

Not All Bad News

April report indicates levels of *E. coli* contamination in ground beef samples remain low, confirming new beef-processing safety measures initiated in 2003 continue to be effective.

by Ed Haag

On April 13, 2007, the Centers for Disease Control (CDC) released a report confirming that the number of cases of foodborne *E. coli* O157:H7 had risen for the second year in a row, erasing all declines recorded in the previous two years.

That grim report came as no surprise to those following the news out of California. In September of 2006 an outbreak of *E. coli* that killed three people and sickened more than 200 people across the U.S. was traced back to packaged cut spinach originating from San Benito County in west central California.

An investigative report released in March 2007 by the California Food Emergency Response Team — the state and federal scientists charged with the responsibility of determining the cause of the outbreak — traced the contamination back to a 50-acre spinach plot. The strain of *E. coli* responsible for the outbreak was also found in a nearby stream and in feces of wild pigs and cattle.

For Morris Potter, Food and Drug Administration (FDA) lead scientist for epidemiology, the ongoing battle to protect the public from the dangers of contracting *E. coli* O157:H7 appears to have entered a new stage with the recent influx of cases attributed to the consumption of contaminated raw greens.

“This is a relatively new area of food safety for us,” he says. “This is not where our decades of food safety experience have taken us.”

He goes on to point out that until recently *E. coli* research has focused on concerns that emerged out of outbreaks that occurred in the last two decades of the 20th century.

“When we first learned about the bacteria, it was closely linked to ground beef,” he says. “The approach that was taken to protecting the public health was to try to make ground beef cleaner.”

If there is any good news to emerge out of the 1993 outbreak of *E. coli* O157:H7, in which four lives were lost and hundreds of

others sickened, it is what followed. During the last 14 years, beef researchers and industry leaders have been able to mobilize their resources, scientifically isolate the causes of contamination, and use that information to promote the procedural changes necessary to dramatically reduce a serious threat to public health.

Potter notes that the effectiveness of the effort has been well-documented. The U.S. Department of Agriculture (USDA) Food Safety and Inspection Service (FSIS) reported in December 2005 a 54% reduction in the rate of *E. coli* O157:H7 positives for raw ground beef samples from fiscal year (FY) 2003 to FY 2005. Further analysis of the numbers confirmed their accuracy.

FSIS officials noted that the decrease in the rate of O157:H7 positives most likely resulted from policy changes and industry actions, instead of an annual variation in rates.

Positive beef numbers holding

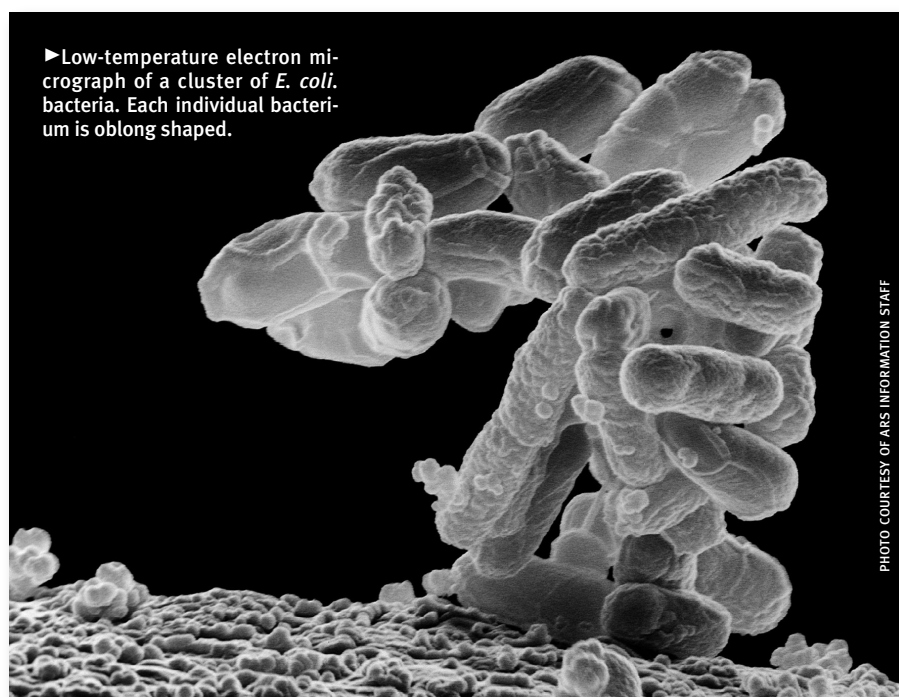
Even in 2006, as the number of reported cases of *E. coli* climbed back up to 1996-1998 baseline levels, this was not reflected in a parallel rise of positives in ground beef samples.

