SURVEY OF PATHOGEN INTERVENTIONS AND BEST PRACTICES USED

BY

BEEF HARVESTERS AND PROCESSORS

A Thesis

by

SCOTT PAUL LANGLEY

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

August 2010

Major Subject: Animal Science

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Approved by:

Chair of Committee,	Jeffrey W. Savell
Committee Members,	Davey B. Griffin
	Kerri B. Harris
	R. Daniel Lineberger
Head of Department,	Gary R. Acuff

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ABSTRACT

Survey of Pathogen Interventions and Best Practices Used by Beef Harvesters and Processors. (August 2010)

Scott Paul Langley, B.S., Texas A&M University

Chair of Advisory Committee: Dr. Jeffrey W. Savell

A survey was developed and sent out to each sector of the beef industry (slaughter, non-intact processing and grinding) by using the FSIS Meat, Poultry and Egg Product Inspection Directory. Survey questions were specific to processes and interventions being applied, and the use and familiarity with Industry Best Practices documents for beef processing. Returned completed surveys. A total of 469 beef processing operations responded and of survey respondents, 119 establishments were called and asked additional questions. Critical Control Points (CCPs) and testing for *E. coli* O157:H7 were common discussion point during phone calls. Plant visits were made to confirm the answers that were provided in the written survey.

Plants that further processed beef were found to need to reassess their HACCP plan based on their response to the question, "Is *E. coli* O157:H7 a reasonably likely to occur food safety hazard?" *E. coli* O157:H7 is considered an adulterant in the products that they produced if they answered yes to this question.

Based on survey responses, slaughter establishments were using available technologies to reduce or eliminate possible microbiological contamination. Further

process operations, especially those plants that produced intact steaks and roasts, marinated/enhanced steaks and roasts, and plants that produced needle/blade tenderized steaks and roasts, used documentation such as supplier purchasing specifications instead of using processes to control, reduce, or eliminated microbiological food safety hazards.

Industry Best Practices were being utilized most frequently by slaughter and ground beef operations. Plants that further process beef still need to implement the use of the Industry Best Practices specific to them.

Plants used testing for *E. coli* O157:H7 throughout the beef industry regardless of plant size or type.

DEDICATION

This thesis is dedicated to my family, my parents, Jean and Paul, and my brother, Ray. I thank my mom and brother for their continued love and support throughout my time as a graduate student. Furthermore, I thank my dad who is no longer with us. Without him instilling work ethic, morals, passion and desire in me, I would not be the person I am today.

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Finally, I thank my family and friends; without you this process would not have been possible.

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CHAPTER I

INTRODUCTION AND REVIEW OF LITERATURE

Food safety is a common goal for the meat industry and has been for many years. By designing and implementing food safety systems to address specific pathogens of concern, each establishment is ensuring that safe beef products are made available to the consumer, which is the ultimate goal of the industry. In 1996, USDA's Food Safety and Inspection Service (FSIS) finalized the Pathogen Reduction, Hazard Analysis, and Critical Control Point (HACCP) system regulation (USDA-FSIS, 1996a). This regulation mandated the implementation of HACCP in meat and poultry establishments. HACCP is "a systematic approach to food safety" (Scott & Stevenson, 2006). When an establishment creates a HACCP plan, the initial step is determining what biological, chemical, and physical food safety hazards are reasonably likely to occur in the item being produced. After determining which hazards are reasonably likely to occur, critical control points (CCPs) should be identified to prevent, eliminate or reduce the identified hazard to an acceptable level. Scientific data are used to support the selection of CCPs and to validate the effectiveness of in-plant controls. Validation is defined by (Scott & Stevenson, 2006), "as the element of verification focused on collecting and evaluating scientific and technical information." Being able to validate critical control points is vital to a HACCP plan.

This thesis follows the style of *Meat Science*.

E. coli O157:H7 is often identified as a significant food safety hazard during the harvest process because data have shown that cattle are potential carriers of the bacteria. (Dewell et al., 2005, Elder et al., 2000). "*E. coli* O157:H7 is an adulterant in ground beef, products intended for grinding, and non-intact beef products" (USDA-FSIS, 1999). Therefore, the beef industry has developed many different strategies to reduce or eliminate reasonably likely to occur hazards, including *E. coli* O157:H7. Many of these strategies are commonly referred to as antimicrobial interventions.

Chemical dehairing is one intervention that has been used to reduce contamination on the hide (Bowling & Clayton, 1992). Bowling and Clayton (1992) described the process with three bacteriostatic/bactericidal steps: application of sodium sulfide, use of hydrogen peroxide, and rinsing with lactic acid. In a lab setting, chemical dehairing was used to reduce *Salmonella* Typhimurum and *E. coli* O157:H7 from an initial number of 5.1 to 5.3 $\log_{10}$ CFU/cm^2 to levels below the detection limit of 0.5 $\log_{10}$ CFU/cm^2 after chemical dehairing (Castillo, Dickson, Clayton, Lucia, & Acuff, 1998a).

Trimming is an additional intervention that has been effective in reducing *E. coli* O157:H7 bacterial loads on beef carcasses. FSIS implemented a zero tolerance trimming directive which required establishments to remove any visible signs of feces, milk or ingesta prior to washing or chilling (USDA-FSIS, 1993) and (Horne, 1993). After conducting a study of various interventions including various chemical solutions, water (16 to 74°C) spray-washing and hand trimming/spray-washing treatments (Gorman, Sofos, Morgan, Schmidt, & Smith, 1995) concluded that, "Trimming under the zero tolerance directive of FSIS-USDA to reduce microbiological contamination after

carcasses are contaminated with fecal material". A study was conducted with 48 beef sides selected on 3 different days from a commercial processor. This study tested treatments of trimming, but not washing, trimming and washing, and not trimming paired with not washing. The treatment that showed the greatest reduction in aerobic plate counts (APC) ($\log_{10}$ CFU/cm^2) was trimming followed by water wash (Prasai et al., 1995).

Using a hot water rinse is acknowledged by USDA-FSIS (1996b) as having a sanitizing effect on carcasses when the water temperature is > 74°C (Barkate, Acuff, Lucia, & Hale, 1993). A significant ($P < 0.05$) reduction in bacterial numbers is observed when comparing control (pre-spray) and hot (95°C) water treated beef carcass surfaces. The use of (95°C) hot water spray was proven to reduce levels of pathogens from inoculated levels of 5.0 $\log_{10}$ CFU/cm^2 *E. coli* O157:H7 and *Salmonella* Typhimurum and other indicator organisms. By 2.7 to 4.3 logs (Castillo, Lucia, Goodson, Savell, & Acuff, 1998b).

Steam pasteurization is permitted for means of carcass decontamination (USDA-FSIS, 1996b). When used at five different locations (inside round, loin, midline, brisket and neck), significant ($P \leq 0.001$) reduction occurred in naturally occurring bacterial populations. Steam pasteurization was most effective when used on the inside round, loin, and brisket (Nutsch et al., 1998). The neck, midline, and rump of beef carcasswere sampled for *Escherichia coli, Enterobacteriaceae* and total aerobic mesophilic plate counts on 30 carcass sides that were exposed to steam pasteurization (90°C, 10 s exposure time) and 30 carcass sides that were not exposed to steam pasteurization.

Significant reduction in *E. coli* incidence ($P \leq 0.05$) and counts, 0.5 $\log_{10}$ CFU 1000 cm^{-2}) ($P \leq 0.05$) were observed on rump sites only. Significant reductions (>0.8 $\log_{10}$ CFU 1000 cm^{-2}) of *Enterobacteriaceae* were observed at all carcass sites sampled ($P < 0.05$). *Enterobacteriaceae* reductions (>2 $\log_{10}$ CFU 1000 cm^{-2}) were significant at the more contaminated sites ($P < 0.001$) was shown by (Minihan, Whyte, O'Mahony, & Collins, 2003).

Steam vacuuming is the application of steam or hot water to beef carcasses followed by vacuuming (Dorsa, 1996). Beef carcass surfaces soiled with visible contamination had a reduction in APCs and total coliform counts (TCCs), by 1.73 and 1.67 $\log_{10}$ CFU/cm^2 (vacuum Unit-A) and by 2.03 and 2.13 $\log_{10}$ CFU/cm^2 (vacuum Unit B) when two different steam vacuums were used (Kochevar, Sofos, Bolin, Reagan, & Smith, 1997). The use of a household steam cleaning system was used in (four small and very small) meat processing plants. Seventy two beef carcasses were sampled at the midline, neck and rump. The left side of each carcass was used as the control and the right side was treated with steam vacuuming. Samples were taken before, immediately after, and 24 hours after the steam treatment. The mean populations of total aerobes, coliforms and *Enterobacteriaceae* recovered from three anatomical sites on the beef carcasses were 1.88, 1.89, and 1.36 $\log_{10}$ CFU/cm^2, respectively, before the steam treatment. Immediately after steam treatments 1.00, 0.71, and 0.52 $\log_{10}$ CFU/cm^2, were observed and 1.10, 0.95, and 0.50 $\log_{10}$ CFU/cm^2, respectively, 24 hours after the steam treatment. The steam treatment significantly reduced the total aerobes, coliforms, and

Enterobacteriaceae at all three locations sampled on the carcasses ($P< 0.05$) (Trivedi, Reynolds, & Chen, 2007).

The most frequently used chemical decontaminant is a solution of organic acid (Belk, 2001).Organic acids can be used as an approved antimicrobial when used at a concentration of 1.5-2.5% (USDA-FSIS, 1996b). Using lactic acid spray as a decontamination method for beef, veal, and pig carcasses, as well as for pig liver and veal brain reduced the APC by approximately 1.5 $\log_{10}$ CFU/cm^2 for the APCs. However, this was largely dependent on the substrate and conditions of decontamination, (Snijders, van Logtestijn, Mossel, & Smulders, 1985). Phosphoric acid–activated acidified sodium chloride spray and a citric acid–activated acidified sodium chlorite spray applied at room temperature in combination with a water wash, was compared to water wash only on various hot-boned beef cuts. Initial numbers for were reduced by 3.8 to 3.9 $\log_{10}$ CFU/cm^2 for *E. coli* O157:H7 and *Salmonella* Typhimurium by using water wash followed by phosphoric acid–activated acidified sodium chloride spray. By using water wash followed by citric acid-activated acidified sodium chlorite, a reduction of 4.5 to 4.6 $\log_{10}$ CFU/cm^2 was observed. The results of this study concluded that the use of acidified sodium chlorite was effective when used to decontaminate beef carcass surfaces (Castillo, Lucia, Kemp, & Acuff, 1999). In another study, mean log reduction of 3.56 and 3.59 was observed on the external surface of veal and beef carcasses inoculated with a high dose of *E. coli* O157:H7 ($\log_{10}$ CFU/cm^2) after spraying with peroxyacetic acid (Penney et al., 2007). The application of organic acids during processing is a way to reduce the risk of food borne illness associated with *E. coli* O157:H7. Use of acidified

sodium chlorite (1,200 ppm) and acetic and lactic acids (2 and 4%), respectively were effective in reducing foodborne pathogens in beef trim prior to grinding in a simulated processing environment. An approximate 1.5 log reduction of the number of pathogens was shown with no significant differences among treatments (Harris, Miller, Loneragan, & Brashears, 2006).

Pre-evisceration interventions are applied to carcasses during harvest before possible cross contamination can occur since the hides of cattle are known for containing possible microbiological hazards. After pre-evisceration wash and spray with lactic acid (2%) at a commercial packing plant, the number of aerobes recovered from carcasses were >1 $\log_{10}$ CFU/cm^2less than the number on untreated carcasses, but the number of coliforms and *E. coli* were < 0.5 $\log_{10}$ CFU/cm^2 less on treated than on untreated carcasses (Gill & Landers, 2003). Trimming cattle hair pre-slaughter then treating the clipped hides in areas where hides are to be opened can reduce could bacterial loads. Application of 1% cetylpyridinium chloride to clipped hide surfaces caused a reduction of APCs by 3.8 $\log_{10}$CFU/ 100-cm^2 (Baird, Lucia, Acuff, Harris, & Savell, 2006).

In order to eliminate or reduce microbial growth, "multiple hurdles" have been employed in which several interventions are used sequentially. Results show that when multiple hurdles are used bacterial load reductions on beef carcasses are more substantial than single interventions alone (Arthur et al., 2004, Bacon et al., 2000, Castillo, Lucia, Goodson, Savell, & Acuff, 1998a). Carcass wash followed by a 2% organic acid spray, particularly lactic acid, is more effective than either trimming or washing with water alone to reduce *E. coli* O157:H7 and *Salmonella* Typhimurium from beef carcasses

(Hardin, Acuff, Lucia, Oman, & Savell, 1995). Using combinations of trimming, water spray (35°C), hot water/steam vacuuming and 2% lactic acid sprays (54°C, pH 2.25) a reduction of 3.5 to 5.3 $\log_{10}$CFU/cm^2 was observed (Phebus et al., 1997). Following water washing (16 or 35°C) of carcasses with hydrogen peroxide (5%) and ozonated water (0.5%), a bacterial load reduction of 2.60 to 2.87 $\log_{10}$CFU/cm^2 for hydrogen peroxide and 2.72 to 2.86 $\log_{10}$CFU/cm^2 for ozonated water was observed. When water wash was combined with acetic acid, a reduction in counts by 2.01 to 2.02 $\log_{10}$CFU/cm^2 was observed. Furthermore, when trisodium phosphate (12%) was combined with spray-washing a reduction in counts of 2.26 to 2.3 $\log_{10}$CFU/cm^2 were observed (Gorman et al., 1995).

Several advancements in intervention technology have been made, however minimal knowledge of the number of plant using which interventions is known. One step that the beef industry took upon itself was to provide knowledge on methods of how to produce the safest product possible. These methods are called Industry Best Practices, and they were designed to focus on specific types of operations or specific areas within an operation. Best Practices for Beef Slaughter covers several ways in which an establishment can apply interventions in their plant and achieve food safety improvement (Beef Industry Food Safety Council, 2009a). Needle tenderization and enhancement is a technology that has evolved in order to make products more consistent and appealing to the consumer. However, these practices can also be a possible means of spreading contamination. In order to assist in educating the industry to reduce the risk of contamination while using these quality improving technologies, the Industry Best

Practices for Pathogen Control During Tenderizing/Enhancing of Whole Muscle Cuts was developed (Beef Industry Food Safety Council, 2006). The product Identified as having the highest risk for harboring biological hazards in the current beef industry is ground beef. The Industry Best Practices for Raw Ground Beef (Beef Industry Food Safety Council, 2009b) was developed to inform establishments on how and where the establishments should implement practices to reduce the risk of these biological hazards. Approximately 46.7 percent of money spent on food is going to restaurants (Beef Industry Food Safety Council, 2005a). With such a significant portion of the consumers' income being spent in this sector, a set of guidelines was created to help ensure that the minimal practice were being followed, and these guidelines were termed, Best Practices for Foodservice Operations. Retail stores are commonly the last areas for consumers to purchase ground beef products for consumption at home. To give retail stores guidance on how to produce raw ground beef the Best Practices for Retailer Operations Producing Raw Ground Beef (Beef Industry Food Safety Council, 2005b) was created.

Each time there is a recall or a food safety outbreak, the beef industry practices are questioned, and often criticized by both public and private agencies. Due to recent recalls and outbreaks due to *E. coli* O157:H7, industry practices are currently under scrutiny. The current study was conducted to allow the beef industry to better defend itself and determine areas of need for further research, or possible extension actives and outreach.

CHAPTER II

MATERIALS AND METHODS

2.1 Survey development

A written survey (Appendix) was developed with sections designed for each type of operation surveyed: slaughter, fabrication, intact raw beef products, non-intact raw beef products, and raw ground beef. The survey was designed to obtain information from establishments about the types and frequency of pathogen testing conducted, types of pathogen intervention(s) being applied, methods used to validate these intervention(s), frequency of validation, sampling procedures, protocols for pathogen testing, and the use of Industry Best Practices. Demographic information was collected on FSIS establishment size classification (large =500 or more employees, small = 10-499 employees and very small = less than 10 employees) and the number of employees per establishment.

2.2 Selection criteria

Participants for the survey were selected by using the FSIS Meat, Poultry and Egg Product Inspection Directory (http://www.fsis.usda.gov/PDF/MPI_Directory _Establishment_Number.pdf) all establishments that had an M (meat) grant of inspection was sent a survey. There was no way to remove plants that harvested other species. Prior to sending the survey, a postcard (Appendix) was mailed out to inform establishments of the forthcoming survey and importance of collecting data on existing food safety programs for the beef industry. Five days after the postcard was sent the survey was

mailed. A cover letter was included in the survey packet notifying establishments that the survey may be completed through an online website or by the enclosed survey form.

2.3 Telephone interview

Upon return of the surveys, telephone interviews were conducted to clarify answers to written survey questions and to obtain additional information. These questions were specific to critical control points, antimicrobial interventions, and *E. coli* O157:H7 testing which can be found in the appendix.

2.4 Onsite interview

Randomly selected establishments that completed the written survey from each sector (harvest, fabricate, non-intact and needle/blade tenderized, non-intact and enhanced/marinated, and grinding) were visited to verify that information collected from the written survey was actually being applied in plant.

2.5 Statistical analysis

Data were analyzed by PROC FREQ (SAS, Cary, NC). Frequency analyses were utilized to display occurrence of Industry Best Practice use and understanding.

CHAPTER III

RESULTS

Once plants that had a M (meat) grant of inspection were singled out, 5667 surveys were mailed, of which 217 were returned due to various problems with postal delivery. Surveys with delivery issues included 102 which were returned with “no such street” stated on the envelope. The remaining 115 surveys were returned for other reasons such as “not deliverable as addressed,” “unable to forward,” “insufficient address,” “moved, left no address,” and “no mail receptacle.” One-thousand-one-hundred and sixty-one surveys were completed and returned. Table 1 shows the response rate of the survey and the number of slaughter plants, plants that fabricated primal and subprimals, plants that produced intact steaks and roasts, plants that produced marinated/enhanced steaks and roasts, plants that produced needle/blade tenderized steaks and roasts, and plants that produced ground beef.

Table 1. Results of the responses from the survey

	Number of participants
Total number of responses	1161
Total number of beef operations	469
Total number of surveys completed online	218
Type of plant	
Slaughter	167
Fabricated primal and subprimals	210
Produced intact steaks and roasts	267
Produced marinated/enhanced steaks and roasts	87
Produced needle/blade tenderized steaks and roasts	145
Produced ground beef	316

3.1. General questions asked of all plants in the survey

3.1.1 Is E. coli *O157:H7 reasonably likely to occur?*

Included in the survey were questions that were asked to all plants regardless of type. Figure 1 displays how many plants responded that *E. coli* O157:H7 is a reasonably likely to occur food safety hazard in the slaughter HACCP plan; fabrication HACCP plan; raw, not ground HACCP plan used to produce intact steaks and roasts; raw, not ground HACCP plan used to produce marinated/enhanced steaks and roast; raw, not ground HACCP plan used to produce needle/blade tenderized steaks and roasts; and in the raw, ground HACCP plan used to produce ground beef. The majority of plants, regardless of type and size, stated that *E. coli* O157:H7 was identified as a reasonably likely to occur food safety hazard in their HACCP plan. Slaughter plants, plants that fabricated primal and subprimals, and plants that produce intact steaks and roasts have to have a specific control measure in their HACCP plan to control *E. coli* O157:H7. FSIS established that *E. coli* O157:H7 is an adulterant in needle/blade tenderized roasts and steaks, marinated/enhanced roasts and steaks and raw ground beef. Therefore, products that are found to have *E. coli* O157:H7 must be processed into ready-to-eat products.

With the results of Figure 1, if marinated/enhanced, needle/blade tenderized, and ground beef plants are not producing ready-to-eat products, their HACCP plan needs to be re-evaluated or there may be legal/regulatory issues with these plants.

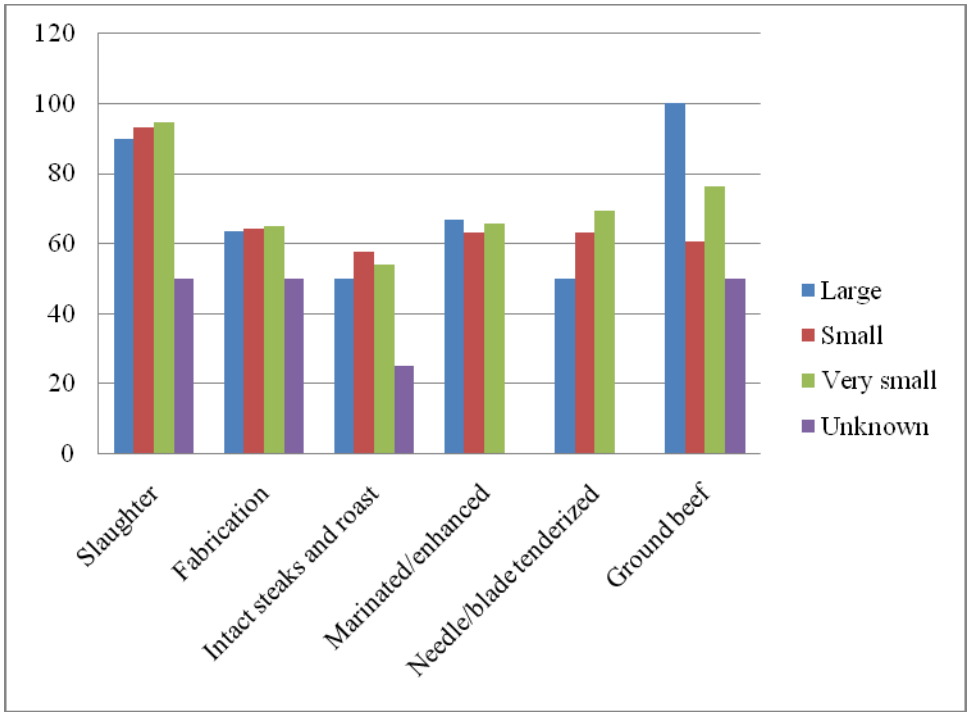

Figure 1. "Is *E. coli* O157:H7 identified as a reasonably likely to occur food safety hazard?"

3.1.2. Have Critical Control Points been validated?

Validation of CCPs is a vital step to HACCP plan development. Validation is the process of obtaining scientific or supporting documentation that verifies that the processes within a plant's HACCP plan will control, reduce or eliminate hazards that are reasonably likely to occur. Within Figure 2, information shows that the majority of all

plants had validated CCPs. The majority of large plants that slaughtered, fabricated primals and subprimals, marinated/enhanced steaks and roasts, and produced ground beef used in-plant testing as part of their validation process. A majority of small plant that slaughtered, fabricated primals and subprimals, and produced ground beef used in-plant testing as part of their validation process. In addition, a majority of very small plants that slaughtered used in-plant testing as part of their validation process. All of the plants of unknown size that produced needle/blade tenderized steaks and roasts conducted in-plant testing as part of their validation process. The minority of plants of unknown plant size that slaughtered, very small plants and plants of unknown size that fabricated primals and subprimals, small and very small plants that produced intact steaks and roasts, small and very small plants that produced marinated/enhanced products, small and very small plants that produced needle/blade tenderized products, and small plants that produced raw ground beef used in-plant testing as part of the validation process. None of the large and plants of unknown size that produced intact steaks and roast, and none of the plants of unknown size plants that produced ground beef used in-plant testing as part of the validation process.

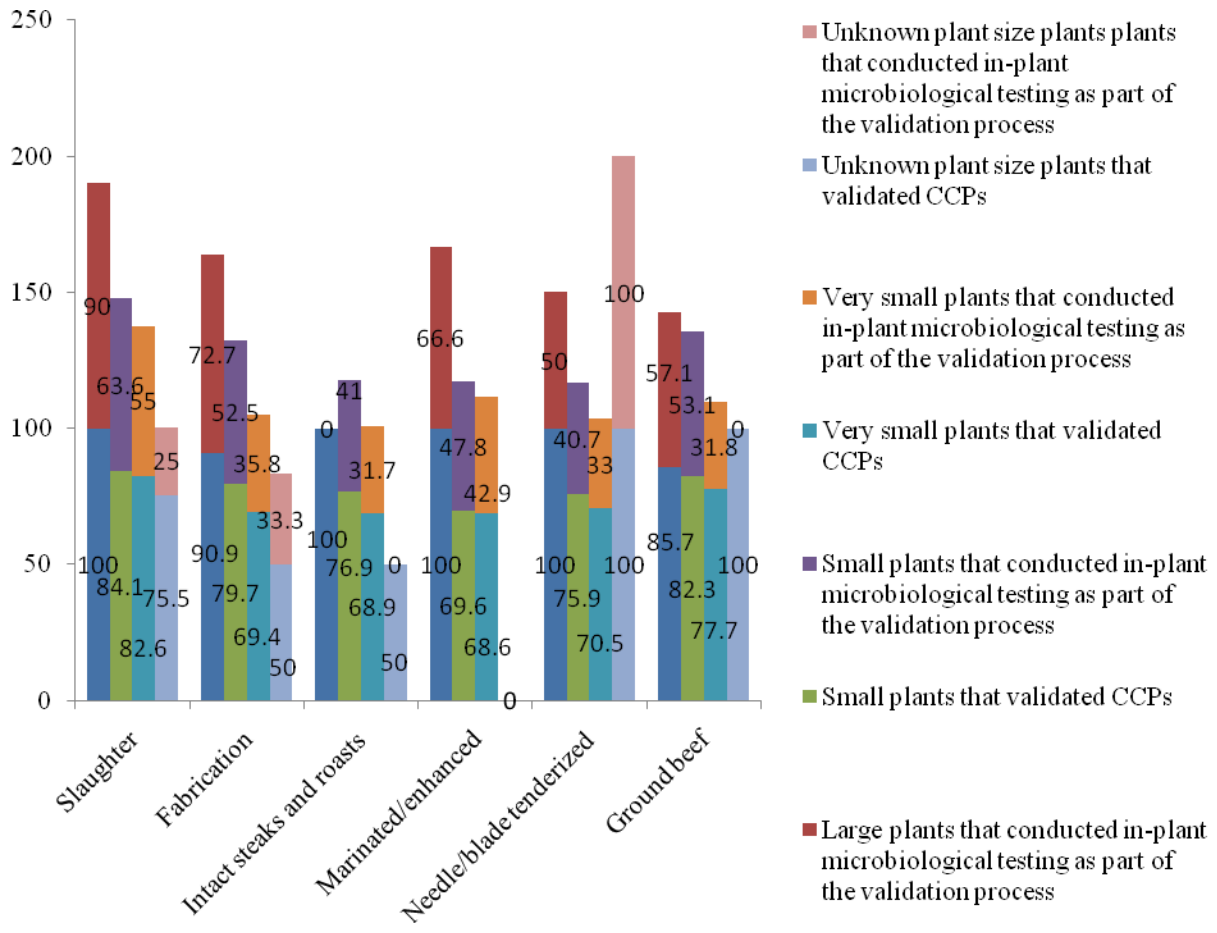

Figure 2. Have CCPs been validated and if CCPs were validated was in-plant testing part of the validation process

3.1.3. Industry Best Practices

The Industry Best Practices were developed to help plants of all sizes and types use information available on how to produce the safest products possible. Table 2 exhibits the frequency at which plants used the Industry Best Practices that are specific to each type of plant. Throughout the Industry's Best Practices for slaughter and spinal cord removal, a majority of all plants regardless of plant size used them. Within the plants that fabricated primals and subprimals, the majority of large plants and plants of unknown size used Industry Best Practices for vacuum-packed subprimals. The majority of large plants and plants of unknown size that produced intact steaks and roasts used the Industry Best Practices for vacuum-packed subprimals. The majority of large plants and small plants that produced marinated/enhanced steaks and roasts, and large plants and small plants that produced needle/blade tenderized steaks and roasts used the Industry's Best Practices for pathogen control during tenderization. Regardless of plant size the majority of plants that produced ground beef were using the Industry's Best Practices for processing raw ground beef products and the Industry's Best Practices for holding tested products. While information is made available to industry, some plants are still not using this information.

Table 2. Frequency of responses (%) by plant size for the use of the Industry Best Practices

	Plant Size															
	Large				Small				Very Small				Unknown			
	n	Yes	No	Not sure	*n*	Yes	No	Not sure	*n*	Yes	No	Not sure	*n*	Yes	No	Not sure
S*laughter*																
For slaughter	10	90.0	0	10.0	44	61.4	2.3	36.3	109	59.6	8.3	32.1	4	50.0	0	50.0
For spinal cord removal	10	90.0	0	10.0	44	54.5	4.5	41.0	109	62.4	5.5	32.1	4	50.0	0	50.0
Fabrication of primals and subprimals																
For vacuum-packed subprimals	11	63.6	9.1	27.3	59	45.8	23.7	30.5	134	36.6	30.6	32.8	6	50.0	0	50.0
Production of intact steaks and roasts																
For vacuum-packed subprimals	2	100.0	0	0	78	47.4	25.6	27.0	183	31.1	31.1	37.8	4	50.0	0	50.0
Production of marinated/enhanced steaks and roasts																
For pathogen control during tenderization	3	66.7	0	33.3	46	54.3	13.0	32.7	35	42.9	17.1	40.0	0	0	0	0
Production of needle/ blade tenderized steaks and roasts																
For pathogen control during tenderization	2	100.0	0	0	54	57.4	13.0	29.6	88	48.9	21.6	29.5	1	0	0	100.0
Production of ground beef																
Best practices for processing raw ground beef products	7	100.0	0	0	96	78.1	9.4	12.5	211	68.7	8.1	23.2	2	100.0	0	0
Best practices for holding tested products	7	85.7	14.3	0	96	80.2	10.4	9.4	211	74.4	12.8	12.8	2	100.0	0	0

3.2. Processes used by plants

3.2. 1. Slaughter

Several processes have been implemented into plants to control, reduce or eliminate the possibility of foodborne illness. Slaughter plants have implemented processes to control or reduce food borne illness that are used pre-evisceration, post-evisceration and some that are used throughout the process. Pre-evisceration processes are displayed in Table 3. Fifty percent of large plants (n=10) used pre-evisceration water wash, 40% used pre-evisceration antimicrobial spray and 30% used hide wash as pre-evisceration processes. These could have also been used in two-way and three-way combinations. Twenty percent of large plants used hide wash × pre-evisceration water wash, hide wash × pre-evisceration antimicrobial spray (20%), and pre-evisceration water wash × pre-evisceration antimicrobial spray (30%). Twenty percent of large plants used all three in combination. Twenty-five percent of small plants (n=44) used at least a hide wash, 15.9% used pre-evisceration water wash, and 18.2% used pre-evisceration antimicrobial spray. Less than10% of small plants used multiple combinations of hide wash, pre-evisceration water wash, and pre-evisceration antimicrobial spray. Of very small plants (n=109), most used pre-evisceration water wash (13.8%). All other processes were used by themselves or in a combination by less than 10% of very small plants. Fifty percent of the plants of unknown size used hide wash and pre-evisceration antimicrobial spray, and hide wash × pre-evisceration water wash. Pre-evisceration antimicrobial spray, hide wash × pre-evisceration antimicrobial spray and hide wash × pre-evisceration water wash were used by 25% of the plants of unknown size.

Table 3. Frequency of responses (%) by plant size for pre-evisceration processes used by beef slaughter plants from the survey

	Plant Size			
	Large (*n*=10)	Small (*n*=44)	Very Small (*n*=109)	Unknown (*n*=4)
Single processes				
Hide wash	30.0	25.00	7.3	50.0
Pre-evisceration water wash	50.0	15.9	13.8	50.0
Pre-evisceration antimicrobial spray	40.0	18.2	7.3	25.0
Two-way combinations				
Hide wash × pre-evisceration water wash	20.0	6.8	4.6	50.0
Hide wash × pre-evisceration antimicrobial spray	20.0	6.8	2.8	25.0
Pre-evisceration water wash × pre-evisceration antimicrobial spray	30.0	9.1	2.8	25.0
Three-way combinations				
Hide wash × pre-evisceration antimicrobial spray × pre-evisceration water wash	20.0	4.6	1.8	25.0

Table 4 shows the post evisceration process used by slaughter plants. Ninety percent of large plants (*n*=10) used lactic acid spray of the carcass, and 80% used hot water carcass wash. Steam pasteurization and acetic acid spray of the carcass were both used by 10% of the large plants. Hot water carcass wash × lactic acid spay was used by 70% of large plants. Ten percent of large plants used hot water carcass wash × acetic acid spray, steam pasteurization × lactic acid spray, lactic acid × acetic acid spray, and acetic acid spray × hot water carcass wash × lactic acid spray. Of the small plants (*n*=44) the most often used processes were lactic acid spray (65.9%), hot water carcass wash (59.1%), and acetic acid spray (29.6%). The most popular combination used by 38.6% of small used hot water carcass wash × lactic acid spray. Of the very small plants (*n*=109), the most popular processes used were hot water carcass wash (59.6%), and lactic acid

spray (54.1%). The most popular combination of processes used by very small plants was hot water carcass wash × lactic acid spray (28.4%). Fifty percent of plants of unknown size (*n*=4) used acetic acid spray as the single-most used post evisceration process.

