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National Meat Association is pleased to be joined by the Southwest Meat Association, the American Meat Institute and the National Cattlemen's Beef Association in the development of these Best Practices for beef slaughter. Leading representatives of beef slaughtering companies met in late 2002 in Kansas City, Missouri and under the guidance of Dr. Kerri Harris of the Department of Animal Science at Texas A&M University developed the information for these Best Practices.

The operating practices at every company may vary slightly from these Best Practices, depending on differing operating situations. Slaughterers are urged to consider these Best Practices as guidelines for their own internal practices and documentation.

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Guidelines for Developing Best Practices

For

Beef Slaughter

Coordinated by

Department of Animal Science
Texas A&M University

For

National Meat Association
Southwest Meat Association
American Meat Institute
National Cattlemen's Beef Association

August 2003

Best Practices for Slaughter
Developed on October 9-10, 2002
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This document was designed to discuss best practices that can be used throughout the slaughter operation to achieve the optimal end-result on the finished product. The use of best practices and current science and technology allows slaughter operators to produce visibly clean carcass and to reduce the incidence levels of pathogenic contamination (based on known load level) to reach a specified log reduction. 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 their individual operation. This document is not designed to force the use of any specific system or technology, but to stress the importance of knowing that the optimal end-results can be reached based on the plant's specific system in-place.

It is also important to note that the finished product is still a raw product and may not be free of pathogens. Because we are not able to identify the carcasses that are contaminated with pathogens, it is best to assume and treat 100% of the carcasses as if they are contaminated.

Before we discuss the steps that can be taken at each point of the process, there are several broad issues that each establishment should take into consideration.

Facilities:

All establishments should evaluate their facilities to ensure that the design, construction, flow, and overall operation contribute to the production of safe and wholesome product. While we realize that many of the establishments were constructed decades ago and not initially designed with food safety in-mind, there are still several steps that can be taken to optimize the facility.

For example, is it possible to design a "hide-on vs. hide-off" (dirty side vs. clean side) of the operation by adding a physical barrier or redesigning the flow of the operation. The clean vs. dirty concept should include design of facilities, as well as actions taken by maintenance, QA, inspectors, and flow of traffic (employees and tour groups) to prevent contamination of clean carcasses. For example, separate cafeterias or break-rooms for employees or scheduling of breaks and lunch to reduce the potential for contamination during these times. Each operator should look at the entire operation to determine locations and/or activities that can be separated to minimize the potential for contamination.

Other areas that should be evaluated:

- Equipment (pallet jacks, fork lifts, etc.) should be cleaned and sanitized as it moves through areas.
- Mid-shift clean-up should be conducted in a manner to prevent splash onto product contact surfaces or product.
- Employee practices should be evaluated to determine potential problem areas, such as walk-ways for entering the plant, locations for smoking, entrance and exit locations on the floor, location of welfare facilities and break rooms, etc.
- In-house programs should be developed to monitor employee hygienic practices, handwashing practices, cleanliness of dress, use of equipment, etc.
- Employee training is a critical part of the success of the overall operation. Establishments should be committed to providing the employees with the knowledge and the resources to conduct their jobs as efficiently and effectively as possible.
- Air-flow should minimize the potential contamination of the hide-off cattle from the hide-on side.

Water Re-use:

Operations re-using water must follow all FSIS guidelines including treatments to ensure that there is no introduction of pathogens. This applies to re-circulated water in thermal pasteurization units. If re-use water is not reaching a potable water standard, then it is important to ensure that this re-used water is not used in areas that could cause contamination of equipment, contact surfaces or product.

Plant Sanitation Program:

Each plant should develop and implement an effective sanitation program that will ensure sanitary conditions for both pre-operational and operational activities. The program should focus on specific areas, complete equipment breakdown, zone cleaning, etc. The plant should set a target level to demonstrate sanitary conditions and develop a system for monitoring and documenting that it has been reached. It is important to be able to demonstrate the effectiveness of the program.

Validation:

Validation is a very important issue that each plant must address. Validation should include both the individual parameters, (i.e., CCPs) and the overall food safety system. Validation is the process of ensuring that the CCPs and program will control the identified food safety hazards. This can be done using scientific literature, in-plant studies, and other information. To achieve the optimum level of safety, a company must have a validated program and must be able to successfully execute the program. Failure to validate or failure to implement will cause failure of the overall system.

The rest of the document focuses on the major steps for processing cattle. We know that every establishment has a slightly different process, but these were identified as key steps.

Cattle Receiving:

The facility construction and trailer off-loading areas should be of sound condition to prevent injury and allow for humane handling practices. Trailers should be clean prior to loading cattle and trailers should be washed prior to reloading.