“From the data available, it looks like human infection is increasing but the level of ground beef contamination is not increasing,” Potter says. “It has dropped to a low level, and it is staying low.”

Potter adds that even though drawing connections between human infection rates and the levels of ground beef contamination is not unlike comparing proverbial apples and oranges. In the absence of more conclusive data, he says, legitimate extrapolations can be made regarding low ground beef contamination rates and the public health risk from the same.

“While existing data aren’t complete, the data that are available are not consistent with an increasing human public health problem associated with ground beef.”

So what precisely precipitated the drop and stabilization in the rate of *E. coli*



► Low-temperature electron micrograph of a cluster of *E. coli* bacteria. Each individual bacterium is oblong shaped.

PHOTO COURTESY OF ARS INFORMATION STAFF

O157:H7 positives for ground beef samples? And are there some principles that were developed in the process of reducing the incidence of *E. coli* O157:H7 in ground beef that could be applied to problems with fresh produce?

To properly answer those questions one must look at what has transpired between 1993 and now.

Back to square one

For Mohammad Koohmaraie, director of the Roman L. Hruska U.S. Meat Animal Research Center (USMARC) in Clay Center, Neb., the ongoing success at addressing *E. coli* O157 in ground beef can be directly attributed to the efforts and perseverance of those associated with the beef industry.

“When we realized there was a problem, after the Jack in the Box outbreak in 1993, everyone in the industry rolled up their sleeves and got to work,” he says. “It took hundreds of millions of dollars and the efforts of thousands to get where we are now.”

For Koohmaraie and his team of researchers, it was a matter of revisiting all possible sources of contamination, eliminating one after another as the investigation progressed. Then in 2000 the team launched a one-year study to determine the seasonal prevalence of *E. coli* O157:H7 at three separate packing plants. Samples for testing were taken of the carcass, the feces and the hide.

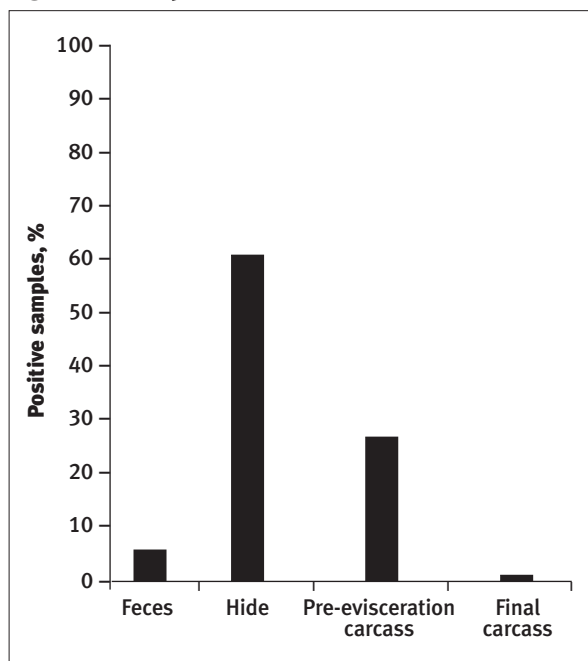
“What we saw on the carcass was running 30% to 40%, what we saw on the hide was running 50% to 60%, and what we saw in the feces was less than 5%,” Koohmaraie says. “Based on those observations we hypothesized that the hide is the primary source of transmission because 3% in the feces cannot account for 40% on the carcass.”

The carcass prevalence data was taken from carcasses immediately after hide removal and before any intervention.

Tommy Wheeler, another Clay Center researcher who participated in the study, notes that their results ran contrary to the common perception. “Prior to our study, the general impression in the industry would have been that the source of the contamination was in the feces,” he says.

A follow-up study that involved chemically removing hair on the hide confirmed that the team’s first hypothesis was correct. “The chemical dehairing experiment showed definitively that if you cleaned the hide real well before you

Fig. 1: Overall prevalence of *E. coli* O157:H7



Source: Roman L. Hruska U.S. Meat Animal Research Center, Clay Center, Neb.

removed it, you had almost zero contamination on the carcass,” Wheeler says.

Research leads to new approach

While chemical dehairing proved a highly effective method for reducing the level of *E. coli* on the hides, two serious drawbacks in the process made it unworkable on a commercial scale. First, the agent used to dehair the hide changed its pH and made it unusable in the conventional tanning process. Second, in order to accommodate residue created by the dehairing process, major modifications would have had to be made to the existing sewer system.