Table 4. Frequency of responses (%) by plant size for post evisceration processes used by slaughter plants from the survey

	Plant Size			
	Large (*n*=10)	Small (*n*=44)	Very Small (*n*=109)	Unknown (*n*=4)
Single processes				
Hot water carcass wash	80.0	59.1	59.6	25.0
Steam pasteurization	10.0	6.8	1.8	25.0
Lactic acid spray	90.0	65.9	54.1	25.0
Acetic acid spray	10.0	29.6	20.2	50.0
Two-way combinations				
Hot water carcass wash × steam pasteurization	0.0	0.0	0.9	25.0
Hot water carcass wash × lactic acid spray	70.0	38.6	28.4	0.0
Hot water carcass wash × acetic acid spray	10.0	15.9	11.0	25.0
Steam pasteurization × lactic acid spray	10.0	4.6	0.9	0.0
Steam pasteurization × acetic acid spray	0.0	0.0	0.0	25.0
Lactic acid spray × acetic acid spray	10.0	15.9	2.8	0.0
Three-way combinations				
Acetic acid spray × hot water carcass wash × lactic acid spray	10.0	9.1	0.9	0.0
Acetic acid spray × hot water carcass wash × steam pasteurization	0.0	0.0	0.0	25.0

Steam vacuuming and trimming were two processes that could have been used throughout the slaughter process. Table 5 examines how many plants used steam vacuuming and trimming. Ninety percent of large plants, 22.7% of the small plants, 3.7% of the very small plants, and 25% of the plants of unknown size used steam

vacuuming. All large plants used trimming, 90.9% of the small plants, and 87.2% of the very small plants, and 50% of the plants of unknown size used trimming at some point during the slaughter process. Ninety percent of the large plants, 20.5% of the small plants, 3.7% of the very small, and 25% of the plants of unknown size used steam vacuuming × trimming during the slaughter process.

Table 5. Frequency of responses (%) by plant size for processes that could have been used throughout the slaughter process from the survey

	Plant Size			
	Large (*n*=10)	Small (*n*=44)	Very Small (*n*=109)	Unknown (*n*=4)
Single process				
Steam vacuuming	90.0	22.7	3.7	25.0
Trimming	100.0	90.9	87.2	50.0
Two-way combination				
Steam vacuuming × trimming	90.0	20.5	3.7	25.0

Critical control points are points in the process or procedures that reduce, prevent or eliminate food safety hazards, which must have records kept to make sure that these have been done. Table 6 examines the number of critical control points that were used by slaughter plants from the telephone interviews. Of the large beef slaughter plants (*n*=2), fifty percent had two CCPs, and 50.0% had three CCPs. Within the small plants that slaughtered beef (*n*=7), 57.1% had three CCPs, 28.6% had four CCPs, and 14.3% had six CCPs. For very small (*n*=20) plants that responded, 10% had one CCP, 35.0% had two CCPs, 40.0% had three CCPs, 5.0% had four CCPs, and 10% had five CCPs. The one plant of unknown size that slaughtered had two CCPs.

Table 6. Frequency of responses (%) by plant size for number of CCPs used by slaughter plants from the survey

	Plant Size			
	Large (*n*=2)	Small (*n*=7)	Very Small (*n*=20)	Unknown (*n*=1)
One CCP	0.0	0.0	10.0	0.0
Two CCPs	50.0	0.0	35.0	100.0
Three CCPs	50.0	57.1	40.0	0.0
Four CCPs	0.0	28.6	5.0	0.0
Five CCPs	0.0	0.0	10.0	0.0
Six CCPs	0.0	14.3	0.0	0.0

The critical control points that slaughter plants that were interviewed over the telephone used are exhibited in Table 7. One hundred percent of large plants (*n*=2) had zero tolerance carcass trimming, 50.0% had antimicrobial spray, 50.0% had hot water carcass wash, and 50.0% had zero tolerance head and offal trimming as CCPs. For the small plants (*n*=7), 100.0% of the plants used zero tolerance carcass trimming, 71.4% had lactic acid spray, and 57.1% had zero tolerance head and offal trimming as CCPs. The most frequently listed CCPs for the very small plants (*n*=20) were zero tolerance carcass trimming (80.0%), lactic acid (35.0%), chilling (25.0%), and carcass wash (25.0%). Of the unknown plant size (*n*=1), hot water carcass wash and zero tolerance carcass trimming were both listed (100.0%).

Table 7. Frequency of responses (%) by plant size for beef slaughter CCPs from the telephone interviews

	Plant Size			
	Large (*n*=2)	Small (*n*=7)	Very Small (*n*=20)	Unknown (*n*=1)
Antimicrobial spray	50.0	28.6	15.0	0.0
Acetic acid spray	0.0	0.0	10.0	0.0
Chilling	0.0	28.6	25.0	0.0
Carcass wash	0.0	0.0	25.0	0.0
Cooler temperature	0.0	14.3	15.0	0.0
Dry aging	0.0	0.0	5.0	0.0
Hot water carcass wash	50.0	14.3	10.0	100.0
Steam pasteurization	0.0	0.0	5.0	0.0
Lactic acid carcass spray	0.0	71.4	35.0	0.0
Lactic acid head and offal spray	0.0	0.0	5.0	0.0
Product temperature	0.0	14.3	10.0	0.0
Steam pasteurization	0.0	14.3	5.0	0.0
Specified risk materials	0.0	0.0	5.0	0.0
Surface temperature	0.0	14.3	5.0	0.0
Variety meet chilling	0.0	14.3	5.0	0.0
Zero tolerance carcass trimming	100.0	100.0	80.0	100.0
Zero tolerance head and offal trimming	50.0	57.1	5.0	0.0

3.2. 2. Fabrication

Fabrication plants were asked what processes were being used as carcasses as carcasses entered fabrication and during the fabrication process. Table 8 reveals the antimicrobials that were sprayed on carcasses as they entered the fabrication floor. For the large plants (*n*=11), lactic acid spray was the most often used antimicrobial (45.5%). Small plants (*n*=59) most often used antimicrobial that was applied as it entered the fabrication floor was peroxyacetic acid (71.2%). Of the very small plants (*n*=134), the most often used antimicrobial that was applied as it entered the fabrication floor was lactic acid (11.9%). Plants of unknown size (*n*=6) most often used antimicrobials that were applied as it entered the fabrication flour were acetic acid and peroxyactic acid both used by 16.7% of the unknown plants.

Table 8. Frequency of responses (%) by plant size for antimicrobials that were sprayed on carcasses as they entered the fabrication floor from the survey

	Plant Size			
	Large (*n*=11)	Small (*n*=59)	Very Small (n=134)	Unknown (*n*=6)
Lactic acid spray	45.5	13.6	11.9	0.0
Acidified sodium chlorite spray	0.0	18.6	5.2	0.0
Acetic acid spray	0.0	3.4	3.7	16.7
Peroxyacetic acid spray	27.3	71.2	1.5	16.7
Other antimicrobial spray (not listed above)	0.0	0.0	0.8	0.0

Plants that fabricated carcasses were asked in telephone interviews if they applied antimicrobial interventions to carcasses as they enter fabrication. None of the large plants, 72.3% of the small plants, 9.1% of the very small plants stated that they applied antimicrobial interventions to carcasses as they entered fabrication. Table 9 contains the percent of plants that applied antimicrobials to carcasses as they entered fabrication from the telephone interviews acidified sodium chlorite, lactic acid, peroacetic acid, and Sanova® were all used by plants that responded to the telephone interviews. Lactic acid was the most often used antimicrobial intervention used by large plants (*n*=1), small plants (*n*=11), and very small plants, 100%, 36.4%, and 13.6%, respectively.

Table 9. Frequency of responses (%) by plant size for, "What antimicrobial intervention is applied to the carcass as it enters fabrication?" from the telephone interviews

	Plant Size			
	Large (*n*=1)	Small (*n*=11)	Very Small (*n*=22)	Unknown (*n*=0)
Acidified sodium chlorite	0	18.2	0	0
Lactic acid	100.0	36.4	13.6	0
Peracetic acid	0	9.1	0	0
Sanova®	0	9.1	0	0

Fabrication plants were asked if they trimmed primals and subprimals as well as if they applied an antimicrobial intervention prior to vacuum packaging products which are shown in Table 10. The majority of large small and very small plants used trimming of primals and subprimals. Only 45.5% of the large plants, 11.9% of the small plants and 0.8% of very small plants used antimicrobial interventions prior to vacuum packaging.

Table 10. Frequency of responses (%) by plant size for trimming of primals and subprimals as well as application of antimicrobial intervention prior to vacuum packaging products for fabrication from the survey

	Plant Size			
	Large (*n*=11)	Small (*n*=59)	Very Small (n=134)	Unknown (*n*=6)
Trimming	72.7	54.2	63.4	33.3
Antimicrobial prior to vacuum packaging	45.5	11.9	0.8	0.0

Plants that fabricated carcasses were asked in telephone interviews if they applied an antimicrobial intervention to primal and subprimal cuts prior to prior to packaging. Twenty-seven and three-tenths percent of small plants and 4.5% of very small plants stated that they applied antimicrobial intervention to primal and sub primal cuts prior to packaging. Fabrication plants that did apply antimicrobial interventions to primal and subprimal cuts prior to packaging were then asked what specific antimicrobial intervention was applied these are displayed in Table 11. Of the small plants 9.1% used acidified sodium chlorite, lactic acid or peroacetic acid, and 4.5% of the very small plants used lactic acid as an antimicrobial applied to primal and subprimal cuts prior to packaging.

Table 11. Frequency of responses (%) by plant size from telephone interviews for, "What antimicrobial intervention is applied to primal and subprimal cuts prior to packaging?"

	Plant Size			
	Large (*n*=1)	Small (*n*=11)	Very Small (*n*=22)	Unknown (*n*=0)
Acidified sodium chlorite	0	9.1	0	0
Lactic acid	0	9.1	4.5	0
Peracetic acid	0	9.1	0	0

Fabrication plants were asked if they continuously or periodically sanitized their conveyer belts (Table 12). Of the large plants, 45.5% used continuous belt sanitizing, which was the largest portion of plants to use continuous belt sanitizing. Within the small plants, 13.6% of them used periodic belt sanitizing. Less than 10% of the large, and the very small plants used periodic conveyer belt sanitizing.

Table 12. Frequency of responses (%) by plant size for fabrication plants that continuously or periodically sanitized their conveyer belts from the survey

	Plant Size			
	Large (*n*=11)	Small (*n*=59)	Very Small (n=134)	Unknown (*n*=6)
Continuous belt sanitizing	45.5	15.3	2.2	0.0
Periodic belt sanitizing	9.1	13.6	2.2	0.0

Fabrication plants stated in the telephone interviews that they either had no, one or two critical control points in their HACCP plan. Table 13 displays that the majority of fabrication plants used one or two critical control points.

Table 13. Frequency of responses (%) by plant size for number of CCPs for fabrication plants from the telephone interviews

	Plant Size			
	Large (*n*=1)	Small (*n*=11)	Very Small (n=22)	Unknown (*n*=0)
Zero CCP	0.0	9.1	0.0	0.0
One CCP	0.0	81.8	90.9	0.0
TwoCCPs	100.0	9.1	9.1	0.0

When it came to the critical control points used by fabrication plants, most plants stated temperature, whether or not it was combo temperature, cooler temperature, or product temperature is used as their critical control point (Table 14).

Table 14. Frequency of responses (%) by plant size for fabrication CCPs from telephone interviews

	Plant Size			
	Large (*n*=1)	Small (*n*=11)	Very Small (*n*=22)	Unknown (*n*=0)
Combo temperature	100.0	0.0	0.0	0.0
Cooler temperature	100.0	63.6	86.4	0.0
Lactic acid	0.0	9.1	13.6	0.0
Product temperature	0.0	18.2	13.6	0.0
Identification and segregation of product that tested positive for *E. coli* O157:H7	0.0	0.0	4.5	0.0
Unknown	0.0	9.1	0.0	0.0

3.2. 3. Intact steaks and roasts

Plants that produced intact steaks and roasts used antimicrobials applied to products prior to use and trimming in their processes (Table 15). Fifty percent of large plants (*n*=2) used both during their process. Small plants (*n*=78) and very small plants (*n*=183) applied antimicrobial interventions, 16.7% and 17.5%. respectively, prior to products being used. Trimming was used by (30.8%) of the small plants, and (44.8%) of the very small plants.

Table 15. Frequency of responses (%) by plant size for antimicrobial intervention applied to products and trimming of external surface prior to being used to produce intact steaks and roasts from the survey

	Plant Size			
	Large (*n*=2)	Small (*n*=78)	Very Small (*n*=183)	Unknown (*n*=4)
Antimicrobial prior to use	50.0	16.7	17.5	0.0
Trimming	50.0	30.8	44.8	25.0

Continuous and periodic belt sanitizing was not used often by plants that produced intact steaks and roasts which are examined in Table 16. Only 9% of small plants producing intact steaks and roasts used periodic conveyer belt sanitizing, which was the most that plants of all the sizes used continuous or periodic conveyer belt sanitizing.

Table 16. Frequency of responses (%) by plant size for production of intact steaks and roasts that continuously or periodically sanitized their conveyer belts from the survey

	Plant Size			
	Large (*n*=2)	Small (*n*=78)	Very Small (*n*=183)	Unknown (*n*=4)
Continuous belt sanitizing	0.0	2.6	1.6	0.0
Periodic belt sanitizing	0.0	9.0	5.5	0.0

3.2. 4. Marinated/enhanced steaks and roasts

Plants that produced marinated/enhanced steaks and roasts used partial or complete trimming of the external surface prior to use as a process in their operations as displayed in Table 17. Sixty six and seven-tenths percent of the large plants, (28.3%) of the small plants, and (37.1%) of the very small plants used partial trimming of external surface of in their plants. Complete trimming was used by 15.2% of small plants, and 17.1 of very small plants.

Table 17. Frequency of responses (%) by plant size for plants that produced marinated/enhanced steaks and roasts that partially or completely trim the external surface prior to being used from the survey

	Plant Size		
	Large (*n*=3)	Small (*n*=46)	Very Small (*n*=35)
Partial trim	66.7	28.3	37.1
Complete trim	0.0	15.2	17.1

Table 18 exhibits the plants that produced marinated/enhanced steaks and roasts that continuously or periodically sanitized their conveyer belts. Continuous belt sanitizing was used by 33.3% of large plants, and 6.5% of small plants. Periodic belt sanitizing was used by 33.3% of large plants, and 4.4% of very small plants.

Table 18. Frequency of responses (%) by plant size for plants that produced marinated/enhanced steaks and roasts that continuously or periodically sanitized their conveyer belts from the survey

	Plant Size		
	Large (*n*=3)	Small (*n*=46)	Very Small (*n*=35)
Continuous belt sanitizing	33.3	6.5	0.0
Periodic belt sanitizing	33.3	4.4	0.0

When asked in the telephone interviews how many CCPs they had marinated/enhanced plants used zero, one or two CCPs in their plant (Table 19). The large plant had two CCPs, 27.3% of the small plants (*n*=11), had zero CCPs, 63.6% had one CCP, and 9.1% had two CCPs. Within the very small plants, 22.2% had zero CCPs, 55.6% had one CCP, and 22.2% had two CCPs.

Table19. Frequency of responses from marinated/enhanced steaks and roasts plants (%) by plant size for the number of CCPs from the telephone interview

	Plant Size		
	Large (*n*=1)	Small (*n*=11)	Very Small (*n*=9)
Zero CCP	0.0	27.3	22.2
One CCP	0.0	63.6	55.6
Two CCPs	100.0	9.1	22.2

The CCP that plants that produced marinated/enhanced steaks and roasts used most often was cooler temperature. The large plant also used identification and segregation of product that tested positive for *E. coli* O157:H7 (Table 20).

Table 20. Frequency of responses (%) by plant size for plants that produced marinated/enhanced steaks and roasts for CCPs from telephone interviews

	Plant Size			
	Large (*n*=1)	Small (*n*=8)	Very Small (*n*=4)	Unknown (*n*=0)
Cooler temperature	100.0	62.5	75.0	0.0
Product temperature	0.0	12.5	25.0	0.0
Package temperature	0.0	12.5	0.0	0.0
Identification and Segregation of Product that tested positive for *E. coli* O157:H7	100.0	0.0	0.0	0.0

Plants that produced marinated/enhanced steaks and roasts used antimicrobial interventions prior to trimming and post trimming which are revealed in Table 21. Antimicrobial interventions applied prior to trimming were used by 66.7% of the large plants, 15.2% of the small plants, and 34.3% of the very small plants. Antimicrobial interventions applied after trimming were used 66.7% of the large plants, 4.4% of the small plants, and 11.4% of the very small plants.

Table 21. Frequency of responses (%) by plant size for plants that produced marinated/enhanced steaks and roasts that applied antimicrobial interventions prior to trimming or after trimming, but prior to non-intact processing

	Plant Size		
	Large (*n*=3)	Small (*n*=46)	Very Small (*n*=35)
Antimicrobial applied prior to trimming	66.7	15.2	34.3
Antimicrobial applied post trimming	66.7	4.4	11.4

Plants that responded to the telephone interview that produced marinated/enhanced steaks and roasts stated that they used antimicrobial intervention for primal and subprimal cuts. The large plant applied an antimicrobial intervention to primal and subprimal cuts prior to enhancement. Twenty-five percent of small plants (*n*=8), and very small plants (*n*=4) applied an antimicrobial intervention to primal and subprimal cuts prior to marination/enhancement.

After plants were asked if they applied antimicrobials intervention to primal and subprimal cuts in the telephone interview, plants asked what they applied (Table 22). The antimicrobial that was commonly used by all plant sizes was lactic acid.

Table 22. Frequency of responses (%) by plant size for, "What antimicrobial intervention is being applied to the primal and subprimal cuts prior to enhancement or marination?"

	Plant Size			
	Large (*n*=1)	Small (*n*=8)	Very Small (*n*=4)	Unknown (*n*=0)
Lactic acid	100.0	12.5	25.0	0.0
Inspexx™ 200	0.0	12.5	0.0	0.0

3.2. 5. Needle/blade tenderized steaks and roasts

Plants that produced needle/blade tenderized steaks and roasts used partial or completely trimmed external surface prior to being used (Table 23). All of the large plants (*n*=2) and the plants of unknown size (*n*=1) used partial trimming, 24.1% of the small plants (*n*=54), and 26.1% of the very small plants (*n*=88) used partial trimming. Small plants (18.5%) and very small plants(22.7%) used complete trimming of the external surface prior to products being used for needle/blade tenderized steaks and roasts.

Table 23. Frequency of responses (%) by plant size for plants that produced needle/blade tenderized steaks and roasts that partially or completely trim the external surface prior to being used

	Plant Size			
	Large (*n*=2)	Small (*n*=54)	Very Small (*n*=88)	Unknown (*n*=1)
Partial trim	100.0	24.1	26.1	100.0
Complete trim	0.0	18.5	22.7	0.0

Few plants that produced needle/blade tenderized steaks and roasts used continuous or periodically conveyer belt sanitization (Table 24). Less than 4% of the small plants and 1.1% of very small plants used continuous conveyer belt sanitizing. Periodic belt sanitizing was used more frequently by (7.4%) of small plants, and (5.7%) of very small plants.

Table 24. Frequency of responses (%) by plant size for plants that produced needle/blade tenderized steaks and roasts that continuously or periodically sanitized their conveyer belts

	Plant Size			
	Large (*n*=2)	Small (*n*=54)	Very Small (*n*=88)	Unknown (*n*=1)
Continuous belt sanitizing	0.0	3.7	1.1	0.0
Periodic belt sanitizing	0.0	7.4	5.7	0.0

Majority of plants that produced marinated/enhanced steaks and roasts stated that they had one CCP (Table 25). Twelve and a half percent of the small plants had no CCPs. Twelve and a half percent of the small plants had two CCPs, and 25% of the very small plants had two CCPs.

Table 25. Frequency of responses from needle/blade tenderized plants (%) by plant size for the number of CCPs from the telephone interviews

	Plant Size		
	Large (*n*=1)	Small (*n*=11)	Very Small (*n*=9)
Zero CCP	0.0	12.5	0.0
One CCP	100.0	75.0	75.0
Two CCPs	0.0	12.5	25.0

Regardless of plant size the most frequently used CCP for plants that produced needle/blade tenderized steaks and roasts was cooler temperature from the telephone interview which can be observed in Table 26. The large plant also used identification and segregation of products that test positive for *E. coli* O157:H7.

Table 26. Frequency of responses (%) by plant size for CCPs used for needle/blade tenderized steaks and roasts from telephone interviews

	Plant Size		
	Large (*n*=1)	Small (*n*=11)	Very Small (*n*=9)
Cooler temperature	100.0	54.5	55.6
Product temperature	0.0	9.1	22.2
Package temperature	0.0	9.1	11.1
Lactic acid spray	0.0	9.1	11.1
Identification and segregation of products that test positive for *E. coli* O157:H7	100.0	0.0	0.0

Some plants that produced needle/blade steaks and roasts applied antimicrobial interventions prior to trimming and or they used antimicrobial post trimming in (Table 27).One hundred percent of the large plants, 24.1% of small plants, and 23.9% of very small plants used antimicrobial that were applied prior to trimming. Both of the large plants applied antimicrobial post trimming, and 6.8% of very small plants did so as well.

Table 27. Frequency of responses (%) by plant size for plants that produced needle/blade tenderized steaks and roasts that applied antimicrobial interventions prior to trimming or after trimming, but prior to non-intact processing

	Plant Size			
	Large (*n*=2)	Small (*n*=54)	Very Small (*n*=88)	Unknown (*n*=1)
Antimicrobial applied prior to trimming	100.0	24.1	23.9	0.0
Antimicrobial applied post trimming	100.0	0.0	6.8	0.0

Antimicrobial interventions applied to primal and subprimal cuts prior to needle /blade tenderization was used by 36.4% of the small plants and 11.1% of the very small plants that responded to the telephone interview. Lactic acid was the antimicrobial in common between these two plant sizes as displayed in Table 28.

Table 28. Frequency of responses (%) by plant size for antimicrobial interventions applied to primal and subprimal cuts prior to needle/blade tenderization from the telephone interview

	Plant Size			
	Large (*n*=1)	Small (*n*=11)	Very Small (*n*=9)	Unknown (*n*=0)
Acidified sodium chlorite	0.0	9.1	0.0	0.0
Lactic acid	0.0	18.2	11.1	0.0
Inspexx™ 200	0.0	9.1	0.0	0.0

3.2. 6. Ground beef

Ground beef operations most often used one CCP (Table 29). Of the small plants (*n*=11), and the very small plants (*n*=20), 90.9%, and 75%, respectively used one CCP.

Table 29. Frequency of responses (%) by plant size for the number of CCPs from the telephone interviews for ground beef plants

	Plant Size		
	Large (*n*=0)	Small (*n*=11)	Very Small (*n*=20)
Zero CCP	0.0	9.1	5.0
One CCP	0.0	90.9	75.0
Two CCPs	0.0	0.0	20.0

Ground beef operation that responded to the telephone interview most often listed CCP was cooler temperature. Seventy two and seven-tenths percent the small plants, and (80%) of the very small ground beef operations listed cooler temperature as their CCP that they used. Table 30 displays the various critical control points used by ground beef operations.

Table 30. Frequency of responses (%) by plant size for ground beef CCPs from the telephone interviews

	Plant Size		
	Large (*n*=1)	Small (*n*=11)	Very Small (*n*=9)
Cooler temperature	0.0	72.7	80.0
Product temperature	0.0	9.1	10.0
Package temperature	0.0	9.1	10.0
Antimicrobial spray	0.0	0.0	10.0
Product temperature out of the grinder	0.0	0.0	10.0

Ground beef operations were asked in the survey if they applied and antimicrobial agent prior to grinding of trim or during the grinding process as seen in Table 31. Large plants (*n*=7), small plants (*n*=96), and very small plants (*n*=211) added antimicrobial agents prior to grinding, (28.6%), (16.7%), and (0.4%) respectively. Antimicrobial agents were applied during grinding for 14.3% of the large plants, 3.1% of the small plants, and 2.4% of the very small plants.

Table 31. Frequency of responses (%) by plant size for plant that produced raw ground beef that responded that they applied an antimicrobial agent prior to grinding trim or during grinding of trim

	Plant Size			
	Large (*n*=7)	Small (*n*=96)	Very Small (*n*=211)	Unknown (*n*=2)
Prior to grinding	28.6	16.7	0.4	0
During grinding	14.3	3.1	2.4	0

Ground beef operations were asked during the telephone interview if they applied an antimicrobial intervention to trimmings prior to grinding or during the grinding process. Twenty seven and three-tenths percent of the small plants (*n*=11) and 10.0% of very small plants (*n*=20) responded that they applied an antimicrobial intervention to trimmings prior to or during the grinding process.

The plants that applied an antimicrobial intervention from the telephone interview stated that 27.3% of small plants, and 10% of very small plants used lactic acid prior to or during the grinding process.

3.3 Supplier purchasing specifications

Supplier specifications are used by plants that purchase products from other plants that they will further process. These purchasing specifications simply state that the establishment selling the product to the further processor has at least one CCP that has been validated to control, reduce or eliminated *E. coli* O157:H7 to levels below detection. Table 32 displays the number of further processing plants that used purchasing specification in their operation. The majority of the small and very small plants that were producing intact steaks and roasts, marinated/enhanced steaks and roasts, and needle/ blade tenderized steaks and roasts used purchasing specifications related to *E. coli*

O157:H7. Thirteen percent of the small plants that produced marinated/enhanced steaks and roasts as well as needle/blade tenderized steaks and roasts only purchased primals and subprimals that had tested negative for *E. coli* O157:H7.Very small plants used only primals and subprimals that had been tested negative for *E. coli* O157:H7 used them to make marinated/enhanced, and needle/blade tenderized steaks and roasts in (17.1%) of very small plants. Large plants used supplier purchase specification related to *E. coli* O157:H7 by a majority of plants that produced marinated/enhanced steaks and roasts. The one unknown plant that produced needle/blade tenderized steaks and roasts used supplier purchase specifications related to *E. coli* O157:H7.

Table 32. Frequency of responses (%) by plant size for plants that used supplier purchasing specifications and those that purchased only primals and subprimals that have been tested negative for *E. coli* O157:H7

	Plant Size							
	Large		Small		Very Small		Unknown	
	(*n*)	%	(*n*)	%	(*n*)	%	(*n*)	%
Intact steaks and roasts	2		78		183		4	
Supplier purchase specification related to *E. coli* O157:H7		50.0		87.2		71.0		50.0
Marinated/enhanced steaks and roasts	3		46		35		0	
Supplier purchase specification related to *E. coli* O157:H7		66.7		89.1		80.0		0.0
Purchase only primals and subprimals that have been tested negative for *E. coli* O157:H7		33.3		13.0		17.1		0.0
Needle/blade tenderized steaks and roasts	2		54		88		1	
Supplier purchase specification related to *E. coli* O157:H7		50.0		90.7		73.9		100.0
Purchase only primals and subprimals that have been tested negative for *E. coli* O157:H7		0.0		13.0		17.1		0.0

3.4 7. E. coli *O157:H7 testing*

Table 33 reveals plants that were testing primals and subprimals for *E. coli* O157:H7 and plants that were testing trim for *E. coli* O157:H7 from the survey. Fifty percent of the large plants, 37.2% of the small plant, 19.1% of the very small plants and 25% of plants of unknown size that were producing intact steaks and roast were testing primals and subprimals. Forty-eight and seven-tenths percent of the small plants, 43.2% of the very small plants, and 50% of plants of unknown size plants that produced intact steaks and roasts were testing trim for *E. coli* O157:H7. Thirty and four-tenths percent of the small plants and 22.9% of the very small plants producing marinated/enhanced steaks and roasts tested primal and subprimals for *E. coli* O157:H7. Thirty-three and three-tenths percent of the large plants, 39.1% of the small plants, and 28.6% of the very small plants producing marinated/enhanced steaks and roasts were testing trim for *E. coli* O157:H7. Thirty-eight and nine-tenths percent of the small plants and 21.6% of the very small plants that produced needle/blade tenderized steaks and roasts were testing primals and subprimals for *E. coli* O157:H7. Fifty percent of large plants, 37.0% of the small plants, 37.5% of the very small plants, and the one plant of unknown size that produced intact steaks and roasts tested trim for *E. coli* O157:H7.

Table 33. Frequency of responses (%) by plant size for plants that test primals and subprimals for *E. coli* O157:H7 as well as those that tested trim for *E. coli* O157:H7 from the survey

	Plant Size							
	Large		Small		Very Small		Unknown	
	(*n*)	%	(*n*)	%	(*n*)	%	(*n*)	%
Intact steaks and roasts	2		78		183		4	
Testing of primals and subprimals for *E. coli* O157:H7		50.0		37.2		19.1		25.0
Testing trim for *E. coli* O157:H7		0.0		48.7		43.2		50.0
Marinated/enhanced steaks and roasts	3		46		35		0	
Testing of primals and subprimals for *E. coli* O157:H7		0.0		30.4		22.9		0.0
Testing trim for *E. coli* O157:H7		33.3		39.1		28.6		0.0
Needle/blade tenderized steaks and roasts	2		54		88		1	
Testing of primals and subprimals for *E. coli* O157:H7		0.0		38.9		21.6		0.0
Testing trim for *E. coli* O157:H7		50.0		37.0		37.5		100.0

Figure 3 displays the frequency (%) for slaughter plants that tested for *E. coli* O157:H7. Thirty percent of the large plants, 36.4% of the small plants, 57.8% of the very small plants, and 50% of the plants of unknown size slaughter plants tested beef carcasses for *E. coli* O157:H7.

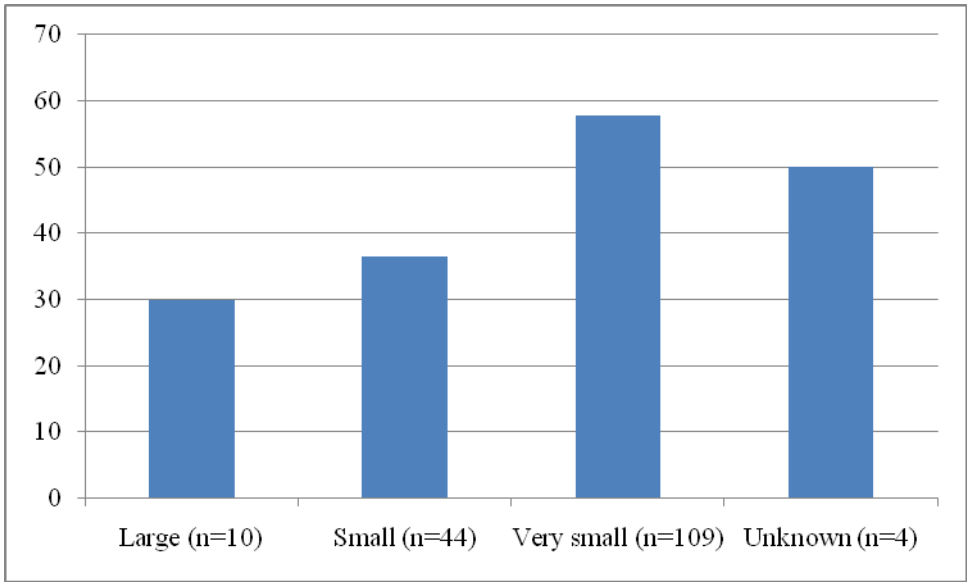

Figure 3. Slaughter plants that test beef carcasses for *E. coli* O157:H7

Figure 4 examines ground beef plants that included 'bench trim' or trim from the plants cutting operation in the production of ground beef. Furthermore, if the plant included 'bench trim' or trim from the plants cutting operation was this trim tested for *E. coli* O157:H7 before it was ground. Of the large plants, 42.9% included their 'bench trim' or trim from their operation in their production of ground beef (100%) tested it prior to grinding. Of the 38.5% of small plants that included their 'bench trim' or trim from their operation in their production of ground beef, 48.6% tested it prior to grinding. Of the 60.2% of very small plants that included their 'bench trim' or trim from their operation in their production of ground beef, 28.3% tested it prior to grinding.