Plant personnel should oversee the off-loading of all cattle to ensure the proper handling of livestock, including downers. If the plant policy allows the processing of downers, then proper procedures should be in place to meet all Humane Handling requirements.

Based on current information, it is noted that incoming cattle may have a high level of *E. coli* O157:H7. Therefore, processors may consider implementing a mudscore system to allow them to identify problem cattle. This information could be given back to the suppliers to let them know how they are doing, and it could be used to help control line speed on the slaughter floor.

It is noted that all operators should be receiving statements to confirm compliance with the ruminant feed ban from all cattle suppliers. These should be on file and updated as needed to ensure compliance.

If the operation processes high-risk cattle that may have a greater potential for chemical residue, then procedures should be in place to relate information back to the suppliers. This system should help identify repeat violators and decrease the potential for violative chemical residues.

Holding Pens:

Holding pens should be kept clean. Recommend washing pens with a pathogen-free water supply.

A pen cleaning schedule should be developed that would ensure that pens are kept as clean as possible irrespective of the season and condition of the cattle. If an establishment is using reclaimed water for housing animals or cleaning pens, then it should have been treated for pathogens prior to use.

All operations should comply with Humane Handling requirements.

Cattle Washing:

There is still an uncertainty on the microbial benefits or problems created by washing cattle prior to entering the pens. Some establishments have demonstrated that washing the cattle helps reduce visible contamination and aids with the sanitary dressing procedures. Misting the cattle often helps reduce airborne dust and dirt particles on the slaughter floor. There is a tremendous amount of variation with seasonal influences and types of cattle being processed; therefore, if an establishment chooses to implement a cattle wash system, the procedures for application may vary.

Stunning:

Establishments must ensure that they are following proper stunning procedures to ensure Humane Handling. (Grandin 2001.)

Sticking:

Initial hide opening should be done with as small of opening as possible to expose the jugular. Actual bleeding may be performed by a second employee using a sanitized knife, and it may be beneficial to use a two knife system that allows for one knife to remain in the sanitizer while the other one is being used. It is important that the sanitizing process for equipment is sufficient to effectively sanitize the knife. If using hot water, then the establishment may need to leave the knife in the dip long enough sanitize (180°F has been shown to take approximately 4-6 seconds, but this varies based on the level of contamination). Other options include adding a chemical sanitizer. Remember, it is important that the plant be able to demonstrate proper sanitation.

Hide Removal: (Manual and Mechanical)

Establishments should have sanitary dressing procedures during hide removal. The success of proper dressing procedures relies heavily upon the employees conducting the activities with a high level of skill and care. Therefore, the employees must be trained, supervised effectively, and audited routinely to ensure proper dressing.

Manual: Initial opening of the exterior of the hide should be on as clean of an area as possible, such as removing visible contamination with air knives, vacuuming the cut line, etc., to reduce contamination. Optimal procedures for cutting through the hide should allow for the use of clean and sanitized equipment to prevent contamination onto the carcass surface. Operations can explore the possibilities for having multiple employees conducting the skinning procedures, as well as ensuring the effectiveness of the sanitizing of equipment.

Mechanical: The use of mechanical hide pullers should be implemented to reduce the hide slaps, splatters, and operator contamination from the hide onto the carcass. The

operator should maintain clean hands and equipment to prevent contaminating the carcass during removal. Operators should closely observe the equipment to ensure that it is functioning properly to prevent cross-contamination of the carcass from the equipment.

Operations can explore opportunities for using hooks for holding the hide, having multiple air-knives for use, or using two employees to conduct the activities to prevent them from contaminating the opposite sides. Also, the use of paper/plastic on key areas (brisket, leg, etc.) and bags (tails and bungs) may reduce contamination.

Any carcass that is identified as having a special problem (abscess, large hide slap, etc.) should be identified and handled appropriately throughout the system to recondition the carcass.

Open Brisket:

The brisket opening is usually a two-part process (knife and saw). The initial knife cut should be made with a clean and sanitized knife. The saw should be cleaned and sanitized between carcasses to prevent cross-contamination.

Head Removal:

Heads must be removed in a sanitary manner to prevent contamination. This process step may also involve the activities for dehorning, ear removal, etc. Regardless of the type of mechanical puller and/or procedure for head removal and skinning process, the procedures must be conducted in a sanitary manner. All equipment should be cleaned and sanitized appropriately to prevent contamination. Employees must clean and sanitize hands and equipment throughout the head removal process to ensure sanitary dressing.

