Best Practices: Pathogen Control During Tenderizing/Enhancing of Whole Muscle Cuts

Supported by:

National Cattlemen's Beef Association
American Meat Institute
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The American Meat Institute (AMI), National Cattlemen's Beef Association (NCBA), National Meat Association (NMA), and Southwest Meat Association (SMA) are pleased to have developed these industry *Best Practices for Pathogen Control for Tenderizing Operations of Whole Muscle Cuts*. In September 2003 leading manufacturers of non-intact meat products collaborated under the guidance of the American Meat Institute, National Meat Association, Southwest Meat Association, National Cattlemen's Beef Association, and developed the Best Practices for review by the Beef Industry Food Safety Council (BIFSCo). The Best Practices for Beef Slaughter (NMA et al., 2003a) and Best Practices for Handling Vacuum Packed Subprimal Beef Cuts (AMI et al., 2003) were used as resources in developing recommendations for non-intact beef products. Substantial updating of this document was completed following the Non-intact Products Processing Workshop (December 2005) based on meeting participants' comments. A full summary of this meeting is documented in *Beef Industry Addresses the Safety of Non-Intact Beef Products* (NCBA, 2006).

While the operating practices at individual companies may vary, producers of non-intact whole-muscle cuts are urged to consider these Best Practices as guidelines for their own internal practices and documentation. These practices are the best conditions known at the date of publication.

The following individuals should be recognized for their contribution to the development of these Best Practices:

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Industry Best Practices for Pathogen Control During Tenderizing/Enhancing of Whole Muscle Cuts

Purpose

This document is designed to discuss Best Practices that can be implemented throughout the tenderizing or enhancing operation, as well as during cleaning and sanitizing operations, to reduce the likelihood that contamination with potential pathogens (specifically *E. coli* O157:H7) will occur. There are multiple ways to reach the optimal end-result, and each operator must be able to apply the practices and procedures that best fit an individual operation. This document is not designed to mandate the use of any specific system or technology, but rather, to stress the importance of validating that the tenderizing or enhancing system is optimized to reduce the risk of contamination.

Introduction

FSIS defines non-intact beef products as ground beef; beef injected with solution, beef that has been mechanically tenderized by needling, cubing, frenching, or pounding devices, and beef that has been reconstructed into formed entrees. Whole muscle cuts (e.g., chucks, ribs, tenderloins, strip loins, top sirloin butts, rounds) may be treated to increase tenderness or to add ingredients for quality purposes, a practice that often occurs before subsequent fabrication at the same or external location. Treatments may include solid-needle tenderizing or hollow-needle tenderizing where a solution is pumped into the whole muscle. In the latter case, the solution typically is re-circulated, refrigerated and treated to ensure the quality of the pumping solution. It is important that the management of these operations be such that the equipment, refrigeration, solutions and product are optimized for quality and safety.

Producers of raw non-intact beef products recognize that these products may pose a risk if potential pathogens are moved to the interior portions of the meat products (Krizner, 1999; Phebus et al., 2000; Lambert et al., 2001; Hajmeer et al., 2002), and the product is not cooked adequately to destroy the pathogens inside the meat product. As is discussed below, the likelihood of potential pathogens being transferred to the inside from the outside of the product is extremely low because of a very low prevalence of pathogens on meat portions being tenderized or enhanced (Ransom et al., 2002; Warren et al., 2003). If equipment used in the operation is contaminated somehow, and not cleaned and sanitized, the tenderizing or enhancing equipment, and perhaps the solution to be injected, may become the vehicle of the contamination. To reduce the risk, it is extremely important that processors implement Best Practices by focusing on cleaning and sanitation practices for tenderizing and enhancing operations.

One of the primary considerations in assessing the likelihood of contamination of products that are tenderized or enhanced is whether or not contamination, especially with *E. coli* O157:H7, is a hazard reasonably likely to occur on the surface of intact meat portions before the tenderizing or enhancing operation. Several studies indicate that *E. coli* O157:H7 is not a hazard reasonably likely to occur on the surface of intact meat portions. A study was conducted by Warren et al. (2003) where sponge samples were taken of 1,014 subprimal cuts from six beef processing plants

over a five-week period. Only two samples (0.2%) tested positive for *E. coli* O157:H7. Enumeration indicated that each of the two positive samples had <3.0 CFU per 200 cm^2 sampled.

Two later studies were conducted by ABC Research Corporation (Gainesville, Fla.) throughout 2004 to determine the prevalence of *E. coli* O157:H7 and indicator organisms on the surface of beef subprimals that would be used as raw materials for tenderizing or enhancing operations. These studies used cuts of meat specifically used for tenderizing or enhancing operations, namely, briskets, rounds, chucks and middle meats. One study (I) focused on raw materials produced during the winter months (January and February); the second study (II) collected data during the late summer and fall (August into November).

In Study I, 600 samples comprising six subprimal cut types (100/type) were collected from five plants from the southern Midwest, Midwest, northern Midwest and the Southeast. Each sample was a sponge sample of the entire surface of a subprimal. None of the 600 samples had *E. coli* O157:H7. In study II, 599 samples (following the same scheme described above for study I) tested negative for *E. coli* O157:H7. Based on limits of methodologies and the results from Studies I and II, the authors concluded that the overall incidence of *E. coli* O157:H7 on beef subprimals was < 0.083% (Kennedy and Badnaruk, 2004, 2005).

This document provides Best Practices for tenderizing and enhancing operations and can be used by establishments to develop plant specific programs. Although these Best Practices are applicable to both production of raw and fully cooked tenderized and/or enhanced items, this document primarily focuses on the manufacture of raw non-intact products (excluding ground beef). These Best Practices are designed to provide a recommended set of practices and procedures that processors may want to adopt in their entirety, or in part to ensure optimal wholesomeness.

Raw Material Control

Best Practices begin with optimizing raw material (i.e. whole muscle cuts) quality and safety. Tenderizing and enhancing operations should identify requirements for raw material suppliers and have a system for verification that the requirements are being met and achieving the goals of the quality and safety program.

