your knowledge of Clostridium perfringens?

- I know everything
- I know quite a bit
- I know a little
- I've only heard of Clostridium perfringens
- I've never heard of Clostridium perfringens

*32. How would you rate your knowledge of Listeria monocytogenes?

- I know everything
- I know quite a bit
- I know a little
- I've only heard of Listeria monocytogenes
- I've never heard of Listeria monocytogenes

*33. How would you rate your knowledge of Salmonella?

- I know everything
- I know quite a bit
- I know a little
- I've only heard of Salmonella
- I've never heard of Salmonella

*34. How would you rate your knowledge of Escherichia coli (E. coli O157:H7)?

- I know everything
- I know quite a bit
- I know a little
- I've only heard of E. coli O157:H7
- I've never heard of E. coli O157:H7

*35. How important is it to you to know how to prevent food borne illness from fresh produce?

- Very important
- Somewhat important
- Somewhat unimportant
- Not important at all

Consumer Knowledge of Fresh Produce Safety and the Food Safety Modernization Act.

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Consumer Knowledge of Fresh Produce Safety and the Food Safety Modernization Act.

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