What you need to know about:

Meat Inspection

BEEF SAFETY TOPIC BRIEF

Overview:
Under the Meat Act, the United States Department of Agriculture (USDA) and the Food Safety Inspection Service (FSIS) inspect all meat sold in interstate commerce and re-inspect imported products to ensure they fulfill all U.S. requirements. The FSIS had over 9,000 full-time employees serving to ensure that all regulatory requirements are met in approximately 6,200 federally inspected establishments. Unlike the Food and Drug Administration's (FDA) inspection system that includes periodic visits by inspectors to food establishments, FSIS inspectors are in the establishments every day to ensure that the products are fit for human consumption and in compliance with all Federal laws governing the wholesomeness and safety of meat products. Therefore, the meat industry is truly the most highly regulated food industry in the country.

Ante-mortem Inspection:
The inspection process starts with the live animal. Ante-mortem inspection involves a visual and physical evaluation of the live animal prior to slaughter to identify any conditions that may indicate disease or illness. The inspection personnel are responsible for identifying any high-risk animals and making determinations to allow them or condemn them from entering the food chain. These actions are taken to ensure that meat is safe and wholesome for consumption.

Postmortem Inspection:
The inspectors are responsible for conducting a thorough examination of the lymph nodes, organs, and the entire carcass to identify signs of disease and unwholesome conditions. This inspection process involves all slaughtered animals. The postmortem inspection allows inspectors to further evaluate the carcass and tissues from any animal they suspect to be a high risk during ante-mortem inspection before a final decision on product use is determined. If any carcass or its parts are identified as diseased or unwholesome, they are condemned and prevented from entering the food supply.

Product Inspection:
The inspection system continues throughout the entire processing segment of the industry, including both raw and fully cooked products. Processing inspectors are responsible for processed meat products and all other ingredients contained in the finished product. These inspectors are responsible for cured and smoked products, frozen dinners, canned meats, and other processed products. They must verify that the establishment is maintaining sanitary conditions and following all procedures as well as labeling regulations.

The USDA Inspection Legend:
The USDA's Food Safety and Inspection Service has authority over the production of wholesome and safe meat products. Each federally inspected establishment is granted an establishment number that is placed on the official inspection legend. The inspection legend is stamped onto carcasses at various locations and placed onto product labels of packaged meats. The application of the inspection legend means that the operation has complied with all of the agency's regulatory requirements.

Example inspection stamp for beef carcasses:

Example inspection stamp for boxed beef:

Key Points:

- The FSIS inspects all meat products during all phases of production beginning with the live animal all the way to the end product.
- The meat industry is the most highly regulated food industry in the United States
- The FSIS has over 9,000 full-time employees which visit approximately 6,200 federally inspected establishments.

References:

http://www.fsis.usda.gov/Fact_Sheets/Inspection_&_Grading/index.asp

http://www.fsis.usda.gov/Fact_Sheets/Slaughter_Inspection_101/index.asp

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What you need to know about:

Pre-harvest Safety Interventions

BEEF SAFETY TOPIC BRIEF

The immediate goal of researching and developing pre-harvest safety interventions is to reduce pathogen loads on cattle presented for slaughter, so in-plant safety systems are not overwhelmed. While 100 percent reduction in pathogen shedding would reap huge benefits, it's not realistic. In most instances, post-harvest interventions are extremely effective and the additive effect of pre-harvest interventions to decrease pathogen loads on hides would increase the efficacy of the entire safety system.

Most of the experiments evaluating pre-harvest safety interventions have been performed at the feedlot level as it is a production stage that is more intensely managed and is the stage in beef production immediately before harvest. Additionally, most research in pre-harvest beef safety has focused on *E. coli* O157:H7 as it is the pathogen that has had the greatest impact on beef safety. Research is expanding to include other pathogens such as *Salmonella*, *Listeria monocytogenes,* and *Campylobacter jejuni* as well as issues such as the development of antibiotic-resistant bacteria.