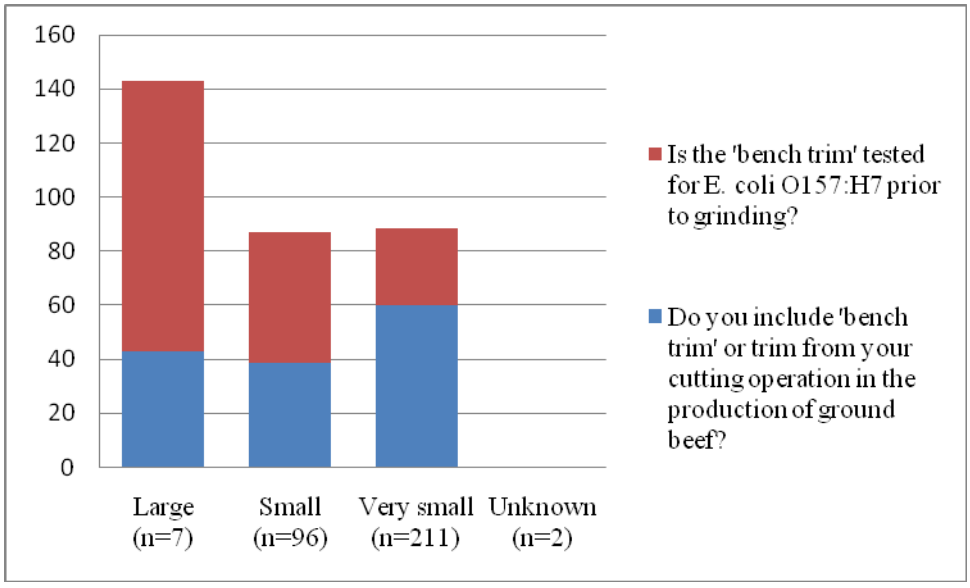

Figure 4. Do you include 'bench trim' or trim from your cutting operation in the production of ground beef and if they did is the 'bench trim' tested for *E. coli* O157:H7?

Figure 5 displays how many ground beef plants purchase beef trim that has been tested for *E. coli* O157:H7 and how many ground beef plants conduct finished product testing for *E. coli* O157:H7. Seventy-one and four-tenths percent of the large plants, 75% of the small plants, 47.9% of the very small plants and 50% of the plants of unknown size purchased beef trim that was tested for *E. coli* O157:H7. Twenty-eight and six-tenths percent of the large plants, 75% of the small plants, 70.1% of the very small plants, and 100% of the plants of unknown size conduct finished product testing for *E. coli* O157:H7.

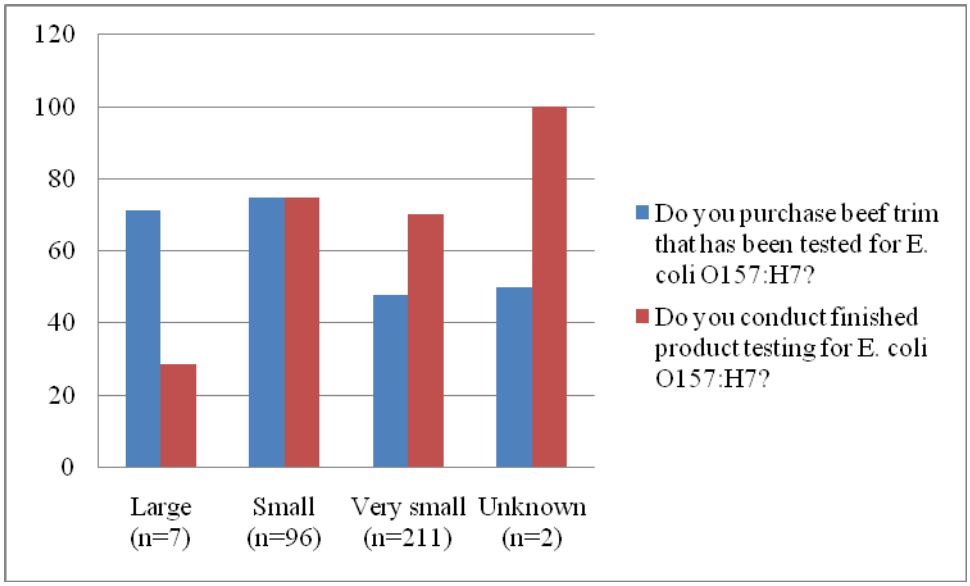

Figure 5. Ground beef testing questions

Table 34 examines the frequency of responses (%) for plant testing for *E. coli* O157:H7 from the telephone interviews. For slaughter operations, 100.0% of the large plants (*n*=2), 100.0% of the small plants (*n*=7), 90.0% of the very small *n*=20 and 100.0% of the unknown plant size (*n*=1) were testing for *E. coli* O157:H7. Among fabrication operations 100.0% of the large plants (*n*=2), 100.0% of the small plants (*n*=12), and 86.4% of the very small plants (*n*=22) were testing for *E. coli* O157:H7. For ground beef operations 100.0% of the large plants (*n*=1), 81.8% of the small plants (*n*=11), and 90.5% of the very small (*n*=21) were testing for *E. coli* O157:H7. Across non-intact, needle/blade tenderized or needle injected operations, 100.0% of the large plants (*n*=2), 70.0% of the small plants (*n*=10), 88.9% of the very small (*n*=9) were testing for *E. coli* O157:H7. Of non-intact, enhanced/marinated operations, 100.0% of

the large plants (*n*=1), 71.4% of the small plants (*n*=7), and 45.0% of the very small (*n*=4) were testing for *E. coli* O157:H7.

Table 34. Frequency of responses (%) by plant size for plants testing for *E. coli* O157:H7 from the telephone interviews

	Plant Size							
	Large		Small		Very Small		Unknown	
	(*n*)	%	(*n*)	%	(*n*)	%	(*n*)	%
Slaughter	2	100.0	7	100.0	20	90.0	1	100.0
Fabrication	2	100.0	12	100.0	22	86.4	0	0.0
Grinding	1	100.0	11	81.8	21	90.5	0	0.0
Non-intact; needle/blade tenderized or needle injected products:	2	100.0	10	70.0	9	88.9	0	0.0
Non-intact; enhanced/ marinated products	1	100.0	7	71.4	4	75.0	0	0.0

The frequency of responses (%) for products being tested for *E. coli* O157:H7 can be seen in Table 35. For slaughter operations the most frequently tested products by large plants (*n*=2) were trim (50.0%) and final products (50.0%), 85.7% of small (*n*=7) plants tested trim, 50.0% of very small plants (n=20) conducted carcass testing, and for

the unknown plant size (*n*=1) carcass testing was 100.0%. The most frequently tested products in fabrication were represented by 50.0% of large plants (*n*=2) testing trim and 50.0% final products, 75.0% of small plants (*n*=12) testing trim, and 50.0% of very small plants (*n*=20) tested ground beef. Ground beef operations most frequently tested products were 100.0% of large plants (*n*=1) tested ground beef, 55.5% of small (*n*=9) plants tested trim, and 47.4% of very small plants (*n*=19) tested ground beef testing. Non-intact, needle/blade tenderized or needle injected operations most frequently tested products were, 50.0% of large plants (*n*=2) were testing trim, ground beef and products to be tenderized, 57.1% of small (*n*=7) plants testing trim, and 37.5% of very small plants (*n*=8) testing carcasses and final products. Non-intact, enhanced/marinated operations most frequently tested products were, 100.0% of large plants (*n*=1) tested primals, 40.0% of small (*n*=5) plants testing primal, and 66.7% of very small plants (*n*=3) testing final products.

Table 35. Frequency of responses (%) by plant size for products being tested for *E. coli* O157:H7 from telephone interviews

	Plant Size			
	Large	Small	Very Small	Unknown
Slaughter (n)	*(2)*	*(7)*	*(20)*	*(1)*
Bench trim	0.0	0.0	0.0	0.0
Carcass testing	0.0	14.3	50.0	100.0
Incoming raw material	0.0	0.0	0.0	0.0
Primal testing	0.0	14.3	5.0	0.0
Trim testing	50.0	85.7	35.0	0.0
Ground beef	0.0	0.0	45.0	0.0
Product to be tenderized	0.0	0.0	5.0	0.0
Final products	50.0	0.0	5.0	0.0
Fabrication (n)	*(2)*	*(12)*	*(19)*	*(0)*
Bench trim	0.0	0.0	0.0	0.0
Carcass testing	0.0	8.3	52.6	0.0
Incoming raw material	0.0	0.0	0.0	0.0
Primal testing	0.0	8.3	5.3	0.0
Trim testing	50.0	75.0	36.8	0.0
Ground beef	0.0	16.7	47.4	0.0
Product to be tenderized	0.0	8.3	5.3	0.0
Final products	50.0	0.0	10.5	0.0
Grinding (n)	*(1)*	*(9)*	*(19)*	*(0)*
Bench trim	0.0	0.0	5.3	0.0
Carcass testing	0.0	0.0	47.4	0.0
Incoming raw material	0.0	11.1	5.3	0.0
Primal testing	0.0	11.1	5.3	0.0
Trim testing	0.0	55.5	31.6	0.0
Ground beef	100.0	22.2	47.4	0.0
Product to be tenderized	0.0	0.0	0.0	0.0
Final products	0.0	11.1	15.8	0.0
Non-intact; needle/blade tenderized or needle injected products (n)	*(2)*	*(7)*	*(8)*	*(0)*
Bench trim	0.0	0.0	12.5	0.0
Carcass testing	0.0	0.0	37.5	0.0
Incoming raw material	0.0	14.3	0.0	0.0
Primal testing	0.0	14.3	0.0	0.0
Trim testing	50.0	57.1	12.5	0.0
Ground beef	50.0	14.3	25.0	0.0
Product to be tenderized	50.0	14.3	12.5	0.0
Final products	0.0	14.3	37.5	0.0

Table 35. Continued

	Plant Size			
	Large	Small	Very Small	Unknown
Non-intact; enhanced/ marinated products (n)	*(1)*	*(5)*	*(3)*	*(0)*
Bench trim	0.0	0	33.3	0.0
Carcass testing	0.0	20.0	0.0	0.0
Incoming raw material	0.0	20.0	0.0	0.0
Primal testing	100.0	40.0	33.3	0.0
Trim testing	0.0	20.0	0.0	0.0
Ground beef	0.0	0.0	0.0	0.0
Product to be tenderized	0.0	20.0	0.0	0.0
Final products	0.0	20.0	66.7	0.0

Table 36 represents the frequency of responses (%) for the question, "How frequently do you test for *E. coli* O157:H7?" The most common responses for slaughter operations were, 50.0% of large plants (*n*=2) tested products by the lot, 50.0% tested products weekly, 57.1% of small plants (*n*=7) tested products by the lot, 38.9% of very

small plants (*n*=18) tested products quarterly, and 100.0% of plants of unknown size plant (*n*=1) tested products biannually. Fabrication operations tested products most frequently by these processes; 50.0% of large plants (*n*=2) tested products by the lot and 50.0% tested products weekly, 50.0% of small plants (*n*=12) tested products by lot and 42.1% of very small plants (*n*=19) tested products quarterly for *E. coli*.O157:H7. Ground beef operations responded most frequently that they tested products, 100.0% of large plants (*n*=1) tested products quarterly, 44.4% of small plants (n=9) tested products by the lot, and 36.8% very small plants (*n*=19) were tested products monthly or quarterly. Non-intact, needle/blade tenderized or needle injected operations tested products most frequently by, 50.0% of large plants (*n*=2) tested products by the lot and 50.0% quarterly, 57.1% of small plants (*n*=7) tested products by the lot, and 62.5% of very small plants (*n*=8) were testing quarterly. Non-intact, enhanced /marinated operations were tested most frequently by, 100.0% of large plants (*n*=1) tested products by lot, 60.0% of small plants (*n*=5) tested products by the lot, and 66.6% of very small plants (*n*=3) tested products monthly.

Table 36. Frequency of responses (%) by plant size for, "How frequently do you test for *E. coli* O157:H7?"

	Plant Size			
	Large	Small	Very Small	Unknown
Slaughter (n)	*(2)*	*(7)*	*(18)*	*(1)*
By lot	50.0	57.1	11.1	0.0
Daily	0.0	14.3	0.0	0.0
Weekly	50.0	14.3	0.0	0.0
Biweekly	0.0	14.3	0.0	0.0
Monthly	0.0	0.0	33.3	0.0
Bimonthly	0.0	0.0	5.6	0.0
Quarterly	0.0	0.0	38.9	0.0
Biannually	0.0	0.0	5.6	100.0
Annually	0.0	0.0	0.0	0.0
Every 300 carcasses	0.0	0.0	5.6	0.0
Fabrication(n)	*(2)*	*(12)*	*(19)*	*(0)*
By lot	50.0	50.0	10.5	0.0
Daily	0.0	8.3	0.0	0.0
Weekly	50.0	8.3	0.0	0.0
Biweekly	0.0	16.7	0.0	0.0
Monthly	0.0	8.3	36.8	0.0
Bimonthly	0.0	0.0	5.3	0.0
Quarterly	0.0	8.3	42.1	0.0
Biannually	0.0	0.0	5.3	0.0
Annually	0.0	0.0	0.0	0.0
Every 300 carcasses	0.0	0.0	0.0	0.0
Grinding (n)	*(1)*	*(9)*	*(19)*	*(0)*
By lot	0.0	44.4	10.5	0.0
Daily	0.0	11.1	0.0	0.0
Weekly	0.0	11.1	0.0	0.0
Biweekly	0.0	11.1	0.0	0.0
Monthly	0.0	11.1	36.8	0.0
Bimonthly	0.0	0.0	5.3	0.0
Quarterly	100.0	11.1	36.8	0.0
Biannually	0.0	0.0	10.5	0.0
Annually	0.0	0.0	0.0	0.0
Every 300 carcasses	0.0	0.0	0.0	0.0
Non-intact; needle/blade tenderized or needle injected products (n)	*(2)*	*(7)*	*(8)*	*(0)*
By lot	50.0	57.1	12.5	0.0
Daily	0.0	14.3	0.0	0.0
Weekly	0.0	14.3	0.0	0.0
Biweekly	0.0	0.0	0.0	0.0
Monthly	0.0	14.3	25.0	0.0
Bimonthly	0.0	0.0	0.0	0.0
Quarterly	50.0	0.0	62.5	0.0
Biannually	0.0	0.0	0.0	0.0
Annually	0.0	0.0	0.0	0.0
Every 300 carcasses	0.0	0.0	0.0	0.0

Table 36. Continued

	Plant Size			
	Large	Small	Very Small	Unknown
Non-intact; enhanced/ marinated products (n)	*(1)*	*(5)*	*(3)*	*(0)*
By lot	100.0	60.0	33.3	0.0
Daily	0.0	0.0	0.0	0.0
Weekly	0.0	0.0	0.0	0.0
Biweekly	0.0	20.0	0.0	0.0
Monthly	0.0	20.0	66.7	0.0
Bimonthly	0.0	0.0	0.0	0.0
Quarterly	0.0	0.0	0.0	0.0
Biannually	0.0	0.0	0.0	0.0
Annually	0.0	0.0	0.0	0.0
Every 300	0.0	0.0	0.0	0.0

The frequency of responses (%) for the question, "What test method is being used to test for *E. coli* O157:H7?" can be examined in Table 37. The test methods slaughter operations most often employed to test for *E. coli* O157:H7 were, 50.0% of large plants (*n*=2) used IEH multiplex and 50.0% didn't know what they used, 42.9% of small plants (*n*=7) used PCR, 72.2% of very small plants (*n*=18) didn't know what method of testing was used and 100.0% of plants of unknown size (*n*=1) used a robust

test method. Fabrication operations most often responded that 50.0% of large plants (*n*=2) used IEH multiplex and 50.0% didn't know what they used, 42.9%, of small plants (*n*=12) used PCR 42.9%, and 72.2% of very small plants (*n*=19) didn't know what method of testing was used to test for *E. coli* O157:H7. Ground beef operations were testing most often responded that, 100% of large plants (*n*=1) used PCR, 55.6% of small plants (*n*=9) didn't know what method of test was used and 63.2% of very small plants (*n*=19) 63.2% didn't know what method of test was used. Non-intact; needle/blade tenderized or needle injected operations most often responded that, 50.0% of large plants (*n*=2) were using PCR and IEH multiplex, 57.1% of small plants (*n*=7) didn't know what method of test was used and75.0% of very small plants (*n*=8) didn't know what method of test was used. The most often used methods of testing for *E. coli* O157:H7 for plants that produced non-intact; enhanced /marinated operations were, 100.0 % of large plants (*n*=1) used IEH multiplex (100.0 %), 40.0% of small plants used AOAC and 40.0% didn't know method was used, and 33.3% very small plants (*n*=3) used PCR, EIA technology and 33.3% didn't know what test was used.

Table 37. Frequency of responses (%) by plant size for, "What test method is being used to test for *E. coli* O157:H7?"

	Plant Size			
	Large	Small	Very Small	Unknown
Slaughter (n)	*(2)*	*(7)*	*(18)*	*(1)*
AOAC	0.0	0.0	16.7	0.0
GDS™ (DNA)	0.0	14.3	0.0	0.0
PCR	0.0	42.9	11.1	0.0
10 JIM	0.0	14.3	0.0	0.0
IEH multiplex	50.0	0.0	0.0	0.0
Neogen (Reveal®)	0.0	0.0	0.0	0.0
EIA technology	0.0	0.0	0.0	0.0
Robust	0.0	0.0	0.0	100.0
Unknown	50.0	28.6	72.2	0.0
Fabrication (n)	*(2)*	*(12)*	*(19)*	*(0)*
AOAC	0.0	16.7	15.8	0.0
GDS™ (DNA)	0.0	8.3	0.0	0.0
PCR	0.0	25.0	10.5	0.0
10 JIM	0.0	8.3	0.0	0.0
IEH multiplex	50.0	0.0	0.0	0.0
Neogen (Reveal®)	0.0	8.3	0.0	0.0
EIA technology	0.0	0.0	5.3	0.0
Robust	0.0	0.0	0.0	0.0
Unknown	50.0	33.3	68.4	0.0
Grinding (n)	*(1)*	*(9)*	*(19)*	*(0)*
AOAC	0.0	33.3	21.1	0.0
GDS™ (DNA)	0.0	0.0	0.0	0.0
PCR	100.0	0.0	10.5	0.0
10 JIM	0.0	0.0	0.0	0.0
IEH multiplex	0.0	0.0	0.0	0.0
Neogen (Reveal®)	0.0	11.1	0.0	0.0
EIA technology	0.0	0.0	5.3	0.0
Robust	0.0	0.0	0.0	0.0
Unknown	0.0	55.6	63.2	0.0
Non-intact; needle/blade tenderized or needle injected products (n)	*(2)*	*(7)*	*(8)*	*(0)*
AOAC	0.0	28.6	0.0	0.0
GDS™ (DNA)	0.0	0.0	0.0	0.0
PCR	50.0	0.0	12.5	0.0
10 JIM	0.0	0.0	0.0	0.0
IEH multiplex	50.0	0.0	0.0	0.0
Neogen (Reveal®)	0.0	14.3	0.0	0.0
EIA technology	0.0	0.0	12.5	0.0
Robust	0.0	0.0	0.0	0.0
Unknown	0.0	57.1	75.0	0.0

Table 37. Continued

	Plant Size			
	Large	Small	Very Small	Unknown
Non-intact; enhanced/ marinated products (n)	*(1)*	*(5)*	*(3)*	*(0)*
AOAC	0.0	40.0	0.0	0.0
GDS™ (DNA)	0.0	0.0	0.0	0.0
PCR	0.0	0.0	33.3	0.0
10 JIM	0.0	0.0	0.0	0.0
IEH multiplex	100.0	0.0	0.0	0.0
Neogen (Reveal®)	0.0	20.0	0.0	0.0
EIA technology	0.0	0.0	33.3	0.0
Robust	0.0	0.0	0.0	0.0
Unknown	0.0	40.0	33.3	0.0

Table 38 exhibits the frequency of responses (%) for the question, "Are you using an in-house laboratory or sending the samples to an outside laboratory to test for *E. coli* O157:H7?" One hundred percent of large slaughter operations were using outside laboratory, 100.0% of small plants used an outside laboratory, 94.4% of very small plants used outside testing, and 100% of plant of unknown size were used an outside laboratory. One hundred percent of fabrication operations used an outside laboratory, 83.3% of small plants used an outside laboratory, and 94.7% of very small plants outside laboratory. One hundred percent of large plants that produced ground beef used an outside laboratory, 88.9 % of small plants used an outside laboratory and 94.7% of very small plants used an outside laboratory to test samples. One hundred percent of large plants that produced non-intact, needle/blade tenderized or needle injected steaks and roast used an outside laboratory, 100% of small plants used an outside laboratory, and 100.0% of very small plants used outside laboratory to test samples. One hundred percent of large plants that produced non-intact and enhanced/marinated steaks and

roasts used an outside laboratory, 80.0% of small plants used an outside laboratory, and 100% of very small plants used an outside laboratory to test their samples.

Table 38. Frequency of responses (%) by plant size for, "Are you using an in-house laboratory or sending the samples to an outside laboratory to test for *E. coli* O157:H7?"

	Plant Size			
	Large	Small	Very Small	Unknown
Slaughter (n)	*(2)*	*(7)*	*(18)*	*(1)*
In-house laboratory	0.0	28.6	5.6	0.0
Outside laboratory	100.0	100.0	94.4	100.0
Both	0.0	28.6	5.6	0.0
Fabrication (n)	*(2)*	*(12)*	*(19)*	*(0)*
In-house laboratory	0.0	25.0	5.3	0.0
Outside laboratory	100.0	83.3	94.7	0.0
Both	0.0	8.3	5.3	0.0
Grinding (n)	*(1)*	*(9)*	*(19)*	*(0)*
In-house laboratory	0.0	11.1	5.3	0.0
Outside laboratory	0.0	88.9	94.7	0.0
Both	0.0	0.0	0.0	0.0
Non-intact; needle/blade tenderized or needle injected products (n)	*(2)*	*(7)*	*(8)*	*(0)*
In-house laboratory	0.0	0.0	0.0	0.0
Outside laboratory	100.0	100.0	100.0	0.0
Both	0.0	0.0	0.0	0.0
Non-intact; enhanced/ marinated products (n)	*(1)*	*(5)*	*(3)*	*(0)*
In-house laboratory	0.0	20.0	0.0	0.0
Outside laboratory	100.0	80.0	100.0	0.0
Both	0.0	0.0	0.0	0.0

3.4. Onsite interview

Upon completion of plant visits in all of the sectors covered by the survey, it was very apparent that plants had done what was reported in the survey. CCPs in slaughter operations were validated by applying an indicator organism such as *lactobacillus* and were performed annually. It was also concluded that government inspectors were commonly the source for information for plants.

CHAPTER IV

DISCUSSION AND CONCLUSIONS

4.1. Discussion

Plants that produced marinated/enhanced steaks and roasts, needle/blade tenderized steaks and roasts and ground beef responded that *E. coli* O157:H7 was a reasonably likely to occur food safety hazard. This response means that their HACCP plan is not working and that they need to re-access their plan. FSIS states that *E. coli* O157:H7 is an adulterant in these products therefore these plants would need to make ready to eat products in order to destroy *E. coli* O157:H7.

A majority of the plants validated their CCPs. Since some of the plants had not validated their CCPs, some plants may have used CCPs in their plants that did not control, reduce or eliminate microbiological hazards.

The Industry Best Practices were developed to help plants produce the safest product possible. While the majority of all slaughter and ground beef plants used the Industry's Best Practices that pertained to them the other Industry Best Practices are not being used as frequently. In order get plants to use the Industry Best Practices for vacuum-packed subprimal and the Industry Best Practices for pathogen control during tenderizing/enhancing of whole muscle cuts, greater communication between inspection personnel and plant personnel should take place.

Slaughter plants used multiple processes and testing for *E. coli* O157:H7 to produce the safest products possible.

Plants that produced intact steaks and roasts used some process and testing for *E. coli* O157:H7.But plants that produced intact steaks and roasts need use process more often that they may already have around them to improve the safety of the products they produce.

Marinated/enhanced plants and plants that produced needle/blade tenderized steaks and roasts both relied heavily on the use of supplier purchasing specification. While a small number of are using processes this area is an area that needs to be greater utilized rather if processes or interventions are used.

All plants were testing for *E. coli* O157:H7 at some level regardless of plant size or type of plant. Most of the testing is done after the fact or just prior to plants grinding trim. This is possibly due to the amount of time that it takes to process samples to test them for *E. coli* O157:H7. Evolving the tests that currently are being used to decrease the amount of time that is needed to produce accurate may increase the use of testing prior to processing.

Consumers are the last step in protection against foodborne illness. A study done in New Zealand in which residents were asked questions about the way they handled their meat and poultry, showed that 30% of residents would place meat on the top shelf of their refrigerator. Most residents (46.2%) preferred to thaw their meat at room temperature. The survey asked a question to see if residents washed their hands in a manner in which they would not cross contaminate before, during or after cooking and 47.8% responded that they would in some way cross contaminate their hands (Gilbert et al., 2007). Consumers still are in need of greater education on food handling: therefore,

it is vital that all possible precautions are taken before consumers receive the final product.

Irradiation is a technology that is not widely used because it is not widely accepted by the American consumer. Most of the concerns consumers have are caused by uncertainty of the safety of irradiated products. Before consumers that participated in study done about irradiation in Turkey were told the benefits of using irradiation, only 21% of participants stated that they wanted irradiated products. After hearing the benefits of irradiated products, 62% of Turkish consumers stated they would buy the irradiated product (Gunes & Deniz Tekin, 2006). Greater exposure to science based information may help with the acceptance of irradiated products. Therefore giving the meat industry one more technology to reduce or eliminate the microbiological hazards.

In 2009, out of 12,065 samples of raw ground beef products analyzed for *E. coli.* O157:H7, there were 36 positive cases (Levine, 2010). This number shows that plants are effectively using available technologies. Yet there are still some areas for improvement or advancement. Additional extension programs and available resources such as the Industry Best Practices could be used to increase the knowledge of personnel in charge of HACCP are needed.

4.2. Conclusions

Within the data collected during this study, further processing plants need to reassess their HACCP plans based on their response to, "Is *E. coli* O157:H7 a reasonably likely food safety hazard. Greater communication about the Industry Best Practices specific to plants that further process beef needs to happen so that more plants will implement these practices. Plants that produced marinated/enhanced steaks and roasts, plants that produced needle/blade tenderized steaks and roasts and ground beef operations need to use process around them not just purchasing specifications to ensure that they are producing the safest products possible.

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APPENDIX

Table A-1 shows the frequency at which slaughter plants used single processes. In large plants, trimming was the most used process (100.0%), followed by steam vacuuming (90.0%), and lactic acid (90.0%). Most common small plants process were trimming (90.0%), lactic acid (65.9%), and hot water carcass wash (59.1%). Very small plant commonly utilized trimming (87.2%), carcass testing for *E. coli* O157:H7 (65.1%), and hot water carcass wash (59.6%). Plants of unknown most commonly reported use of other (75%), carcass testing for *E. coli* O157:H7, trimming (50%), acetic acid spray (50%) pre-evisceration water wash(50%) and hide wash (50%).

Table A-1. Frequency of responses (%) by plant size for single used process of beef slaughter plants

	Plant Size			
	Large (*n*=10)	Small (*n*=44)	Very Small (*n*=109)	Unknown (*n*=4)
Hide wash	30.0	25.00	7.3	50.0
Pre-evisceration water wash	50.0	15.9	13.8	50.0
Pre-evisceration antimicrobial spray	40.0	18.2	7.3	25.0
Hot water carcass wash	80.0	59.1	59.6	25.0
Steam pasteurization	10.0	6.8	1.8	25.0
Lactic acid spray	90.0	65.9	54.1	25.0
Acetic acid spray	10.0	29.6	20.2	50.0
Steam vacuuming	90.0	22.7	3.7	25.0
Trimming	100.0	90.9	87.2	50.0
Carcass testing for *E. coli* O157:H7	30.0	52.3	65.1	75.0
Other	70.0	4.6	11.9	75.0

The frequency at which slaughter plants utilize two combinations can be found in Table A-2. Large plants used lactic acid spray × trimming (90%), steam vacuuming × trimming (90%), lactic acid spray × trimming (80%), hot water carcass wash × trimming (80%) most often. Small plants used lactic acid × trimming (61.4%), hot water carcass wash × trimming (54.6%), trimming × carcass testing for *E. coli* O157:H7 (52.3%) at the highest frequency. Very small plants commonly employed trimming × carcass testing for *E. coli* O157:H7 (63.3%), hot water carcass wash × trimming (54.1%), and lactic acid × trimming (49.5%). Double combinations for plants of unknown size were hide wash × pre-evisceration water wash (50%), hide wash × trimming (50%), hide wash × carcass testing for *E. coli* O157:H7 (50%), pre-evisceration water wash × trimming (50%), pre-evisceration water wash × carcass testing for *E. coli* O157:H7 (50%), acetic acid spray carcass testing for *E. coli* O157:H7 (50%), and trimming × carcass testing for *E. coli* O157:H7 (50%).

