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Outbreak of Salmonellosis Associated with Beef Jerky in New Mexico

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On September 23, 2003, the New Mexico Department of Health (NMDOH) Scientific Laboratory Division (SLD) identified *Salmonella* Kiambu from stool obtained from six unrelated patients. *Salmonella* Kiambu was first isolated in New Mexico in January 2003. Six isolates of this uncommon salmonella serotype suggested an outbreak, and the NMDOH and the City of Albuquerque Environmental Health Department (EHD) began an investigation to determine the source. Available case reports from culture positive patients were reviewed, and no common source was identified. Patients were contacted again using a more rigorous questionnaire and only beef jerky emerged as a common exposure.

New Mexico has had a long history of gastrointestinal illness associated with the consumption of dried meat (meat jerky/carne seca). Since 1966, NMDOH has investigated 8 gastroenteritis outbreaks associated with meat jerky consumption that resulted in at least 250 illnesses. Salmonella was the implicated organism in 6 of the 8 outbreaks[1,2,3].

Typically, dried meat is processed without preservatives or salt curing. Following the previous outbreaks, new policies dealing with beef jerky production were instituted and regulated by city and state environmental inspectors. However, new information shows that meat jerky produced at high altitude and in a dry environment may allow for the survival of bacteria such as salmonella[4,5,6].

Methods

To determine the source of infection, we conducted an age- and region-matched case-control study. A case was defined as a NM resident with diarrhea ($\geq$ 3 loose stools in a 24 hour period) and culture confirmed *S.* Kiambu during May - October 2003. Cases and controls were interviewed using a standardized questionnaire. The questionnaire was modified to control for bias once the media published reports of illness associated with beef jerky consumption to include a question, "Have you recently seen or heard about beef jerky and Salmonella?" Sequential random-digit dialing was used to contact controls by telephone. Controls were selected if their age was within $\pm$ 5 years of a case and the control resided in one of the northern NM counties where cases had been confirmed. Controls were eliminated if their age and/or region did not match or if they admitted to recently hearing about the association of beef jerky and salmonella infection.

The NMDOH Scientific Laboratory Division (SLD) serotyped all human salmonella isolates. SLD also cultured and serotyped environmental swabs, food samples, and performed pulsed-field gel electrophoresis (PFGE). PFGE is a molecular fingerprinting technique used on bacterial strains from human and food specimens to help match an isolate to outbreaks and the source of infection.

Table. Outbreak Symptom Frequency

Symptom	Percent of Affected Patients
Diarrhea	100 %
Fever	77 %
Bloody diarrhea	88 %
Abdominal Pain	44 %
Vomiting	39 %

The EHD and the NMDOH conducted an environmental investigation that included an on-site inspection during beef jerky production, a facility inspection including Hazard Analysis Critical Control Points (HACCP) plan review, and the collection of food samples and environmental swabs. All employees were interviewed for recent gastrointestinal illness and stool samples were obtained from all food handlers. The Food Safety Inspection Service (FSIS), of the United States Department of Agriculture (USDA), also conducted an on-site investigation.

Results

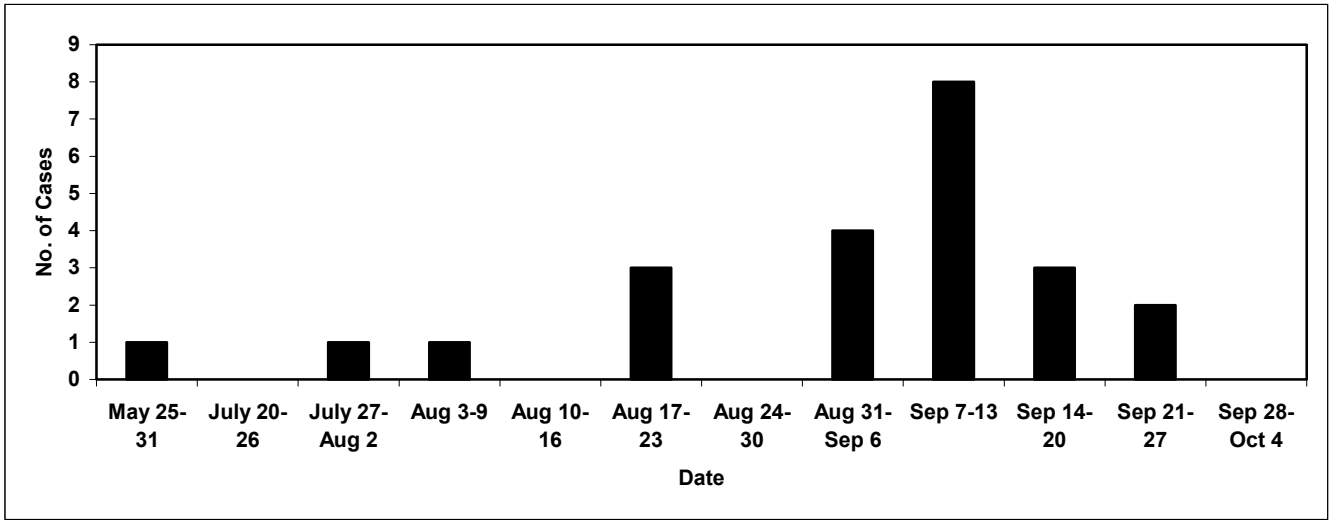
Of 26 case-patients identified, the median age of patients was 26.5 years (range 16 months to 84 years). Fourteen or 54% of culture-confirmed patients were female. Five patients required hospitalization. There were no fatalities. The case-patients resided in five northern NM counties: Bernalillo, Los Alamos, Rio Arriba, Santa Fe, and Taos. The case-control study included 18 of the 26 case-patients along with 48 age- and region-matched controls. Four culture-confirmed patients were not included in the study because controls were biased by media exposure to the outbreak. The other four culture-confirmed patients were not included either because we were unable to contact them or they refused participation. Seventeen of eighteen study-patients (94%) and only 8 of 48 controls (17 %) reported beef jerky consumption within three days of their onset of illness (odds ratio = 85.0; 95% confidence interval = 9.1 – 2010.0).

