Researchers from Edrington’s group are also investigating the incidence of multi-drug resistant generic E. coli, which is common in young dairy calves and disappears with age. Results may provide information on how to eliminate these bacteria from the gut population at an earlier age in cattle.

Feedlot cattle research to determine whether acylhomoserine-lactone autoinducer (AHL) is correlated with E. coli O157:H7 populations was presented. AHL may repress gene expression that is required for bacterial colonization in cattle. Preliminary results indicate that a forage diet may positively influence AHL.

Edrington presented other research projects examining the effect of stressors on acquisition of multi drug resistance by Salmonella, as well as the role of bacteriophage in the acquisition of MDR by Salmonella.

Edrington’s group has also worked for some years on validating chlorate as a preharvest intervention. Supplementing cattle drinking water with chlorate has been shown to be an effective intervention strategy at the feedlot level and was awarded its first patent in 2002. However, chlorate’s use as a feed additive is still under review by the Center for Veterinary Medicine, Food and Drug Administration.

Conclusion

All of these research projects demonstrate the evolution that has taken place in the understanding of beef’s safety challenges. By sponsoring this research, the beef industry has demonstrated its commitment to finding effective strategies for reducing, and potentially eliminating, safety challenges to the U.S. beef supply.

For more information, visit
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www.beefresearch.org

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Salmonella

One of the projects tracked a group of cattle that were preselected for 100 percent prevalence rate. The researchers determined DGQ consumption appeared to impact the prevalence of E. coli O157:H7; however, Drouillard cautioned the audience against foregone conclusions. “It is important to determine that a variety of factors including the removal of starch from the diet, the alteration of the rumen microbial environment, and the number of bacteria present may also play roles in this phenomenon. When grain is removed from a ration and replaced with different grains, starch is being removed from the ration,” said Drouillard. “That dynamic may modify the environment to the point that it is more hospitable to pathogens or they are better able to proliferate.”

To examine that effect, Drouillard and his colleagues conducted a study that added starch back into the ration to potentially make the post-intestinal environment friendlier to competitive bacteria. That study revealed no differences in pathogen prevalence between cattle on treatment and control diets. However, Drouillard said this result may be due to low prevalence rates in the study animals to the point that it was difficult to accurately determine differences in shedding rates. Future research efforts will continue to focus on altering the microbial environment so that competitive bacteria can displace the pathogenic species.

**Highlights of beef safety research from the U.S. Meat Animal Research Center (MARC)**

Mohammad Koohmaraie, Ph.D., MARC, Agricultural Research Service, U.S. Department of Agriculture

Highlights of research to control pathogens in the beef supply focused on work to improve hold and test procedures in beef processing facilities; attribution of antibiotic resistant Salmonella to cow culls; and projects examining the effect of feeding wet distillers grains (WDG) on E. coli O157:H7 shedding in feedlot cattle.

Previous research has indicated that cow culls may have a higher prevalence of multi drug-resistant (MDR) Salmonella than younger cattle processed in feedlot facilities. The effect of raising had to be eliminated to accurately test the hypothesis. The researchers found that sampling feces from the distal colon after elicitation reflected Salmonella shedding rates at the production site and eliminated effects that raise contamination might have on study results. The study validating this sampling procedure has been submitted for publication in the *Journal of Food Protection*.

In the attribution study, researchers sampled hides at processing plants (cull cow/bull and fed) to determine centrifugal rates in lairage pens. Feces from the distal colon were sampled to determine Salmonella rates in the production environment. Salmonella positive fecal samples were more prevalent in all dairy animals (70.2 percent) versus beef market animals (37.9 percent) and fed cattle (7.0 percent).

**Prevalence of Salmonella**

<table>
<thead>
<tr>
<th>Hides Salmonella</th>
<th>Fecal Salmonella</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong># positive %</strong></td>
<td><strong># positive %</strong></td>
</tr>
<tr>
<td>Dairy Cow</td>
<td>327</td>
</tr>
<tr>
<td>Dairy Bull</td>
<td>24</td>
</tr>
<tr>
<td>All Dairy</td>
<td>351</td>
</tr>
<tr>
<td>Beef Cow</td>
<td>82</td>
</tr>
<tr>
<td>Beef Bull</td>
<td>7</td>
</tr>
<tr>
<td>All Beef</td>
<td>89</td>
</tr>
<tr>
<td>Fed Cattle</td>
<td>29</td>
</tr>
</tbody>
</table>

**Fecal sample prevalence of multi drug-resistant (MDR) Salmonella** followed similar trends—32.5 percent dairy market animals, 16.2 percent of beef market animals and 0.8 percent fed cattle, were positive respectively.

