

## MICROBIAL STRESS

### **SURVIVAL AND GROWTH OF *ESCHERICHIA COLI* O157:H7 IN ROAST BEEF AND SALAMI AFTER EXPOSURE TO AN ALKALINE CLEANER** (M. Sharma, G. M. Richards, and L. R. Beuchat)

Dry, fermented salami and sausage have been implicated as vehicles in outbreaks of enterohemorrhagic *Escherichia coli* (EHEC) infections. Exposure of foodborne pathogens to acid or alkali stress may cross protect cells against other stresses. Highly alkaline cleaners are used to clean smokehouses, commercial ovens, and high pressure and mechanized systems. The widespread use of these cleaners in pre- and post-processing environments may result in adaptation of foodborne pathogens to alkaline pH and cross protection to subsequent stress environments. The objective of this research was to determine the survival characteristics of *E. coli* O157:H7 cells exposed to alkaline cleaners, inoculated into sliced roast beef and hard salami, and stored at various temperatures. The *rpoS* gene was examined for its role in initiating mechanisms resulting in the protection of cells against treatment with alkaline cleaner and subsequently promoting survival and growth in roast beef and salami.

Survival and growth of wild-type (EDL 933) and *rpoS*-deficient (FRIK 816-3) strains of *E. coli* O157:H7 after exposure to an alkaline cleaner for 2 min and inoculation into roast beef (pH 6.3) and hard salami (pH 4.9) at low (0.003 – 0.52 cfu/g) and high (0.69 – 31.5 cfu/g) populations were determined. Roast beef was stored at 4 and 12°C; salami was stored at 4, 12, and 20°C. At 4°C, untreated cells of both strains showed greater reductions in populations in salami than in roast beef during a 21-day storage period. Populations of treated and untreated cells recovered from roast beef and salami stored at 4°C on tryptic soy agar were significantly ( $P \leq 0.05$ ) higher than on sorbitol MacConkey agar, indicating that a portion of the cells was injured. Treated and untreated cells grew in roast beef at 12°C. Growth of treated cells of the FRIK 816-3 strain in roast beef at 12°C was significantly slower than that of the EDL 933 strain. Populations of both strains decreased at different rates in salami stored at different temperatures (20°C > 12°C > 4°C). *E. coli* O157:H7 strain EDL 933 grew more rapidly at 20°C in a slurry (pH 5.97) prepared from stored salami (17 days at 20°C) on which *Penicillium chrysogenum* had grown than in slurry (5.23) prepared from salami showing no mold growth. Within 2 - 3 days, populations were ca. 3 log cfu/ml higher in slurry made from infected salami compared to control salami. Results indicate that treatment of *E. coli* O157:H7 with an alkaline cleaner for 2 min does not impair resuscitation and growth of surviving cells in roast beef at 12°C. Cross protection of cells exposed to an alkaline cleaner against subsequent stress conditions imposed by roast beef and salami stored at 4°C was not evident in either of the test strains.

### **FATE OF ACID-ADAPTED AND NONADAPTED *ESCHERICHIA COLI*, *LISTERIA MONOCYTOGENES*, AND *SALMONELLA* ON GROUND OR WHOLE BEEF JERKY** (R. A. Morrow, M. A. Harrison, and J. A. Harrison)

The objective of this study was to determine the fate of acid-adapted and nonadapted *Escherichia coli* O157:H7, *Salmonella*, and *Listeria monocytogenes* on ground and whole beef jerky strips during the home-style jerky process. Each organism and meat type was compared separately and analyzed using a split-plot experimental design. To achieve acid-adapted and nonadapted cultures, each pathogen was grown in tryptic soy broth with and without dextrose, respectively. After incubation, the pH of the acid-adapted culture was 4.88 and the nonadapted was 6.97. Inoculated strips were dried in a vertical dehydrator with an air temperature of 60.0°C. For ground beef strips, samples were taken at time 0, 2, 4, 6, and 10 h. After 10 h, population reductions of acid-adapted and nonadapted *E. coli* O157:H7, *Salmonella*, and *L. monocytogenes* were 5.86 and 5.30, 4.73 and 3.96, and 4.28, and 4.51 log<sub>10</sub>, respectively. When population reductions were compared for the same organism, there was no significant

difference ( $p>0.05$ ) between acid-adapted and nonadapted *E. coli* O157:H7, *Salmonella*, and *L. monocytogenes* on ground beef strips. Whole beef strips were sampled after inoculation, after marination, and at 4, 8, 12, and 14 h. Population reductions after 14 h for acid-adapted and nonadapted *E. coli* O157:H7, *Salmonella*, and *L. monocytogenes* were 5.25 and 5.13, 4.85 and 4.82, and 4.81 and 4.87  $\log_{10}$ , respectively. When population reductions were compared for the same organism, there was no significant difference ( $p>0.05$ ) between acid-adapted and nonadapted *E. coli* O157:H7, *Salmonella* and *L. monocytogenes* on whole beef strips.