Production Best Practices

Many producers follow specific basic principles which are the foundation to good animal-health management. These best practices are the first step in addressing any foodborne pathogens in beef products that may impact human health. While no clear reduction in pathogen shedding has been demonstrated by research when applying these practices, they can still serve as a foundation for future efforts and align closely to principles outlined in the industry Beef Quality Assurance (BQA) program.

Basic principles of production best practices include:

- Clean feed
- Clean water
- Appropriately drained and maintained environment
- Biosecurity

Additionally, researchers have been exploring modifications to existing management practices to determine how they might reduce pathogen levels in cattle.

The most notable area of research has been ration modification focusing on type of feed, frequency of feeding and feed quality, which has all been hypothesized to impact bacterial shedding rates in cattle.

Direct-Fed Microbials

This category includes probiotics, which contain bacteria or microorganisms that are beneficial to the host animal and reduce harmful pathogens through competitive exclusion. Most of the research in this area has focused on a specific *Lactobacillius*-based direct-fed microbial. This research has demonstrated a reduction in *E. coli* O157:H7 prevalence in cattle and a subsequent reduction of hide contamination. Hundreds of strains of *Lactobacillus* exist and a comprehensive research project evaluating 650 strains found that only five show promise of reducing *E. coli* O157:H7. Of particular importance is the fact that some actually demonstrated the potential to increase pathogen shedding, versus decrease shedding.

- Zerby, 2006
- Brashears, 2004

Seaweed Extract

An extract has been identified from a specific variety of seaweed *(Ascophylum nodosum),* which is a known source of cytokinon which is shown to have antioxidant effects. Research has evaluated the supplementation of this extract in feedlot rations prior to harvest. Efficacy in reducing *E. coli* O157:H7 shedding has been variable in research trials.

- Braden et al., 2004
- Bach et al., 2008

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Orange Peel and Pulp

These by-products of the citrus juice industry are being utilized in some feedlot and dairy rations as a low-cost ingredient. Orange peel and pulp and other citrus fruits contain essential oils that are toxic to bacteria and exhibit an antioxidant effect in host animals. An experimental trial using sheep showed that feeding orange peel for seven days reduces *Salmonella* populations in the animals.

- Callaway et al., 2010
- Goodridge et al, 2010

Ractopamine

This is a beta-agonist commercially available as a medicated feed additive and is approved for use in feedlot cattle as a means of increasing lean-meat yield. Some experimental work has been conducted to determine its impact on decreasing *E. coli* O157:H7 and *Salmonella* but the mechanism for such a result is currently unknown.

- Edrington et al., 2006

Antibiotic Feed Additives

Including commercially available additives such as ionophores, neomycin sulphate, tetracycline and oxytetracycline have been proposed as possible means of decreasing pathogen shedding; however, results have been inconclusive. Neomycin sulfate has shown significant promise in reducing *E. coli* O157 in multiple feedlot studies; however, a label change would be required before it could be sold to control *E. coli* O157 in cattle. Additionally, concerns about antibiotic use in livestock and antimicrobial resistance may hinder future research in this area. Potential benefits for human health would have to be balanced with concerns about antimicrobial resistance when evaluating antibiotic feed additives as a pre-harvest intervention.

- Brashears & Loneragan, 2005
- Ransom & Belk, 2003

Competitive Exclusions

Other strains of *E. coli* produce antimicrobial proteins that can inhibit *E. coli* O157:H7. By feeding these other strains to feedlot cattle, researchers have proposed it may lessen fecal shedding. This research is still very experimental in nature and its benefits have not been clearly defined.

Sodium Chlorate

This compound has been researched as an additive to feed and water and significant reductions in the shedding of *E. coli* O157 as well as *Salmonella* have been observed with its use. This product is awaiting FDA approval for this specific use and currently may not be used in cattle going to slaughter for human food.

- Edrington et al., 2009
- Anderson & Carr, 2002

Salmonella Vaccine

A conditionally licensed *Salmonella* Newport bacterial-extract vaccine is also available in the United States and is undergoing further validation studies to secure a full license for use as a means of reducing *Salmonella* Newport in cattle populations.