Table A-2. Frequency of responses (%) by plant size for two-way combinations of item used by beef slaughter plants

	Plant Size			
	Large (*n*=10)	Small (*n*=44)	Very Small (*n*=109)	Unknown (*n*=4)
Hot water carcass wash × acetic acid spray	10.0	15.9	11.0	25.0
Hot water carcass wash × steam vacuuming	70.0	13.6	1.8	25.0
Hot water carcass wash × trimming	80.0	54.6	54.1	25.0
Hot water carcass wash × carcass testing for *E. coli* O157:H7	30.0	34.1	39.5	25.0
Steam pasteurization × lactic acid spray	10.0	4.6	0.9	0.0
Steam pasteurization × acetic acid spray	0.0	0.0	0.0	25.0
Steam pasteurization × steam vacuuming	10.0	4.6	1.8	25.0
Steam pasteurization × trimming	10.0	6.8	1.8	25.0
Steam pasteurization × carcass testing for *E. coli* O157:H7	0.0	2.3	1.8	25.0
Lactic acid spray × acetic acid spray	10.0	15.9	2.8	0.0
Lactic acid spray × steam vacuuming	80.0	18.2	2.8	0.0
Lactic acid spray × trimming	90.0	61.4	49.5	25.0
Lactic acid spray × carcass testing for *E. coli* O157:H7	30.0	36.4	35.8	25.0
Acetic acid spray × steam vacuuming	10.0	4.6	0.9	25.0
Acetic acid spray × trimming	10.0	27.3	17.4	25.0
Acetic acid spray × carcass testing for *E. coli* O157:H7	0.0	18.2	13.8	50.0
Steam vacuuming × trimming	90.0	20.5	3.7	25.0
Steam vacuuming × carcass testing for *E. coli* O157:H7	20.0	9.1	3.7	25.0
Trimming × carcass testing for *E. coli* O157:H7	30.0	52.3	63.3	50.0

Table A-2. Continued

	Plant Size			
	Large (*n*=10)	Small (*n*=44)	Very Small (*n*=109)	Unknown (*n*=4)
Hide wash ×pre-evisceration water wash	20.0	6.8	4.6	50.0
Hide wash × pre-evisceration antimicrobial spray	20.0	6.8	2.8	25.0
Hide wash × hot water carcass wash	20.0	13.6	4.6	25.0
Hide wash × steam pasteurization	0.0	0.0	0.0	25.0
Hide wash × lactic acid spray	30.0	15.9	3.7	25.0
Hide wash × acetic acid spray	0.0	13.6	0.9	25.0
Hide wash × steam vacuuming	30.0	4.6	0.0	25.0
Hide wash × trimming	30.0	25.0	7.3	50.0
Hide wash × carcass testing for *E. coli* O157:H7	10.0	9.1	6.4	50.0
Pre-evisceration water wash × pre-evisceration antimicrobial spray	30.0	9.1	2.8	25.0
Pre-evisceration water wash × hot water carcass wash	50.0	15.9	8.3	25.0
Pre-evisceration water wash × steam pasteurization	0.0	0.0	0.0	25.0
Pre-evisceration water wash × lactic acid spray	40.0	9.1	7.3	25.0
Pre-evisceration water wash × acetic acid spray	0.0	2.3	3.7	25.0
Pre-evisceration water wash × steam vacuuming	50.0	6.8	0.9	25.0
Pre-evisceration water wash × trimming	50.0	15.9	12.8	50.0
Pre-evisceration water wash × carcass testing for *E. coli* O157:H7	20.0	6.8	9.2	50.0
Pre-evisceration antimicrobial spray × hot water carcass wash	40.0	13.6	2.8	25.0
Pre-evisceration antimicrobial spray × steam pasteurization	0.0	2.3	0.9	25.0
Pre-evisceration antimicrobial spray × lactic acid spray	40.0	18.2	4.6	0.0
Pre-evisceration antimicrobial spray × acetic acid spray	10.0	4.6	0.9	25.0
Pre-evisceration antimicrobial spray × steam vacuuming	40.0	9.1	1.8	25.0
Pre-evisceration antimicrobial spray × trimming	40.0	15.9	7.3	25.0
Pre-evisceration antimicrobial spray × carcass testing for *E. coli* O157:H7	10.0	6.8	6.4	25.0
Hot water carcass wash × steam pasteurization	0.0	0.0	0.9	25.0
Hot water carcass wash × lactic acid spray	70.0	38.6	28.4	0.0

Table A-2. Continued

	Plant Size			
	Large (*n*=10)	Small (*n*=44)	Very Small (*n*=109)	Unknown (*n*=4)
Hot water carcass wash × acetic acid spray	10.0	15.9	11.0	25.0
Hot water carcass wash × steam vacuuming	70.0	13.6	1.8	25.0
Hot water carcass wash × trimming	80.0	54.6	54.1	25.0
Hot water carcass wash × carcass testing for *E. coli* O157:H7	30.0	34.1	39.5	25.0
Steam pasteurization × lactic acid spray	10.0	4.6	0.9	0.0
Steam pasteurization × acetic acid spray	0.0	0.0	0.0	25.0
Steam pasteurization × steam vacuuming	10.0	4.6	1.8	25.0
Steam pasteurization × trimming	10.0	6.8	1.8	25.0
Steam pasteurization × carcass testing for *E. coli* O157:H7	0.0	2.3	1.8	25.0
Lactic acid spray × acetic acid spray	10.0	15.9	2.8	0.0
Lactic acid spray × steam vacuuming	80.0	18.2	2.8	0.0
Lactic acid spray × trimming	90.0	61.4	49.5	25.0
Lactic acid spray × carcass testing for *E. coli* O157:H7	30.0	36.4	35.8	25.0
Acetic acid spray × steam vacuuming	10.0	4.6	0.9	25.0
Acetic acid spray × trimming	10.0	27.3	17.4	25.0
Acetic acid spray × carcass testing for *E. coli* O157:H7	0.0	18.2	13.8	50.0
Steam vacuuming × trimming	90.0	20.5	3.7	25.0
Steam vacuuming × carcass testing for *E. coli* O157:H7	20.0	9.1	3.7	25.0
Trimming × carcass testing for *E. coli* O157:H7	30.0	52.3	63.3	50.0

Frequencies for plant use of three combinations of items used can be seen within Table A-3. Large plants used the combination lactic acid spray × trimming × steam vacuuming (80%), hot water carcass wash × lactic acid spray × trimming (70%), and lactic acid spray × pre-evisceration antimicrobial spray × pre-evisceration water wash (70%) in the greatest frequency. Most common combinations used by small plants were hot water carcass wash × lactic acid spray × trimming (38.6%), lactic acid spray × pre-evisceration antimicrobial spray × pre-evisceration water wash (38.6%), hot water carcass wash × lactic acid spray × carcass testing for *E. coli* O157:H7 (27.3%), and hot water carcass wash × trimming × steam vacuuming (27.3%). Very small plants preferred hot water carcass wash × lactic acid spray × trimming (26.6%), lactic acid spray × pre-evisceration antimicrobial spray × pre-evisceration water wash (26.6%), hot water carcass wash × lactic acid spray × carcass testing for *E. coli* O157:H7 (19.3%), and hot water carcass wash × trimming × steam vacuuming (19.3%). For the plants with unknown size (n=4) occasionally one or two plants responded as utilizing a three intem combination.

Table A-3. Frequency of responses (%) by plant size for three-way beef slaughter intem combinations

	Plant Size			
	Large (*n*=10)	Small (*n*=44)	Very Small (*n*=109)	Unknown (*n*=4)
Acetic acid spray × hide wash × hot water carcass wash	0.0	6.8	0.9	25.0
Acetic acid spray × hide wash × lactic acid spray	0.0	6.8	0.0	0.0
Acetic acid spray × hide wash × pre-evisceration antimicrobial spray	0.0	2.3	0.0	25.0
Acetic acid spray × hide wash × pre-evisceration water wash	0.0	0.0	0.0	25.0
Acetic acid spray × hide wash × steam pasteurization	0.0	0.0	0.0	25.0
Acetic acid spray × hide wash × carcass testing for *E. coli* O157:H7	0.0	6.8	0.9	25.0
Acetic acid spray × hide wash × trimming	0.0	13.6	0.9	25.0
Acetic acid spray × hide wash × steam vacuuming	0.0	0.0	0.0	25.0
Acetic acid spray × hot water carcass wash × lactic acid spray	10.0	9.1	0.9	0.0
Acetic acid spray × lactic acid spray × pre-evisceration antimicrobial spray	10.0	4.6	0.0	0.0
Acetic acid spray × lactic acid spray × pre-evisceration water wash	0.0	0.0	1.8	0.0
Acetic acid spray × hot water carcass wash × steam pasteurization	0.0	0.0	0.0	25.0
Acetic acid spray × hot water carcass wash × carcass testing for *E. coli* O157:H7	0.0	11.4	8.3	25.0
Acetic acid spray × hot water carcass wash × trimming	10.0	2.3	11.0	25.0
Acetic acid spray × hot water carcass wash × steam vacuuming	10.0	2.3	0.0	25.0
Acetic acid spray × hot water carcass wash × pre-evisceration antimicrobial spray	10.0	2.3	0.0	25.0
Acetic acid spray × hot water carcass wash × pre-evisceration water wash	0.0	2.3	1.8	25.0
Acetic acid spray × lactic acid spray × carcass testing for *E. coli* O157:H7	0.0	11.4	1.8	0.0
Acetic acid spray × lactic acid spray × trimming	10.0	13.6	2.8	0.0
Acetic acid spray × lactic acid spray × steam vacuuming	10.0	4.6	0.9	0.0

Table A-3. Continued

	Plant Size			
	Large (*n*=10)	Small (*n*=44)	Very Small (*n*=109)	Unknown (*n*=4)
Acetic acid spray × pre-evisceration antimicrobial spray × steam pasteurization	0.0	0.0	0.0	25.0
Acetic acid spray × pre-evisceration antimicrobial spray × carcass testing for *E. coli* O157:H7	0.0	0.0	0.9	25.0
Acetic acid spray × pre-evisceration antimicrobial spray × trimming	10.0	2.3	0.9	25.0
Acetic acid spray × pre-evisceration antimicrobial spray × steam vacuuming	10.0	2.3	0.0	25.0
Acetic acid spray × pre-evisceration water wash × pre-evisceration antimicrobial spray	0.0	0.0	0.0	25.0
Acetic acid spray × pre-evisceration water wash × steam pasteurization	0.0	0.0	0.0	25.0
Acetic acid spray × pre-evisceration water wash × carcass testing for *E. coli* O157:H7	0.0	2.3	0.9	25.0
Acetic acid spray × pre-evisceration water wash × trimming	0.0	2.3	2.8	25.0
Acetic acid spray × pre-evisceration water wash × steam vacuuming	0.0	0.0	0.0	25.0
Acetic acid spray × steam pasteurization × carcass testing for *E. coli* O157:H7	0.0	0.0	0.0	25.0
Acetic acid spray × steam pasteurization × trimming	0.0	0.0	0.0	25.0
Acetic acid spray × steam pasteurization × steam vacuuming	0.0	0.0	0.0	25.0
Acetic acid spray × carcass testing for *E. coli* O157:H7 × trimming	0.0	18.2	13.8	25.0
Acetic acid spray × carcass testing for *E. coli* O157:H7 × steam vacuuming	0.0	2.3	0.9	0.0
Acetic acid spray × trimming × steam vacuuming	10.0	2.3	0.9	25.0
Hide wash × hot water carcass wash × lactic acid spray	20.0	9.1	1.8	0.0
Hide wash × hot water carcass wash × pre-evisceration antimicrobial spray	20.0	6.8	0.9	25.0
Hide wash × hot water carcass wash × pre-evisceration water wash	20.0	6.8	2.8	25.0
Hide wash × hot water carcass wash × steam pasteurization	0.0	0.0	0.0	25.0
Hide wash × hot water carcass wash × carcass testing for *E. coli* O157:H7	10.0	4.6	4.6	25.0
Hide wash × hot water carcass wash × trimming	20.0	13.6	4.6	25.0

Table A-3. Continued

	Plant Size			
	Large (*n*=10)	Small (*n*=44)	Very Small (*n*=109)	Unknown (*n*=4)
Hide wash × hot water carcass wash × steam vacuuming	20.0	4.6	0.0	25.0
Hide wash × lactic acid spray × pre-evisceration antimicrobial spray	20.0	6.8	2.8	25.0
Hide wash × lactic acid spray × pre-evisceration water wash	20.0	4.6	1.8	0.0
Hide wash × lactic acid spray × steam pasteurization	0.0	0.0	0.0	0.0
Hide wash × lactic acid spray × carcass testing for *E. coli* O157:H7	10.0	6.8	2.8	25.0
Hide wash × lactic acid spray × trimming	30.0	15.9	3.7	25.0
Hide wash × lactic acid spray × steam vacuuming	30.0	2.3	0.0	0.0
Hide wash × pre-evisceration antimicrobial spray × pre-evisceration water wash	20.0	4.6	1.8	25.0
Hide wash × pre-evisceration antimicrobial spray × steam pasteurization	0.0	0.0	0.0	25.0
Hide wash × pre-evisceration antimicrobial spray × carcass testing for *E. coli* O157:H7	10.0	2.3	1.8	25.0
Hide wash × pre-evisceration antimicrobial spray × trimming	20.0	6.8	2.8	25.0
Hide wash × pre-evisceration antimicrobial spray × steam vacuuming	20.0	2.3	0.0	25.0
Hide wash × pre-evisceration water wash × steam pasteurization	0.0	0.0	0.0	25.0
Hide wash × pre-evisceration water wash × carcass testing for *E. coli* O157:H7	10.0	2.3	4.6	0.0
Hide wash × pre-evisceration water wash × trimming	0.0	6.8	4.6	0.0
Hide wash × pre-evisceration water wash × steam vacuuming	20.0	4.6	0.0	25.0
Hide wash × steam pasteurization× carcass testing for *E. coli* O157:H7	0.0	0.0	0.0	25.0
Hide wash × steam pasteurization × trimming	0.0	0.0	0.0	25.0
Hide wash × steam pasteurization × steam vacuuming	0.0	0.0	0.0	25.0
Hide wash × carcass testing for *E. coli* O157:H7 × trimming	10.0	9.1	6.4	0.0

Table A-3. Continued

	Plant Size			
	Large (*n*=10)	Small (*n*=44)	Very Small (*n*=109)	Unknown (*n*=4)
Hide wash × carcass testing for *E. coli* O157:H7 × steam vacuuming	10.0	0.0	0.0	25.0
Hide wash × trimming × steam vacuuming	30.0	4.6	0.0	25.0
Hot water carcass wash × lactic acid spray × pre-evisceration antimicrobial spray	40.0	13.6	1.8	0.0
Hot water carcass wash × lactic acid × pre-evisceration water wash spray	40.0	9.1	4.6	0.0
Hot water carcass wash × lactic acid spray × carcass testing for *E. coli* O157:H7	30.0	27.3	19.3	0.0
Hot water carcass wash × lactic acid spray × trimming	70.0	38.6	26.6	0.0
Hot water carcass wash × lactic acid spray × steam vacuuming	60.0	11.4	0.9	0.0
Hot water carcass wash × pre-evisceration antimicrobial spray × pre-evisceration water wash	30.0	9.1	1.8	25.0
Hot water carcass wash × pre-evisceration antimicrobial spray × steam pasteurization	0.0	0.0	0.9	25.0
Hot water carcass wash × pre-evisceration antimicrobial spray × carcass testing for *E. coli* O157:H7	10.0	6.8	2.8	25.0
Hot water carcass wash × pre-evisceration antimicrobial spray × trimming	40.0	13.6	2.8	25.0
Hot water carcass wash × pre-evisceration antimicrobial spray × steam vacuuming	40.0	4.6	1.8	25.0
Hot water carcass wash × pre-evisceration water wash × steam pasteurization	0.0	0.0	0.0	25.0
Hot water carcass wash × pre-evisceration water wash × carcass testing for *E. coli* O157:H7	20.0	6.8	4.6	25.0
Hot water carcass wash × pre-evisceration water wash × trimming	50.0	15.9	8.3	25.0
Hot water carcass wash × pre-evisceration water wash × steam vacuuming	50.0	6.8	0.9	25.0

Table A-3. Continued

	Plant Size			
	Large (*n*=10)	Small (*n*=44)	Very Small (*n*=109)	Unknown (*n*=4)
Hot water carcass wash × steam pasteurization × carcass testing for *E. coli* O157:H7	10.0	0.0	0.0	25.0
Hot water carcass wash × steam pasteurization × trimming	30.0	4.6	0.0	25.0
Hot water carcass wash × steam pasteurization × steam vacuuming	40.0	13.6	1.8	0.0
Hot water carcass wash × carcass testing for *E. coli* O157:H7 × trimming	40.0	9.1	4.6	0.0
Hot water carcass wash × trimming × steam vacuuming	30.0	27.3	19.3	0.0
Lactic acid spray × pre-evisceration antimicrobial spray × pre-evisceration water wash	70.0	38.6	26.6	0.0
Lactic acid spray × pre-evisceration antimicrobial spray × steam pasteurization	60.0	11.4	0.9	0.0
Lactic acid spray × pre-evisceration antimicrobial spray × carcass testing for *E. coli* O157:H7	30.0	9.1	1.8	25.0
Lactic acid spray × pre-evisceration antimicrobial spray × trimming	0.0	0.0	0.9	25.0
Lactic acid spray × pre-evisceration antimicrobial spray × steam vacuuming	10.0	6.8	2.8	25.0
Lactic acid spray × pre-evisceration water wash × steam pasteurization	40.0	13.6	2.8	25.0
Lactic acid spray × pre-evisceration water wash × carcass testing for *E. coli* O157:H7	40.0	4.6	1.8	25.0
Lactic acid spray × pre-evisceration water wash × trimming	0.0	0.0	0.0	25.0
Lactic acid spray × pre-evisceration water wash × steam vacuuming	20.0	6.8	4.6	25.0
Lactic acid spray × steam pasteurization × carcass testing for *E. coli* O157:H7	50.0	15.9	8.3	25.0
Lactic acid spray × steam pasteurization × trimming	50.0	6.8	0.9	25.0
Lactic acid spray × steam pasteurization × steam vacuuming	10.0	0.0	0.0	25.0
Lactic acid spray × carcass testing for *E. coli* O157:H7 × trimming	30.0	4.6	0.0	25.0

Table A-3. Continued

	Plant Size			
	Large (*n*=10)	Small (*n*=44)	Very Small (*n*=109)	Unknown (*n*=4)
Lactic acid spray × carcass testing for *E. coli* O157:H7 × steam vacuuming	20.0	6.8	2.8	0.0
Lactic acid spray × trimming × steam vacuuming	80.0	15.9	2.8	0.0
Pre-evisceration antimicrobial spray × pre-evisceration water wash × steam pasteurization	0.0	0.0	0.0	25.0
Pre-evisceration antimicrobial spray × pre-evisceration water wash × carcass testing for *E. coli* O157:H7	10.0	4.6	2.8	25.0
Pre-evisceration antimicrobial spray × pre-evisceration water wash × trimming	30.0	9.1	2.8	25.0
Pre-evisceration antimicrobial spray × pre-evisceration water wash × steam vacuuming	30.0	4.6	0.9	25.0
Pre-evisceration antimicrobial spray × steam pasteurization × carcass testing for *E. coli* O157:H7	0.0	0.0	0.9	25.0
Pre-evisceration antimicrobial spray × steam pasteurization × trimming	0.0	2.2	0.9	25.0
Pre-evisceration antimicrobial spray × steam pasteurization × steam vacuuming	0.0	2.3	0.9	25.0
Pre-evisceration antimicrobial spray × carcass testing for *E. coli* O157:H7 × trimming	10.0	6.8	6.4	25.0
Pre-evisceration antimicrobial spray × Carcass testing for *E. coli* O157:H7 × steam vacuuming	10.0	0.0	1.8	25.0
Pre-evisceration antimicrobial spray × trimming × steam vacuuming	40.0	6.8	1.8	25.0
Pre-evisceration water wash × steam pasteurization × carcass testing for *E. coli* O157:H7	0.0	0.0	0.0	25.0
Pre-evisceration water wash × steam pasteurization × trimming	0.0	0.0	0.0	25.0
Pre-evisceration water wash × steam pasteurization × steam vacuuming	0.0	0.0	0.0	25.0
Pre-evisceration water wash × carcass testing for *E. coli* O157:H7 × trimming	20.0	6.8	9.2	0.0
Pre-evisceration water wash × carcass testing for *E. coli* O157:H7 × steam vacuuming	20.0	0.0	0.9	25.0

Table A-3. Continued

	Plant Size			
	Large (*n*=10)	Small (*n*=44)	Very Small (*n*=109)	Unknown (*n*=4)
Pre-evisceration water wash × trimming × carcass testing for *E. coli* O157:H7	20.0	0.0	9.2	0.0
Pre-evisceration water wash × trimming × steam vacuuming	50.0	6.8	0.9	25.0
Steam pasteurization × carcass testing for *E. coli* O157:H7 × trimming	0.0	2.3	1.8	25.0
Steam pasteurization × carcass testing for *E. coli* O157:H7 × steam vacuuming	0.0	0.0	1.8	25.0
Steam pasteurization × trimming × steam vacuuming	10.0	4.6	1.8	25.0
Carcass testing for *E. coli* O157:H7 × trimming × steam vacuuming	0.0	9.1	3.7	25.0

Fabrication

Table A-4 exhibits the frequency of responses for single beef fabrication items used by plant size. Large plants (*n*=11) used trim testing for *E. coli* O157:H7 (90.9%), trimming (72.7%), lactic acid spray (45.5%), antimicrobial prior to vacuum packaging (45.5%), continuous belt sanitizing (45.5%) most commonly. Small (*n*=59) plants used peroxyacetic acid spray (71.2%), trim testing for *E. coli* O157:H7 (69.5%), trimming (54.2%) at the greatest frequency. Very small plants (*n*=134) used trimming (63.4%), trim testing for *E. coli* O157:H7 (47.8%), primal and subpriaml testing for *E. coli* O157:H7 (21.6%) most often. Plants of an unknown size (*n*=6) commonly used trim testing for *E. coli* O157:H7 (50.0%), and trimming (33.3%).

Table A-4. Frequency of responses (%) by plant size for single beef fabrication items

	Plant Size			
	Large (*n*=11)	Small (*n*=59)	Very Small (n=134)	Unknown (*n*=6)
Lactic acid spray	45.5	13.6	11.9	0.0
Acidified sodium chlorite spray	0.0	18.6	5.2	0.0
Acetic acid spray	0.0	3.4	3.7	16.7
Peroxyacetic acid spray	27.3	71.2	1.5	16.7
Other antimicrobial spray	0.0	0.0	0.8	0.0
Trimming	72.7	54.2	63.4	33.3
Antimicrobial prior to vacuum packaging	45.5	11.9	0.8	0.0
Continuous belt sanitizing	45.5	15.3	2.2	0.0
Periodic belt sanitizing	9.1	13.6	2.2	0.0
Primal and subprimal testing for *E. coli* O157:H7	9.1	35.6	21.6	16.7
Trim testing for *E. coli* O157:H7	90.9	69.5	47.8	50.0

Table A-5 portrays the frequency of responses (%) for two-way combinations of items used by fabrication plants. Large plants commonly used trimming × trim testing

for *E. coli* O157:H7 (63.6%), lactic acid spray × trim testing for *E. coli* O157:H7 (45.5%), antimicrobial spray prior to vacuum packaging × trim testing for *E. coli* O157:H7 (45.5%), continuous belt sanitizing × trim testing for *E. coli* O157:H7 (45.5%). Small plants frequently used trimming × trim testing for *E. coli* O157:H7 (45.8%), primal and subprimal testing for *E. coli* O157:H7 ×trim testing for *E. coli* O157:H7 (27.1%) and trimming × primal and subprimal testing for *E. coli* O157:H7 (22.0%). Very small plants used trimming × trim testing for *E. coli* O157:H7 (33.6%), trimming × primal and subprimal testing for *E. coli* O157:H7 (16.4%), primal and subprimal testing for *E. coli* O157:H7 × trim testing for *E. coli* (15.7%) most often. Plant of unknown size choose to use combinations of trimming × trim testing for *E. coli* O157:H7 (33.3%), acetic acid × trimming (16.7%), and acetic acid × trim testing for *E. coli* O157:H7 (16.7%).

Table A-5. Frequency of responses (%) by plant size for two-way beef fabrication items used in combinations

	Plant Size			
	Large (*n*=11)	Small (*n*=59)	Very Small (*n*=134)	Unknown (*n*=6)
Lactic acid spray × acetic acid spray	0.0	1.7	0.0	0.0
Lactic acid spray × trimming	36.4	10.2	9.7	0.0
Lactic acid spray × antimicrobial prior to vacuum packaging	18.2	1.7	0.0	0.0
Lactic acid spray × continuous belt sanitizing	27.3	5.1	0.0	0.0
Lactic acid spray × periodic belt sanitizing	0.0	3.4	0.0	0.0
Lactic acid spray × primal and subprimal testing for *E. coli* O157:H7	0.0	3.4	4.5	0.0
Lactic acid spray × trim testing for *E. coli* O157:H7	45.5	11.9	8.2	0.0
Acidified sodium chlorite spray × acetic acid spray	0.0	1.7	0.0	0.0
Acidified sodium chlorite spray × peroxyacetic acid spray	0.0	1.7	0.0	0.0
Acidified sodium chlorite spray × trimming	0.0	10.2	3.0	0.0
Acidified sodium chlorite spray × antimicrobial prior to vacuum packaging	0.0	6.8	0.8	0.0
Acidified sodium chlorite spray × continuous belt sanitizing	0.0	6.8	0.0	0.0
Acidified sodium chlorite spray × periodic belt sanitizing	0.0	5.1	0.0	0.0
Acidified sodium chlorite spray × primal and subprimal testing for *E. coli* O157:H7	0.0	10.2	0.8	0.0
Acidified sodium chlorite spray × trim testing for *E. coli* O157:H7	0.0	15.3	2.2	0.0
Acetic acid spray × peroxyacetic acid spray	0.0	1.7	0.0	0.0
Acetic acid spray × trimming	0.0	1.7	2.2	16.7
Acetic acid spray × antimicrobial prior to vacuum packaging	0.0	3.4	0.0	0.0
Acetic acid spray × continuous belt sanitizing	0.0	1.7	0.0	0.0
Acetic acid spray × periodic belt sanitizing	0.0	1.7	0.0	0.0
Acetic acid spray × primal and subprimal testing for *E. coli* O157:H7	0.0	1.7	0.0	0.0
Acetic acid spray × trim testing for *E. coli* O157:H7	0.0	3.4	1.5	16.7
Peroxyacetic acid spray × other antimicrobial spray	0.0	0.0	0.0	0.0
Peroxyacetic acid spray × trimming	27.3	0.0	1.5	0.0

Table A-5. Continued

	Plant Size			
	Large (*n*=11)	Small (*n*=59)	Very Small (*n*=134)	Unknown (*n*=6)
Peroxyacetic acid spray × antimicrobial prior to vacuum packaging	27.3	1.7	0.0	0.0
Peroxyacetic acid spray × continuous belt sanitizing	9.1	0.0	0.0	0.0
Peroxyacetic acid spray × periodic belt sanitizing	9.1	3.4	0.0	0.0
Peroxyacetic acid spray × primal and subprimal testing for *E. coli* O157:H7	9.1	0.0	0.8	0.0
Peroxyacetic acid spray × trim testing for *E. coli* O157:H7	27.3	3.4	1.5	0.0
Trimming × antimicrobial prior to vacuum packaging	36.4	5.1	0.8	0.0
Trimming × continuous belt sanitizing	27.3	11.9	1.5	0.0
Trimming × periodic belt sanitizing	9.1	6.8	1.5	0.0
Trimming × primal and subprimal testing for *E. coli* O157:H7	9.1	22.0	16.4	0.0
Trimming × trim testing for *E. coli* O157:H7	63.6	45.8	33.6	33.3
Antimicrobial prior to vacuum packaging × continuous belt sanitizing	27.3	6.8	0.0	0.0
Antimicrobial prior to vacuum packaging × periodic belt sanitizing	9.1	3.4	0.0	0.0
Antimicrobial prior to vacuum packaging × primal and subprimal testing for *E. coli* O157:H7	9.1	6.8	0.0	0.0
Antimicrobial prior to vacuum packaging × trim testing for *E. coli* O157:H7	45.5	10.2	0.0	0.0
Continuous belt sanitizing × primal and subprimal testing for *E coli* O157:H7	9.1	8.5	1.5	0.0
Continuous belt sanitizing × trim testing for *E. coli* O157:H7	45.5	13.6	2.2	0.0
Periodic belt sanitizing × primal and subprimal testing for *E. coli* O157:H7	0.0	5.1	0.8	0.0
Periodic belt sanitizing × trim testing for *E. coli* O157:H7	9.1	13.6	0.8	0.0
Primal and subprimal testing for *E. coli* O157:H7 × trim testing for *E. coli* O157:H7	9.1	27.1	15.7	0.0

Table A-6 displays the frequency of responses for plants using combinations of three fabrication items. Large plants (*n*=11) commonly used lactic acid × trimming × trim testing for *E. coli* O157:H7 (36.4%), trimming × antimicrobial prior to vacuum packaging x trim testing for *E. coli* O157:H7 (36.4%). Small plants (*n*=59) frequently used combinations of trimming × primal and subprimal testing for E. ecoli × trim testing for *E. coli* O157:H7 (22.0%), trimming × continuous belt sanitizing × trim testing for *E. coli* O157:H7 (11.9%), acidified sodium chlorite spray × trimming × trim testing for *E. coli* O157:H7 (10.2%), lactic acid spray × trimming × trim testing for *E. coli* O157:H7 (10.2%). Very small plants (*n*=134) chose to use the combination of trimming × primal and subprimal testing for *E. coli* O157:H7 × trim testing for *E. coli* O157:H7 (13.4%), lactic acid spray × trimming × trim testing for *E. coli* O157:H7 (7.5%), lactic acid spray × trimming × primal and sub primal testing for *E. coli* O157:H7 (4.5%). Plants of unknown size (*n*=6)selected intervention combination of acetic acid spray × trimming × trim testing for *E. coli* O157:H7 (16.7%).

Table A-6. Frequency of responses (%) by plant size for three-way beef fabrication items used in combinations

	Plant Size			
	Large (*n*=11)	Small (*n*=59)	Very Small (*n*=134)	Unknown (*n*=6)
Lactic acid spray × acetic acid spray × trimming	0.0	1.7	0.0	0.0
Lactic acid spray × acetic acid spray × antimicrobial prior to vacuum packaging	0.0	1.7	0.0	0.0
Lactic acid spray × acetic acid spray × continuous belt sanitizing	0.0	1.7	0.0	0.0
Lactic acid spray × acetic acid spray × primal and subprimal testing for *E. coli* O157:H7	0.0	1.7	0.0	0.0
Lactic acid spray × acetic acid spray × trim testing for *E. coli* O157:H7	0.0	1.7	0.0	0.0
Lactic acid spray × trimming × antimicrobial prior to vacuum packaging	9.1	1.7	0.0	0.0
Lactic acid spray × trimming × continuous belt sanitizing	18.2	5.1	0.0	0.0
Lactic acid spray × trimming × periodic belt sanitizing	0.0	1.7	0.0	0.0
Lactic acid spray × trimming × primal and subprimal testing for *E. coli* O157:H7	0.0	3.4	4.5	0.0
Lactic acid spray × trimming × trim testing for *E. coli* O157:H7	36.4	10.2	7.5	0.0
Lactic acid spray × antimicrobial prior to vacuum packaging × continuous belt sanitizing	18.2	1.7	0.0	0.0
Lactic acid spray × antimicrobial prior to vacuum packaging × primal and subprimal testing for *E. coli* O157:H7	0.0	1.7	0.0	0.0
Lactic acid spray × antimicrobial prior to vacuum packaging × trim testing for *E. coli* O157:H7	18.2	1.7	0.0	0.0
Lactic acid spray × continuous belt sanitizing × periodic belt sanitizing	0.0	0.0	0.0	0.0
Lactic acid spray × continuous belt sanitizing × primal and subprimal testing for *E. coli* O157:H7	9.1	1.7	0.0	0.0
Lactic acid spray × continuous belt sanitizing × trim testing for *E. coli* O157:H7	27.3	5.1	0.0	0.0
Lactic acid spray × periodic belt sanitizing × primal and subprimal testing for *E. coli* O157:H7	0.0	1.7	0.0	0.0

Table A-6. Continued

	Plant Size			
	Large (*n*=11)	Small (*n*=59)	Very Small (*n*=134)	Unknown (*n*=6)
Lactic acid spray × periodic belt sanitizing × trim testing for *E. coli* O157:H7	0.0	3.4	0.0	0.0
Lactic acid spray × primal and subprimal testing for *E. coli* O157:H7 × trim testing for *E. coli* O157:H7	0.0	3.4	4.5	0.0
Acidified sodium chlorite spray × acetic acid spray × peroxyacetic acid spray	0.0	1.7	0.0	0.0
Acidified sodium chlorite spray × acetic acid spray × periodic belt sanitizing	0.0	1.7	0.0	0.0
Acidified sodium chlorite spray × acetic acid spray × trim testing for *E. coli* O157:H7	0.0	1.7	0.0	0.0
Acidified sodium chlorite spray × peroxyacetic acid spray × antimicrobial prior to vacuum packaging	0.0	1.7	0.0	0.0
Acidified sodium chlorite spray × peroxyacetic acid spray × periodic belt sanitizing	0.0	1.7	0.0	0.0
Acidified sodium chlorite spray × peroxyacetic acid spray × trim testing for *E. coli* O157:H7	0.0	1.7	0.0	0.0
Acidified sodium chlorite spray × trimming × antimicrobial prior to vacuum packaging	0.0	1.7	0.8	0.0
Acidified sodium chlorite spray × trimming × continuous belt sanitizing	0.0	3.4	0.0	0.0
Acidified sodium chlorite spray × trimming × periodic belt sanitizing	0.0	3.4	0.0	0.0
Acidified sodium chlorite spray × trimming × primal and subprimal testing for *E. coli* O157:H7	0.0	6.8	0.8	0.0
Acidified sodium chlorite spray × trimming × trim testing for *E. coli* O157:H7	0.0	10.2	1.5	0.0
Acidified sodium chlorite spray × antimicrobial prior to vacuum packaging × continuous belt sanitizing	0.0	3.4	0.0	0.0
Acidified sodium chlorite spray × antimicrobial prior to vacuum packaging × periodic belt sanitizing	0.0	3.4	0.0	0.0

Table A-6. Continued

	Plant Size			
	Large (*n*=11)	Small (*n*=59)	Very Small (*n*=134)	Unknown (*n*=6)
Acidified sodium chlorite spray × antimicrobial prior to vacuum packaging × primal and subprimal testing for *E. coli* O157:H7	0.0	5.1	0.0	0.0
Acidified sodium chlorite spray × antimicrobial prior to vacuum packaging × trim testing for *E. coli* O157:H7	0.0	5.1	0.0	0.0
Acidified sodium chlorite spray × continuous belt sanitizing × periodic belt sanitizing	0.0	0.0	0.0	0.0
Acidified sodium chlorite spray × continuous belt sanitizing × primal and subprimal testing for *E. coli* O157:H7	0.0	5.1	0.0	0.0
Acidified sodium chlorite spray × continuous belt sanitizing × trim testing for *E. coli* O157:H7	0.0	5.1	0.0	0.0
Acidified sodium chlorite spray × periodic belt sanitizing × primal and subprimal testing for *E. coli* O157:H7	0.0	1.7	0.0	0.0
Acidified sodium chlorite spray × periodic belt sanitizing × trim testing for *E. coli* O157:H7	0.0	5.1	0.0	0.0
Acidified sodium chlorite spray × primal and subprimal testing for *E. coli* O157:H7 × trim testing for *E. coli* O157:H7	0.0	8.5	0.8	0.0
Acetic acid spray × peroxyacetic acid spray × antimicrobial prior to vacuum packaging	0.0	1.7	0.0	0.0
Acetic acid spray × peroxyacetic acid spray × periodic belt sanitizing	0.0	1.7	0.0	0.0
Acetic acid spray × peroxyacetic acid spray × trim testing for *E. coli* O157:H7	0.0	1.7	0.0	0.0
Acetic acid spray × trimming × antimicrobial prior to vacuum packaging	0.0	1.7	0.0	0.0
Acetic acid spray × trimming × continuous belt sanitizing	0.0	1.7	0.0	0.0
Acetic acid spray × trimming × primal and subprimal testing for *E. coli* O157:H7	0.0	1.7	0.0	0.0
Acetic acid spray × trimming × trim testing for *E. coli* O157:H7	0.0	1.7	0.8	16.7