Criteria to select raw material suppliers should include that suppliers have process interventions in place to reduce or eliminate potential enteric pathogens. Raw material suppliers should have validated process interventions and/or validated critical control points (CCPs) in place to prevent, eliminate or reduce *E. coli* O157:H7 to a non-detectable level. As always, multiple interventions (hurdles) are preferable to single microbial interventions. Validation may include scientific literature and/or plant specific validation using indicator organisms, and it should be specific to the process being applied at the establishment. This validation can be incorporated into the processor's purchase specifications or other plant programs to ensure that all raw materials are produced using validated CCPs or process interventions. These purchase specifications should have a means to ensure that they are being met. Examples of such verification tools include, but are not limited to third party process reviews, customer audits and microbiological testing. This is true for both domestic and imported suppliers of raw materials to be used in production of non-intact product. Purchase specifications should be updated regularly

(at least annually). An example letter from a harvest/fabrication facility to meet the processor's prerequisite program requirements has been provided and is included in Best Practices: Appendix A.

Another important criterion for supplier selection is the ability and demonstrated maintenance of cold chain management. This includes rapid chilling of hot carcasses to control microbial growth and proper carcass rotation within the cooler to ensure timely fabrication.

Lastly, it is important for non-intact beef processors to have specific data on *E. coli* O157:H7 incidence to support the position taken during the hazard analysis as "not reasonably likely to occur." These data must relate to the raw materials and/or finished product(s). Routine microbiological testing may include sampling and testing for *E. coli* O157:H7. Other microbiological testing includes analyses for *Salmonella*, Aerobic Plate Count (APC), Total Plate Count (TPC), coliforms, and generic *E. coli.* For all microbiological testing, it is important that there be a written protocol for sample collection, lab analysis and proficiency testing, as well as the procedures for reporting the results. It is important to establish how the results will be used before the data are collected. Most of these microbiological tests are used for tracking supplier trends over time; however, each establishment must clearly define how they are going to use the information and the consequences of failing to meet internal microbiological guidelines.

Supplier Evaluations

Raw material suppliers are critical to both food safety and quality aspects of producing tenderized and enhanced products. In addition to well-defined requirements it is important that there are procedures established to evaluate the raw material supply whether from an internal or external vendor source. Guidelines developed for the Raw Ground Products Best Practices can be used to help design a system for evaluating supply sources for other non-intact raw materials. A more detailed discussion of supplier evaluations can be found in the *Best Practices for Raw Ground Products* document (NMA et al., 2003b; www.bifsco.org/BestPractices.htm).

Temperature Control

Cold chain management is a continuum from the time a carcass leaves the slaughter process and enters the chilling process through processing, packaging, storage and distribution. The goal is to achieve and maintain the temperature that will inhibit the growth of foodborne pathogens and slow the growth of spoilage microflora. The minimum growth temperatures for the pathogens of most concern are 44.6°F (7°C) for salmonellae and 44.6-46.4°F (7-8°C) for pathogenic *E. coli* (ICMSF, 1996). If cold chain control is violated at any point in the chain, product safety and quality may be compromised.

Cold chain management is especially important at the tenderizing or enhancing operation. Specific points where temperature should be controlled, other control points related to temperature control, and examples of operating limits in tenderizing or enhancing operations include:

- Receiving and storage of raw materials at 40°F or less
- Processing raw materials using a "First In First Out" (FIFO) rotation
- Monitoring raw materials and finished products using a process room/cooler control program

- Verifying the potability of process water
- Maintaining process water at 40°F or less
- Maintaining finished product temperatures at 40°F or less throughout their shelf life
- Controlling brine solutions to 40°F or less
- Pre-chilling shipping containers to 40°F or less before loading
- Maintaining temperatures at 40°F or less throughout transport

While temperatures are specified at 40°F or less in the above list based on the growth limitations for pathogenic *Salmonella* and *E. coli* O157:H7, it is generally recognized that the colder the temperature the better.

Process Controls

There are three general types of processing that are recognized within tenderizing and enhancing operations. These include needle tenderizing, brine-injecting (enhancing), and suspension injecting. Specific Best Practices will be presented for each of these categories due to unique differences between the processes. Example Standard Operating Procedures (SOP) are provided in the appendix as a reference for cleaning and sanitizing of injector assembly (Best Practices: Appendix B). Every process and enhancement system is unique and appropriate SOP's should be in place depending on the situation.

Needle Tenderized Products

- Documented GMPs (including needle integrity checks) exist for tenderizing operations
- If possible, needle the product from the side opposite of the external surface to minimize any bacterial translocation
- Traceability program is in place for all finished products
- Food Defense program exists to prevent tampering with operational equipment, and raw materials

Enhanced/Brine-Injected Products

- Letters of guarantee and certificates of analysis exist for ingredients used in pumping solution (brine or pickle solution)
- Documented General Manufacturing Practices (including needle integrity checks) exist for injecting operations
- Chilled water feeding system is preferable to complete chilling of brine following mixing
- Maximum age is established for reuse brine (pickle) solutions (e.g., 24 hours), with a mandatory break in the use cycle (e.g., every 24 hours)
- Use of an antimicrobial intervention (e.g., filtration, UV) for recirculating pickle solution is implemented if deemed necessary by the hazard analysis
- Use of bacterostatic ingredients in the brine solution (e.g. lactate, diacetate, sodium metasilicate) is implemented if deemed necessary by the hazard analysis
- If possible, inject the product from the side opposite of the external surface to minimize any bacterial translocation
- Daily needle removal and soaking in sanitation solution is conducted
- Established protocol exists for managing rework, including traceability and a time frame for incorporation into manufacturing

- Traceability program is in place for all finished products
- Food Defense program exists to prevent tampering with operational equipment, raw materials and pickle solutions

Meat Protein Suspension Injection Products[1]

