Project Summary

Regulation of Shiga Toxin Production in *E. coli* from Bovine and Human Sources

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Background
Highly publicized outbreaks of food-borne illness since 1993, primarily caused by bacteria such as *E. coli* O157:H7, *Salmonella* spp. and *Listeria monocytogenes*, elicited intense consumer concern about meat safety. In response, regulatory authorities, researchers and the beef industry initiated efforts to implement food safety management systems that would improve microbiological quality. The USDA Food Safety and Inspection Service (FSIS) began initiating new regulatory requirements during the mid-1990s. Packers were required to knife-trim carcasses to remove all visible contaminants, comply with written sanitation standard operating procedures (SSOP), implement Hazard Analysis Critical Control Point (HACCP) systems, and meet microbiological performance criteria and standards for *E. coli* and *Salmonella* as a means to verify HACCP effectiveness and pathogen reduction.

Researchers and beef packers/processors have addressed consumer food safety concerns by developing a variety of methods that are now implemented, or are being further developed, to reduce numbers of bacteria on beef and beef products and improve microbiological safety. These microbiological decontamination technologies include:

- Animal cleaning;
- Chemical dehairing at slaughter;
- Spot-cleaning of carcasses by knife-trimming or steam/hot water vacuuming; and
- Spraying/washing/rinsing of carcasses before evisceration and/or before chilling, with water, chemical solutions and/or steam or hot water.

Certain strains of the Shiga toxin-producing bacterium *E. coli* have emerged as an important cause of food-borne disease around the world. The most common Shiga-toxin producing *E. coli* strain in the United States is known as *E. coli* O157. The main objective of this study was to develop a simple and rapid molecular test that can distinguish between strains of *E. coli* O157 that produce large amounts of toxin from those that produce very little toxin.

Methodology and Findings
A total of 195 *E. coli* O157 isolates (79 human and 116 bovine sources) were tested and markers were found that predicted either high or low shiga toxin production. Further, toxin production from 102 *E. coli* O157 isolates (51 bovine and 51 isolates from cases of human disease) was measured.

The findings of this study suggest that nearly all *E. coli* O157 isolates associated with human illness include the molecular marker for high-toxin production. In contrast, the majority of *E. coli* O157 from cattle in the United States contain the low toxin-producing marker, produce very little toxin, and are rarely isolated from cases of human disease. Therefore, it appears that only a fraction of *E. coli* O157 that colonize cattle pose a risk to public health.
Implications

*E. coli* is implicated in many outbreaks of food-borne illness and interventions at multiple beef processing stages are currently in use. This new test will assist in the tracking of *E. coli* O157 throughout the food production system and allow for a simple and rapid method to predict whether a particular strain of *E. coli* O157 is a risk to human health.

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