Table A-6. Continued

	Plant Size			
	Large (*n*=11)	Small (*n*=59)	Very Small (*n*=134)	Unknown (*n*=6)
Acetic acid spray × antimicrobial prior to vacuum packaging × continuous belt sanitizing	0.0	1.7	0.0	0.0
Acetic acid spray × antimicrobial prior to vacuum packaging × periodic belt sanitizing	0.0	1.7	0.0	0.0
Acetic acid spray × antimicrobial prior to vacuum packaging × primal and subprimal testing for *E. coli* O157:H7	0.0	1.7	0.0	0.0
Acetic acid spray × antimicrobial prior to vacuum packaging × trim testing for *E. coli* O157:H7	0.0	3.4	0.0	0.0
Acetic acid spray × continuous belt sanitizing × primal and subprimal testing for *E. coli* O157:H7	0.0	1.7	0.0	0.0
Acetic acid spray × continuous belt sanitizing × trim testing for *E. coli* O157:H7	0.0	1.7	0.0	0.0
Acetic acid spray × periodic belt sanitizing × trim testing for *E. coli* O157:H7	0.0	1.7	0.0	0.0
Acetic acid spray × primal and subprimal testing for *E. coli* O157:H7 × trim testing for *E. coli* O157:H7	0.0	1.7	0.0	0.0
Peroxyacetic acid spray × trimming × antimicrobial prior to vacuum packaging	27.3	0.0	0.0	0.0
Peroxyacetic acid spray × trimming × continuous belt sanitizing	9.1	0.0	0.0	0.0
Peroxyacetic acid spray × trimming × periodic belt sanitizing	9.1	0.0	0.0	0.0
Peroxyacetic acid spray × trimming × primal and subprimal testing for *E. coli* O157:H7	9.1	0.0	0.8	0.0
Peroxyacetic acid spray × trimming × trim testing for *E. coli* O157:H7	27.3	0.0	1.5	0.0
Peroxyacetic acid spray × antimicrobial prior to vacuum packaging × continuous belt sanitizing	9.1	0.0	0.0	0.0
Peroxyacetic acid spray × antimicrobial prior to vacuum packaging × periodic belt sanitizing	9.1	1.7	0.0	0.0

Table A-6. Continued

	Plant Size			
	Large (*n*=11)	Small (*n*=59)	Very Small (*n*=134)	Unknown (*n*=6)
Peroxyacetic acid spray × antimicrobial prior to vacuum packaging × primal and subprimal testing for *E. coli* O157:H7	9.1	0.0	0.0	0.0
Peroxyacetic acid spray × antimicrobial prior to vacuum packaging × trim testing for *E. coli* O157:H7	27.3	1.7	0.0	0.0
Peroxyacetic acid spray × continuous belt sanitizing × primal and subprimal testing for *E. coli* O157:H7	9.1	0.0	0.0	0.0
Peroxyacetic acid spray × continuous belt sanitizing × trim testing for *E. coli* O157:H7	9.1	0.0	0.0	0.0
Peroxyacetic acid spray × periodic belt sanitizing × trim testing for *E. coli* O157:H7	9.1	3.4	0.0	0.0
Peroxyacetic acid spray × primal and subprimal testing for *E. coli* O157:H7 × trim testing for *E. coli* O157:H7	9.1	0.0	0.8	0.0
Trimming × antimicrobial prior to vacuum packaging × continuous belt sanitizing	18.2	3.4	0.0	0.0
Trimming × antimicrobial prior to vacuum packaging × periodic belt sanitizing	9.1	1.7	0.0	0.0
Trimming × antimicrobial prior to vacuum packaging × primal and subprimal testing for *E. coli* O157:H7	9.1	3.4	0.0	0.0
Trimming × antimicrobial prior to vacuum packaging × trim testing for *E. coli* O157:H7	36.4	5.1	0.0	0.0
Trimming × continuous belt sanitizing × primal and subprimal testing for *E. coli* O157:H7	9.1	5.1	1.5	0.0
Trimming × continuous belt sanitizing × trim testing for *E. coli* O157:H7	27.3	11.9	1.5	0.0
Trimming × periodic belt sanitizing × primal and subprimal testing for *E. coli* O157:H7	0.0	5.8	0.0	0.0
Trimming × periodic belt sanitizing × trim testing for *E. coli* O157:H7	9.1	6.8	0.8	0.0
Trimming × primal and subprimal testing for *E. coli* O157:H7 × trim testing for *E. coli* O157:H7	9.1	22.0	13.4	0.0

Table A-6. Continued

	Plant Size			
	Large (*n*=11)	Small (*n*=59)	Very Small (*n*=134)	Unknown (*n*=6)
Antimicrobial prior to vacuum packaging × continuous belt sanitizing × primal and subprimal testing for *E. coli* O157:H7	9.1	5.1	0.0	0.0
Antimicrobial prior to vacuum packaging × continuous belt sanitizing × trim testing for *E. coli* O157:H7	27.3	5.1	0.0	0.0
Antimicrobial prior to vacuum packaging × periodic belt sanitizing × primal and subprimal testing for *E. coli* O157:H7	0.0	1.7	0.0	0.0
Antimicrobial prior to vacuum packaging × periodic belt sanitizing × trim testing for *E. coli* O157:H7	9.1	3.4	0.0	0.0
Antimicrobial prior to vacuum packaging × primal and subprimal testing for *E. coli* O157:H7 × trim testing for *E. coli* O157:H7	9.1	5.1	0.0	0.0
Continuous belt sanitizing × primal and subprimal testing for *E coli* O157:H7 × trim testing for *E. coli* O157:H7	9.1	6.8	1.5	0.0
Periodic belt sanitizing × primal and subprimal testing for *E. coli* O157:H7 × trim testing for *E. coli* O157:H7	0.0	5.1	0.0	0.0

Frequency of responses for written survey questions specific to plants that fabricated beef primal and subprimal cuts can be found in Table A-7. The first question asked was, “Do you co-mingle primal and subprimal cuts during fabrication?” Of the large plant that fabricated primal (*n*=11) 54.5% answered that they do co-mingle primal and sub-primals during fabrication. Thirty five and a half percent of small (*n*=59) fabrication plants co-mingled primal and sub-primals during fabrication. Very small (*n*=134) fabrication plants co-mingle primal and subprimals during fabrication 59.7% of the time. Of the unknown plants (*n*=6) 50.0% co-mingle primal and sub-primals during fabrication. Plants were also asked, “Do you keep records documenting that co-mingling does not occur during fabrication?” Of the plants that responded, 9.1% of the large plants (*n*=11) stated they did keep records documenting that co-mingling does not occur during fabrication. Of small plants (*n*=59), 16.9% kept records documenting that co-mingling does not occur during fabrication. Ten and four tenths of very small plants (*n*=134) kept documentation that co-mingling does not occur during fabrication. None of the unknown size (*n*=6) were keeping records to indicate that co-mingling does not occur during fabrication.

Table A-7. Frequency of responses (%) by plant size for questions specific to plants involved in the fabrication of beef primals and subprimals

	Plant Size											
	Large (*n*=11)			Small (*n*=59)			Very Small (*n*=134)			Unknown (*n*=6)		
	Yes	No	Not sure	Yes	No	Not sure	Yes	No	Not sure	Yes	No	Not sure
Do you co-mingle primals and sub-primals during fabrication?	54.5	27.3	18.2	59.3	30.5	10.2	59.7	34.3	6.0	50.0	16.7	33.3
Do you Keep Records documenting that co-mingling does not occur during fabrication?	9.1	18.2	72.7	16.9	10.2	72.9	10.4	19.4	70.2	0	0	100.0

Intact steaks and roasts

The frequency for a single items used in the production of intact products by plant size are exhibited in Table A-8. The items used most frequently by the large plants (*n*=2) supplier specifications related to *E. coli* O157:H7 (50.0%), antimicrobial prior to use (50.0%), trimming (50.0%), and primal and subprimal testing for *E. coli* O157:H7 (50.0%). Small plants (*n*=78) utilized supplier specifications related to *E. coli* O157:H7 (87.2%), trim testing for *E. coli* O157:H7 (48.7%), and primal and subprimal testing for *E. coli* O157:H7 (37.2%) most often. Very small plants (*n*=183) most frequently used were supplier specifications related to *E. coli* O157:H7 (71.0%), trimming (44.8%), and trim testing for *E. coli* O157:H7 (43.2%). The plant of unknown size (*n*=4) selected items supplier specifications related to *E. coli* O157:H7 (50.5%), trim testing for *E. coli* O157:H7 (50.0%), trimming (25.0%), and primal and subprime testing for *E. coli* O157:H7 (25.0%).

Table A-8. Frequency of responses (%) by plant size for single items used in the production of intact beef steaks and roasts

	Plant Size			
	Large (*n*=2)	Small (*n*=78)	Very Small (*n*=183)	Unknown (*n*=4)
Supplier specifications related to *E. coli* O157:H7	50.0	87.2	71.0	50.0
Antimicrobial prior to use	50.0	16.7	17.5	0.0
Trimming	50.0	30.8	44.8	25.0
Continuous belt sanitizing	0.0	2.6	1.6	0.0
Periodic belt sanitizing	0.0	9.0	5.5	0.0
Primal and subprimal testing for *E. coli* O157:H7	50.0	37.2	19.1	25.0
Trim testing for *E. coli* O157:H7	0.0	48.7	43.2	50.0

Table A-9 displays two item combinations for the production of intact products. Large plants (*n*=2) most popular used two item combinations were supplier specifications related to *E. coli* O157:H7 × trimming (50.0%), antimicrobial prior to use × trimming (50.0%), antimicrobial prior to use × trim testing for *E. coli* O157:H7 (50.0%), and trimming × trim testing for *E. coli* O157:H7 (50.0%). Small plants (n=78) most frequently used two item combinations were supplier specifications related to *E. coli* O157:H7 × trim testing for *E. coli* O157:H7 (41.0%), supplier specifications related to *E. coli* O157:H7 × primal and subprimal testing for *E. coli* O157:H7 (34.6%), and supplier specifications related to *E. coli* O157:H7 × trimming (26.9%). Very small plants (*n*=183) most frequently used supplier specifications related to *E. coli* O157:H7 × trimming (26.8%), supplier specifications related to *E. coli* O157:H7 × trim testing for *E. coli* O157:H7 (26.8%), and trimming × trim testing for *E. coli* O157:H7 (23.0%). Plants of unknown size (*n*=4) used specifications related to *E. coli* O157:H7 × trimming (25.0%), supplier specifications related to *E. coli* O157:H7 × primal and subprimal testing for *E. coli* O157:H7 (25.0%), supplier specifications related to *E. coli* O157:H7 × trim testing for *E. coli* O157:H7 (25.0%), and trimming × trim testing for *E. coli* O157:H7 (25.0%) most often.

Table A-9. Frequency of responses (%) by plant size for two-way beef item combinations used in the production of intact steaks and roasts

	Plant Size			
	Large (*n*=2)	Small (*n*=78)	Very Small (*n*=183)	Unknown (*n*=4)
Supplier specifications related to *E. coli* O157:H7 × antimicrobial prior to use	0.0	14.1	12.6	0.0
Supplier specifications related to *E. coli* O157:H7 × trimming	50.0	26.9	26.8	25.0
Supplier specifications related to *E. coli* O157:H7 × continuous belt sanitizing	0.0	2.6	0.0	0.0
Supplier specifications related to *E. coli* O157:H7 × periodic belt sanitizing	0.0	7.7	2.7	0.0
Supplier specifications related to *E. coli* O157:H7 × primal and subprimal testing for *E. coli* O157:H7	0.0	34.6	13.1	25.0
Supplier specifications related to *E. coli* O157:H7 × trim testing for *E. coli* O157:H7	0.0	41.0	26.8	25.0
Antimicrobial prior to use × trimming	50.0	7.7	9.3	0.0
Antimicrobial prior to use × continuous belt sanitizing	0.0	1.3	0.0	0.0
Antimicrobial prior to use × periodic belt sanitizing	0.0	5.1	0.0	0.0
Antimicrobial prior to use × primal and subprimal testing for *E. coli* O157:H7	0.0	7.7	2.2	0.0
Antimicrobial prior to use × trim testing for *E. coli* O157:H7	50.0	7.7	8.7	0.0
Trimming × continuous belt sanitizing	0.0	2.6	1.6	0.0
Trimming × periodic belt sanitizing	0.0	7.7	2.7	0.0
Trimming × primal and subprimal testing for *E. coli* O157:H7	0.0	18.0	9.8	0.0
Trimming × trim testing for *E. coli* O157:H7	50.0	19.2	23.0	25.0
Continuous belt sanitizing × periodic belt sanitizing	0.0	1.3	1.6	0.0
Continuous belt sanitizing × primal and subprimal testing for *E. coli* O157:H7	0.0	2.6	1.1	0.0
Continuous belt sanitizing × trim testing for *E. coli* O157:H7	0.0	2.6	1.6	0.0
Periodic belt sanitizing × primal and subprimal testing for *E. coli* O157:H7	0.0	6.4	2.2	0.0
Periodic belt sanitizing × trim testing for *E. coli* O157:H7	0.0	7.7	4.4	0.0
Primal and subprimal testinf for *E. coli* O157:H7 × trim testing for *E. coli* O157:H7	0.0	24.4	12.0	0.0

Frequency of responses (%) for three-intervention combinations used in the production of intact products by plant size can be seen in Table A-10. The only chosen three item-combination employed by large plants (*n*=2) was; antimicrobial prior to use × trimming × trim testing for *E. coli* O157:H7 (50.0%). Small plants (*n*=78) selected supplier specifications related to *E. coli* O157:H7 × primal and subprimal testing for *E. coli* O157:H7 × trim testing for *E. coli* O157:H7 (23.0%), supplier specifications related to *E. coli* O157:H7 × trimming × trim testing for *E. coli* O157:H7 (18.0%) and supplier specifications related to *E. coli* O157:H7 × trimming× primal and subprimal testing for *E. coli* O157:H7 (16.7%). Very small plants (*n*=183) chose supplier specifications related to *E. coli* O157:H7 × trimming × trim testing for *E. coli* O157:H7 (12.6%), trimming × primal and subprimal testing for *E. coli* O157:H7 × trim testing for *E. coli* O157:H7 (7.7%) and supplier specifications related to *E. coli* O157:H7 × primal and subprimal testing for *E. coli* O157:H7 × trim testing for *E. coli* O157:H7 (7.1%). Plants of unknown size (*n*=4) selected supplier specifications related to *E. coli* O157:H7 × trimming × trim testing for *E. coli* O157:H7 (25.0%).

Table A-10. Frequency of responses (%) by plant size for three-way item combinations used in production of intact steaks and roasts

	Plant Size			
	Large (*n*=2)	Small (*n*=78)	Very Small (*n*=183)	Unknown (*n*=4)
Supplier specifications related to *E. coli* O157:H7 × antimicrobial prior to use × trimming	0.0	6.4	6.0	0.0
Supplier specifications related to *E. coli* O157:H7 × antimicrobial prior to use × continuous belt sanitizing	0.0	1.3	0.0	0.0
Supplier specifications related to *E. coli* O157:H7 × antimicrobial prior to use × periodic belt sanitizing	0.0	3.9	0.0	0.0
Supplier specifications related to *E. coli* O157:H7 × antimicrobial prior to use × primal and subprimal testing for *E. coli* O157:H7	0.0	6.4	1.6	0.0
Supplier specifications related to *E. coli* O157:H7 × antimicrobial prior to use × trim testing for *E. coli* O157:H7	0.0	5.1	6.0	0.0
Supplier specifications related to *E. coli* O157:H7 × trimming × continuous belt sanitizing	0.0	2.6	0.0	0.0
Supplier specifications related to *E. coli* O157:H7 × trimming × periodic belt sanitizing	0.0	7.7	0.6	0.0
Supplier specifications related to *E. coli* O157:H7 × trimming × primal and subprimal testing for *E. coli* O157:H7	0.0	16.7	4.9	0.0
Supplier specifications related to *E. coli* O157:H7 × trimming × trim testing for *E. coli* O157:H7	0.0	18.0	12.6	25.0
Supplier specifications related to *E. coli* O157:H7 × continuous belt sanitizing × periodic belt sanitizing	0.0	1.3	0.0	0.0
Supplier specifications related to *E. coli* O157:H7 × continuous belt sanitizing × primal and subprimal testing for *E. coli* O157:H7	0.0	2.6	0.0	0.0
Supplier specifications related to *E. coli* O157:H7 × continuous belt sanitizing × trim testing for *E. coli* O157:H7	0.0	2.6	0.0	0.0
Supplier specifications related to *E. coli* O157:H7 × periodic belt sanitizing × primal and subprimal testing for *E. coli* O157:H7	0.0	6.4	0.0	0.0
Supplier specifications related to *E. coli* O157:H7 × periodic belt sanitizing × trim testing for *E. coli* O157:H7	0.0	6.4	1.6	0.0

Table A-10. Continued

	Plant Size			
	Large (*n*=2)	Small (*n*=78)	Very Small (*n*=183)	Unknown (*n*=4)
Supplier specifications related to *E. coli* O157:H7 × primal and subprimal testing for *E. coli* O157:H7 × trim testing for *E. coli* O157:H7	0.0	23.1	7.1	0.0
Antimicrobial prior to use × trimming × continuous belt sanitizing	0.0	1.3	0.0	0.0
Antimicrobial prior to use × trimming × periodic belt sanitizing	0.0	3.9	0.0	0.0
Antimicrobial prior to use × trimming × primal and subprimal testing for *E. coli* O157:H7	0.0	6.4	1.6	0.0
Antimicrobial prior to use × trimming × trim testing for *E. coli* O157:H7	50.0	6.4	4.9	0.0
Antimicrobial prior to use × continuous belt sanitizing × periodic belt sanitizing	0.0	1.3	0.0	0.0
Antimicrobial prior to use × continuous belt sanitizing × primal and subprimal testing for *E. coli* O157:H7	0.0	1.3	0.0	0.0
Antimicrobial prior to use × continuous belt sanitizing × trim testing for *E. coli* O157:H7	0.0	1.3	0.0	0.0
Antimicrobial prior to use × periodic belt sanitizing × primal and subprimal testing for *E. coli* O157:H7	0.0	3.9	0.0	0.0
Antimicrobial prior to use × periodic belt sanitizing × trim testing for *E. coli* O157:H7	0.0	3.9	0.0	0.0
Antimicrobial prior to use × primal and subprimal testing for *E. coli* O157:H7 × trim testing for *E. coli* O157:H7	0.0	5.1	2.2	0.0
Trimming × continuous belt sanitizing × periodic belt sanitizing	0.0	1.3	1.6	0.0
Trimming × continuous belt sanitizing × primal and subprimal testing for *E. coli* O157:H7	0.0	2.6	1.1	0.0
Trimming × continuous belt sanitizing × trim testing for *E. coli* O157:H7	0.0	2.6	1.6	0.0
Trimming × periodic belt sanitizing × Pprimal and subprimal testing for *E. coli* O157:H7	0.0	6.4	1.6	0.0
Trimming × periodic belt sanitizing × trim testing for *E. coli* O157:H7	0.0	6.4	2.7	0.0
Trimming × primal and subprimal testing for *E. coli* O157:H7 × trim testing for *E. coli* O157:H7	0.0	12.8	7.7	0.0
Continuous belt sanitizing × periodic belt sanitizing × primal and subprimal testing for *E. coli* O157:H7	0.0	1.3	1.1	0.0

Table A-10. Continued

	Plant Size			
	Large (*n*=2)	Small (*n*=78)	Very Small (*n*=183)	Unknown (*n*=4)
Continuous belt sanitizing × periodic belt sanitizing × trim testing for *E. coli* O157:H7	0.0	1.3	1.6	0.0
Continuous belt sanitizing × primal and subprimal testing for *E. coli* O157:H7 × trim testing for *E. coli* O157:H7	0.0	2.6	1.1	0.0
Periodic belt sanitizing × primal and subprimal testing for *E. coli* O157:H7 × trim testing for *E. coli* O157:H7	0.0	5.1	2.2	0.0

Marinated/enhanced steaks and roasts

Table A-11 contains the frequency of responses (%) for single item used in the production of marinated/enhanced products. The most frequently used items were supplier specifications related to *E. coli* O157:H7 (66.7%), antimicrobial applied prior to trimming (66.7%), antimicrobial applied post trimming (66.7%), and partial trim (66.7%) in large plants (*n*=3). The most commonly selected single itemss among the small plants (*n*=46) were supplier specifications related to *E. coli* O157:H7 (89.1%), trim testing for *E. coli* O157:H7 (39.1%), and primal and subprimal testing for *E. coli* O157:H7 (30.4%). The very small plants (*n*=35) chose supplier specifications related to *E. coli* O157:H7 (80.0%), partial trim (37.1%) and antimicrobial applied prior to trimming (34.3%) most often. There were no responses from plant of unknown size for this category.

Table A-11. Frequency of responses (%) by plant size for single itemss used in the production of marinated/enhanced products

	Plant Size		
	Large (*n*=3)	Small (*n*=46)	Very Small (*n*=35)
Supplier specifications related to *E. coli* O157:H7	66.7	89.1	80.0
Purchase only products with negative *E. coli* O157:H7 test	33.3	13.0	17.1
Antimicrobial applied prior to trimming	66.7	15.2	34.3
Antimicrobial applied post trimming	66.7	4.4	11.4
Partial trim	66.7	28.3	37.1
Complete trim	0.0	15.2	17.1
Continuous belt sanitizing	33.3	6.5	0.0
Periodic belt sanitizing	33.3	4.4	0.0
Primal and subprimal testing for *E. coli* O157:H7	0.0	30.4	22.9
Trim testing for *E. coli* O157:H7	33.3	39.1	28.6

Frequency of responses (%) for combinations of two items used in the production of marinated/enhanced products by plant size can be seen in Table A-12. Large plants (*n*=3) most frequently chose antimicrobial applied prior to trimming × antimicrobial applied post trimming (66.7%), antimicrobial applied prior to trimming × partial trim (66.7%), and antimicrobial applied post trimming × partial trim (66.7%). Small plants selected specifications related to *E. coli* O157:H7 × trim testing for *E. coli* O157:H7 (32.6%), specifications related to *E. coli* O157:H7 × primal and subprimal testing for *E. coli* O157:H7 (28.3%), and supplier specifications related to *E. coli* O157:H7 × partial trim (26.1%) most often. Very small plants (*n*=35) most frequently used supplier specifications related to *E. coli* O157:H7 × partial trim (31.4%), supplier specifications related to *E. coli* O157:H7 × antimicrobial applied prior to trimming (28.6%) and supplier specifications related to *E. coli* O157:H7 × trim testing for *E. coli* O157:H7 (25.7%). There were no responses from plant of unknown size for this category.

Table A-12. Frequency of responses (%) by plant size for two-way item combinations used in the production of marinated/enhanced products.

	Plant Size		
	Large (*n*=3)	Small (*n*=46)	Very Small (*n*=35)
Supplier specifications related to *E. coli* O157:H7 × purchase only products with negative *E. coli* O157:H7 test	33.3	13.0	14.3
Supplier specifications related to *E. coli* O157:H7 × antimicrobial applied prior to trimming	33.3	13.0	28.6
Supplier specifications related to *E. coli* O157:H7 × antimicrobial applied post trimming	33.3	4.4	8.6
Supplier specifications related to *E. coli* O157:H7 × partial trim	33.3	26.1	31.4
Supplier specifications related to *E. coli* O157:H7 × complete trim	0.0	15.2	14.3
Supplier specifications related to *E. coli* O157:H7 × continuous belt sanitizing	33.3	6.5	0.0
Supplier specifications related to *E. coli* O157:H7 × periodic belt sanitizing	33.3	4.4	0.0
Supplier specifications related to *E. coli* O157:H7 × primal and subprimal testing for *E. coli* O157:H7	0.0	28.3	22.9
Supplier specifications related to *E. coli* O157:H7 × trim testing for *E. coli* O157:H7	0.0	32.6	25.7
Purchase only products with negative *E. coli* O157:H7 test × antimicrobial applied prior to trimming	0.0	6.5	2.9
Purchase only products with negative *E. coli* O157:H7 test × partial trim	0.0	10.9	5.7
Purchase only products with negative *E. coli* O157:H7 test × complete trim	0.0	8.7	0.0
Purchase only products with negative *E. coli* O157:H7 test × continuous belt sanitizing	33.3	2.2	0.0
Purchase only products with negative *E. coli* O157:H7 test × periodic belt sanitizing	33.3	2.2	0.0
Purchase only products with negative *E. coli* O157:H7 test × primal and subprimal testing for *E. coli* O157:H7	0.0	13.0	0.0
Purchase only products with negative *E. coli* O157:H7 test × trim testing for *E. coli* O157:H7	0.0	4.4	5.7

Table A-12. Continued

	Plant Size		
	Large (*n*=3)	Small (*n*=46)	Very Small (*n*=35)
Antimicrobial applied prior to trimming × antimicrobial applied post trimming	66.7	2.2	5.7
Antimicrobial applied prior to trimming × partial trim	66.7	8.7	11.4
Antimicrobial applied prior to trimming × complete trim	0.0	4.4	8.6
Antimicrobial applied prior to trimming × continuous belt sanitizing	0.0	4.4	0.0
Antimicrobial applied prior to trimming × periodic belt sanitizing	0.0	2.2	0.0
Antimicrobial applied prior to trimming × primal and subprimal testing for *E. coli* O157:H7	0.0	8.7	14.3
Antimicrobial applied prior to trimming × trim testing for *E. coli* O157:H7	33.3	8.7	17.1
Antimicrobial applied post trimming × partial trim	66.7	2.2	2.9
Antimicrobial applied post trimming × complete trim	0.0	2.2	5.7
Antimicrobial applied post trimming × primal and subprimal testing for *E. coli* O157:H7	0.0	0.0	8.6
Antimicrobial applied post trimming × trim testing for *E. coli* O157:H7	33.3	0.0	2.9
Partial trim × complete trim	0.0	10.9	8.6
Partial trim × periodic belt sanitizing	0.0	2.2	0.0
Partial trim × primal and subprimal testing for *E. coli* O157:H7	0.0	15.2	8.6
Partial trim × trim testing for *E. coli* O157:H7	33.3	10.9	14.3
Complete trim × primal and subprimal testing for *E. coli* O157:H7	0.0	8.7	11.4
Complete trim × trim testing for *E. coli* O157:H7	0.0	6.5	8.6
Continuous belt sanitizing × periodic belt sanitizing	33.3	0.0	0.0
Continuous belt sanitizing × primal and subprimal testing for *E. coli* O157:H7	0.0	2.2	0.0
Continuous belt sanitizing × trim testing for *E. coli* O157:H7	0.0	2.2	0.0
Periodic belt sanitizing × primal and subprimal testing for *E. coli* O157:H7	0.0	2.2	0.0
Periodic belt sanitizing × trim testing for *E. coli* O157:H7	0.0	2.2	0.0
Primal and subprimal testing for *E. coli* O157:H7 × trim testing for *E. coli* O157:H7	0.0	15.2	17.1

Table A-13 displays the frequency of responses (%) for three-item combinations used in the production of marinated/enhanced products. Large plants (*n*=3) most frequently used combination was antimicrobial applied prior to trimming × antimicrobial applied post trimming × partial trim (66.7%). Small plants (*n*=46) most commonly employed supplier specifications related to *E. coli* O157:H7 × partial trim × primal and subprimal testing for *E. coli* O157:H7 (13.0%), supplier specifications related to *E. coli* O157:H7 × purchase only products with negative *E. coli* O157:H7 × primal and subprimal testing for *E. coli* O157:H7 (13.0%), and supplier specifications related to *E. coli* O157:H7 × primal and subprimal testing for *E. coli* O157:H7 × trim testing for *E. coli* O157:H7(13.0%). Very small plants (*n*=35) used supplier specifications related to *E. coli* O157:H7 × antimicrobial applied prior to trimming × trim testing for *E. coli* O157:H7 (17.1%), supplier specifications related to *E. coli* O157:H7 × primal and subprimal testing for *E. coli* O157:H7 × trim testing for *E. coli* O157:H7 (17.1%), and supplier specifications related to *E. coli* O157:H7 × applied prior to trimming × primal and subprimal testing for *E. coli* O157:H7 (14.3%). There were no responses from plants of unknown size for this category.