- Letters of guarantee and certificates of analysis exist for ingredients used in the processing of the suspension solution (to include all meat and nonmeat ingredients in the brine or pickle solution, as well as documentation on "supplier evaluation" on the sources the trim raw material used)
- Documented GMPs (including needle integrity checks) exist for injecting operations
- Chilled water feeding system is preferable to complete chilling of brine following mixing and as the suspension is generated from it
- Maximum age is established for reuse brine (pickle) solutions (e.g., 24 hours), with a mandatory break in the use cycle (e.g., every 24 hours)
- Maximum age is established for reuse suspension solutions (e.g., 8 hours), with a mandatory break in the use cycle (e.g., every 16-20 hours)
- Use of an antimicrobial intervention (e.g., UV) for re-circulating pickle solution is implemented if needed as determined by the hazard analysis
- Use of bacterostatic ingredients in the brine solution (e.g. lactate, diacetate, sodium metasilicate) if needed as determined by the hazard analysis
- If possible, inject the product from the side opposite of the external surface to minimize any bacterial translocation
- Daily needle removal and soaking in sanitation solution is conducted
- Established protocol exists for managing rework, including traceability and a time frame for incorporation into manufacturing
- Traceability program is in place for all finished products
- Food Defense program exists to prevent tampering with operational equipment, raw materials and pickle solutions

Lotting

All non-intact processors should have a lotting mechanism for coding and recording all products to allow trace back and trace forward of products throughout the manufacturing and distribution system. FSIS recognizes that the establishment will define a lot and expects scientific or other supportive basis for defining the lot. Lotting systems can range from very simplistic, e.g., handwritten numbering, to very elaborate, e.g., computerized, automated bar coding. Lotting is often based on some unit of time (e.g., hour, shift, day); however lotting can be driven by other factors including raw material source, production line or processing room. Some processors may choose to further divide lots of product into sublots. By creating smaller lot units, process control can be demonstrated and documented more frequently; and there is a potential to minimize the

[1] Cozzini's SUSPEN**TEC** ™ system is a patented method of reducing meat, poultry or fish trimmings to micron size and incorporating them into traditional brines to create a suspension; the suspensions can then be injected into whole-muscle products. The use of this equipment is governed by FSIS Policy Memo PM041B. At the time this document was put together, Cozzini's SUSPEN**TEC** ™ system was the only such technology available for Beef, Pork and Poultry. These practices may or may not be applicable to other suspension technologies when they become available.

volume of product implicated in the event a recall is ever required. In tenderizing and enhanced operations, there is some precedence that FSIS will accept a single bag of subprimals as a lot, provided the processing facility can show adequate separation. If lots are intended to be broken at some frequency by needle rotation, accompanying sanitation of the feed-in area (debagging tables, conveyors) is also necessary. Additionally, establishments should maintain records associated with all production lots. Information to be recorded is dependent on the individual system; however the following data typically are recorded:

- Raw material vendor, vendor lot
- Process date, time of production
- Raw material, brine, room and product temperature
- Microbiological data
- Equipment evaluations

A more detailed discussion of lotting can be found in the *Best Practices for Raw Ground Products* document (NMA et al., 2003b; www.bifsco.org/BestPractices.htm).

HACCP System

Non-intact products will be produced under FSIS or state inspection, thereby meeting all Federal or State (equal to) requirements pertaining to HACCP systems (9 CFR 417), Sanitation SOPs (9 CFR 416) and pre-requisite programs. All processors should be able to support the decisions that are made in the HACCP program and to use the documentation generated from the program to demonstrate product safety.

HACCP is a proactive, systematic approach to food safety designed to prevent, eliminate or reduce food safety hazards to an acceptable level. Processing establishments must consider biological, physical, and chemical food safety hazards. As far as the authors know, there are no data to suggest that through a hazard analysis, *E. coli* O157:H7 should be considered a hazard reasonably likely to occur in tenderizing or enhancing operations. In fact, as mentioned earlier, data (nearly 1200 data points collected in the winter, fall and summer of 2004) have established that *E. coli* O157:H7 is not a hazard reasonably likely to occur on whole muscle cuts destined for tenderizing or enhancing operations. Likewise, additional studies have documented the very low incidence of *E. coli* O157:H7 on the surface of subprimals destined to be enhanced or mechanically tenderized. Data show only three to four percent of surface bacterial populations are translocated to an average interior depth of ¼" of the cuts during processing (Sporing, 1999; Lambert et al., 2001). Thus, mechanically tenderized and enhanced products pose no greater risk than intact cuts when cooked to a rare degree of doneness (140°F) (Marsden et al., 1999). A review of current research results is presented by the NCBA white paper entitled *Beef Industry Addresses the Safety of Non-intact Beef Products* (NCBA, 2006).

However, because these are raw meat processing operations, consideration should be given to *E. coli* O157:H7 as a potential, sporadic contaminate that could find its way into the processing environment and specific tenderizing or enhancing processing systems. Additionally, FSIS gave notice that all processors must reassess their HACCP systems to consider three foodborne outbreaks of *E. coli* O157:H7 that may have been linked to enhanced/tenderized beef steaks in their hazard analysis (FSIS-USDA, 2005). Thus, processors must focus on what practical strategies can be applied during the tenderizing or enhancing process to minimize the potential

for growth of *E. coli* O157:H7 if present as a process contaminant or as a highly unlikely contaminant of subprimals. These strategies typically involve prevention of harborages and niches through cleaning and sanitation of equipment, maintaining cold temperatures and using antimicrobial interventions on the subprimals prior to processing and during recirculation of enhancement solutions. Occasional verification that *E. coli* O157:H7 is not being harbored in the plant environment by swabbing equipment is recommended.

Sanitation and Facilities

Production of tenderized and enhanced products must occur in facilities that meet all Federal regulations (9 CFR 307, 310, 313, 314, 317, 318, 320, and 416) and the equipment used must meet sanitary operating guidelines. Establishments should meet all regulatory requirements of the Sanitation Standard Operating Procedures and should consider the guidelines presented in the Sanitation Performance Standards.