**Prevalence of MDR-Salmonella**

A two-phase project examined the effect of varying percentages of wet distillers grain (WDG) on cattle performance, and the effect of WDG (0 to 60 percent of ration, dry matter basis) on E. coli O157:H7 shedding. In the second phase of the study, the researchers examined the differences between a control diet and one that included 40 percent WDG on E. coli O157:H7 shedding rates. Fecal samples were collected monthly from October until the cattle were harvested in June. Results revealed variations that could not be explained by treatment in shedding rates between pens and within pens throughout the trial.

**Salmonella**

**Beef Safety Interventions**

Mindy Brashears, Ph.D., International Center for Food Industry Excellence, Texas Tech University

Results from several studies addressing beef safety interventions, carcass sampling protocols and preharvest intervention practices were presented by Brashears.

A study that examined the timing of three safety interventions (lactic acid-producing bacteria; acidified sodium lactate; and 3 percent lactic acid spray) on enhanced beef strip loins determined that in general, all three treatments significantly reduced E. coli O157:H7 after 21 days of storage prior to enhancement. The effects the three intervention treatments had on sensory characteristics were also examined. Salty flavors were detected in the samples treated with interventions and then enhanced with a solution containing salt and phosphate, so formula alterations might be necessary.

An in-plant study designed to determine the location of E. coli O157 on carcasses provided more insight for implementing targeted safety interventions. Researchers determined that the hindshank showed the highest level of contamination across several plants.

Results from another study examining the susceptibility of both MDR and non MDR Salmonella to lactic acid treatments was presented. According to Brashears, lactic acid, an intervention strategy commonly used in industry, appears to deal effectively with MDR, as well as drug-susceptible Salmonella. Another study examining the necessary dose of lactic acid bacteria to effectively inhibit foodborne pathogens in meat found a lower dose (10^8 CFU/g) was as effective as a higher dose (10^11 CFU/g).

Texas Tech University researchers have conducted several research studies over the years focusing on preharvest safety interventions. The prevention of cross contamination through dust control was examined during load out of cattle at feedlot facilities. Controlling dust resulted in fewer pathogens being isolated from air samples. These results indicate that dust control may play an important role in reducing subsequent contamination of cattle hides and, consequently, carcasses.

Another preharvest research project analyzed the effectiveness of Lactobacillus acidophilus strain NP 51 (LAB) in reducing E. coli O157:H7 prevalence in fecal samples. The results indicate that LAB could be applied to manure via spraying to reduce pathogen levels and subsequent contamination of beef hides. The research may also have implications for manure used in fertilizer applications in ready-to-eat crops. LAB applications in a feedlot setting might also reduce environmental contamination of nearby water bodies or crops in the event of excessive storm run-off.

**Siderophore receptor and porin protein (SRP)-based vaccines for control of E. coli O157**

Guy Loneragan, B.V.Sc., SVM, West Texas A&M University

Loneragan presented preharvest beef safety research examining the potential of a siderophore receptor and porin protein (SRP) based vaccine for control of E. coli O157. All bacteria require iron for survival, and in bacteria, iron is acquired via siderophore and porin proteins. A vaccine was developed that stimulates immunity against these cell-surface proteins, which would in turn reduce iron acquisition.

A challenge study was initially conducted to validate the concept. Two subsequent field efficacy studies were performed. Trends to decrease pathogen populations were desirable, however prevalence in study animals was so low in the first field study that biological significance was questionable. The second field study demonstrated a vaccine efficacy of 86 percent with a 98 percent reduction in contamination in fecal samples. The vaccine did not negatively affect animal performance and demonstrated effectiveness in reducing the burden of E. coli O157:H7.