- Farrow et al., 2010
- Renter & Thomson, 2009
- Arthur, 2007

Cattle-Hide Washing

Washing cattle prior to harvest removes visible manure, and can potentially reduce the likelihood of contamination occurring at harvest when the hide is removed.

- Savell, 2001

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E. coli O157 Vaccines

Currently two vaccines are being investigated which are designed to reduce fecal shedding of *E. coli* O157:H7 in cattle. One of the vaccines defends against *E. coli* O157:H7 by disrupting the bacteria's iron transport system and is conditionally licensed in the United States. The other vaccine is a bacterial extract and is fully licensed in Canada. The vaccine manufacturers are seeking conditional licensing in the United States. While the vaccines employ different technology, both have been shown in experimental studies to reduce fecal shedding in commercial environments. The use of vaccines as intervention tools has significant potential because their use is a management practice producers are familiar with and can incorporate easily into existing management programs. As researchers determine the most effective dose and time of administration and these products work through the regulatory approval process, one important point to consider will be how to encourage adoption of these interventions as well as other promising technologies among farmers and ranchers when no discernible benefit to animal health is seen.

- Klopfenstein, 2005
- Paterson, 2004
- Paterson et al., 2004

Bacteriophages

Viruses that kill bacteria have been approved for use in post-harvest interventions. More recently the U.S. Department of Agriculture (USDA) Food Safety Inspection Service (FSIS) has allowed their use on cattle in holding pens immediately before slaughter with the goal of reducing hide contamination. While this method has shown promise, it also requires application equipment to apply the spray compound to the cattle.

- Callaway, 2005

Conclusion

- Several pre-harvest interventions are currently being researched and are showing promise in reducing pathogen loads on cattle presented for slaughter. In addition to efficacy however, the feasibility of use in current production systems must be considered. This would include the time commitment to animal handling needed for delivery/application of the intervention as well as the use of specialized equipment. While the majority of pre-harvest interventions examined to date have focused on the feedlot sector, as this field of research continues to expand, interventions may be introduced that could be applied at the cow-calf or dairy level.

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What you need to know about:

E. coli O157:H7

BEEF SAFETY TOPIC BRIEF

Generic *E. coli* (short for *Escherichia coli*) is the name for certain members of the bacterial family *Enterobacteriaceae*. The *E. coli* group literally has hundreds of members, or strains. Some strains live in animals' intestines, helping digestion and keeping harmful bacteria under control as well as producing and processing important vitamins. Humans need *E. coli* and other kinds of bacteria within the intestinal tract to remain healthy. In fact, *E. coli* represents approximately 0.1 percent of the total bacteria within an adult's intestines. Some virulent strains of *E. coli*, however, especially *E. coli* O157:H7, produce toxins that can damage the lining of the human intestine and cause serious illness. First recognized as a disease-causing organism in 1982, knowledge surrounding *E. coli* O157 has significantly increased over the years, resulting in a decrease in the number of people affected by this pathogen. Unfortunately, however, approximately 70,000 cases of human illness due to *E. coli* O157:H7 still occur in the United States annually, according to the Centers for Disease Control and Prevention (CDC). People with weak immune systems, such as young children or the elderly are more susceptible to bacterial infection from *E. coli* O157:H7.

E. coli O157 can be found almost anywhere. Animals, including sheep, cattle, horses, goats, elk, pigs, deer, rabbits, opossums, raccoons, dogs, poultry, wild birds and houseflies, can all be hosts to *E. coli* O157. When an animal has *E. coli* O157 within its intestine, it typically "sheds" the organism through its feces. As a result, the bacteria can be found throughout the environment.

Once consumed by humans, the bacteria move through the digestive tract and settle in the intestine and can lead to illness. Examples of ways humans might introduce *E. coli* O157 into their bodies include eating contaminated, undercooked meat; drinking unpasteurized milk or fruit juice; or consuming produce that has been cross-contaminated. Other sources of exposure might be less obvious, such as swimming in feces-contaminated water, or touching your mouth after playing on grass containing feces from infected geese.

E. coli O157 can be linked to beef as cattle are one of the primary hosts. Cross-contamination can occur when cattle are harvested and a hide with cattle feces comes in contact with a carcass or meat products. The beef processing sector implements several layers of safety interventions and works cooperatively with government inspectors to prevent this from occurring, but limited instances of contamination still occur.