For optimal operation, the entire system should be process engineered. The idea of process engineering encompasses facility design, equipment design, product movement, supply movement and employee movement to create an environment that minimizes microbial contamination. The American Meat Institute's *Sanitary Design of Equipment and Facilities* (AMI, 2003) serves as a good reference. A checklist and a fact sheet, can be accessed at the following Web sites:
(http://www.meatami.com/Content/ContentGroups/Food_Safety_Inspection/Inspection1/Sanitation1/AMIEquipmentdesignChecklist.xls

http://www.meatami.com/Content/NavigationMenu/PressCenter/FactSheets_InfoKits/FactSheetSanitaryDesign.pdf).

FSIS personnel (Engeljohn, 2005) have suggested that insufficient sanitation of equipment was the biggest issue in the three *E. coli* O157:H7 outbreaks possibly linked to enhanced/tenderized beef steaks. The agency believes proper sanitation to be the single most important control measure available to processors of mechanically tenderized and enhanced products to prevent foodborne outbreaks.

Specifically, enhanced and mechanically tenderized processors should follow sanitation practices much like those adhered to by ready to eat (RTE) operations. A comprehensive review of RTE sanitation and practices are found in the *Guidelines for Developing Good Manufacturing Practices (GMPs), Standard Operating Procedures (SOPs) and Environmental Sampling/Testing Recommendations (ESTRs) in Ready to Eat (RTE) Products* (NMA, 1999).

As the tenderizers/injectors pass through the product they may introduce biological hazards to the interior or the product. Inadequate injection needle sanitation poses the greatest risk to spread any microbial contaminants present on the incoming raw materials, thus needle sanitation is critical. All needles must be removed at least daily and soaked in a sanitation solution prior to inspection and reassembly of the needle injector. Ideally, two sets of needles could be rotated to allow for maximum soaking time and potentially greater sanitation efficacy. Injection systems should be cleaned in place (CIP) using a validated sanitation process of cleaning followed by

sanitizing. Standard operating procedures should include the chemical concentration, frequency of cleaning, responsible party and how it will be verified.

Validation and verification of sanitation practices are always challenging, however the nature of small diameter hollow injection needles further compounds this issue. To validate the efficacy of the sanitation system needles can be sacrificed (broken) to determine if the cleaning and sanitizing procedures are adequate. Likewise, routine verification of sanitation practices for needles can be determined by sacrificing and sampling needles at some frequency. One processor has reported sacrificing one needle per cleaning cycle to verify internal needle cleanliness.

Interventions/Inhibitors

When called for by the hazard analysis, a validated intervention may be appropriate. The most basic intervention is knife trimming; which can be utilized with primals, subprimals, roasts and steaks prior to penetration. Other current applied technologies include application of antimicrobial solutions to the raw materials before processing, treatment of the brine with an inhibitory process (e.g., ultraviolet and/or filtration), addition of inhibitory ingredient to the brine and the use of an intervention or inhibitor applied to the finished product or packaging materials. New antimicrobial intervention and inhibitors that may be applicable in tenderizing or enhancing operations continue to be developed. A list of potential interventions at the time this document was written is included in Best Practices: Appendix C. For illustrative purposes, an in-plant study on the antimicrobial properties of a tenderizing pickle solution has been provided in Best Practices: Appendix D.

Microbiological Testing

Some producers have elected to sample and test for *E. coli* O157:H7 on subprimals destined for non-intact processing operations. Therefore, their verification testing data would serve as a basis for the hazard analysis.

Finished product microbiological testing is a means to verify process control and evaluate that the Best Practices discussed throughout this document are being used effectively to reduce the likelihood of contamination by potential pathogens and the overall microbial load on the finished product. However, finished product sampling cannot be used to ascertain the safety of the product unless enough samples are taken to develop a statistically based rationale for acceptance (e.g., 95 percent confidence that the probability of contamination is no greater than five percent). Generally, the economics of testing finished products and the high numbers of samples required to have a relatively high degree of confidence that a low level of contamination will be detected, make finished product testing impractical. There may be instances where finished product testing has some value, e.g., for periodic verification using indicator organisms, or when a process is out-of-control and an assignable cause is being sought.

Processors can achieve verification of the efficacy of a harvest/fabrication facility's processes to minimize microbial contaminants without microbial testing of incoming raw materials (subprimals). One way is to obtain copies of the harvest/fabrication facility's latest (at least annually) third-party food safety/HACCP audit. Additionally, processors can request that the harvest/fabrication facilities share their own routine microbiological verification data with the non-intact processor.

Packaging and Labeling

Packaging of non-intact beef cuts must occur in a manner to minimize the likelihood of contamination from packaging equipment, the environment, or food contact surfaces. Routine microbiological audit sampling and testing may be used to verify the efficacy of cleaning and sanitation, both on a routine basis and following equipment maintenance or relocation (AMI et al., 2003).

It is the belief of FSIS that consumers do not understand or expect whole muscle steaks and roasts to have been needled. Thus, the agency has suggested that processors consider voluntary labeling of enhanced and mechanically tenderized products to identify them as non-intact and to include cooking instructions. At least one large processor currently includes cooking instructions (145°F for three minutes) on such products.

Integrated Approach to Control

One way to evaluate the overall safety of a product is by calculating the integrated control measures, which is an evaluation of the baseline incidence and the bateriostatic / bacteriocidal effects of all the variables which contribute to the safety of the end product. The integrated approach to control includes, but is not limited to the following factors:

- Organism incidence rates in live animals
- Interventions applied at harvest and fabrication
- Raw material incidence rates
- Application of industry recognized best practices
- Interventions (including knife trimming) applied prior to injection/mechanical tenderization
- Organism translocation rates due to injection/mechanical tenderization
- Antimicrobial effects of an enhancement brine
- Ingredients affecting the heat liability of the organism
- Temperature control to minimize microbial amplification
- Cooking practices applied to the products
- Integrated time-temperature processing (integrated lethality)—incorporates all heat treatments, i.e. the increase in temperature as the product heats and the temperature levels as the product cools. Microbial destruction takes place during the entire heating and cooling process, not just at the minimum internal temperature.
- Relationship between depth of possible translocation, cooking time and temperature to effectively destroy microorganisms

By considering all of these variables, the true safety of the product can be determined.