Instead, the researchers turned to on-carcass hide washing prior to skinning.

“Although washing cabinets have been used for many years in beef processing plants, the hide-washing cabinets presented us with a new set of challenges,” Koohmaraie says. “We provided Cargill and the Chad Co. (cabinet manufacturers) with critical information, such as effective pressure, steam vacuuming, length of exposure and a list of compounds with the ability to kill *E. coli* on the hide.”

The completed system, a wash cabinet approximately 30 feet (ft.) by 15 ft., was designed to accept a carcass immediately after the animal is stunned and exsanguinated, and before any other portion of the hide was opened. A 1.5% solution of sodium hydroxide was used in the washing process.

Once installed and operational, the prototype cabinet was evaluated for its ability to remove harmful bacteria from the hide. In a series of tests, hides were sampled before entering and after exiting the cabinet. Resulting data showed that the prevalence of *E. coli* O157 on the hide was reduced from 44% to 17% and on the pre-evisceration carcass from 17% to 2%.

“This represents a major reduction of *E. coli* O157 early in the process,” Koohmaraie says. “We knew immediately it would have a real positive impact on meat quality.”

Representatives from Cargill Meat Solutions shared Koohmaraie’s enthusiasm for the new system and have, since studying the data, installed the new cabinet in all their

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Table 1: Microbiological results of raw ground beef products analyzed for *E. coli* O157:H7

Year	No. positives	No. tested	% positive
1994	0	891	0.0
1995	3	5,407	0.05
1996	4	5,703	0.07
1997	4	6,065	0.07
1998	14 ^a	8,080	0.17
1999	32 ^b	7,785	0.4
2000	55	6,375	0.86
2001	59	7,010	0.84
2002	55	7,025	0.78
2003	20	6,584	0.30
2004	14	8,010	0.17
2005	19	10,976	0.17
2006	20	11,779	0.17

^aDuring October 1997, the amount analyzed was increased from a 25g sample to a 325g sample to provide increased detection sensitivity.

Source: U.S. Department of Agriculture Food Safety & Inspection Service (USDA-FSIS).

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packing plants across North America. “This represents a really serious financial commitment on the part of the beef industry to control *E. coli* O157,” Koohmaraie adds. “We are talking several million dollars per unit.”

For smaller operations that do not require a hide wash cabinet as large as the one currently available, the Clay Center research team has been actively involved in the development of a wash cabinet that is one-third the size of the original and less expensive.

Test and hold

While Koohmaraie and his team were working to isolate the source of *E. coli* O157, some proactive industry leaders began to implement the test-and-hold program in which raw ground beef materials (beef trim) or finished ground beef would be sampled and tested for the presence of *E. coli* O157:H7. If the meat proved negative for *E. coli* O157, the product would be released into commerce. If positive, the entire lot [typically 10,000 pounds (lb.) for trim and 1 hour of

production, or about 90,000 lb. for ground beef] would be diverted to fully cooked product or rendered.

“Test results are generally back in 12 hours,” Koohmaraie says.

Parts of a large initiative

Koohmaraie is quick to note that in spite of the success seen with the new hide wash cabinets and the test-and-hold program, the credit for the reduction of *E. coli* O157 in ground beef samples goes to a much broader base of interventions. As he states in a paper published in *Meat Science* in 2005: “Because none of the interventions are 100% effective, all beef processors now utilize a ‘multiple-hurdle’ intervention system of sequential interventions at various processing steps to ensure the safety of their products.”

He goes on to list steam vacuuming of surfaces that will come in contact with knife blades, new protocols requiring blade disinfecting between carcasses, use of a thermal pasteurization chamber after evisceration and splitting, and finally, a heated organic acid or acidified chlorine

rinse before the carcasses enter the sales cooler.

“In addition, many processors have instituted good manufacturing practices and changes in their processing facilities to improve beef safety,” Koohmaraie says, adding that these changes have involved increasing spacing between carcasses to reduce cross-contamination, improving lighting to reveal contaminants, installing positive pressure ventilation systems, using two knives on the slaughter/skinning lines (one in use and one sitting in a sterilizer) and stabilizing ambient air temperatures in the plants.



Editor's Note: *The sources were interviewed and this story was written prior to the ground beef recalls conducted this summer. However, it is this editor's opinion that the events of this summer do not change the overall context of this story.*