EXECUTIVE SUMMARY

INCIDENCE OF *ESCHERICHIA COLI* O157:H7 ON HIDE, CARCASS AND BEEF TRIMMINGS SAMPLES COLLECTED FROM UNITED STATES PACKING PLANTS

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PRINCIPLE CONCLUSIONS/FINDINGS

1. *Escherichia coli* O157:H7 was present on the surface of beef hides (3.56%) more frequently ($P < .025$) then on the surface of beef carcasses before application of decontamination interventions (0.44%), and least frequently ($P < .025$) on the surface of beef carcasses following application of decontamination interventions (but before carcass chilling). On days in which carcasses were sampled, no beef trimmings destined for ground beef production were found to test positive for *Escherichia coli* O157:H7. This finding supported those of previous studies that have demonstrated the effectiveness of using enumerated indicator-organism counts to verify process control for slaughter procedures and carcass decontamination intervention systems.
2. Current ground beef *Escherichia coli* O157:H7 testing protocols (conducted by USDA-FSIS) result in accumulation of approximately 6,373 total sample tests per year. Conceptually, sampling 1 out of every 300 carcasses (using a surface sponging technique that accounts for approximately 2.5 times that amount of surface area on each carcass normally evaluated in routine generic *Escherichia coli* verification plans) on a national basis, would result in accumulation of over 120,000 total samples tested annually (fed beef plus market cow/bull carcasses)—a 19-fold increase in the number of samples tested per year compared to the current program and a substantial increase in total carcass surface area tested.
3. Logically, pathogen testing for purposes of verifying food safety system-control would prove more effective if utilized upstream in the production chain, as opposed to testing closer to the consumer, because carcasses testing positive for pathogens could be removed from commerce before reaching the consumer and appropriate corrective actions could be taken to regain system control. Additionally, a "carcass" processing step would appear to be a more appropriate testing point in the production system because carcasses have not yet been separated into hundreds of pieces which, should one of the carcass pieces be contaminated, subsequently also can contaminate cuts in which it comes into contact with downstream.

SUMMARY

Colorado State University researchers were commissioned by the American Meat Institute Foundation to analyze data collected in twelve beef packing plants to determine the incidence of *Escherichia coli* O157:H7 on the hides of cattle entering slaughter facilities and to determine the influence of slaughter procedures on incidence of *Escherichia coli* O157:H7 on beef carcasses and beef trimmings.

The survey was conducted in September and October, 1999. Plants (n = 12) participating in the study were expected to conduct microbiological sampling and testing procedures for *E. coli* O157:H7 on hides, carcass sides after hide removal and carcass sides after application of decontamination interventions. If a cooperating packing plant sampled beef trimmings for *E. coli* O157:H7 as part of their normal business activities, those results also were to be provided (n = 6). Detailed procedures were specified for collecting and testing hide (tested at the Pennsylvania State University *E. coli* Reference Library) and carcass samples (tested at private laboratories), but no specific sampling, shipping or *E. coli* O157:H7 testing protocol for beef trimmings was specified. The submitted data from each day of production during the pilot study was coded by personnel of the American Meat Institute Foundation and sent to scientists at Colorado State University for analyses, summarization and interpretation.

When the expression "from hides" is used, it was presumed by CSU personnel that those samples were collected after the animal had been stuck and bled; when the expression "prior to carcass washing" is used, it was presumed by CSU personnel that those samples were collected after zero tolerance inspection but before application of interventions; and when the expression "after zero tolerance inspection" is used, it was presumed by CSU personnel that those samples were obtained prior to carcass chilling but following application of interventions. Conclusions apply only to the data available to Colorado State University and apply only to the conditions under which the microbiological samples were collected and analyzed. According to AMIF officials, the samples obtained from the hide, the side prior to carcass washing, and the side after application of carcass decontamination interventions were correlated (from the same animal and carcass), but beef trimmings samples, collected sometime before shipment from the plant, were randomly selected during the day on which each hide/carcass was sampled and may or may not have contained parts originating from carcasses that were sampled previously.

A summary of microbiological data obtained from hide and carcass side samples at the 12 packing plants is presented in Table 1. In the complete data-set, the incidence of confirmed positive *E. coli* O157:H7 tests was 3.56% for hide samples, 0.44% for side samples prior to carcass washing, and 0.00% for side samples after application of final carcass decontamination interventions. In addition, for those beef trimmings samples collected and tested in 6 packing plants during the same period, 0.00% were found to be positive for *E. coli* O157:H7. Based on these percentage incidences, across the complete population, 1 of 28 cattle entering the packing plants from which these samples were obtained, and during this time period and conditions of this study, had confirmed positives for *E. coli* O157:H7 on their hide and 1 of 227 side samples tested prior to carcass washing had confirmed positive tests for *E. coli* O157:H7 on their surfaces, but none (0.00%) of the side samples tested after application of carcass decontamination interventions and none (0.00%) of the beef trimmings samples examined during that period of time had a confirmed positive test for *E. coli* O157:H7. The total number of samples tested were 2245, 2248, and 2248 for hides, sides prior to carcass washing, and sides after application of carcass decontamination interventions, respectively. Considering the generally low incidence of *E. coli* O157:H7, a larger number of samples tested, especially for sides and beef trimmings, may have yielded more samples that tested positive.