Best Practices: References

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Best Practices: Appendix A
Example *E. coli* O157:H7 Purchase Specification Letter for Supplier Evaluations

Attention: Customer Name

Edible beef products from the plants listed at the end of this letter meet all USDA requirements for the production, sale and distribution of meat products. Such requirements include, but are not restricted to the categories listed below. Updates will be issued annually or as significant changes are made.

HACCP/Pathogen Reduction Regulation (Megareg) Compliance

- Testing of carcasses for *E. coli* Biotype I (9 CFR Part 310, §310.25), effective June 1997. (all Beef Slaughter plants)
- Implementation of SSOP (Sanitation Standard Operating Procedures, 9 CFR, Part 416, §416.11 - §416.17), effective January 26, 1997 for all plants.
- Implementation of HACCP Systems (9 CFR, Part 417, §417.1 - §417.8), effective January 27, 1998 for plants with greater than 500 employees.
- Implementation of HACCP Systems (9 CFR, Part 417, §417.1 - §417.8), effective June 1, 1998 for smaller plants noted separately by "*"
- Testing of carcasses and/or ground beef for *Salmonella* as conducted by USDA in accordance with §310.25.

Federal Register Docket 00-022N, dated 10/7/02 (*E. coli* O157:H7 Reassessment)

- Reassessment of HACCP plans for *E. coli* O157:H7 in accordance with the Notice 22-04, dated 10/7/02 conducted in all Company Name beef plants effective 12/6/02.
- Completion of annual reassessment of HACCP plans in accordance with 9CFR 417.4 (a) (3) effective January each calendar year. This reassessment included review and verification of adequacy of the HACCP plans in addressing *E. coli* O157:H7.

Directive 6420.2 – Issued 3/31/04

- CCP's in place and effect for zero tolerance requirements for head meat, cheek meat and weasand meat for all plants effective 5/17/04. **Note:** Zero Tolerance on carcasses has been in place as a CCP since the implementation of HACCP in 1998.

Directive 10,010.1 – revised 3/31/04

Labeling

- USDA approval for the following label disclaimer/instructional statements are available on site at the producing est.:
    - *For Cooking Only*
    - *Lot Tested and Found Negative for ECH7"*

Disposition CCP's

- All materials that are tested for *E. coli* O157:H7 that are not negative are addressed within the HACCP plans under a product disposition CCP.
- These materials are controlled, relabeled (when applicable) with the statement, "For Cooking Only" and are cooked or otherwise disposed of to inedible or rendering.
- Records reflect appropriate disposition of affected material.

Testing for *E. coli* O157:H7

Carcasses – Daily validation testing for *E. coli* O157:H7 is conducted at each beef slaughter plant. This has been in place and effect since 2000. Carcasses are sampled at the same sites as listed in 9CFR 310.25 for *E. coli* Biotype I and are retained pending results.

Beef Materials Destined For Non-Company Name Grinding

In accordance with the intended use described in the plants' Raw Not Ground HACCP plans (including trim and some variety meats harvested in slaughter), all materials destined for raw ground use are subjected to a statistically based sampling plan[1] for *E. coli* O157:H7. All boxed materials that are *"Lot tested and found to be negative for E. coli O157:H7"* are labeled with that statement. Combo'd trim does not carry this on the label as combo'd trim materials are tested per customer order and a Certificate of Analysis, (COA), specific to those combos is provided to the contracted end user. Since boxes may be broken down into smaller ship units by a primary (or secondary or tertiary, etc.) distributor, we deemed it necessary to label the individual box so the ultimate end user is aware that the materials were part of sampling lot that tested negative for *E. coli* O157:H7.

These labeling components are addressed in our HACCP plan as they are an integral part of the intended use.

Ground Beef

- All raw materials destined for grinding in the plants listed in this document are pre-tested[1] and negative for *E. coli* O157:H7 prior to grinding.
- External sources of trim raw material must have a validated carcass intervention for *E. coli* O157:H7 in place and a copy of that compliance is maintained on file at the receiving establishment.
- External sources of raw material must meet Company Name requirements for outside vendors including but not limited to: validated HACCP systems, 3rd party food safety/GMP audits, *E. coli* O157:H7 testing programs that meet or exceed 95% confidence for detection capability.
- Certificate of Analysis (COA's) received for all outside materials sent to grind.

Laboratory Verification Testing

- Verification of *E. coli* O157:H7 lab methods is routinely performed at each Company Name Laboratory in conjunction with the American Proficiency Institute Microbiological Performance Evaluation Program.

HACCP

Critical Control Points in place and in effect at present include:

HACCP Category	Critical Control Points
Slaughter	Steam Cabinet operational and functional with regard to ambient temperature and transit time to deliver a minimum of 160°F to the carcass surface to address *E. coli* O157:H7.
	Zero Tolerance for feces, ingesta and milk on carcasses.
	Carcass Chilling to reduce the surface down to 45°F or less within 24 hours to control microbial growth.
	Disposition CCP to assure proper disposition of any carcasses that do not test negative for *E. coli* O157:H7.
Raw Not Ground – Trim	Pre-cut Carcass Surface Temperature below 45°F to control microbial growth.
	Disposition CCP to assure proper disposition of any products that do not test negative for *E. coli* O157:H7.
Raw Not Ground – Variety Meats	Zero Tolerance for feces, ingesta and milk on head, cheek and weasand meat.
	Chilling to reduce the surface down to 45°F or less within 24 hours to preclude microbial growth.
	Disposition CCP to assure proper disposition of any products that do not test negative for *E. coli* O157:H7
Raw Ground	Inbound Raw Material Temperature ≤ 45°F to preclude microbial growth
	Functioning metal detector, verified for timing and sensitivity at the start of operations.
	Disposition CCP to assure proper disposition of any products that do not test negative for *E. coli* O157:H7

A CCP is *"A point, step, or procedure in a food process at which control can be applied and, as a result, a food safety hazard can be prevented, eliminated, or reduced to acceptable levels"*[2] It should be clearly understood that these CCP's are in place to accomplish just that for *E. coli* O157:H7; control, eliminate or reduce to an acceptable level. The acceptable level for *E. coli* O157:H7 is undetectable.