Table A-13. Frequency of responses (%) by plant size for three-way beef item combinations used in the production of marinated/enhanced products

	Plant Size		
	Large (*n*=3)	Small (*n*=46)	Very Small (*n*=35)
Supplier specifications related to *E. coli* O157:H7 × antimicrobial applied prior to trimming × Periodic belt sanitizing	0.0	2.2	0.0
Supplier specifications related to *E. coli* O157:H7 × antimicrobial applied prior to trimming × primal and subprimal testing for *E. coli* O157:H7	0.0	6.5	14.3
Supplier specifications related to *E. coli* O157:H7 × antimicrobial applied prior to trimming × trim testing for *E. coli* O157:H7	0.0	6.5	17.1
Supplier specifications related to *E. coli* O157:H7 × antimicrobial applied post trimming × partial trim	33.3	2.2	2.9
Supplier specifications related to *E. coli* O157:H7 × antimicrobial applied post trimming × complete trim	0.0	2.2	5.7
Supplier specifications related to *E. coli* O157:H7 × antimicrobial applied post trimming × continuous belt sanitizing	0.0	0.0	0.0
Supplier specifications related to *E. coli* O157:H7 × antimicrobial applied post trimming × periodic belt sanitizing	0.0	0.0	0.0
Supplier specifications related to *E. coli* O157:H7 × antimicrobial applied post trimming × primal and subprimal testing for *E. coli* O157:H7	0.0	0.0	8.6
Supplier specifications related to *E. coli* O157:H7 × antimicrobial applied post trimming × trim testing for *E. coli* O157:H7	0.0	2.2	2.9
Supplier specifications related to *E. coli* O157:H7 × partial trim × complete trim	0.0	10.9	8.6
Supplier specifications related to *E. coli* O157:H7 × partial trim × continuous belt sanitizing	0.0	0.0	0.0
Supplier specifications related to *E. coli* O157:H7 × partial trim × periodic belt sanitizing	0.0	2.2	0.0
Supplier specifications related to *E. coli* O157:H7 × partial trim × primal and subprimal testing for *E. coli* O157:H7	0.0	13.0	8.6
Supplier specifications related to *E. coli* O157:H7 × partial trim × trim testing for *E. coli* O157:H7	0.0	8.7	11.4

Table 13-A. Continued

	Plant Size		
	Large (*n*=3)	Small (*n*=46)	Very Small (*n*=35)
Supplier specifications related to *E. coli* O157:H7 × Purchase only products with negative *E. coli* O157:H7 test × antimicrobial applied prior to trimming	0.0	6.5	2.9
Supplier specifications related to *E. coli* O157:H7 × purchase only products with negative *E. coli* O157:H7 test × partial trim	0.0	10.9	5.7
Supplier specifications related to *E. coli* O157:H7 × purchase only products with negative *E. coli* O157:H7 test × complete trim	0.0	8.7	0.0
Supplier specifications related to *E. coli* O157:H7 × purchase only products with negative *E. coli* O157:H7 test × continuous belt sanitizing	33.3	2.2	0.0
Supplier specifications related to *E. coli* O157:H7 × purchase only products with negative *E. coli* O157:H7 test × periodic belt sanitizing	33.3	2.2	0.0
Supplier specifications related to *E. coli* O157:H7 × purchase only products with negative *E. coli* O157:H7 test × primal and subprimal testing for *E. coli* O157:H7	0.0	13.0	0.0
Supplier specifications related to *E. coli* O157:H7 × purchase only products with negative *E. coli* O157:H7 test × trim testing for *E. coli* O157:H7	0.0	4.4	5.7
Supplier specifications related to *E. coli* O157:H7 × antimicrobial applied prior to trimming × antimicrobial applied post trimming	33.3	2.2	2.9
Supplier specifications related to *E. coli* O157:H7 × antimicrobial applied prior to trimming × partial trim	33.3	6.5	11.4
Supplier specifications related to *E. coli* O157:H7 × antimicrobial applied prior to trimming × complete trim	0.0	4.4	8.6
Supplier specifications related to *E. coli* O157:H7 × antimicrobial applied prior to trimming × continuous belt sanitizing	0.0	4.4	0.0

Table 13-A. Continued

	Plant Size		
	Large (*n*=3)	Small (*n*=46)	Very Small (*n*=35)
Supplier specifications related to *E. coli* O157:H7 × complete trim × primal and subprimal testing for *E. coli* O157:H7	0.0	8.7	11.4
Supplier specifications related to *E. coli* O157:H7 × complete trim × trim testing for *E. coli* O157:H7	0.0	6.5	8.6
Supplier specifications related to *E. coli* O157:H7 × continuous belt sanitizing × periodic belt sanitizing	33.3	0.0	0.0
Supplier specifications related to *E. coli* O157:H7 × continuous belt sanitizing × primal and subprimal testing for *E. coli* O157:H7	0.0	2.2	0.0
Supplier specifications related to *E. coli* O157:H7 × continuous belt sanitizing × trim testing for *E. coli* O157:H7	0.0	2.2	0.0
Supplier specifications related to *E. coli* O157:H7 × periodic belt sanitizing × primal and subprimal testing for *E. coli* O157:H7	0.0	2.2	0.0
Supplier specifications related to *E. coli* O157:H7 × periodic belt sanitizing × trim testing for *E. coli* O157:H7	0.0	2.2	0.0
Supplier specifications related to *E. coli* O157:H7 × primal and subprimal testing for *E. coli* O157:H7 × trim testing for *E. coli* O157:H7	33.3	13.0	17.1
Purchase only products with negative *E. coli* O157:H7 test × antimicrobial applied prior to trimming × partial trim	0.0	4.4	0.0
Purchase only products with negative *E. coli* O157:H7 test × antimicrobial applied prior to trimming × complete trim	0.0	2.2	0.0
Purchase only products with negative *E. coli* O157:H7 test × antimicrobial applied prior to trimming × continuous belt sanitizing	0.0	2.2	0.0
Purchase only products with negative *E. coli* O157:H7 test × antimicrobial applied prior to trimming × periodic belt sanitizing	0.0	2.2	0.0

Table 13-A. Continued

	Plant Size		
	Large (*n*=3)	Small (*n*=46)	Very Small (*n*=35)
Purchase only products with negative *E. coli* O157:H7 test × antimicrobial applied prior to trimming × primal and subprimal testing for *E. coli* O157:H7	0.0	6.5	0.0
Purchase only products with negative *E. coli* O157:H7 test × antimicrobial applied prior to trimming × trim testing for *E. coli* O157:H7	0.0	2.2	2.9
Purchase only products with negative *E. coli* O157:H7 test × partial trim × complete trim	0.0	8.7	0.0
Purchase only products with negative *E. coli* O157:H7 test × partial trim × continuous belt sanitizing	0.0	0.0	0.0
Purchase only products with negative *E. coli* O157:H7 test × partial trim × periodic belt sanitizing	0.0	2.2	0.0
Purchase only products with negative *E. coli* O157:H7 test × partial trim × primal and subprimal testing for *E. coli* O157:H7	0.0	10.9	0.0
Purchase only products with negative *E. coli* O157:H7 test × partial trim × trim testing for *E. coli* O157:H7	0.0	4.4	2.9
Purchase only products with negative *E. coli* O157:H7 test × complete trim × primal and subprimal testing for *E. coli* O157:H7	0.0	8.7	0.0
Purchase only products with negative *E. coli* O157:H7 test × complete trim × trim testing for *E. coli* O157:H7	0.0	4.4	0.0
Purchase only products with negative *E. coli* O157:H7 test × continuous belt sanitizing × periodic belt sanitizing	33.3	0.0	0.0
Purchase only products with negative *E. coli* O157:H7 test × continuous belt sanitizing × primal and subprimal testing for *E. coli* O157:H7	0.0	2.2	0.0
Purchase only products with negative *E. coli* O157:H7 test × periodic belt sanitizing × primal and subprimal testing for *E. coli* O157:H7	0.0	2.2	0.0
Purchase only products with negative *E. coli* O157:H7 test × primal and subprimal testing for *E. coli* O157:H7 × Trim testing for *E. coli* O157:H7	0.0	4.4	0.0
Antimicrobial applied prior to trimming × antimicrobial applied post trimming × partial trim	66.7	2.2	0.0

Table 13-A. Continued

	Plant Size		
	Large (*n*=3)	Small (*n*=46)	Very Small (*n*=35)
Antimicrobial applied prior to trimming × antimicrobial applied post trimming × complete trim	0.0	2.2	0.0
Antimicrobial applied prior to trimming × antimicrobial applied post trimming × primal and subprimal testing for *E. coli* O157:H7	0.0	0.0	2.9
Antimicrobial applied prior to trimming × antimicrobial applied post trimming × trim testing for *E. coli* O157:H7	33.3	2.2	0.0
Antimicrobial applied prior to trimming × partial trim × complete trim	0.0	4.4	2.9
Antimicrobial applied prior to trimming × partial trim × periodic belt sanitizing	0.0	2.2	0.0
Antimicrobial applied prior to trimming × partial trim × primal and subprimal testing for *E. coli* O157:H7	0.0	6.5	5.7
Antimicrobial applied prior to trimming × partial trim × trim testing for *E. coli* O157:H7	33.3	6.5	8.6
Antimicrobial applied prior to trimming × complete trim × primal and subprimal testing for *E. coli* O157:H7	0.0	2.2	5.7
Antimicrobial applied prior to trimming × complete trim × trim testing for *E. coli* O157:H7	0.0	4.4	5.7
Antimicrobial applied prior to trimming × continuous belt sanitizing × primal and subprimal testing for *E. coli* O157:H7	0.0	2.2	0.0
Antimicrobial applied prior to trimming × continuous belt sanitizing × trim testing for *E. coli* O157:H7	0.0	2.2	0.0
Antimicrobial applied prior to trimming × periodic belt sanitizing × primal and subprimal testing for *E. coli* O157:H7	0.0	2.2	0.0
Antimicrobial applied prior to trimming × primal and subprimal testing for *E. coli* O157:H7 × trim testing for *E. coli* O157:H7	0.0	4.4	11.4
Antimicrobial applied post trimming × partial trim × complete trim	0.0	2.2	2.9
Antimicrobial applied post trimming × partial trim × primal and subprimal testing for *E. coli* O157:H7	0.0	0.0	2.9

Table 13-A. Continued

	Plant Size		
	Large (*n*=3)	Small (*n*=46)	Very Small (*n*=35)
Antimicrobial applied post trimming × partial trim × trim testing for *E. coli* O157:H7	33.3	2.2	0.0
Antimicrobial applied post trimming × complete trim × primal and subprimal testing for *E. coli* O157:H7	0.0	0.0	5.7
Antimicrobial applied post trimming × complete trim × trim testing for *E. coli* O157:H7	0.0	2.2	2.9
Antimicrobial applied post trimming × primal and subprimal testing for *E. coli* O157:H7 × trim testing for *E. coli* O157:H7	0.0	0.0	2.9
Antimicrobial applied post trimming × complete trim × periodic belt sanitizing	0.0	8.7	0.0
Antimicrobial applied post trimming × complete trim × primal and subprimal testing for *E. coli* O157:H7	0.0	6.5	0.0
Antimicrobial applied post trimming × periodic belt sanitizing × primal and subprimal testing for *E. coli* O157:H7	0.0	2.2	0.0
Antimicrobial applied post trimming × primal and subprimal testing for *E. coli* O157:H7 × trim testing for *E. coli* O157:H7	0.0	6.5	0.0
Partial trim × complete trim × primal and subprimal testing for *E. coli* O157:H7	0.0	0.0	5.7
Partial trim × complete trim × trim testing for *E. coli* O157:H7	0.0	0.0	2.9
Partial trim × primal and subprimal testing for *E. coli* O157:H7 × trim testing for *E. coli* O157:H7	0.0	0.0	5.7
Complete trim × primal and subprimal testing for *E. coli* O157:H7 × trim testing for *E. coli* O157:H7	0.0	4.4	8.6

Needle/blade tenderized steaks and roasts

Frequency of responses (%) for single items used in the production of needle/blade tenderized products are seen in Table A-14. Large plants (*n*=2) most commonly used antimicrobial applied prior to trimming (100.0%), antimicrobial applied post trimming (100.0%), and partial trim (100.0%). Supplier specifications related to *E. coli* O157:H7 (90.7%), primal and subprimal testing for *E. coli* O157:H7 (38.9%) and trim testing for *E. coli* O157:H7 (37.0%) were the most often used single interventions by small plants (*n*=54). Very small plants (*n*=88) most frequently used supplier specifications related to *E. coli* O157:H7 (73.9%), trim testing for *E. coli* O157:H7 (37.5%) and partial trim (26.1%). The one plant of unknown size used supplier specifications related to *E. coli* O157:H7 (100.0%), partial trim (100.0%), and trim testing for *E. coli* O157:H7 (100.0%).

Table A-14. Frequency of responses (%) by plant size for single items used in the production of needle/blade tenderized products

	Plant Size			
	Large (*n*=2)	Small (*n*=54)	Very Small (*n*=88)	Unknown (*n*=1)
Supplier specifications related to *E. coli* O157:H7	50.0	90.7	73.9	100.0
Purchase only products with negative *E. coli* O157:H7 test	0.0	13.0	17.1	0.0
Antimicrobial applied prior to trimming	100.0	24.1	23.9	0.0
Antimicrobial applied post trimming	100.0	0.0	6.8	0.0
Partial trim	100.0	24.1	26.1	100.0
Complete trim	0.0	18.5	22.7	0.0
Continuous belt sanitizing	0.0	3.7	1.1	0.0
Periodic belt sanitizing	0.0	7.4	5.7	0.0
Primal and subprimal testing for *E. coli* O157:H7	0.0	38.9	21.6	0.0
Trim testing for *E. coli* O157:H7	50.0	37.0	37.5	100.0

Table A-15 displays the frequency of responses (%) for two item combinations used in the production of needle/blade tenderized products. Within large plants (*n*=2), the most commonly employed two-item combinations were antimicrobial applied prior to trimming × trim testing for *E. coli* O157:H7 (50.0%), partial trim × trim testing for *E. coli* O157:H7 (50.0%), supplier specifications related to *E. coli* O157:H7 × antimicrobial applied prior to trimming (50.0%), supplier specifications related to *E. coli* O157:H7 × antimicrobial applied post trimming (50.0%), and supplier specifications related to *E. coli* O157:H7 × partial trim (50.0%). Small plants (*n*=54) utilized supplier specifications related to *E. coli* O157:H7 × primal and subprimal testing for *E. coli* O157:H7 (35.2%), supplier specifications related to *E. coli* O157:H7 × trim testing for *E. coli* O157:H7 (29.6%), and supplier specifications related to *E. coli* O157:H7 × partial trim (22.2%). Very small plants (*n*=88) chose to use supplier specifications related to *E. coli* O157:H7 × trim testing for *E. coli* O157:H7 (29.6%), supplier specifications related to *E. coli* O157:H7 × partial trim (20.5%), and supplier specifications related to *E. coli* O157:H7 × primal and subprimal testing for *E. coli* O157:H7 (19.3%) The single plant of unknown size used the combination of supplier specifications related to *E. coli* O157:H7 × partial trim (100.0%).

Table A-15. Frequency of responses (%) by plant size for two-way beef item combinations used in the production of needle/blade tenderized products

	Plant Size			
	Large (*n*=2)	Small (*n*=54)	Very Small (*n*=88)	Unknown (*n*=1)
Antimicrobial applied prior to trimming × antimicrobial applied post trimming	0.0	0.0	2.3	0.0
Antimicrobial applied prior to trimming × partial trim	0.0	13.0	6.8	0.0
Antimicrobial applied prior to trimming × complete trim	0.0	7.4	4.6	0.0
Antimicrobial applied prior to trimming × continuous belt sanitizing	0.0	1.9	0.0	0.0
Antimicrobial applied prior to trimming × periodic belt sanitizing	0.0	3.7	0.0	0.0
Antimicrobial applied prior to trimming × primal and subprimal testing for *E. coli* O157:H7	0.0	13.0	6.8	0.0
Antimicrobial applied prior to trimming × trim testing for *E. coli* O157:H7	0.0	11.1	6.8	0.0
Antimicrobial applied post trimming × partial trim	0.0	0.0	2.3	0.0
Antimicrobial applied post trimming × complete trim	0.0	0.0	1.1	0.0
Antimicrobial applied post trimming × periodic belt sanitizing	0.0	0.0	1.1	0.0
Antimicrobial applied post trimming × trim testing for *E. coli* O157:H7	50.0	0.0	1.1	0.0
Partial trim × complete trim	0.0	7.4	8.0	0.0
Partial trim × continuous belt sanitizing	0.0	1.9	1.1	0.0
Partial trim × periodic belt sanitizing	0.0	3.7	4.6	0.0
Partial trim × primal and subprimal testing for *E. coli* O157:H7	0.0	13.0	5.7	0.0
Partial trim × trim testing for *E. coli* O157:H7	50.0	13.0	10.2	100.0
Complete trim × periodic belt sanitizing	0.0	3.7	2.3	0.0
Complete trim × primal and subprimal testing for *E. coli* O157:H7	0.0	11.1	8.0	0.0
Complete trim × trim testing for *E. coli* O157:H7	0.0	7.4	11.4	0.0
Continuous belt sanitizing × periodic belt sanitizing	0.0	0.0	1.1	0.0
Continuous belt sanitizing × primal and subprimal testing for *E. coli* O157:H7	0.0	3.7	0.0	0.0

Table 15-A. Continued

	Plant Size			
	Large (*n*=2)	Small (*n*=54)	Very Small (*n*=88)	Unknown (*n*=1)
Continuous belt sanitizing × Trim testing for *E. coli* O157:H7	0.0	1.9	1.1	0.0
Periodic belt sanitizing × primal and subprimal testing for *E. coli* O157:H7	0.0	3.7	1.1	0.0
Periodic belt sanitizing × trim testing for *E. coli* O157:H7	0.0	3.7	2.3	0.0
Primal and subprimal testing for *E. coli* O157:H7 × trim testing for *E. coli* O157:H7	0.0	16.7	11.4	0.0
Supplier specifications related to *E. coli* O157:H7 × purchase only products with negative *E. coli* O157:H7 test	0.0	11.1	15.9	0.0
Supplier specifications related to *E. coli* O157:H7 × antimicrobial applied prior to trimming	50.0	20.4	17.1	0.0
Supplier specifications related to *E. coli* O157:H7 × antimicrobial applied post trimming	50.0	0.0	4.6	0.0
Supplier specifications related to *E. coli* O157:H7 × partial trim	50.0	22.2	20.5	100.0
Supplier specifications related to *E. coli* O157:H7 × complete trim	0.0	18.5	15.9	0.0
Supplier specifications related to *E. coli* O157:H7 × continuous belt sanitizing	0.0	3.7	1.1	0.0
Supplier specifications related to *E. coli* O157:H7 × periodic belt sanitizing	0.0	7.4	5.7	0.0
Supplier specifications related to *E. coli* O157:H7 × primal and subprimal testing for *E. coli* O157:H7	0.0	35.2	19.3	0.0
Supplier specifications related to *E. coli* O157:H7 × trim testing for *E. coli* O157:H7	0.0	29.6	29.6	0.0
Purchase only products with negative *E. coli* O157:H7 test × antimicrobial applied prior to trimming	0.0	5.6	3.4	0.0
Purchase only products with negative *E. coli* O157:H7 test × antimicrobial applied post trimming	0.0	0.0	2.3	0.0
Purchase only products with negative *E. coli* O157:H7 test × partial trim	0.0	3.7	5.7	0.0
Purchase only products with negative *E. coli* O157:H7 test × complete trim	0.0	7.4	4.6	0.0

Table 15-A. Continued

	Plant Size			
	Large (*n*=2)	Small (*n*=54)	Very Small (*n*=88)	Unknown (*n*=1)
Purchase only products with negative *E. coli* O157:H7 test × continuous belt sanitizing	0.0	1.9	0.0	0.0
Purchase only products with negative *E. coli* O157:H7 test × periodic belt sanitizing	0.0	1.9	1.1	0.0
Purchase only products with negative *E. coli* O157:H7 test × primal and subprimal testing for *E. coli* O157:H7	0.0	11.1	5.7	0.0
Purchase only products with negative *E. coli* O157:H7 test × trim testing for *E. coli* O157:H7	0.0	0.0	9.1	0.0

In table A-16, the frequency of responses (%) for three item combinations used in the production of needle/blade tenderized products can be found. For large plants (*n*=2), the most frequently used three item combinations were antimicrobial applied prior to trimming × antimicrobial applied post trimming × partial trim (100.0%), supplier specifications related to *E. coli* O157:H7 × antimicrobial applied post trimming × partial trim (50.0%), antimicrobial applied prior to trimming × antimicrobial applied post trimming × trim testing for *E. coli* O157:H7 (50.0%), antimicrobial applied prior to trimming × partial trim × trim testing for *E. coli* O157:H7 (50.0%), and antimicrobial applied post trimming × partial trim × trim testing for *E. coli* O157:H7 (50.0%). Small plants (*n*=54) most commonly selected supplier specifications related to *E. coli* O157:H7 × primal and subprimal testing for *E. coli* O157:H7× trim testing for *E. coli* O157:H7 (13.0%), supplier specifications related to *E. coli* O157:H7 × purchase only products

with negative *E. coli* O157:H7 test × primal and subprimal testing for *E. coli* O157:H7 (11.1%), supplier specifications related to *E. coli* O157:H7 × antimicrobial applied prior to trimming × partial trim (11.1%), supplier specifications related to *E. coli* O157:H7 × partial trim × primal and subprimal testing for *E. coli* O157:H7(11.1%), supplier specifications related to *E. coli* O157:H7 × partial × trim testing for *E. coli* O157:H7 (11.1%), supplier specifications related to *E. coli* O157:H7 trim × complete trim × primal and subprimal testing for *E. coli* O157:H7 (11.1%). Very small plants (*n*=88), utilized supplier specifications related to *E. coli* O157:H7 × partial × trim testing for *E. coli* O157:H7 (10.2%), supplier specifications related to *E. coli* O157:H7 × primal and subprimal testing for *E. coli* O157:H7× trim testing for *E. coli* O157:H7 (10.2%), supplier specifications related to *E. coli* O157:H7 × purchase only products with negative *E. coli* O157:H7 test × primal and subprimal testing for *E. coli* O157:H7 (9.1%). The one plant of unknown size used supplier specifications related to *E. coli* O157:H7 × partial × trim testing for *E. coli* O157:H7 (100.0%).

Table A-16. Frequency of responses (%) by plant size for three-way item combinations used in the production of needle/blade tenderized products

	Plant Size			
	Large (*n*=2)	Small (*n*=54)	Very Small (*n*=88)	Unknown (*n*=1)
Supplier specifications related to *E. coli* O157:H7 × purchase only products with negative *E. coli* O157:H7 test × antimicrobial applied prior to trimming	0.0	5.6	3.4	0.0
Supplier specifications related to *E. coli* O157:H7 × purchase only products with negative *E. coli* O157:H7 test × antimicrobial applied post trimming	0.0	0.0	2.3	0.0
Supplier specifications related to *E. coli* O157:H7 × purchase only products with negative *E. coli* O157:H7 test × partial trim	0.0	3.7	5.7	0.0
Supplier specifications related to *E. coli* O157:H7 × purchase only products with negative *E. coli* O157:H7 test × complete trim	0.0	7.4	4.6	0.0
Supplier specifications related to *E. coli* O157:H7 × purchase only products with negative *E. coli* O157:H7 test × continuous belt sanitizing	0.0	1.9	0.0	0.0
Supplier specifications related to *E. coli* O157:H7 × purchase only products with negative *E. coli* O157:H7 test × periodic belt sanitizing	0.0	1.9	1.1	0.0
Supplier specifications related to *E. coli* O157:H7 × purchase only products with negative *E. coli* O157:H7 test × primal and subprimal testing for *E. coli* O157:H7	0.0	11.1	5.7	0.0
Supplier specifications related to *E. coli* O157:H7 × purchase only products with negative *E. coli* O157:H7 test × trim testing for *E. coli* O157:H7	0.0	0.0	9.1	0.0
Supplier specifications related to *E. coli* O157:H7 × antimicrobial prior to trimming × antimicrobial applied post trimming	0.0	0.0	1.1	0.0
Supplier specifications related to *E. coli* O157:H7 × antimicrobial applied prior to trimming × partial trim	0.0	11.1	4.6	0.0
Supplier specifications related to *E. coli* O157:H7 × antimicrobial applied prior to trimming × complete trim	0.0	7.4	3.4	0.0
Supplier specifications related to *E. coli* O157:H7 × antimicrobial applied prior to trimming × continuous belt sanitizing	0.0	1.9	0.0	0.0

Table A-16. Continued

	Plant Size			
	Large (*n*=2)	Small (*n*=54)	Very Small (*n*=88)	Unknown (*n*=1)
Supplier specifications related to *E. coli* O157:H7 × antimicrobial applied prior to trimming × periodic belt sanitizing	0.0	3.7	0.0	0.0
Supplier specifications related to *E. coli* O157:H7 × antimicrobial applied prior to trimming × primal and subprimal testing for *E. coli* O157:H7	0.0	9.3	6.8	0.0
Supplier specifications related to *E. coli* O157:H7 × antimicrobial applied prior to trimming × trim testing for *E. coli* O157:H7	0.0	7.4	6.8	0.0
Supplier specifications related to *E. coli* O157:H7 × antimicrobial applied post trimming × partial trim	50.0	0.0	2.3	0.0
Supplier specifications related to *E. coli* O157:H7 × antimicrobial applied post trimming × complete trim	0.0	0.0	1.1	0.0
Supplier specifications related to *E. coli* O157:H7 × antimicrobial applied post trimming × periodic belt sanitizing	0.0	0.0	1.1	0.0
Supplier specifications related to *E. coli* O157:H7 × antimicrobial applied post trimming × trim testing for *E. coli* O157:H7	0.0	0.0	1.1	0.0
Supplier specifications related to *E. coli* O157:H7 × partial trim × complete trim	0.0	7.4	6.8	0.0
Supplier specifications related to *E. coli* O157:H7 × partial trim × continuous belt sanitizing	0.0	1.9	1.1	0.0
Supplier specifications related to *E. coli* O157:H7 × partial trim × periodic belt sanitizing	0.0	3.7	4.6	0.0
Supplier specifications related to *E. coli* O157:H7 × partial trim × primal and subprimal testing for *E. coli* O157:H7	0.0	11.1	5.7	0.0
Supplier specifications related to *E. coli* O157:H7 × partial trim × trim testing for *E. coli* O157:H7	0.0	11.1	10.2	100.0
Supplier specifications related to *E. coli* O157:H7 × complete trim × periodic belt sanitizing	0.0	3.7	2.3	0.0
Supplier specifications related to *E. coli* O157:H7 × complete trim × primal and subprimal testing for *E. coli* O157:H7	0.0	11.1	6.8	0.0

Table A-16. Continued

	Plant Size			
	Large (*n*=2)	Small (*n*=54)	Very Small (*n*=88)	Unknown (*n*=1)
Supplier specifications related to *E. coli* O157:H7 × complete trim × trim testing for *E. coli* O157:H7	0.0	7.4	9.1	0.0
Supplier specifications related to *E. coli* O157:H7 × continuous belt sanitizing × periodic belt sanitizing	0.0	0.0	1.1	0.0
Supplier specifications related to *E. coli* O157:H7 × continuous belt sanitizing × primal and subprimal testing for *E. coli* O157:H7	0.0	3.7	0.0	0.0
Supplier specifications related to *E. coli* O157:H7 × continuous belt sanitizing × trim testing for *E. coli* O157:H7	0.0	1.9	1.1	0.0
Supplier specifications related to *E. coli* O157:H7 × periodic belt sanitizing × primal and subprimal testing for *E. coli* O157:H7	0.0	3.7	1.1	0.0
Supplier specifications related to *E. coli* O157:H7 × periodic belt sanitizing × trim testing for *E. coli* O157:H7	0.0	3.7	2.3	0.0
Supplier specifications related to *E. coli* O157:H7 × primal and subprimal testing for *E. coli* O157:H7 × trim testing for *E. coli* O157:H7	0.0	13.0	10.2	0.0
Purchase only products with negative *E. coli* O157:H7 test × antimicrobial applied prior to trimming × antimicrobial applied post trimming	0.0	0.0	1.1	0.0
Purchase only products with negative *E. coli* O157:H7 test × antimicrobial applied prior to trimming × partial trim	0.0	3.7	2.3	0.0
Purchase only products with negative *E. coli* O157:H7 test × antimicrobial applied prior to trimming × complete trim	0.0	1.9	2.3	0.0
Purchase only products with negative *E. coli* O157:H7 test × antimicrobial applied prior to trimming × continuous belt sanitizing	0.0	1.9	0.0	0.0
Purchase only products with negative *E. coli* O157:H7 test × antimicrobial applied prior to trimming × periodic belt sanitizing	0.0	1.9	0.0	0.0
Purchase only products with negative *E. coli* O157:H7 test × antimicrobial applied prior to trimming × primal and subprimal testing for *E. coli* O157:H7	0.0	5.6	2.3	0.0

Table A-16. Continued

	Plant Size			
	Large (*n*=2)	Small (*n*=54)	Very Small (*n*=88)	Unknown (*n*=1)
Purchase only products with negative *E. coli* O157:H7 test × antimicrobial applied prior to trimming × trim testing for *E. coli* O157:H7	0.0	0.0	1.1	0.0
Purchase only products with negative *E. coli* O157:H7 test × antimicrobial applied post trimming × partial trim	0.0	0.0	1.1	0.0
Purchase only products with negative *E. coli* O157:H7 test × antimicrobial applied post trimming × complete trim	0.0	0.0	1.1	0.0
Purchase only products with negative *E. coli* O157:H7 test × partial trim × complete trim	0.0	1.9	1.1	0.0
Purchase only products with negative *E. coli* O157:H7 test × partial trim × periodic belt sanitizing	0.0	1.9	0.0	0.0
Purchase only products with negative *E. coli* O157:H7 test × partial trim × primal and subprimal testing for *E. coli* O157:H7	0.0	3.7	1.1	0.0
Purchase only products with negative *E. coli* O157:H7 test × partial trim × trim testing for *E. coli* O157:H7	0.0	0.0	3.4	0.0
Purchase only products with negative *E. coli* O157:H7 test × complete trim × primal and subprimal testing for *E. coli* O157:H7	0.0	7.4	2.3	0.0
Purchase only products with negative *E. coli* O157:H7 test × complete trim × trim testing for *E. coli* O157:H7	0.0	0.0	2.3	0.0
Purchase only products with negative *E. coli* O157:H7 test × continuous belt sanitizing × primal and subprimal testing for *E. coli* O157:H7	0.0	1.9	0.0	0.0
Purchase only products with negative *E. coli* O157:H7 test × periodic belt sanitizing × primal and subprimal testing for *E. coli* O157:H7	0.0	1.9	0.0	0.0
Purchase only products with negative *E. coli* O157:H7 test × periodic belt sanitizing × trim testing for *E. coli* O157:H7	0.0	0.0	1.1	0.0
Purchase only products with negative *E. coli* O157:H7 test × primal and subprimal testing for *E. coli* O157:H7 × trim testing for *E. coli* O157:H7	0.0	0.0	4.6	0.0

Table A-16. Continued

	Plant Size			
	Large (*n*=2)	Small (*n*=54)	Very Small (*n*=88)	Unknown (*n*=1)
Antimicrobial applied prior to trimming × antimicrobial applied post trimming × partial trim	100.0	0.0	1.1	0.0
Antimicrobial applied prior to trimming × antimicrobial applied post trimming × complete trim	0.0	0.0	1.1	0.0
Antimicrobial applied prior to trimming × antimicrobial applied post trimming × trim testing for *E. coli* O157:H7	50.0	0.0	0.0	0.0
Antimicrobial applied prior to trimming × partial trim × complete trim	0.0	7.4	1.1	0.0
Antimicrobial applied prior to trimming × partial trim × periodic belt sanitizing	0.0	3.7	0.0	0.0
Antimicrobial applied prior to trimming × partial trim × primal and subprimal testing for *E. coli* O157:H7	0.0	9.3	2.3	0.0
Antimicrobial applied prior to trimming × partial trim × trim testing for *E. coli* O157:H7	50.0	9.3	3.4	0.0
Antimicrobial applied prior to trimming × complete trim × periodic belt sanitizing	0.0	1.9	0.0	0.0
Antimicrobial applied prior to trimming × complete trim × primal and subprimal testing for *E. coli* O157:H7	0.0	5.6	2.3	0.0
Antimicrobial applied prior to trimming × complete trim × trim testing for *E. coli* O157:H7	0.0	5.6	1.1	0.0
Antimicrobial applied prior to trimming × continuous belt sanitizing × primal and subprimal testing for *E. coli* O157:H7	0.0	1.9	0.0	0.0
Antimicrobial applied prior to trimming × continuous belt sanitizing × trim testing for *E. coli* O157:H7	0.0	0.0	0.0	0.0
Antimicrobial applied prior to trimming × periodic belt sanitizing × primal and subprimal testing for *E. coli* O157:H7	0.0	3.7	0.0	0.0
Antimicrobial applied prior to trimming × periodic belt sanitizing × trim testing for *E. coli* O157:H7	0.0	1.9	0.0	0.0

Table A-16. Continued

	Plant Size			
	Large (*n*=2)	Small (*n*=54)	Very Small (*n*=88)	Unknown (*n*=1)
Antimicrobial applied prior to trimming × primal and subprimal testing for *E. coli* O157:H7 × trim testing for *E. coli* O157:H7	0.0	7.4	3.4	0.0
Antimicrobial applied post trimming × partial trim × complete trim	0.0	0.0	1.1	0.0
Antimicrobial applied post trimming × partial trim × periodic belt sanitizing	0.0	0.0	1.1	0.0
Antimicrobial applied post trimming × partial trim × trim testing for *E. coli* O157:H7	50.0	0.0	0.0	0.0
Partial trim × complete trim × continuous belt sanitizing	0.0	0.0	0.0	0.0
Partial trim × complete trim × periodic belt sanitizing	0.0	1.9	2.3	0.0
Partial trim × complete trim × primal and subprimal testing for *E. coli* O157:H7	0.0	5.6	3.4	0.0
Partial trim × complete trim × trim testing for *E. coli* O157:H7	0.0	5.6	2.3	0.0
Partial trim × continuous belt sanitizing × periodic belt sanitizing	0.0	0.0	1.1	0.0
Partial trim × continuous belt sanitizing × primal and subprimal testing for *E. coli* O157:H7	0.0	1.9	0.0	0.0
Partial trim × continuous belt sanitizing × trim testing for *E. coli* O157:H7	0.0	1.9	1.1	0.0
Partial trim × periodic belt sanitizing × primal and subprimal testing for *E. coli* O157:H7	0.0	3.7	1.1	0.0
Partial trim × periodic belt sanitizing × trim testing for *E. coli* O157:H7	0.0	1.9	1.1	0.0
Partial trim × primal and subprimal testing for *E. coli* O157:H7 × trim testing for *E. coli* O157:H7	0.0	7.4	4.6	0.0
Complete trim × periodic belt sanitizing × primal and subprimal testing for *E. coli* O157:H7	0.0	1.9	1.1	0.0
Complete trim × periodic belt sanitizing × trim testing for *E. coli* O157:H7	0.0	3.7	0.0	0.0
Complete trim × primal and subprimal testing for *E. coli* O157:H7 × trim testing for *E. coli* O157:H7	0.0	3.7	5.7	0.0
Continuous belt sanitizing × periodic belt sanitizing × trim testing for *E. coli* O157:H7	0.0	0.0	1.1	0.0
Continuous belt sanitizing × primal and subprimal testing for *E. coli* O157:H7 × trim testing for *E. coli* O157:H7	0.0	1.9	0.0	0.0

Table A-16. Continued

	Plant Size			
	Large (*n*=2)	Small (*n*=54)	Very Small (*n*=88)	Unknown (*n*=1)
Periodic belt sanitizing × primal and subprimal testing for *E. coli* O157:H7 × trim testing for *E. coli* O157:H7	0.0	1.9	0.0	0.0

Ground beef

A set of questions specifically targeted for ground beef production was utilized to collect data from ground beef operation (Table A-17). Regarding the question, "Do you purchase beef trim that has been tested for *E. coli* O157:H7?" 71.4% of the large plants (*n*=7), 75% of the small plants (*n*=96), 47.9% of the very small plants (*n*=211) and 50.0% of plants of unknown size stated that they do purchase beef trim that has been tested for *E. coli* O157:H7.] When asked, "Do you include 'bench trim' or trim from your cutting operation in the production of ground beef?", 42.9% of large plants, 38.5% of small plants, 60.2% of very small plants and no of plants of unknown size were including 'bench trim' or trim from their cutting operation in the production of ground beef. Upon being asked, "Is the 'bench trim' tested for *E. coli* O157:H7 prior to grinding?", 42.9% of the large plants, 18.8% of small plants, 17.5% of very small plants, and none of plants of unknown size were testing bench trim for *E. coli* O157:H7 prior to grinding. The final question asked, "Do you conduct finished product testing for *E. coli* O157:H7?", 28.6% of the large plants, 76.0% of the small plants, 70.1% of the very small and 100.0% of the plants of unknown size stated that they were conducting finished product testing for *E. coli* O157:H7.