Rod Weasand:

To ensure sanitary conditions, employee must wash hands and arms and switch rods and/or sterilize rods between carcasses.

Evisceration:

Evisceration procedures must be developed and implemented for proper sanitary dressing, including the proper weasanding and bunging activities conducted previously. The equipment should be sterilized to prevent contamination. An automated viscera table will often include automatic sanitation; however, establishments using carts/trucks should make sure that procedures are in-place to prevent contamination. If there is a problem during contamination that results in major contamination, then the carcass should be identified and handled appropriately throughout the system to recondition the carcass.

Splitting Saw:

The saw blade should be continuously rinsed with 180°F water, and the housing on the splitting saw should be dipped between carcasses to prevent contamination. Any carcass that is identified by the employee as having a problem will be identified and handled appropriately on the out rail to recondition the carcass. It is very important that carcasses identified earlier in the process as being contaminated are handled appropriately during splitting.

Spinal Cord Removal:

A process must be used for spinal cord removal on the slaughter floor (NMA 2002). The establishment should handle the spinal cord appropriately (e.g., inedible rendering).

Final Trim:

All trim employees must be properly trained to conduct trimming of visible contamination. All equipment (hooks and knives) should be sanitized between each use to reduce cross-contamination between areas.

Rail Out:

All trim employees must be properly trained to conduct trimming of visible contamination. All equipment (hooks and knives) should be sanitized between each use to reduce cross-contamination between areas. Carcasses that are railed out for visible contamination, such as busted guts, fecal contamination, etc., should be re-conditioned as quickly as possible to get the carcass through the process and back into the system.

In some cow slaughter operations, there can be a large number of carcasses railed out for pathological reasons. In these operations, the plant must wait for the FSIS Veterinarian to inspect each carcass before they can re-enter the production line. The establishment should work with agency personnel to ensure that carcasses are moved through the system as rapidly as possible so that they do not remain on the slaughter floor for extended periods.

Carcass Wash:

The carcass washing procedure is designed to remove incidental contamination (blood specs, bone dust, hair, etc.). Carcass washing is designed to impact carcass quality and to prepare the carcass for chilling and not to impact food safety hazards.

If using a wash cabinet, the carcass wash should address the spray patterns, the pressure of the water, the volume of water applied, and the time the carcass is in the cabinet. The pressure should not be high enough to drive the contamination into the fat and carcass

tissue. Also, the drains must be working properly to prevent backup that could create additional contamination as the carcass passes through the wash cabinet.

If the carcass wash is conducted by hand with a hose, then the lift must be sufficient to reach the top of the carcass and the wash should sufficient to remove the visible contamination.

The cabinets must have a preventive maintenance schedule to ensure that the equipment is functioning as designed, including nozzles, filters, etc. The parameters of the equipment should be documented to demonstrate that it is efficient.

Hot Box:

The cooling capacity must be sufficient to reach desired chill rate and to minimize the formation of dripping condensation in the hot boxes. It is noted that condensation in hot boxes is a continuous battle, and that all efforts should be made to reduce the formation. In order to minimize condensation, establishments should explore options for rotating the filling of the hot boxes, carcass spacing, increasing air-flow and BTUs, etc. Carcasses must also be spaced appropriately to allow air-flow for proper chilling. Optimal carcass rotations must be established by each facility to maintain product integrity throughout the system.

Walk-ways should be cleaned on a routine frequency to prevent contamination from the floor and wall from splashing onto the carcass. Hot boxes, including spray chill systems, should be emptied and thoroughly cleaned from the top to the bottom on a rotational basis.

There was some discussion that microbial interventions could be added to the spray chill system to help reduce microbial contamination. However, no recommendations are being made at this time because each operation would need to validate the application, and there are considerations for allowable limits to meet export requirements.

Variety Meats and By-Products:

After much discussion, it was agreed that the following items could be destined for raw ground beef production:

- Cheeks
- Head Meat
- Lips
- Tongue Trim
- Weasand
- Heart
- Hanging Tenders
- Salivary glands

Therefore, operations should carefully consider the potential end-use of these items and the impact that a positive *E. coli* O157:H7 test result could have on the product.

Whole Heads – Proper procedures must be in place for flushing the brains, cutting the tongue, and presenting the heads for post-mortem inspection. Heads can be treated with a microbial intervention.

Processing – Proper procedures for maintaining clean and sanitized equipment must be in-place throughout the process for removing and processing the cheek meat, head meat, salivary glands, lips, tongue, weasand, and the brains. Employees must be trained in the proper handling procedures for these items. Due to the potential for high microbial counts on these items, it is important to properly chill these items to maintain product quality and safety.