Best Practices/Good Manufacturing Practices

In addition to the CCP's, the following practices are utilized in our beef slaughter operations.

- **Steam Vacuums** – are located strategically throughout the slaughter floor and are used on pattern mark areas.
- **Pre-Evisceration Cabinet System (PECS)** – eligible beef carcasses are treated with up to 2.5% organic acid pre-evisceration.
- **Anti microbial spray** – carcasses are treated with an anti microbial spray of organic acid or acidified sodium chlorite after the Steam Cabinet. Heads are treated with an organic acid application immediately after the head wash, prior to USDA Inspection.

Verification

- In accordance with the facilities' HACCP plans, all CCP's have been validated and are verified at the specified frequencies in the HACCP plan in accordance with 9CFR 417.4.
- Company Name is audited on an annual basis by an independent third party auditor. That audit encompasses both regulatory compliance (HACCP, SSOP, 10,010.1, etc.) and good manufacturing practices. A summary matrix of audit scores is available upon request.

Customer Notification

- Company Name plants have a recall plan on file that includes notification to affected customers of any product that may be adulterated or misbranded.

Last, the Company Name plants listed below are federal establishments and operate under the regulatory requirements promulgated in Title 9 of the Code of Federal Regulations. By dint of the Mark of Inspection, we are obligated to adhere to all applicable requirements contained therein.

COMPANY NAME BEEF PLANTS

EST.	**Location**	**Comments**
Est. ###	City, ST	
Est. ###	City, ST	
Est. ###	City, ST	
Est. ###	City, ST	
Est. ###	City, ST	

Best Practices: Appendix B
Standard Operating Procedures for Cleaning and Sanitizing Injector Assembly: Example I

Purpose: To effectively clean and sanitize the injector assembly

Program: At the end of each production day, production personnel will perform the following tasks:

Injector Needles

1. Open the needle assembly and inspect for cleanliness. If any residual brine residue remains, rinse the housing and needles completely.
2. Remove all needles and carefully place the needles in a clean meat lug that has not been used during that day's production.
3. Rinse housing after needles are removed to ensure that all areas of the head are free of visible residue.
4. Add clean & soak chemicals to the meat lug to a level that completely submerges all needles in the container. Needles must soak for a minimum of 6 hours or as recommended by the sanitation chemical manufacture. If necessary, use a second set of cleaned and sanitized needles to ensure adequate cleaning while meeting production requirements.
5. After the needles have soaked for a minimum of 6 hours, each needle must be "blown out" with clean air before being replaced in the injector assembly.
6. Once clean needles have been placed in the injector assembly, they must be sanitized and rinsed before being used in production.

Cleaning and Sanitizing Solutions

1. The composition of the cleaning solution used for nightly cleaning can be used for cleaning the needles and assembly parts unless other solutions have been validated for efficacy.
2. The cleaning and sanitizing chemicals should be rotated periodically.
3. The amount of chemical solution used and the soak time for cleaning should be documented, and verified periodically, e.g., quarterly.

Monitoring & Verification: QA and Production Management will monitor the cleaning and sanitizing process during cleanup hours to ensure proper compliance. QA will verify sanitation daily during pre-operational inspections. An authorized person verifies solution composition and chemical strength nightly. Microbial sampling of cleaned and sanitized surfaces will be conducted as per the documented microbiological sampling schedule.

Standard Operating Procedure Clean In Place System Cleaning: Example II

PURPOSE: To minimize bacterial growth.

PROGRAM: A CIP cleaning solution will be ran through the injection process to ensure proper cleaning of the injection process.

PROCEDURE:

1. Drain all brine material from lines, pumps, and tanks. During the draining process production personnel will continue to rinse all six tanks with potable water until all visible brine residue has disappeared.
2. Fill the two mixing tanks (# 3 & # 6) with 200 Gal. of cold potable water each.
3. Flush 100 Gal. from the line 1 mixing tank (#3) to each of the rear holding tanks (#2 & #1).
4. Flush 100 Gal. from the line 2 mixing tank (#6) to each of the rear holding tanks (#5 & #4).
5. Flush all water from all holding tanks through the CIP system and a minimum of 50 Gal. through each of the injectors (line 1 and line 2).
6. Fill mixing tanks(#3) and (#6) again with 200 Gal. of cold potable water and add appropriate amount of the approved CIP cleaning solution.
7. Mix thoroughly.
8. Flush 100 Gal. of the mixed cleaning solution from the line 1 mixing tank (#3) to each of the rear holding tanks (#2 & #1).
9. Flush 100 Gal. of the mixed cleaning solution from the line 2 mixing tank (#6) to each of the rear holding tanks (#5 & #4).
10. Flush all cleaning solution from all holding tanks through the CIP system pumping from each tank a minimum of 5 minutes.
11. A minimum of 50 Gal. will be pumped from one of the holding tanks of each line through its designated injector (line 1 and line 2).
12. Fill the two mixing tanks (# 3 & # 6) with 200 Gal. of cold potable water each.
13. Flush 100 Gal. from the line 1 mixing tank (#3) to each of the rear holding tanks (#1 & #2).
14. Flush 100 Gal. from the line 2 mixing tank (#6) to each of the rear holding tanks (#5 & #4).
15. Flush all water from all holding tanks through the CIP system and a minimum of 50 Gal. through each of the injectors (line 1 and line 2).

The currently used cleaning solution is STERIS brand Process Klenz alkaline cleaner used at 2.5% by volume. (5 gallons Process Klenz mixed with 200 gallons potable water.)

CORRECTIVE ACTION: Production will not be allowed to start until CIP cleaning has taken place**.**
RELATED FORMS: CIP System Cleaning Verification Process Check

MATERIALS NEEDED: Steris brand process klenz alkaline cleaner.