Table A-17. Frequency of responses (%) by plant size for question specific to ground beef operations

	Plant Size											
	Large (*n*=7)			Small (*n*=96)			Very Small (*n*=211)			Unknown (*n*=2)		
	Yes	No	Not sure	Yes	No	Not sure	Yes	No	Not sure	Yes	No	Not sure
Do you purchase beef trim that has been tested for *E. coli* O157:H7?	71.4	28.6	0	75.0	24.0	1.0	47.9	43.1	9.0	50.0	50.0	0
Do you include 'bench trim' or trim from your cutting operation in the production of ground beef?	42.9	57.1	0	38.5	58.3	3.2	60.2	37.0	2.8	0	100.0	0
Is the 'bench trim' tested for *E. coli* O157:H7 prior to grinding?	42.9	0	57.1	18.8	17.7	63.5	17.5	41.2	41.3	0	0	100
Do you conduct finished product testing for *E. coli* O157:H7?	28.6	71.4	0	76.0	22.9	1.1	70.1	27.0	2.9	100.0	0	0

Industry best practices

The frequency of responses (%) for the use of the Industry Best Practices is shown in Table A-18. When asked if plants were currently using the Industry Best Practices for Slaughter, 90.0% of the large plants (*n*=10), 61.4% of the small plants (*n*=44), and 59.6% of the very small plants (*n*=109), and 50% of plants of unknown size (*n*=4) stated that they were using the Industry Best Practices for Slaughter. Ninety percent of the large plants, 54.5% of the small, 62.4% of the very small and 50.0% of plants of unknown size said they were using the Industry Best Practices for Spinal Cord Removal document as guidance. Upon being asked, "Have you used the Industry Best Practices for Vacuum-packed Subprimals?" of the plants that fabricated primal and subprimals, 63.6% of large plants (*n*=11), 45.8% of small plants (*n*=59), 36.6% of the very small (*n*=134), and 50.0% of plants of unknown size (*n*=6) were using the Industry Best Practices for Vacumm-packed Subprimals document. The plants produced intact steaks and roasts, 100.0% of large plants (*n*=2), 47.4% of small plants (*n*=78),31.1% of very small (*n*=183) and 50.0% of plants of plants of unknown size were using the Industry Best Practices for Vacumm-packed Subprimals. Plants involved in

marinated/enhanced steak and roast production responded with the following, large plants (*n*=3) 66.7%, small plants (*n*=46) 54.3%, and very small plants (*n*=35) 42.9% were using the Industry Best Practices for Pathogen Control during Tenderization. Plants produced needle/blade tendered steaks and roasts, 100.0% of large plants (*n*=2), 57.4% of small plants (*n*=54), 48.9% of very small plants (*n*=88) and 0% of plants of unknown size (*n*=1) were using the Industry Best Practices for Pathogen Control during Tenderization document. Plants that produced ground beef 100.0% of large plants (*n*=7), 78.1% of the small plants (*n*=96), 68.7% of the very small plants, 100% of plants of unknown size were using the Industry Best Practices for processing raw ground beef products. Responses from plants producing ground beef displayed that 85.7% of large plants (*n*=7), 80.2% of the small plants (*n*=96), 74.4% of the very small plants, 100% of unknown plants size were using the Industry Best Practices for Holding Tested Products document.

Table A-18. Frequency of responses (%) by plant size for the use of the Industry Best Practices

	Plant Size															
	Large				Small				Very Small				Unknown			
	n	Yes	No	Not sure	*n*	Yes	No	Not sure	*n*	Yes	No	Not sure	*n*	Yes	No	Not sure
Slaughter																
For slaughter	10	90.0	0	10.0	44	61.4	2.3	36.3	109	59.6	8.3	32.1	4	50.0	0	50.0
For spinal cord removal	10	90.0	0	10.0	44	54.5	4.5	41.0	109	62.4	5.5	32.1	4	50.0	0	50.0
Fabrication of primals and subprimals																
For vacuum-packed subprimals	11	63.6	9.1	27.3	59	45.8	23.7	30.5	134	36.6	30.6	32.8	6	50.0	0	50.0
Production of intact steaks and roast																
For vacuum-packed subprimals	2	100.0	0	0	78	47.4	25.6	27.0	183	31.1	31.1	37.8	4	50.0	0	50.0
Production of marinated/enhanced steaks and roast																
For pathogen control during tenderization	3	66.7	0	33.3	46	54.3	13.0	32.7	35	42.9	17.1	40.0	0	0	0	0
Production of needle/ blade tenderized steaks and roast																
For pathogen control during tenderization	2	100.0	0	0	54	57.4	13.0	29.6	88	48.9	21.6	29.5	1	0	0	100.0
Production of ground beef																
Best practices for processing raw ground beef products	7	100.0	0	0	96	78.1	9.4	12.5	211	68.7	8.1	23.2	2	100.0	0	0
Best practices for holding tested products	7	85.7	14.3	0	96	80.2	10.4	9.4	211	74.4	12.8	12.8	2	100.0	0	0

In-plant microbiological testing

All plants were asked the question, "Did you conduct in-plant microbiological testing as part of the validation process?" (Table A-19). Of beef slaughter operations, 90.0% of large plants (*n*=10), 63.6% of small plants (*n*=44), 55.0% of very small plants (*n*=109), 25.0% of plants of unknown size (*n*=4) stated that they conducted in-plant microbiological testing as part of the validation process. Amongst plants that fabricated beef primals and subprimals 72.7% of large plants (*n*=11), 52.5% of small plants (*n*=59), 35.8% of very small plants (*n*=134), and 33.3% of plants of unknown size (*n*=6) conducted in-plant microbiological testing as part of the validation process. Plants that produce intact steaks and roasts 0.0% of large plants (*n*=2), 41.0% of small plants (*n*=78), 31.7% of very small plants (*n*=183), 0.0% of plants of unknown size (*n*=4) conducted in-plant microbiological testing as part of the validation process. Plants produced marinate/enhanced intact steaks and roasts 66.6% of large plants (*n*=3), 47.8% of small plants (*n*=46), 42.9% of very small plants (*n*=35), conducted in-plant microbiological testing as part of the validation process. Plants that produced needle/blade tenderized products 50.0% of large plants (*n*=2), 40.7% of small plants (*n*=54), 33.3% of very small plants (*n*=88), 100.0% of plants of unknown size (*n*=1) conducted in-plant microbiological testing as part of the validation process. Of plants producing raw ground beef products 50.0% of large plants (*n*=2), 53.1% of small plants (*n*=96), 31.8% of very small plants (*n*=211), 0.0% of plants of unknown size (*n*=2) conducted in-plant microbiological testing as part of the validation process.

Table A-19. Frequency of responses (%) by plant size for, “Did you conduct in-plant microbiological testing as part of the validation process?”

	Plant Size															
	Large				Small				Very Small				Unknown			
	n	Yes	No	Not sure	*n*	Yes	No	Not sure	*n*	Yes	No	Not sure	*n*	Yes	No	Not sure
Beef Slaughter Operations	10	90.0	10.0	0	44	63.6	18.2	18.2	109	55.0	25.7	19.3	4	25.0	0.0	75.0
Fabrication of Beef Primals and Subprimals	11	72.7	9.1	18.2	59	52.5	23.7	23.8	134	35.8	32.8	31.4	6	33.3	0.0	66.7
Raw, not ground used to produce intact steaks and roast	2	0.0	50.0	50.0	78	41.0	33.3	25.7	183	31.7	35.0	33.3	4	0.0	50.0	0.0
Raw, not ground used to produce marinated/enhanced intact steaks and roasts	3	66.6	33.3	0.0	46	47.8	21.7	30.5	35	42.9	25.7	31.4	0	0.0	0.0	0.0
Raw, not ground, used for needle/blade tenderized	2	50.0	50.0	0.0	54	40.7	35.2	24.1	88	33.0	36.4	30.6	1	100.0	0	0.0
Raw, Ground	7	57.1	28.6	14.3	96	53.1	28.1	18.8	211	31.8	31.8	36.4	2	0	0	100.0

Is E. coli O157:H7 reasonably likely to occur?

All plants were asked the question, "Is *E. coli* O157:H7 identified as reasonably likely to occur food safety hazard?" Table A-20 shows beef slaughter operation responses, 90.0% of large plants (*n*=10), 93.2% of small plants (*n*=44), 94.5% of very small plants (*n*=109), 50.0% of plants of unknown size (*n*=4) stated that they conducted in-plant microbiological testing as part of the validation process. Amongst plants that fabricated beef primals and subprimals 63.6% of large plants (*n*=11), 64.4% of small plants (*n*=59), 64.9% of very small plants (*n*=134), and 50.0% of plants of unknown size (*n*=6) conducted in-plant microbiological testing as part of the validation process. Plant produced raw, not used to produce intact steaks and roasts 50.0% of large plants (*n*=2), 57.7% of small plants (*n*=78), 54.1% of very small plants (*n*=183), 25.0% of plants of unknown size (*n*=4) conducted in-plant microbiological testing as part of the validation process. Of plants which produced marinate/enhanced intact steaks and roasts 66.6% of large plants (*n*=3), 63.0% of small plants (*n*=46), 65.7% of very small plants (*n*=35), conducted in-plant microbiological testing as part of the validation process. Plants that produced needle/blade tenderized products responded as 50.0% of large plants (*n*=2), 63.3% of small plants (*n*=54), 69.3% of very small plants (*n*=88), and 0.0% of plants of unknown size (*n*=1) conducted in-plant microbiological testing as part of the validation process. Responses from raw ground beef production operations were: 100.0% of large plants (*n*=2), 60.4% of small plants (*n*=96), 76.3% of very small plants (*n*=211), 50.0% of plants of unknown size (*n*=2) conducted in-plant microbiological testing as part of the validation process.

Table A-20. Frequency of responses (%) by plant size for, "Is *E. coli* O157:H7 identified as a reasonably likely to occur food safety hazard?"

	Plant Size															
	Large				Small				Very Small				Unknown			
	n	Yes	No	Not sure	*n*	Yes	No	Not Sure	*n*	Yes	No	Not Sure	*n*	Yes	No	Not sure
Beef slaughter operations	10	90.0	10.0	0	44	93.2	4.5	2.3	109	94.5	3.7	1.8	4	50.0	25.0	25.0
Fabrication of beef primals and subprimals	11	63.6	27.3	9.1	59	64.4	33.9	1.7	134	64.9	32.1	3.0	6	50.0	50.0	0.0
Raw, not ground used to produce intact steaks and roast	2	50.0	50.0	0.0	78	57.7	42.3	0.0	183	54.1	43.2	2.7	4	25.0	25.0	50.0
Raw, not ground used to produce marinated/enhanced intact steaks and roasts	3	66.7	33.3	0.0	46	63.0	37.0	0.0	35	65.7	28.6	5.7	0	0.0	0.0	0.0
Raw, not ground, used for needle/blade tenderized	2	50.0	50.0	0.0	54	63.3	35.2	1.5	88	69.3	29.5	1.2	1	0.0	0.0	100.0
Raw, Ground	7	100.0	0.0	0.0	96	60.4	38.5	1.1	211	76.3	19.9	3.8	2	50.0	50.0	0.0

Critical Control Point validation

All plants were asked the question, "Have the critical control points been validated?" As displayed in table A-21, regarding beef slaughter operations, 100.0% of large plants (*n*=10), 84.1% of small plants (*n*=44), 82.6% of very small plants (*n*=109), and 75.0% of plants of unknown size (*n*=4) stated that they conducted in-plant microbiological testing as part of the validation process. Among plants that fabricated beef primals and subprimals, 90.9% of large plants (*n*=11), 79.7% of small plants (*n*=59), 69.4% of very small plants (*n*=134), and 50.0% of plants of unknown size (*n*=6) conducted in-plant microbiological testing as part of the validation process. Plants that produced intact steaks and roasts 100.0% of large plants (*n*=2), 76.9% of small plants (*n*=78), 68.9% of very small plants (*n*=183), and 50.0% of plants of unknown size (*n*=4) conducted in-plant microbiological testing as part of the validation process. Plants that utilized product used to produce marinated/enhanced products, 100.0% of large plants (*n*=3), 69.6% of small plants (*n*=46), 68.6% of very small plants (*n*=35), and there were no plants that size wasn't accounted for that conducted in-plant microbiological testing as part of the validation process. Of plants that produced needle/blade tenderized products, 100.0% of large plants (*n*=2), 75.9% of small plants (*n*=54), 70.5% of very small plants (*n*=88), 100.0% of plants of unknown size (*n*=1) conducted in-plant microbiological testing as part of the validation process. Plants producing ground beef products, 85.7% of large plants (*n*=2), 82.3% of small plants (*n*=96), 77.7% of very small plants (*n*=211), 100.0% of plants of unknown size (*n*=2) conducted in-plant microbiological testing as part of the validation process.

Table A-21. Frequency of responses (%) by plant size for, “Have the CCPs been validated?”

	Plant Size															
	Large				Small				Very Small				Unknown			
	n	Yes	No	Not sure	*n*	Yes	No	Not sure	*n*	Yes	No	Not Sure	*n*	Yes	No	Not Sure
Beef slaughter operations	10	100.0	0.0	0.0	44	84.1	9.1	6.8	109	82.6	9.2	8.2	4	75.0	0.0	25.0
Fabrication of beef primals and subprimals	11	90.9	9.1	0.0	59	79.7	11.9	8.4	134	69.4	18.7	11.9	6	50.0	16.7	33.3
Raw, not ground used to produce intact steaks and roast	2	100.0	0.0	0.0	78	76.9	17.9	5.2	183	68.9	16.9	14.2	4	50.0	0.0	50.0
Raw, not ground used to produce marinated/enhanced intact steaks and roasts	3	100.0	0.0	0.0	46	69.6	21.7	8.7	35	68.6	2.9	28.5	0	0.0	0.0	0.0
Raw, not ground, used for needle/blade tenderized	2	100.0	0.0	0.0	54	75.9	18.5	5.6	88	70.5	17.0	12.5	1	100.0	0.0	0.0
Raw, Ground	7	85.7	0.0	14.3	96	82.3	15.2	2.5	211	77.7	12.3	10.0	2	100.0	0.0	0.0

3.2 Telephone interviews

After completion of the written survey, phone interviews were conducted to gather more information on critical control points, antimicrobial interventions that were being applied during various steps during processing of beef, and testing for *E. coli* O157:H7. One hundred-and-nineteen establishments were called by phone, and asked if they would participate in a phone interview. Of the 119 plants that were called five of the phone numbers were no longer working or the numbers to fax lines. One plant was no longer in business and four plants declined the phone interview. Since participants were asked to answer question to the best of their knowledge there were different possible solutions than previously stated. For CCPs carcass chilling (reduction of carcass temperature after chilling ≤40°C within twenty four hours of harvest), cooler temperature (ambient temperature of storage facilities) surface temperatures (surface temperature of the product), specified risk material or SRMs (materials that may contain bovine spongiform encephalopathy agent if present), Sanova® (a proprietary mixed solution of acidified sodium chlorite), and Inspexx™ 200(a trademarked antimicrobial). Furthermore, for the specific test methods used to test for *E. coli* O157:H7, association of analytical communities' method (AOAC), genetic detection system (GDS™), polymerase chain reation based method (PCR),10 JIM, IEH multiplex, Neogens' (Reveal®), enzyme-linked immune sorbent assay (EIH technology), and a robust testing method.

Among the fabrication plants, 100.0% of the large plants (*n*=1) had two CCPs, 9.1% of the small plants (*n*=11) had zero CCPs, 81.8% had one CCP, and 9.1% had two

CCPs, 90.9% of very small (*n*=22) plant had one CCP and the remaining 9.1% had two CCPs. Regarding other beef industry sectors, 9.9% of small plants (*n*=11) that produced ground beef had zero CCPs, and 90.9% had one CCPs. Five percent of very small plants (*n*=20) had zero CCPs, 75.0% had one CCP, and 20.0% had two CCPs. Large plants which produced non-intact needle/blade tenderized or needle injected products (*n*=1) implemented two CCPs. Of the small plants (*n*=11) 27.3% had zero CCPs, 63.6% had one CCP and 9.1% had two CCPs. For the very small plants (*n*=9), 22.2% had zero CCPs, 55.6% had one CCP and 22.2% had two CCPs. The one large plant producing non-intact enhanced/marinated products had one CCP. While 12.5% of small plants (*n*=8) had zero CCPs, 75.0% possessed one CCP and 12.5% had two CCPs. Within the very small plant category for this sector, 75.0% had one CCP, and the remaining 25.0% had two CCPs. Also found in Table 23 are the percent of plants that do not had any CCPs for their fabrication, ground beef, non-intact; needle/blade tenderized or needle injected products and non-intact; enhanced/marinated products. Nine and one-tenth of a percent of small plants had not a CCP in their fabrication HACCP plan. Nine and one-tenth of a percent of small and 5.0% of very small plants had not a CCP in their ground beef HACCP plan. 27.3% of small plants and 22.2% of very small plants had not a CCP for needle/blade tenderized or needle injected products.

Table A-22. Frequency of responses (%) by plant size for the number of CCPs from the telephone interviews

	Plant Size			
	Large	Small	Very Small	Unknown
Slaughter (n)	*(2)*	*(7)*	*(20)*	*(1)*
One CCP	0.0	0.0	10.0	0.0
Two CCPs	50.0	0.0	35.0	100.0
Three CCPs	50.0	57.1	40.0	0.0
Four CCPs	0.0	28.6	5.0	0.0
Five CCPs	0.0	0.0	10.0	0.0
Six CCPs	0.0	14.3	0.0	0.0
Fabrication (n)	*(1)*	*(11)*	*(22)*	*(0)*
Zero CCP	0.0	9.1	0.0	0.0
One CCP	0.0	81.8	90.9	0.0
Two CCPs	100.0	9.1	9.1	0.0
Grinding (n)	(0)	(11)	(20)	(0)
Zero CCP	0.0	9.1	5.0	0.0
One CCP	0.0	90.9	75.0	0.0
Two CCPs	0.0	0.0	20.0	0.0
Non-intact; needle/blade tenderized or needle injected products (n)	*(1)*	*(11)*	*(9)*	*(0)*
Zero CCP	0.0	27.3	22.2	0.0
One CCP	0.0	63.6	55.6	0.0
Two CCPs	100.0	9.1	22.2	0.0
Non-intact; enhanced/ marinated products (n)	*(1)*	*(8)*	*(4)*	*(0)*
Zero CCP	0.0	12.5	0.0	0.0
One CCP	100.0	75.0	75.0	0.0
Two CCPs	0.0	12.5	25.0	0.0

Slaughter

Frequency of responses (%) for single beef slaughter CCPs by plant size for telephone interviews can be seen in Table A-23. Large plants (*n*=2) 100.0% had zero tolerance carcass trimming, 50.0% had antimicrobial spray, 50.0% had hot water carcass wash, and 50.0% had zero tolerance head and offal trimming as CCPs. For small plants (*n*=7), 100.0% implemented zero tolerance carcass trimming, 71.4% had lactic acid spray and 57.1% had zero tolerance head and offal trimming as CCPs. The most frequently listed CCPs for very small plants (*n*=20) were, 80.0% zero tolerance carcass trimming, 35.0% lactic acid, 25.0% chilling, and 25.0% carcass wash. Of the unknown plant size (*n*=1) hot water carcass wash and zero tolerance carcass trimming were both listed (100.0%).

Table A-23. Frequency of responses (%) by plant size for single beef slaughter CCPs from the telephone interviews

	Plant Size			
	Large (*n*=2)	Small (*n*=7)	Very Small (*n*=20)	Unknown (*n*=1)
Antimicrobial spray	50.0	28.6	15.0	0.0
Acetic acid spray	0.0	0.0	10.0	0.0
Chilling	0.0	28.6	25.0	0.0
Carcass wash	0.0	0.0	25.0	0.0
Cooler temperature	0.0	14.3	15.0	0.0
Dry aging	0.0	0.0	5.0	0.0
Hot water carcass wash	50.0	14.3	10.0	100.0
Steam pasteurization	0.0	0.0	5.0	0.0
Lactic acid carcass spray	0.0	71.4	35.0	0.0
Lactic acid head and offal spray	0.0	0.0	5.0	0.0
Product temperature	0.0	14.3	10.0	0.0
Steam pasteurization	0.0	14.3	5.0	0.0
Specified risk materials	0.0	0.0	5.0	0.0
Surface temperature	0.0	14.3	5.0	0.0
Variety meet chilling	0.0	14.3	5.0	0.0
Zero tolerance carcass trimming	100.0	100.0	80.0	100.0
Zero tolerance head and offal trimming	50.0	57.1	5.0	0.0

Table A-24 exhibits the frequency of responses (%) for combinations of CCPs used by beef slaughter operations. The most frequently used combinations in large plants (*n*=2) were antimicrobial spray × zero tolerance carcass trimming 50.0%, and hot water wash × zero tolerance head and offal trimming 50.0%. For small plants (*n*=7), the most frequently used combination was lactic acid carcass spray × zero tolerance carcass trimming × zero tolerance head and offal trimming 28.6%. Very small plants (*n*=20) used zero tolerance carcass trimming 10.0%, how water wash × SRM 10.0%, chilling × lactic acid × zero tolerance carcass trimming 10.0% most frequently. The one plants of unknown size used hot water wash × zero tolerance carcass trimming.

Table A-24. Frequency of responses (%) by plant size for combinations of CCPs used for slaughter operations from the telephone interviews

	Plant Size			
	Large (*n*=2)	Small (*n*=7)	Very Small (*n*=20)	Unknown (*n*=1)
One CCP				
Zero tolerance carcass trimming	0.0	0.0	10.0	0.0
Two CCPs				
Acetic acid carcass wash × zero tolerance carcass trimming	0.0	0.0	5.0	0.0
Dry aging × zero tolerance carcass trimming	0.0	0.0	5.0	0.0
Hot water wash × SRM	0.0	0.0	10.0	0.0
Hot water wash × zero tolerance carcass trimming	0.0	0.0	5.0	100.0
Antimicrobial spray × zero tolerance carcass trimming	50.0	0.0	5.0	0.0
Lactic acid × zero tolerance carcass trimming	0.0	0.0	5.0	0.0
Chiling × zero tolerance carcass trimming	0.0	0.0	5.0	0.0
Three CCPs				
Carcass wash × chilling × zero tolerance carcass trimming	0.0	0.0	5.0	0.0
Carcass wash × carcass surface temperature × zero tolerance carcass trimming	0.0	0.0	5.0	0.0
Carcass wash × antimicrobial spray × zero tolerance trim	0.0	0.0	5.0	0.0
Chilling × lactic acid × zero tolerance carcass trimming	0.0	0.0	10.0	0.0
Chilling × lactic acid × cooler temperature	0.0	0.0	5.0	0.0
Hot water wash × zero tolerance carcass trimming × zero tolerance head and offal trimming	50.0	0.0	0.0	0.0
Lactic acid carcass spray × cooler temperature × zero tolerance carcass trimming	0.0	0.0	5.0	0.0
Lactic acid carcass spray × antimicrobial spray × zero tolerance carcass trimming	0.0	0.0	5.0	0.0
Lactic acid carcass spray × zero tolerance carcass trimming × zero tolerance head and offal trimming	0.0	28.6	0.0	0.0
Lactic acid carcass spray × product temperature × zero tolerance carcass trimming	0.0	0.0	5.0	0.0
Antimicrobial spray × carcass surface temperature × zero tolerance carcass trimming	0.0	14.3	0.0	0.0

Table A-24. Continued

	Plant Size			
	Large (*n*=2)	Small (*n*=7)	Very Small (*n*=20)	Unknown (*n*=1)
Four CCPs				
Acetic acid carcass wash × carcass wash × carcass chilling × zero tolerance carcass trimming	0.0	0.0	5.0	0.0
Hot water carcass wash × lactic acid carcass spray × product temperature × zero tolerance carcass trimming	0.0	14.3	0.0	0.0
Lactic acid carcass spray × cooler temperature × zero tolerance carcass trimming × zero tolerance head and offal trimming	0.0	14.3	0.0	0.0
Five CCPs				
Carcass wash × variety meat chilling × lactic acid carcass spray × product temperature × zero tolerance carcass trimming	0.0	0.0	5.0	0.0
Lactic acid carcass spray × lactic acid spray for offals × steam pasteurization× zero tolerance carcass trimming × zero tolerance head and offal trimming	0.0	0.0	5.0	0.0
Six CCPs				
Carcass chilling × variety meat chilling × antimicrobial spray × steam pasteurization × zero tolerance carcass trimming × zero tolerance head and offal trimming	0.0	14.3	0.0	0.0

Fabrication

Frequency of response (%) for single fabrication CCP by plant size is displayed in Table A-25. Of the large plants (*n*=1) the most frequently listed CCPs were combo temperature 100.0% and cooler temperature 100.0%. For small plants (*n*=11) cooler temperature 63.6% and product temperature 18.2% were used most often. Very small plants (*n*=22) listed cooler temperature 86.4%.

Table A-25. Frequency of responses (%) by plant size for single fabrication CCPs from telephone interviews

	Plant Size			
	Large (*n*=1)	Small (*n*=11)	Very Small (*n*=22)	Unknown (*n*=0)
Combo temperature	100.0	0.0	0.0	0.0
Cooler temperature	100.0	63.6	86.4	0.0
Lactic acid	0.0	9.1	13.6	0.0
Product temperature	0.0	18.2	13.6	0.0
Identification and segregation of product that tested positive for *E. coli* O157:H7	0.0	0.0	4.5	0.0
Unknown	0.0	9.1	0.0	0.0

Frequency of responses (%) for multiple fabrication combinations of CCPs are listed in Table A-26. The large plant that responded utilized combo temperature × package temperature for the one combination. Of the small plants (*n*=11) 9.1% indicated that they used cooler temperature × lactic acid spray as the one combination of fabrication CCPs. 9.1% of very small plants (*n*=2) disclosed that used cooler temperature × package temperature as their multiple fabrication CCPs.

Table A-26. Frequency of responses (%) by plant size for combinations of CCPs for fabrication operations from telephone interviews

	Plant Size			
	Large (*n*=1)	Small (*n*=11)	Very Small (*n*=22)	Unknown (*n*=0)
Cooler temperature × package temperature	0.0	0.0	9.1	0.0
Cooler temperature × lactic acid spray	0.0	9.1	0.0	0.0
Combo temperature × package temperature	100.0	0.0	0.0	0.0

Table A-27 displays the frequency of response (%) for questions specific to fabrication plants. The first question asked was, “Do you apply an antimicrobial intervention to the carcass as it enters fabrication?” Of the 11 small plants, 72.3% were adding an antimicrobial intervention to carcasses as they enters fabrication and 9.1% of very small plants (*n*=22) did the same. Next, the plants were asked, “Do you apply an antimicrobial intervention to primal and subprimal cuts prior to packaging?” Twenty seven and three-tenths percent of small plants were applying an antimicrobial

intervention to primals and subprimals prior to packaging, and 4.5% of very small plants were as well.

Table A-27. Frequency of responses (%) by plant size for questions specific to fabrication operations from the telephone interviews

	Plant Size			
	Large (*n*=1)	Small (*n*=11)	Very Small (*n*=22)	Unknown (*n*=0)
	Yes	Yes	Yes	Yes
Do you apply an antimicrobial intervention to the carcass as it enters fabrication?	0.0	72.3	9.1	0.0
Do you apply an antimicrobial intervention to primal and subprimal cuts prior to packaging?	0.0	27.3	4.5	0.0

Frequency of responses (%) for what antimicrobial intervention types being applied to carcasses as they enter fabrication canbe seen in Table A-28. The large plant that responded was using lactic acid as an antimicrobial intervention. The small plants were represented by (*n*=11) 36.4% that were using lactic acid, 18.2% that were using acidified sodium chlorite, 9.1% that were using peracetic acid, and 9.1% were using Sanova®. Lactic acid also was being applied to carcasses as they entered fabrication in 13.6% of very small plants.

Table A-28. Frequency of responses (%) by plant size for, "What antimicrobial intervention is applied to the carcass as it enters fabrication?"

	Plant Size			
	Large (*n*=1)	Small (*n*=11)	Very Small (*n*=22)	Unknown (*n*=0)
Acidified sodium chlorite	0	18.2	0	0
Lactic acid	100.0	36.4	13.6	0
Peracetic acid	0	9.1	0	0
Sanova®	0	9.1	0	0

Table A-29 contains the frequency of responses (%) for the question, "What antimicrobial intervention is applied to primals and subprimals prior to packaging?" The small plantswere represented by (*n*=11) that were applying antimicrobial interventions to primal and subprimal cuts prior to packaging, 9.1% that were applying acidified sodium chlorite, 9.1% that were applying lactic acid, and 9.1% that were applying peracetic acid. 4.5% of the very small plants (*n*=22) applied lactic acid to primal and subprimal cuts prior to packaging.

Table A-29. Frequency of responses (%) by plant size for, "What antimicrobial intervention is applied to primal and subprimal cuts prior to packaging?"

	Plant Size			
	Large (*n*=1)	Small (*n*=11)	Very Small (*n*=22)	Unknown (*n*=0)
Acidified sodium chlorite	0	9.1	0	0
Lactic acid	0	9.1	4.5	0
Peracetic acid	0	9.1	0	0

Marinated/enhanced

The frequency of responses (%) for, non-intact; marinated/enhanced products for single CCP can be found in Table A-30. The only large plant represented listed cooler

temperature and identification and segregation of product that tested positive for *E. coli* O157:H7 as the two individual CCPs. The most frequently listed CCP by small plants (*n*=8) was cooler temperature 62.5%. Of the very small plants (*n*=4), 75.0% listed cooler temperature as the single CCP.

Table A-30. Frequency of responses (%) by plant size for non-intact and marinated/enhanced products for single CCPs from the telephone interviews

	Plant Size			
	Large (*n*=1)	Small (*n*=8)	Very Small (*n*=4)	Unknown (*n*=0)
Cooler temperature	100.0	62.5	75.0	0.0
Product temperature	0.0	12.5	25.0	0.0
Package temperature	0.0	12.5	0.0	0.0
Identification and Segregation of Product that tested positive for *E. coli* O157:H7	100.0	0.0	0.0	0.0

Table A-31 reveals the frequency of responses (%) for combinations of CCPs used for non-intact; marinated/enhanced products. The only large plant stated that cooler temperature × identification and segregation of product that test positive for *E. coli* O157:H7 was the combination of CCPs that they used. Product temperature × lactic acid spray was the most frequently used (12.5%) CCP for small plants (*n*=8). The most often used combination of CCPs by very small plants (*n*=4) was cooler temperature × lactic acid spray 25.0%.

Table A-31. Frequency of responses (%) by plant size for combinations of CCPs used for non-intact and marinated/enhanced products from the telephone interviews

	Plant Size			
	Large (*n*=1)	Small (*n*=8)	Very Small (*n*=4)	Unknown (*n*=0)
No CCP				
	0.0	14.3	0.0	0.0
One CCP				
Cooler temperature	0.0	62.5	50.0	0.0
Product temperature	0.0	0.0	25.0	0.0
Package temperature	0.0	12.5	0.0	0.0
Identification and segregation of product that tested positive for *E. coli* O157:H7	0.0	0.0	0.0	0.0
Lactic acid spray	0.0	0.0	0.0	0.0
Two CCPs				
Cooler temperature × lactic acid spray	0.0	0.0	25.0	0.0
Cooler temperature × identification and segregation of products that test positive for *E. coli* O157:H7	100.0	0.0	0.0	0.0
Product temperature × lactic acid spray	0.0	12.5	0.0	0.0

The frequency of responses (%) for, "Do you apply an antimicrobial intervention to primal and sub primal cuts prior to enhancement or marination?" The one large plant did apply an antimicrobial intervention to primals or subprimals prior to enhancement or marination. Twenty five percent of small plants (*n*=8) and very small plants (*n*=4) applied an antimicrobial intervention to primals and subprimals prior to enhancement or marination.

