Center for Food Safety, University of Georgia, Griffin, GA (http://www.griffin.uga.edu/cfs)
2004 Highlights

WATER

TREATMENTS FOR CONTROL OF ENTEROHEMORRHAGIC *ESCHERICHIA COLI* IN DRINKING WATER CONTAMINATED WITH RUMEN CONTENT OR FECES (P. Zhao, M. P. Doyle, T. Zhao, J. W. West, J. Bernard, and H. Cross)

E. coli O157:H7 has emerged in the last 10 years as an important foodborne pathogen with an estimated 73,000 cases annually in the U.S. Cattle are the major reservoir and studies revealed that when present in cattle drinking water, *E. coli* O157:H7 was disseminated to other cattle using the contaminated water source. Hence, drinking water for cattle is an important vehicle of *E. coli* O157:H7 transmission. Studies indicate that once contaminated in the drinking water of a cattle farm, *E. coli* O157:H7 can survive for many months.

A variety of treatments have been evaluated for their efficacy in killing *E. coli* O157:H7 in drinking water contaminated with rumen content or cattle feces. Results revealed that most had minimal effect on killing *E. coli* O157:H7 because these treatments were neutralized by organic materials present in the rumen content or feces. The objective of this study was to identify practical treatments to eliminate or control *E. coli* O157:H7 in drinking water simulating on-farm conditions.

Survival of *E. coli* O157:H7 in water containing rumen content at different water:rumen content, *E. coli* O157:H7 cell numbers, and temperatures was determined. At 21°C, *E. coli* O157:H7 inoculated at a high inoculum ($10^{5.8}$ cfu/ml) survived for 8, 15, 23, >56 and 24 weeks and at a low inoculum ($10^{2.9}$ cfu/ml) survived for 8, 11, 10, 11 and 10 weeks at a water:rumen content ratio of 5:1, 10:1, 25:1, 50:1 and 100:1, respectively.

Different treatments, including lactic acid, acidic calcium sulfate, chlorine, chlorine dioxide, hydrogen peroxide, caprylic acid, ozone, butyric acid, sodium benzoate and competitive inhibition *E. coli* were tested individually or in combination for inactivation of *E. coli* O157:H7 in the presence of rumen content. Chlorine (5 ppm) and ozone treatment (22-24 ppm at 5°C or 8-12 ppm at 21°C) of water had minimal effect on killing *E. coli* O157:H7 in the presence of rumen content at ratios of 50:1 and higher. Treatment by competitive inhibition *E. coli* in water with rumen content also had minimal effect on *E. coli* O157:H7 counts compared with untreated controls. Four chemical treatment combinations including: (a) 0.1% lactic acid, 0.9% acidic calcium sulfate and 0.05% caprylic acid (Treatment A); b: 0.1% lactic acid, 0.9% acidic calcium sulfate and 0.1% sodium benzoate (Treatment B); (c) 0.1% lactic acid, 0.9% acidic calcium sulfate and 0.5% butyric acid (Treatment C); (d) 0.1% lactic acid, 0.9% acidic calcium sulfate and 100 ppm chlorine dioxide (Treatment D) were highly effective at 21°C in killing *E. coli* O157:H7, O26:H11 and O111:NM/ml in water heavily contaminated with rumen content (ratio of 10:1 water:rumen content, v/w) or feces (ratio of 20:1, water:feces, v/w). Among them, Treatments A, B and C killed >5 $\log_{10}$ *E. coli* O157:H7, O26:H11 and O111:NM/ml within 30 min in water containing rumen content. For Treatment D, *E. coli* O157:H7, O26:H11, and O111:NM were reduced within 30 min by 2.8, 4.3, and 3.2 log cfu/ml in water containing rumen content, respectively, and by 3.5, 4.9, and 4.6 log cfu/ml in water with feces, respectively.

Cattle fed ad libitum water containing Treatment A, C, or control (untreated water) for two treatment periods at 7-day increments drank an average of 15.2, 13.8, and 30.3 L/day, respectively. Cattle provided water containing 0.1% lactic acid plus 0.9% acidic calcium sulfate (pH 2.1) drank 18.6 L/day. The amount of water consumed for all water treatments was significantly different from the control, and there were no significant differences among water treatments. The covariant was significant, but there were no differences among cow groups or between the two treatment periods. This implies that the covariant effectively removed variation among animals from the statistical analysis, that the randomly assigned groups were similar, and that the treatment effect was consistent between the two experimental periods.

To ensure that treatment effects on water intake were not due to differences in cow body size, cow body weight (BW) was converted to MBW ($BW^{0.75}$), and intake of water per MBW was calculated. Treatment effects for water intake/MBW were similar to those for total water intake. Because water intake was substantially reduced when treated with the chemicals described above, optimal on-farm use of such treatments would be periodic, rather than continuous. In addition, application of chemicals to drinking water systems followed by flushing to remove or dilute the chemicals after 30 minutes of exposure is recommended.