FREQUENCY: Daily

MONITORED BY: QA and Production Management will routinely monitor to ensure proper compliance.

General Manager _____ Date _____

QA Manager _____ Date _____

Standard Operating Procedure Clean In Place System Sanitizing: Example III

PURPOSE: To minimize bacterial growth.

PROGRAM: A CIP Sanitizing solution will be ran through the injection process to ensure proper cleaning of the injection process.

PROCEDURE:

1. Fill the two mixing tanks (# 3 & # 6) with 200 Gal. of cold potable water each.
2. Flush 100 Gal. from the line 1 mixing tank (#3) to each of the rear holding tanks (#2 & #1).
3. Flush 100 Gal. from the line 2 mixing tank (#6) to each of the rear holding tanks (#6 & #4).
4. Flush all water from all holding tanks through the CIP system and a minimum of 50 Gal. through each of the injectors (line 1 and line 2).
5. Fill mixing tanks #3 and #6 again with 200 Gal. of cold potable water and add appropriate amount of the approved CIP sanitizing solution.
6. Mix thoroughly.
7. Flush 100 Gal. of the mixed sanitizing solution from the line 1 mixing tank (#3) to each of the rear holding tanks (#2 & #1).
8. Flush 100 Gal. of the mixed sanitizing solution from the line 2 mixing tank (#6) to each of the rear holding tanks (#5 & #4).
9. Flush all sanitizing solution from all holding tanks through the CIP system pumping from each tank a minimum of 5 minutes.
10. A minimum of 50 Gal. will be pumped from one of the holding tanks of each line through its designated injector (line 1 and line 2).
11. Fill the two mixing tanks (# 3& # 6) with 200 Gal. of cold potable water each.
12. Flush 100 Gal. from the line 1 mixing tank (#3) to each of the rear holding tanks (#2 & #1).
13. Flush 100 Gal. from the line 2 mixing tank (#6) to each of the rear holding tanks (#5 & #4).
14. Flush all water from all holding tanks through the CIP system and a minimum of 50 Gal. through each of the injectors (line 1 and line 2).

The currently used cleaning solution is STERIS brand Process LCS liquid chlorinating sanitizer used at .25 ounce per gallon. (50 ounces mixed with 200 gallons potable water.) Chlorine Days Monday, Wednesday, Friday, Saturday, Sunday. Quat Days: Tuesday, Thursday.

CORRECTIVE ACTION: Production will not be allowed to start until sanitizing has taken place.

RELATED FORMS: NA

MATERIALS NEEDED: Quat or Chlorine

FREQUENCY: Daily

MONITORED BY: QA and Production Management will routinely monitor to ensure proper compliance.

General Manager _____ Date _____

QA Manager _____ Date _____

Standard Operating Procedure Operational Cleaning of Injector Reservoir In-Line Filters: Example IV

PURPOSE: To minimize bacterial growth.

PROGRAM: Injection filters will be cleaned on a regular basis to ensure the injectors operate at an optimal level.

PROCEDURE:

1. Remove the machine side in-line final filter by rotating its holding cylinder to the vertical position where it will latch against the wall of the reservoir.
2. From this position the end cap can be threaded back and spun out of the way so the filter may be removed for cleaning.
3. Remove filter and clean with tempered water of sufficient pressure to remove any built up residue.
4. Replace filter into its holding cylinder and thread back its end cap to secure filter in the cylinder.
5. Return filter assembly to the horizontal position inside the reservoir tank.
6. Remove the off side in-line final filter by rotating its holding cylinder to the vertical position where it will latch against the wall of the reservoir.
7. From this position the end cap can be threaded back and spun out of the way so the filter may be removed for cleaning.
8. Remove filter and clean with tempered water of sufficient pressure to remove any built up residue.
9. Replace filter into its holding cylinder and thread back its end cap to secure filter in the cylinder.
10. Return filter assembly to the horizontal position inside the reservoir tank.

CORRECTIVE ACTON*:* NA

RELATED FORMS: NA

MATERIALS NEEDED: Tempered Water

FREQUENCY: Operational cleaning of injector reservoir filters should be conducted on the hourly basis in order to maintain consistent pump settings.

NOTE: Each employee who handles injector equipment must change gloves before and after as well as clean any additional utensils needed for the tasks. This ten-step process will be used for the reservoir tanks of both line one and line two injectors. If filters are cleaned one at a time than the injector does not need to be shut down for this SOP.

MONITORED BY: QA and Production Management will routinely monitor to ensure proper compliance.

General Manager: _____ Date: _____

QA Manager: _____ Date: _____

Best Practices: Appendix C
Decontamination Interventions for Primals, Subprimals, Trim and Ground Meat

Decontamination Interventions

	Intervention	Effectiveness in Lab setting	Effectiveness in Field / Plant	Regulatory Status
MECHANICAL TREATMENT				
	Irradiation	Widely studied. Effective in reducing pathogens at varying levels depending on dose.	Effective, but control of dose is critical to minimize effects on organoleptic factors.	Approved, labeling required
	Trimming	CSU study indicates surface trimming is as effective as certain chemical treatments. 1.1 log CFU/cm^2 reduction (inoculated with 3.7 log CFU/cm^2).	Effective and implemented widely	Not a limitation
	Steam	Initial results are limited, but may have an effect.	Unknown	Unknown
	Hot water wash	CSU study indicates a significant log reduction. 1.0 log CFU/cm^2 reduction (inoculated with 3.6 log CFU/cm^2).	Unknown	Unknown