Table A-32 discloses the frequency of responses (%) for, "What antimicrobial intervention is being applied to the primal and subprimal cuts prior to enhancement or marination?" One hundred percent of the large plants (*n*=1), 12.5% of the small plants (*n*=8) and 25.0% of very small plants (*n*=4) applied lactic acid to primals and subprimals prior to enhancement or marination. Twelve and a half percent of small plants apply Inspexx™ 200to primal and subprimal cuts prior to enhancement or marination.

Table A-32. Frequency of responses (%) by plant size for, "What antimicrobial intervention is being applied to the primal and subprimal cuts prior to enhancement or marination?"

	Plant Size			
	Large (*n*=1)	Small (*n*=8)	Very Small (*n*=4)	Unknown (*n*=0)
Lactic acid	100.0	12.5	25.0	0.0
Inspexx™ 200	0.0	12.5	0.0	0.0

Needle/blade tenderized steaks and roasts

The frequency of responses (%) for single non-intact; blade tenderized or needle injected product CCP can be seen in Table A-33. The large plant that responded listed cooler temperature and identification and segregation of product that tested positive for *E. coli* O157:H7 as the individual CCPs. Cooler temperature was the most often (54.5%) selected single CCP used by small plants (*n*=11) and 55.6 % of very small plants (*n*=9).

Table A-33. Frequency of responses (%) by plant size for single CCPs used for non-intact and blade tenderized or needle injected products from telephone interviews

	Plant Size			
	Large (*n*=1)	Small (*n*=11)	Very Small (*n*=9)	Unknown (*n*=0)
Cooler temperature	100.0	54.5	55.6	0.0
Product temperature	0.0	9.1	22.2	0.0
Package temperature	0.0	9.1	11.1	0.0
Lactic acid spray	0.0	9.1	11.1	0.0
Identification and segregation of products that test positive for *E. coli* O157:H7	100.0	0.0	0.0	0.0

Table A-34 contains the frequency of responses (%) for combinations of CCPs used for non-intact; blade tenderized or needle injected product. The one large plant

respondent stated that cooler temperature × identification and segregation of product that test positive for *E. coli* O157:H7 was the combination of CCPs they used. Nine and one-tenth percent of small plants (*n*=11) used combination of cooler temperature × lactic acid spray. The most often used combinations of CCPs for very small plants (*n*=9) were cooler temperature × package temperature 11.1% and product temperature × lactic acid 11.1%.

Table A-34. Frequency of responses (%) by plant size for combination of CCPs used for non-intact and blade tenderized or needle injected products for telephone interviews

	Plant Size			
	Large (*n*=1)	Small (*n*=11)	Very Small (*n*=9)	Unknown (*n*=0)
No CCP	0.0	27.3	22.2	0.0
One CCP				
Cooler temperature	0.0	54.5	33.3	0.0
Product temperature	0.0	0.0	22.2	0.0
Package temperature	0.0	9.1	0.0	0.0
Lactic acid spray	0.0	0.0	0.0	0.0
Identification and segregation of products that test positive for *E. coli* O157:H7	0.0	0.0	0.0	0.0
Two CCPs				
Cooler temperature × identification and segregation of products that test positive for *E. coli* O157:H7	100.0	0.0	0.0	0.0
Cooler temperature × package temperature	0.0	0.0	11.1	0.0
Cooler temperature × lactic acid spray	0.0	9.1	0.0	0.0
Product temperature × lactic acid spray	0.0	0.0	11.1	0.0

The frequency of response (%) for, non-intact;blade tendered or needle injected product by plant size for the question, "Do you apply and antimicrobial intervention to

primal and subprimal cuts prior to needle/blade tenderizing or needle injecting?" Thirty six and four-tenths percent of small plants (*n*=11) and 11.1% of very small plants (*n*=9) were applying an antimicrobial intervention to primals and subprimals prior to needle/blade tenderizing or needle injecting.

Table A-35 discloses the frequency of responses (%) for antimicrobial interventions applied to primals and subprimals prior to needle/blade tenderizing or needle injecting. Nine and one-tenth percent of small plants (*n*=11) were applying acidified sodium chlorite to primals and subprimals to needle/blade tenderizing or needle injecting. Eighteen and two-tenths percent of small plants and 11.1% of very small plants (*n*=9) were applying lactic acid chlorite to primals and subprimals prior to needle/blade tenderizing or needle injecting. Nine and one-tenth percent of small plants applied Inspexx™ 200to chlorite to primals and subprimals prior to needle/blade tenderizing or needle injecting.

Table A-35. Frequency of responses (%) by plant size for antimicrobial interventions applied to primal and subprimal cuts prior to needle/blade tenderizing or needle injecting

	Plant Size			
	Large (*n*=1)	Small (*n*=11)	Very Small (*n*=9)	Unknown (*n*=0)
Acidified sodium chlorite	0.0	9.1	0.0	0.0
Lactic acid	0.0	18.2	11.1	0.0
Inspexx™ 200	0.0	9.1	0.0	0.0

Ground beef

The frequency of responses (%) for single ground beef CCPs are shown in Table A-36. The most often listed CCP by small plants (*n*=11) and very small plants (*n*=20) with responses of 72.7% and 80.0% respectively.

Table A-36. Frequency of responses (%) by plant size for single ground beef CCPs from the telephone interviews

	Plant Size			
	Large (*n*=0)	Small (*n*=11)	Very Small (*n*=20)	Unknown (*n*=0)
Cooler temperature	0.0	72.7	80.0	0.0
Product temperature	0.0	9.1	10.0	0.0
Package temperature	0.0	9.1	10.0	0.0
Antimicrobial spray	0.0	0.0	10.0	0.0
Product temperature out of the grinder	0.0	0.0	10.0	0.0

Table A-37 displays the frequency of responses (%) for combinations of CCPs for ground beef products. The most popular combinations of CCPs by very small plants (*n*=20) were cooler temperature × package temperature, cooler temperature × antimicrobial spray, cooler temperature × product temperature out of the grinder all of these combinations were used by 5% of small plants.

Table A-37. Frequency of responses (%) by plant size for combinations of CCPs for ground beef products from telephone interview

	Plant Size			
	Large (*n*=0)	Small (*n*=11)	Very Small (*n*=20)	Unknown (*n*=0)
No CCP				
	0.0	9.1	5.0	0.0
One CCP				
Cooler temperature	0.0	72.7	60.0	0.0
Product temperature	0.0	9.1	10.0	0.0
Package temperature	0.0	9.1	5.0	0.0
Antimicrobial spray	0.0	0.0	0.0	0.0
Product temperature out of the grinder	0.0	0.0	0.0	0.0
Two CCPs				
Cooler temperature × package temperature	0.0	0.0	5.0	0.0
Cooler temperature × antimicrobial spray	0.0	0.0	5.0	0.0
Cooler temperature × product temperature out of the grinder	0.0	0.0	5.0	0.0

The frequency of responses (%) for, “Do you apply an antimicrobial intervention to trimmings prior to grinding or during the grinding process?” Twenty seven and three-tenths percent of small (*n*=11) and 10.0% of very small plants were applying an antimicrobial intervention to trimmings prior to grinding or during the grinding process.

Further response frequencies (%) for, “What antimicrobial intervention is being applied to trimmings prior to grinding or during the grinding process?” Twenty seven and three-tenths percent of small plants (*n*=11) and 10.0% of very small plants were applying lactic acid prior to grinding or during the grinding process.

E.coli O157:H7

Frequency of responses (%) for, familiarity of the Industry Best Practices

	Plant Size																						
	Large						Small						Very small						Unknown					
	n	1[a]	2[b]	3[c]	4[d]	5[e]	n	1[a]	2[b]	3[c]	4[d]	5[e]	n	1[a]	2[b]	3[c]	4[d]	5[e]	n	1[a]	2[b]	3[c]	4[d]	5[e]
Slaughter																								
For slaughter	10	0.0	0.0	10.0	40.0	50.0	44	2.3	2.3	13.6	29.5	52.3	109	2.8	12.8	25.7	31.2	11.0	4	0.0	0.0	0.0	25.0	75.0
For spinal cord removal	10	0.0	0.0	0.0	40.0	60.0	44	9.1	5.5	9.1	25.0	41.3	109	7.3	9.2	18.3	23.9	23.9	4	0.0	0.0	0.0	0.0	100.0
Fabrication of primals and subprimals																								
For vacuum-packed subprimals	11	9.1	0.0	36.4	18.2	36.3	59	16.9	16.9	25.4	30.5	10.3	134	37.3	21.6	20.1	19.3	1.7	6	0.0	0.0	0.0	16.7	83.3
Production of Intact Steaks and Roast																								
For vacuum-packed subprimals	2	0.0	0.0	0.0	50.0	50.0	78	24.4	16.7	23.1	26.9	9.0	183	35.5	16.4	23.5	16.4	8.2	4	0.0	0.0	0.0	25.0	75.0
Production of marinated/enhanced steaks and roast																								
For pathogen control during tenderization	3	33.3	0.0	0.0	33.3	33.	46	17.4	8.7	32.6	28.3	13.0	35	25.7	20.0	14.3	31.4	8.6	0	0.0	0.0	0.0	0.0	0.0
Production of needle/ blade tenderized steaks and roast																								
For pathogen control during tenderization	2	0.0	0.0	0.0	50.0	50.0	54	13.0	9.3	35.2	29.6	13.0	88	21.6	13.6	31.8	26.1	6.8	1	0.0	0.0	0.0	0.0	100.0
Production of ground beef																								
Best practices for processing raw ground beef products	7	0.0	0.0	0.0	42.9	57.1	96	7.3	12.5	27.1	27.1	26.0	211	10.0	12.3	25.6	39.3	12.8	2	0.0	0.0	0.0	50.0	50.0
Best practices for holding tested products	7	0.0	0.0	28.6	14.3	57.1	96	3.1	11.5	17.7	30.2	36.5	211	10.0	9.5	17.1	33.2	30.2	2	0.0	0.0	0.0	50.0	50.0

[a]1= Not familiar at all.
[b]2= Slightly familiar.
[c]3= Somewhat familiar.
[d]4= Mostly familiar.
[e]5= Completely familiar

Pre-Survey Postcard

Food safety is an important component of your business. As a federally inspected meat establishment, you are highly scrutinized by both consumers and government agencies. In the next few days, you will receive a short survey designed to collect information on the food safety controls that you have implemented in your establishment. The survey is being distributed to all federal meat establishments. These data will be used to support and defend the industry's existing food safety programs, as well as identify areas that may need additional research or improvement.

Data will be compiled for reporting purposes, and all individual plant information will remain confidential. If you have any questions, please contact one of us at 979-862-3643.

We thank you in advance for your cooperation in this important endeavor.

Jeff W. Savell

Kerri B. Harris

AgriLIFE EXTENSION
Texas A&M System

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Food Safety and Best Practices Survey for Raw Beef Products

Instructions: Start by entering your establishment number below. Then answer all applicable questions. Based on your responses, you may be directed to skip certain questions and sections. Thank you!

Please enter your establishment number: ☐☐☐☐☐☐☐

1. Is your operation currently involved in processing raw beef (slaughter, fabrication, intact raw beef products, non-intact raw beef products, raw ground beef)?
   - O Yes *(continue with question 2)*
   - O No *(thank you, please do not proceed any further and return the survey)*

2. Is your operation currently involved in Beef Slaughter?
   - O Yes *(continue with question 3)*
   - O No *(skip to question 12)*

Beef Slaughter:

3. Is *E. coli* O157:H7 identified as a reasonably likely to occur food safety hazard in the slaughter HACCP plan?
   - O Yes O No O Not sure

4. Which of the following is used in your operation? ***(select all that apply)***
   - O Hide wash system
   - O Pre-evisceration water wash
   - O Pre-evisceration antimicrobial spray
   - O Hot water carcass wash
   - O Steam pasteurization of carcass
   - O Lactic acid spray of carcass
   - O Acetic acid spray of carcass
   - O Steam vacuuming
   - O Trimming
   - O Carcass testing for *E. coli* O157:H7
   - O Other intervention:

5. Have the CCPs been validated?
   - O Yes *(continue with question 6)*
   - O No *(skip to question 7)*
   - O Not sure *(skip to question 7)*

6. Did you conduct in-plant microbiological testing as part of the validation process?
   - O Yes O No O Not sure

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Please continue on the next page

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7. Do you test beef carcasses for *E. coli* O157:H7?
   O Yes O No O Not sure

8. How familiar are you with the industry's "Best Practices for Beef Slaughter?"
   O Not at all O Slightly O Somewhat O Mostly O Completely

9. Have you used these best practices in your operation?
   O Yes O No O Not sure

10. How familiar are you with the industry's "Best Practices for Spinal Cord Removal?"
    O Not at all O Slightly O Somewhat O Mostly O Completely

11. Have you used these best practices in your operation?
    O Yes O No O Not sure

12. Is your operation currently involved in the Fabrication of Beef Primals/Subprimals?
    O Yes *(continue with question 13)*
    O No *(skip to question 21)*

Fabrication of Beef Primals and Subprimals:

13. Is *E. coli* O157:H7 identified as a reasonably likely to occur food safety hazard in the fabrication HACCP plan?
    O Yes O No O Not sure

14. Which of the following is used in your operation? ***(select all that apply)***
    O Lactic acid carcass spray entering fab floor
    O Acidified sodium chlorite carcass spray entering fab floor
    O Acetic acid carcass spray entering fab floor
    O Peroxyacetic acid carcass spray entering fab floor
    O Antimicrobial (not list above) carcass spray entering fab floor
    O Trimming of primals and subprimals
    O Application of antimicrobial intervention prior to vacuum packaging product
    O Continuous belt sanitizing system
    O Periodic sanitizing system of belt throughout shift
    O Testing of primals and subprimals for *E. coli* O157:H7
    O Testing of trim for *E. coli* O157:H7
    O Other intervention:

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15. Have the CCPs been validated?
- O Yes *(continue with question 16)*
- O No *(skip to question 17)*
- O Not sure *(skip to question 17)*

16. Did you conduct in-plant microbiological testing as part of the validation process?
- O Yes O No O Not sure

17. Do you co-mingle primals and sub-primals during fabrication?
- O Yes *(skip to question 19)*
- O No *(continue with question 18)*
- O Not sure *(skip to question 19)*

18. Do you keep records documenting that co-mingling does not occur during fabrication?
- O Yes O No O Not sure

19. How familiar are you with the industry's "Best Practices for Vacuum-packed subprimals?"
- O Not at all O Slightly O Somewhat O Mostly O Completely

20. Have you used these best practices in your operation?
- O Yes O No O Not sure

21. Is your operation currently involved in the Production of Intact Steaks and Roasts?
- O Yes *(continue with question 22)*
- O No *(skip to question 28)*

Production of Intact Steaks and Roasts:

22. Is *E. coli* O157:H7 identified as a reasonably likely to occur food safety hazard in the raw, not ground HACCP plan used to produce intact steaks and roasts?
- O Yes O No O Not sure

23. Which of the following is used in your operation? ***(select all that apply)***
- O Supplier Purchase specifications related to *E. coli* O157:H7
- O Antimicrobial intervention applied to product prior to use
- O Trimming of external surface prior to use
- O Continuous belt sanitizing system
- O Periodic sanitizing system of belt throughout shift
- O Testing of primals and subprimals for *E. coli* O157:H7
- O Testing of trim for *E. coli* O157:H7
- O Other intervention:

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24. Have the CCPs been validated?
- O Yes *(continue with question 25)*
- O No *(skip to question 26)*
- O Not sure *(skip to question 26)*

25. Did you conduct in-plant microbiological testing as part of the validation process?
- O Yes O No O Not sure

26. How familiar are you with the industry's "Best Practices for Vacuum-packed subprimals?"
- O Not at all O Slightly O Somewhat O Mostly O Completely

27. Have you used these best practices in your operation?
- O Yes O No O Not sure

28. Is your operation currently involved in the Production of Marinated/Enhanced Steaks and Roasts?
- O Yes *(continue with question 29)*
- O No *(skip to question 35)*

Production of Marinated/Enhanced Steaks and Roasts:

29. Is *E. coli* O157:H7 identified as a reasonably likely to occur food safety hazard in the raw, not ground HACCP plan used to produce marinated/enhanced steaks and roasts?
- O Yes O No O Not sure

30. Which of the following is used in your operation? ***(select all that apply)***
- O Supplier Purchase specifications related to *E. coli* O157:H7
- O Purchase only primals and subprimals that have been tested negative for *E. coli* O157:H7
- O Antimicrobial intervention applied to product prior trimming
- O Antimicrobial intervention applied after trimming, but prior to non-intact process
- O Partial trimming of external surface prior to use
- O Complete trimming of external surface prior to use
- O Continuous belt sanitizing system
- O Periodic sanitizing system of belt throughout shift
- O Testing of primals and subprimals for *E. coli* O157:H7
- O Testing of trim for *E. coli* O157:H7
- O Other intervention:

31. Have the CCPs been validated?
- O Yes *(continue with question 32)*
- O No *(skip to question 33)*
- O Not sure *(skip to question 33)*

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32. Did you conduct in-plant microbiological testing as part of the validation process?
O Yes O No O Not sure

33. How familiar are you with the industry's "Best Practices for Pathogen Control During Tenderizing/Enhancing of Whole Muscle Cuts?"
O Not at all O Slightly O Somewhat O Mostly O Completely

34. Have you used these best practices in your operation?
O Yes O No O Not sure

35. Is your operation currently involved in the Production of Needle/Blade Tenderized Steaks and Roasts?
O Yes *(continue with question 36)*
O No *(skip to question 42)*

Production of Needle/Blade Tenderized Steaks and Roasts:

36. Is *E. coli* O157:H7 identified as a reasonably likely to occur food safety hazard in the raw, not ground HACCP plan used to produce needle/blade tenderized steaks and roasts?
O Yes O No O Not sure

37. Which of the following is used in your operation? ***(select all that apply)***
O Supplier Purchase specifications related to *E. coli* O157:H7
O Purchase only primals and subprimals that have been tested negative for *E. coli* O157:H7
O Antimicrobial intervention applied to product prior trimming
O Antimicrobial intervention applied after trimming, but prior to non-intact process
O Partial trimming of external surface prior to use
O Complete trimming of external surface prior to use
O Continuous belt sanitizing system
O Periodic sanitizing system of belt throughout shift
O Testing of primals and subprimals for *E. coli* O157:H7
O Testing of trim for *E. coli* O157:H7
O Other intervention:

38. Have the CCPs been validated?
O Yes *(continue with question 39)*
O No *(skip to question 40)*
O Not sure *(skip to question 40)*

39. Did you conduct in-plant microbiological testing as part of the validation process?
O Yes O No O Not sure

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40. How familiar are you with the industry's "Best Practices for Pathogen Control During Tenderizing/Enhancing of Whole Muscle Cuts?"

O Not at all O Slightly O Somewhat O Mostly O Completely

41. Have you used these best practices in your operation?

O Yes O No O Not sure

42. Is your operation currently involved in the Production of Ground Beef?

O Yes *(continue with question 43)*
O No *(skip to question 56)*

Production of Ground Beef:

43. Is *E. coli* O157:H7 identified as a reasonably likely to occur food safety hazard in the raw, ground HACCP plan used to produce ground beef

O Yes O No O Not sure

44. Do you apply an antimicrobial agent prior to grinding the trim?

O Yes O No O Not sure

45. Do you apply an antimicrobial agent during grinding?

O Yes O No O Not sure

46. Have the CCPs been validated?

O Yes *(continue with question 47)*
O No *(skip to question 48)*
O Not sure *(skip to question 48)*

47. Did you conduct in-plant microbiological testing as part of the validation process?

O Yes O No O Not sure

48. Do you purchase beef trim that has been tested for *E. coli* O157:H7?

O Yes O No O Not sure

49. Do you include "bench trim" or trim from your cutting operation in the production of ground beef?

O Yes *(continue with question 50)*
O No *(skip to question 51)*
O Not sure *(skip to question 51)*

50. Is the "bench trim" tested for *E. coli* O157:H7 prior to grinding?

O Yes O No O Not sure

51. Do you conduct finished product testing for *E. coli* O157:H7?

O Yes O No O Not sure

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52. How familiar are you with the industry's "Best Practices for Processing Raw Ground Beef Products?"

O Not at all O Slightly O Somewhat O Mostly O Completely

53. Have you used these best practices in your operation?

O Yes O No O Not sure

54. How familiar are you with the industry's "Best Practices for Holding Tested Products?"

O Not at all O Slightly O Somewhat O Mostly O Completely

55. Have you used these best practices in your operation?

O Yes O No O Not sure

Background Information

56. Which FSIS size classification is your establishment?

O Large O Small O Very small

57. Number of employees:

O 4 or less
O 5 - 9
O 10 - 49
O 50 - 99
O 100 - 199
O 200 - 299
O 300 - 499
O 500 - 799
O 800+

Thank you!

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Phone Script

Slaughter:

1. How many CCPs do you have in the beef slaughter HACCP plan?
2. Please list them:

Fabrication:

1. How many CCPs do you have in the beef Fabrication HACCP Plan?
2. Please list them:
3. Do you apply an antimicrobial intervention to the carcass as it enters fabrication?
4. If yes, what is it?
5. Do you apply an antimicrobial intervention to primal and subprimal cuts prior to packaging?
6. If yes, what is it?

Grinding:

1. How many CCPs do you have in the ground beef HACCP plan?
2. Please list them:
3. Do you apply an antimicrobial intervention to trimmings prior to grinding or during the grinding process?
4. If yes, what is it?

Non-intact; needle/blade tenderized or needle injected products:

1. How many CCPs do you have in the HACCP plan used to produce needle /blade tenderized or needle injected products?
2. Please list them:
3. Do you apply an antimicrobial intervention to primal and subprimal cuts prior to needle/blade tenderizing or needle injecting?
4. If yes, what is it?

Non-intact; enhanced/ marinated products:

1. How many CCPs do you have in the HACCP plan used to produce enhanced / marinated products?
2. Please list them:
3. Do you apply an antimicrobial intervention to primal and subprimal cuts prior to enhancement or marination?
4. If yes, what is it?

Testing:

1. Are you testing for *E. coli* O157:H7?

If yes:

1. What products are you testing and what is the sample size?
2. How frequently do you test?
3. What test method is being used to analysis the sample?
4. Are you using an in-house lab or sending the samples to an outside laboratory?

Plant Visit Questions

Slaughter

1. When asked is *E. coli* O157:H7 identified as a reasonably likely to occur food safety hazard in the slaughter HACCP plan, How did you determine that *E. coli* O157:H7 was or was not reasonably likely to occur in the slaughter HACCP plan?

2. How did you determine which interventions to use in your plant? (If None were selected) Is there a specific reason why you have not put in place interventions?

3. How did you validate your CCPs?

4. Did you use any in-plant microbiological testing to validate your CCPs, and if so what test or tests were used for your validation process? Please explain how you collected the data.

5. How often do you re-validate your CCPs? How do you re-validate?

6. If CCP were not validated, why were CCPs not validated?

7. What type of on-going verification data to you collect?

8. Do you conduct *E. coli* O157:H7 testing? If so, what do you sample (hot carcass, chilled carcass)? What is the sample size (25g, 325g, other)? What laboratory test is used to analyze the sample?

9. Do you conduct any other microbiological data, and if so what and how is it used?

10. Will you share the results with your customers, upon their requests?

11. Has FSIS conducted a Food Safety Assessment within the past year? If so, would you mind sharing the outcome – No action; NRs; NOIE, other?

12. What is the biggest food safety challenge that you feel that you are facing today?

13. Is there any information or scientific data that would help you with your food safety programs?

14. When you need help with a food safety issue, who do seek assistance from? (trade association, extension specialists, consultant, laboratory, inspector, etc…)

15. If you are familiar with the industry Best Practices, how did you find out about them and did you find them useful?

16. Is there anything else that you would like to share with us concerning your food safety programs?

Fabrication of Beef Primals/Subprimals

1. When asked is *E. coli* O157:H7 identified as a reasonably likely to occur food safety hazard in the fabrication HACCP plan, How did you determine that *E. coli* O157:H7 was or was not reasonably likely to occur in the fabrication HACCP plan?

2. How did you determine which interventions to use in your plant? (If None were selected) Is there a specific reason why you have not put in place interventions?

3. How did you validate your CCPs?

4. Did you use any in-plant microbiological testing to validate your CCPs, and if so what test or tests were used for your validation process? Please explain how you collected the data.

5. How often do you re-validate your CCPs? How do you re-validate?

6. If CCP were not validated, why were CCPs not validated?

7. What type of on-going verification data to you collect?

8. Do you conduct *E. coli* O157:H7 testing? If so, what do you sample? What is the sample size? What laboratory test is used to analyze the sample?

9. Do you conduct any other microbiological data, and if so what and how is it used?

10. Will you share the results with your customers, upon their requests?

11. Has FSIS conducted a Food Safety Assessment within the past year? If so, would you mind sharing the outcome – No action; NRs; NOIE, other?

12. What is the biggest food safety challenge that you feel that you are facing today?

13. Is there any information or scientific data that would help you with your food safety programs?

14. When you need help with a food safety issue, who do seek assistance from? (trade association, extension specialists, consultant, laboratory, inspector, etc…)

15. If you have heard about the industry's Best Practices for Vacuum-Packed subprimals, how did you hear about them and were they useful?

16. Is there anything else that you would like to share with us concerning your food safety programs?

Production of Intact Steaks and Roasts

1. When asked is *E. coli* O157:H7 identified as a reasonably likely to occur food safety hazard in the raw, not ground HACCP plan used to produce intact steaks and roasts, how did you determine that *E. coli* O157:H7 was or was not reasonably likely to occur in the raw, not ground HACCP plan used to produce intact steaks and roasts?

2. How did you determine which interventions to use in your plant? (If None were selected) Is there a specific reason why you have not put in place interventions?

3. How did you validate your CCPs?

4. Did you use any in-plant microbiological testing to validate your CCPs, and if so what test or tests were used for your validation process? Please explain how you collected the data.

5. How often do you re-validate your CCPs? How do you re-validate?

6. If CCP were not validated, why were CCPs not validated?

7. What type of on-going verification data to you collect?

8. Do you conduct *E. coli* O157:H7 testing? If so, what do you sample (hot carcass, chilled carcass)? What is the sample size (25g, 325g, other)? What laboratory test is used to analyze the sample?

9. Do you conduct any other microbiological data, and if so what and how is it used?

10. Will you share the results with your customers, upon their requests?

11. Has FSIS conducted a Food Safety Assessment within the past year? If so, would you mind sharing the outcome – No action; NRs; NOIE, other?

12. What is the biggest food safety challenge that you feel that you are facing today?

13. Is there any information or scientific data that would help you with your food safety programs?

14. When you need help with a food safety issue, who do seek assistance from? (trade association, extension specialists, consultant, laboratory, inspector, etc…)

15. Is there anything else that you would like to share with us concerning your food safety programs?

Production of Marinated/ Enhanced Steaks and Roasts

1. When asked is *E. coli* O157:H7 identified as a reasonably likely to occur food safety hazard in the raw, not ground HACCP plan used to produce marinated/enhanced steaks and roasts, How did you determine that *E. coli* O157:H7 was or was not reasonably likely to occur in the raw, not ground HACCP plan used to produce marinated/enhanced steaks and roasts?

2. How did you determine which interventions to use in your plant? (If None were selected) Is there a specific reason why you have not put in place interventions?

3. How did you validate your CCPs?

4. Did you use any in-plant microbiological testing to validate your CCPs, and if so what test or tests were used for your validation process? Please explain how you collected the data.

5. How often do you re-validate your CCPs? How do you re-validate?

6. If CCP were not validated, why were CCPs not validated?

7. What type of on-going verification data to you collect?

8. Do you conduct *E. coli* O157:H7 testing? If so, what do you sample (hot carcass, chilled carcass)? What is the sample size (25g, 325g, other)? What laboratory test is used to analyze the sample?

9. Do you conduct any other microbiological data, and if so what and how is it used?

10. Will you share the results with your customers, upon their requests?

11. Has FSIS conducted a Food Safety Assessment within the past year? If so, would you mind sharing the outcome – No action; NRs; NOIE, other?

12. What is the biggest food safety challenge that you feel that you are facing today?

13. Is there any information or scientific data that would help you with your food safety programs?

14. When you need help with a food safety issue, who do seek assistance from? (trade association, extension specialists, consultant, laboratory, inspector, etc…)

15. If you have heard about the industry's "Best Practices for Pathogen Control during Tenderizing/Enhancing of Whole Muscle Cuts, how did you find out about the Industry's "Best Practices for Pathogen Control during Tenderizing/Enhancing of Whole Muscle Cuts" and did you find them useful?

16. Is there anything else that you would like to share with us concerning your food safety programs?

Production of Needle/Blade Tenderized Steaks and Roasts

1. When asked is *E. coli* O157:H7 identified as a reasonably likely to occur food safety hazard in the raw, not ground HACCP plan used to produce needle/ blade tenderized steaks and roasts, How did you determine that *E. coli* O157:H7 was or was not reasonably likely to occur in the raw, not ground HACCP plan used to produce needle/ blade tenderized steaks and roasts?

2. How did you determine which interventions to use in your plant? (If None were selected) Is there a specific reason why you have not put in place interventions?

3. How did you validate your CCPs?

4. Did you use any in-plant microbiological testing to validate your CCPs, and if so what test or tests were used for your validation process? Please explain how you collected the data.

5. How often do you re-validate your CCPs? How do you re-validate?

6. If CCP were not validated, why were CCPs not validated?

7. What type of on-going verification data to you collect?
8. Do you conduct *E. coli* O157:H7 testing? If so, what do you sample (hot carcass, chilled carcass)? What is the sample size (25g, 325g, other)? What laboratory test is used to analyze the sample?
9. Do you conduct any other microbiological data, and if so what and how is it used?
10. Will you share the results with your customers, upon their requests?
11. Has FSIS conducted a Food Safety Assessment within the past year? If so, would you mind sharing the outcome – No action; NRs; NOIE, other?
12. What is the biggest food safety challenge that you feel that you are facing today?
13. Is there any information or scientific data that would help you with your food safety programs?
14. When you need help with a food safety issue, who do seek assistance from? (trade association, extension specialists, consultant, laboratory, inspector, etc…)
15. If you have heard about the industry's "Best Practices for Pathogen Control during Tenderizing/Enhancing of Whole Muscle Cuts, how did you find out about the Industry's "Best Practices for Pathogen Control during Tenderizing/Enhancing of Whole Muscle Cuts and do you find them useful?"
16. Is there anything else that you would like to share with us concerning your food safety programs?

Production of Ground Beef

1. When asked is *E. coli* O157:H7 identified as a reasonably likely to occur food safety hazard in the raw, ground HACCP plan used to produce ground beef, How did you determine that it was or was not reasonably likely to occur in the raw, ground HACCP plan used to produce ground beef?
2. How was it determined whether or not to apply antimicrobial agent prior to grinding the trim?
3. How was it determined whether or not to apply an antimicrobial agent during grinding?

4. How did you validate your CCPs?
5. Did you use any in-plant microbiological testing to validate your CCPs, and if so what test or tests were used for your validation process? Please explain how you collected the data.
6. How often do you re-validate your CCPs? How do you re-validate?
7. If CCP were not validated, why were CCPs not validated?
8. What type of on-going verification data to you collect?
9. Do you conduct *E. coli* O157:H7 testing? If so, what do you sample (hot carcass, chilled carcass)? What is the sample size (25g, 325g, other)? What laboratory test is used to analyze the sample?
10. Do you conduct any other microbiological data, and if so what and how is it used?
11. Will you share the results with your customers, upon their requests?
12. Has FSIS conducted a Food Safety Assessment within the past year? If so, would you mind sharing the outcome – No action; NRs; NOIE, other?
13. What is the biggest food safety challenge that you feel that you are facing today?
14. Is there any information or scientific data that would help you with your food safety programs?
15. When you need help with a food safety issue, who do seek assistance from? (trade association, extension specialists, consultant, laboratory, inspector, etc…)
16. If you have heard about the industry's "Best Practices for Processing Raw Ground Beef Products, how did you find out about the Industry's "Best Practices for Processing Raw Ground Beef Products?"
17. If you have heard about the industry's "Best Practices for Holding Tested Products, how did you find out about the industry's "Best Practices for Holding Tested Products?"

18. Is there anything else that you would like to share with us concerning your food safety programs?

VITA

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