Chemicals used as processing aids for certain variety meats should be used according to the manufacturers guidelines.

Edible Blood:
For operations that are collecting edible blood, it is important to ensure sanitary collection practices and proper temperature control of the product. It was noted that most edible blood is tested by the end user for microbial contamination prior to determining disposition.

Edible Rendering: (Edible Fat, Bones, Viscera)

Operations that are collecting product for edible rendering must have a procedure in place to ensure that specified risk materials (i.e., spinal cord) are removed and not allowed to enter the edible rendering process. The temperatures used in the edible rendering process should be controlled and documented.

Interventions:

To maximize the effectiveness of the interventions that are being used, the best practice is to make sure that carcasses are as clean as possible before the application of the intervention.

Steam Vacuum:
Steam vacuums are a processing aid used to help remove visible contamination on the cut pattern. When using steam vacuums, it is important to monitor the temperature, vacuum, and steam pressure of the equipment to ensure that it is working properly. There should be a preventive maintenance procedure for cleaning the canister of the equipment. The steam vacuums should be used according to the manufacturers specifications and maintained in a condition to ensure they can achieve desired results. Operators should

consider developing a procedure for monitoring and documenting the parameters of the equipment.
Operators must also follow the regulatory guidelines for removal contamination based on size. (Find this information and add it to the document.)

Thermal Pasteurization (Hot Water or Steam Pasteurization):

For hot water cabinets, the water pressure is an important factor because it should not be high enough to force contamination into the fat or tissue of the carcass.

For thermal pasteurization, the temperature of water or steam is also important and should be able to deliver hot water (165°F) to the carcass surface for a sufficient time to reach desired results for microbial control. Each operation should know the parameters of their equipment — ability to deliver the temperature of water and time of delivery throughout the process, nozzle placement, etc., to achieve the desired log reduction. The establishment must be able to monitor and document the effectiveness of the equipment in the specific plant operation to achieve the desired reduction.

Organic Acid Application (lactic, acetic, Inspexx, etc):

The concentration of solution, temperature of delivery, pressure, and nozzle location are important parameters to monitor and document delivery. The establishment must be able to monitor and document the effectiveness of the equipment in the specific plant operation to achieve the desired reduction.

Pre-evisceration treatment with organic acid is generally applied in a low-pressure cabinet. The use of pre-evisceration treatments has been demonstrated to deliver a 1 to 1-1/2 log reduction on the carcass.

Trimming:

Operations may decide to trim pattern lines when hide opening occurs to help ensure best dressing procedures. Trimming is also used to remove visible contamination. Trimmers must be properly trained to conduct the trimming in a manner that will create a smooth surface to prevent the formation of flaps and/or rough surfaces that could decrease the effectiveness of the interventions later in the process. It is also important to ensure proper cleaning and sanitizing of knives and equipment to prevent contamination.

Hock Sanitizer (vacuum) or blow-off:

The use of these types of equipments should be designed to prevent air-borne contamination onto other areas or carcasses. The equipment should be used and maintained in a manner to ensure the effective use to accomplish the desired results, such

as maintaining steam temperature and vacuum pressure, etc. All of these are important considerations for an operation to properly implement the equipment into the specific operation.

Future technology:

There are several new technologies that are being explored at this time, such as Emerge VerifEYE®, that may provide additional opportunities for identifying and reducing contamination. As these items are developed and approved for use, then it is important that each operation consider the implementation of these systems into their operations.

Cold Chain Management:

The emphasis of carcass chilling should focus on the carcass surface temperature because this is where the pathogen contamination is most likely. Operators must know the parameters of their cold chain system to achieve the desired chill rate to minimize the potential for pathogen growth. In order to ensure the optimal level, you should know the chill capacity of the boxes, the locations of hot spots, the variation in chill rates for different carcass locations.

Includes all factors that contribute to temperature reduction of the carcass — spray chill, carcass spraying, air-flow, BTUs, etc.

Research Needs:

- Carcass Chilling Guidelines
- Heads and Variety Meat Interventions
- Indicator Organisms
    - TPC, coliforms, generic E. coli or other organisms
    - Can we use existing science to see what has been used and how they compare to actual pathogens?
- Seasonality/prevalence of pathogenic organisms (regionality). This is a long-term issue, and part of the data collection is on-going at this time by other groups.
- Interventions for Heads and Variety Meats going into Ground Beef
- Acceptable Log Reductions
    - What level is required?
    - We need to know the level of reduction from a regulatory standpoint
    - What do the microbiologists think about appropriate reductions?
- Statistically valid plan
    - How best to validate plan
    - What do the microbiologists think about how to best validate a plan

References

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