As a result of the epidemiologic investigation the NMDOH identified two brands of beef jerky associated with the outbreak. Both brands were processed at the same beef jerky production facility in Albuquerque. Patients purchased the implicated beef jerky at convenience stores, a few grocery stores, the New Mexico State Fair, and the production facility in Albuquerque. No other common pattern of Salmonella exposure emerged.

Eighteen human and 2 beef *S*. Kiambu isolates included in this study had matching PFGE patterns. One PFGE matching beef sample was obtained in May 2003 during routine FSIS food surveillance.

An inspection of the facility on September 26, 2003 revealed numerous sanitation violations, resulting in immediate closure of the facility. All food handler stools were negative for salmonella. All environmental surfaces swabbed during the inspection were negative for salmonella. Due to the unsanitary conditions and the epidemiologic link, the NMDOH and EHD issued a statement on September 26 advising the public of the ongoing salmonella outbreak and its association with beef jerky consumption. A

Figure 1. Epidemic Curve of Culture-Confirmed *Salmonella* Kiambu Patients, New Mexico, 2003



few days later one culture of packaged beef jerky obtained during inspection of the production facility on September 26 tested positive for *Salmonella* Kiambu. A statewide recall of the Old Santa Fe Trail and Route 66 brands of beef jerky was issued. The facility's owner also indicated that beef jerky had been shipped to at least 22 other states through a mail order business. The NMDOH notified the appropriate state and federal agencies of the mail ordered contaminated beef jerky and on October 3, 2003 the FSIS of the USDA coordinated a nationwide voluntary recall of all jerky products produced by the Albuquerque facility.

Conclusions

An outbreak of *S.* Kiambu was associated with consumption of beef jerky produced at an Albuquerque, NM facility. Both the epidemiologic, environmental and laboratory investigations linked beef jerky produced at a single producer as the cause of this outbreak. Following the facility's closure two other linked *S.* Kiambu infections were detected, and both had exposure to beef jerky stored and not destroyed following the recall.

As seen in the timeline, routine food surveillance by the FSIS detected *Salmonella* Kiambu in a beef jerky product from this facility in May 2003. The NMDOH SLD also had one human isolate of *Salmonella* Kiambu from May 2003. Unfortunately, we were unable to contact the patient to verify beef jerky consumption; however, both samples' PFGE patterns matched the outbreak pattern and no other *S.* Kiambu isolate have occurred in New Mexico. The patient's PFGE pattern was forwarded to the Centers for Disease Control and Prevention's Pulsenet (a national database of PFGE patterns) on June 18, 2003. However the outbreak was not recognized until more human *S.* Kiambu isolates were identified in September and October with matching PFGE patterns. The May beef jerky PFGE pattern was not connected to the outbreak until after the peak week of infection. Although routine USDA/FSIS food surveillance is a valuable tool for detection of food borne pathogens, this outbreak highlights the importance of communication between food and human surveillance systems for disease prevention.

Recommendations

1. Heat beef to 160 ^{o}F during beef jerky processing to inactivate bacteria[7].
2. Assure that the oven/dehydrator can reach this temperature in a high altitude environment using a calibrated thermometer, as rapidly evaporating liquids in these environments can absorb heat and prevent the meat from achieving the appropriate temperature.
3. Beef jerky production regulations need to be reviewed and producers need to be educated about temperature regulation in high-altitude, dry environments.

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Figure 2. Salmonella Kiambu Beef Jerky Outbreak Timeline