	Intervention	Effectiveness in Lab setting	Effectiveness in Field / Plant	Regulatory Status
CHEMICAL TREATMENT				
	Acidified Sodium Chlorite	Company data 2.9 log reduction of *E. coli* O157. 2.0 log reduction of *E. coli* (generic). KSU 2-3 log CFU/cm^2 reduction of APC. ABC Research found up to a 0.63 log reduction of *E. coli* O157 on inoculated subprimals	Initial trials show approximately a 2 log reduction of APC.	Approved, however weight gain over 0.5% must be labeled.
	Lactic Acid	CSU data supports 2.5% LA @ 55°C resulted in 1.0 log CFU/cm^2, while 5.0% LA @ 55°C resulted in a 1.1 log CFU/cm^2 (inoculated at 3.6 and 3.5 log CFU/cm^2, respectively).	Unknown. 0.4% by weight, of a 2.5% solution was not effective.	Pending approval at 2.5% and 5.0% levels.
	Acidified Calcium Sulfate	Company trials are encouraging.	Unknown	Not approved in Beef trim
	CPC	Company trials show significant log reductions.	Unknown	Not approved in Beef trim, residual levels cited as concern.
	Peroxyacetic acid	ABC Research data found .63 - .71 log reduction of *E. coli* O157:H7 on inoculated subprimals.	Unknown	Approved
	Citric Acid	Laboratory trials show promise.	Unknown	Approved

	Intervention	Effectiveness in Lab setting	Effectiveness in Field / Plant	Regulatory Status
BIOLOGICAL				
	Lactoferrin	CSU study indicates that Lactoferrin applied to inoculated subprimals allowed 4.6 log less growth of *E. coli* O157:H7. Additionlly 5.0% lactic acid used in combination with activated Lactoferrin at 55°C resulted in 0.9 log CFU/cm^2 reduction (inoculated at 3.5 log CFU/cm^2).	Unknown	Approved for Carcasses and parts Directive 7120.1
	Lactobacillus acidophilus	TTU study demonstrated a 90% reduction in *E. coli* O157:H7 and a 99.9% reduction in *Salmonella*	Unknown	Working on petition

Best Practices: Appendix D
Studies on the Antimicrobial Properties of Tenderizing Pickle Solution

Preliminary Report

September 10, 2003

Study I

Objective: To determine antimicrobial properties of a pickle solution used in tenderizing whole muscle cuts

Composition of pickle solution: A typical pickle solution will contain phosphate, salt and flavorings. The solution used in this study contained a proprietary formula based on in finished products, e.g., 0.5%.

Measurement of the antimicrobial effect: The antimicrobial effect of the pickle solution was measured using a micro-titer assay (i.e., providing minimum inhibitory concentrations) and traditional laboratory plating procedures.

Results: Using micro-titer assays, initial experiments determined that the pickle solution reduced the concentrations of *E. coli* O157:H7 and *Salmonella* by at least 2 logs (100-fold). In follow-up experiments, direct inoculation of pickle solution with a cocktail of 3 *E. coli* O157:H7 strains and 3 *Salmonella* strains at levels near 10^6 per mL resulted in complete lethality for all pathogens after 30 minutes of exposure (the first measurement time interval after the zero time measurement).

In a laboratory setting using traditional microbiological techniques, the antimicrobial properties of the pickle solution were determined. Pickle solution was inoculated to 1.73 logs per mL with *E. coli* O157:H7 and stored at room temperature (~73°F) or under refrigeration (37°F). No *E. coli* O157:H7 were recovered from the pickle solution after 2 hours at room temperature and after 24 hours under refrigerated conditions.

	Storage temp	
Time	**Room**	**Refrigerator**
0 min	Positive	Positive
30 min	Positive	Positive
1 hour	Positive	Positive
2 hour	Negative	Positive
4 hour	Negative	Positive
24 hour	Negative	Negative

These data represent the results of a single study using inoculated organisms, and should not be extrapolated to all situations. The storage temperature and times, while different for room temperature versus refrigerated, simply indicate that the brine solution may exhibit inhibitory properties against *E. coli* O157:H7. However, further research would be needed to confirm that this is the case, and multiple variables may be contributing to this effect.

Next steps: Additional validation work will be repeated with meat extract added to evaluate effects of meat components on bactericidal activity and with inoculated meat exposed to the pickle solution.

Study II

Objective: To determine the prevalence of *E. coli* O157:H7 in injection solutions used to enhance various beef products.

Sampling Procedures: One-quart samples of injection solutions were taken from the brine return, before the brine entered the reservoir for recycling with fresh solution, before filtration. Samples were collected at least 20 minutes into production, with each sample set of three samples spaced throughout the scheduled production run. Samples were then sealed and sent to the laboratory for testing.

Results: In total, 19 sample sets (57 samples) were collected through July and August 2003. All samples (Table 1) tested negative for the presence of *E. coli* O157:H7. Preliminary investigation into the recovery of *E. coli* O157:H7 that were inoculated into brine samples indicated that the organism could be recovered from the brine solution, if present.

Table 1. Injection Solution Results for Study II

Date	Meat Cut	*E. coli* O157:H7 Result 1	*E. coli* O157:H7 Result 2	*E. coli* O157:H7 Result 3
29-Jul-03	Flat	NEG	NEG	NEG
29-Jul-03	Flat	NEG	NEG	NEG
29-Jul-03	Ribeye	NEG	NEG	NEG
30-Jul-03	Capoff Inside	NEG	NEG	NEG
30-Jul-03	Flat	NEG	NEG	NEG
30-Jul-03	Ribeye	NEG	NEG	NEG
31-Jul-03	Ribeye	NEG	NEG	NEG
05-Aug-03	Capoff Inside	NEG	NEG	NEG
05-Aug-03	Ribeye	NEG	NEG	NEG
05-Aug-03	Capoff Inside	NEG	NEG	NEG
06-Aug-03	Ribeye	NEG	NEG	NEG
06-Aug-03	Capoff Inside	NEG	NEG	NEG
06-Aug-03	Inside	NEG	NEG	NEG
11-Aug-03	Ribeye	NEG	NEG	NEG
13-Aug-03	Ribeye	NEG	NEG	NEG
20-Aug-03	Inside	NEG	NEG	NEG
20-Aug-03	Capoff Inside	NEG	NEG	NEG
20-Aug-03	Capoff Inside	NEG	NEG	NEG
20-Aug-03	Inside	NEG	NEG	NEG