Chi-square analyses of percentages of samples confirmed positive for *E. coli* O157:H7 indicated that, across all plants, *Escherichia coli* O157:H7 was present on the surface of beef hides (3.56%) more frequently ($P < .025$) then on the surface of beef carcasses before application of decontamination interventions (0.44%), and least frequently ($P < .025$) on the surface of beef

carcasses following application of decontamination interventions (but before carcass chilling). Although the data are limited, and the study conditions were variable among plants and not well-defined, there was some evidence confirming conclusions of other studies (that used enumerated indicator organism counts) that plant processes and decontamination procedures used during the testing period were useful in reducing contamination and incidence of pathogens such as *E. coli* O157:H7.

Microbiological testing for indicator bacteria can be used to validate or verify slaughter procedures (QC, HACCP programs, etc.) and/or carcass decontamination interventions for reducing or eliminating meatborne pathogens, but planned testing for pathogens such as *E. coli* O157:H7 that are of low, infrequent and non-random (unpredictable) incidence with the objective of process monitoring or product safety assurance or verification is not effective and should not be recommended. It appears, however, that because microbial testing of raw products has gained favor with consumers and government officials, it will probably continue—in some form. If testing for meatborne pathogens (e.g., *E. coli* O157:H7) is to continue or be modified, interested groups are encouraged to consult the document developed and published by the American Meat Science Association, in 1999, entitled "The Role Of Microbiological Testing In Beef Food Safety Programs: The Scientific Perspective."

Considering the limitations of sample number, sample size, days and season of testing, the data provided to Colorado State University were interpreted to provide evidence that: (a) some cattle enter the packing plant with *E. coli* O157:H7 on their hides, (b) some *E. coli* O157:H7 is transferred to the outside surface of carcasses between stunning/sticking and carcass washing, (c) the packing plants at which samples were obtained for testing had prerequisite programs (GMPs, SOPs, SSOPs, etc.), QC practices, HACCP programs, and carcass decontamination interventions systems that helped reduce *E. coli* O157:H7 on side samples tested from these plants as the carcasses entered the chill cooler and in/on beef trimmings for the period of time evaluated. However, routine testing for HACCP verification may be more effective using indicator organisms, as suggested by the American Meat Science Association (1999). These data did not provide evidence that sampling of carcasses was equal to, worse than, or the same as, sampling of beef trimmings or ground beef relative to detection of *E. coli* O157:H7 if it was present. If there exists assurances that no *E. coli* O157:H7 contamination occurs at fresh meat handling stages following final carcass decontamination, logic would suggest that microbial sampling of carcasses, as opposed to microbial sampling of beef trimmings or ground beef, would be appropriate because it is conducted upstream, at a point, place, and time where it can be better confirmed and corrected, rather than downstream, at which point the only recourse is for a recall of all product that may have been contaminated by the carcass containing *E. coli* O157:H7.

Table 1. Summary of microbiological data obtained from hide or carcass side samples at twelve commercial beef packing plants.

	Number of samples tested			Incidence of confirmed positive *E. coli* O157:H7, by in-plant sampling location (%)		
Packing plant	Hide	Side prior to carcass washing	Side after application of carcass decontamination interventions	Hide	Side prior to carcass washing	Side after application of carcass decontamination interventions
A	405	405	405	0.74[a]	0.00[a]	0.00[a]
B	135	135	135	3.70[a]	1.48[ab]	0.00[b]
C	74	74	74	18.92[a]	0.00[b]	0.00[b]
D	119	119	119	6.72[a]	0.00[b]	0.00[b]
E	345	345	345	0.00[a]	0.00[a]	0.00[a]
F	345	345	345	1.45[a]	0.00[b]	0.00[b]
G	234	234	234	1.28[a]	1.28[a]	0.00[a]
H	138	138	138	18.12[a]	1.45[b]	0.00[b]
I	114	114	114	10.53[a]	0.00[b]	0.00[b]
J	139	142	142	0.00[a]	0.00[a]	0.00[a]
K	159	159	159	1.89[a]	1.89[a]	0.00[a]
L	38	38	38	5.26[a]	0.00[a]	0.00[a]
All plants	**2245**	**2248**	**2248**	**3.56[a]**	**0.44[b]**	**0.00[c]**

[abc] Means in the same row, bearing a common superscript letter, are not different based on use of chi-square analysis ($P < .025$).