E. coli O157 continues to be a challenge to the beef industry as it continually adapts to different conditions and environments. The organism can remain viable for months at a time in both feces and soil. It can survive and replicate in both standing and free-flowing water. Unlike many other bacteria, *E. coli* O157 can survive and replicate in aerobic and anaerobic environments. It can respond and adapt to differences in environmental chemicals, pH, and temperature in remarkable ways. Worldwide, other virulent strains of *E. coli* also are emerging, and while they are not as prevalent as O157, they have the potential to cause foodborne illness. Researchers in the United States are working to better understand these other strains and their potential impact on beef safety.

Key Points:

- Virulent strains of *E. coli* produce toxins that can damage the lining of the human intestine and cause serious illness.
- Approximately 70,000 cases of human illness due to *E. coli* O157:H7 still occur in the United States annually
- *E. coli* continues to be a challenge in the beef industry as it continually adapts to different conditions and environments.

References:

http://www.cdc.gov/salmonella/

http://www.fsis.usda.gov/Fact_Sheets/Foodborne_Illness_&_Disease_Fact_Sheets/index.asp

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What you need to know about:

Salmonella

BEEF SAFETY TOPIC BRIEF

Salmonella bacteria are one of the most frequently reported causes of foodborne illness. The *Salmonella* family includes over 2,300 serotypes of bacteria. *Salmonella Typhimurium*, *S. Enteritidus*, and *S. Newport* are common serotypes implicated in human infections and *S. Dublin* is a common cause of cattle *Salmonella* infections. An American scientist, Dr. Daniel E. Salmon, discovered that *Salmonella* bacteria were a cause of illness more than 100 years ago.

According to the Centers for Disease Control and Prevention (CDC), *Salmonellosis*, which is the infection caused by the bacteria *Salmonella* in humans, causes an estimated 1.4 million cases of foodborne illness and more than 500 deaths annually in the United States. Most people with *Salmonellosis* experience diarrhea, abdominal cramps, and fever within 8 to 72 hours after the contaminated food is eaten. Additional symptoms may be chills, headache, nausea, and vomiting. Many people with *Salmonellosis* recover without treatment and may never see a doctor. *Salmonella* infections, however, can be life-threatening for certain people with compromised immune systems such as infants, young children, pregnant women and their unborn babies, or the elderly.

Salmonella can be present on livestock operations in the absence of clinical disease. Poultry is considered one of the primary sources of *Salmonella*, but the bacteria are also present in cattle populations. Research on the incidence of *Salmonella* at the production level in cattle is limited, but USDA-sponsored studies detected *Salmonella* on 38 of 100 feedlots, 21 of 187 beef cow-calf operations and 48 of 121 dairy operations.

Healthy animals can become carriers and shed *Salmonella* for long time periods. *Salmonella* live in the intestinal tract of various animal species, including cattle, swine and especially poultry. Once infected, the animals shed *Salmonella* in their feces. *Salmonella* can also be found in the species of some pets, especially those with diarrhea. Reptiles are particularly likely to harbor *Salmonella*. Strains that cause no symptoms in animals can make people sick, and vice versa.

Similar to *E. coli* O157:H7, research to date has not identified specific management strategies or interventions that consistently reduce fecal shedding of *Salmonella* in cattle. Several occurrences can impact *Salmonella* prevalence rates at the farm and ranch level, including exposure to human effluent and contaminated feed, birds or rodents. All of these factors complicate the ability to develop control strategies.

Key Points:

- *Salmonella* bacteria are one of the most frequently reported causes of foodborne illness.
- *Salmonella* infections can be life threatening for people with compromised immune systems or can be mild enough that a person can recover without treatment or ever visiting a doctor.
- *Salmonella* live in the intestinal tract of various animals and once infected, the animals shed the *Salmonella* in their feces.

References:

http://www.cdc.gov/salmonella/

http://www.fsis.usda.gov/Fact_Sheets/Salmonella_Questions_&_Answers/index.asp

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